Latest Features of the Agilent N9038A MXE EMI Receiver

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Keep the test queue flowing

Agilent Technologies

Topics

- General Introduction to the MXE
- HW Architecture Improvements
- Latest Features
- Enhanced Diagnostic Capability
- Precompliance

My Background in EMC

- Over 20 years R&D experience in receiver and spectrum analyzer design at HP and Agilent Technologies
  - ➢ Significant involvement in EMC troubleshooting and verification
- Member of IEC/CISPR Technical Advisory Group A
  - ➢ Expert on the US National Committee
- Program manager for the Agilent 8542/8548 EMI Receivers
- Author of 8 papers on EMI troubleshooting and measurement

Topics

- General Introduction to the MXE
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N9038A MXE EMI Receiver Provides World-Class EMI Measurement Capability

- **Commercial and Military Compliance**
  - CISPR 16-1-1: 2010, MIL-STD-461F
  - all required detectors, bandwidths
- **Excellent accuracy**
  - ±0.5 dB @ 1 GHz
- **Excellent sensitivity**
  - -166 dBm @ 1 GHz
  - Built-in standard preamplifier

N9038A MXE EMI Receiver Blends World-Class EMI Measurement Functionality……..

- Update three detectors simultaneously
- Amplitude correction
- Regulatory limit lines

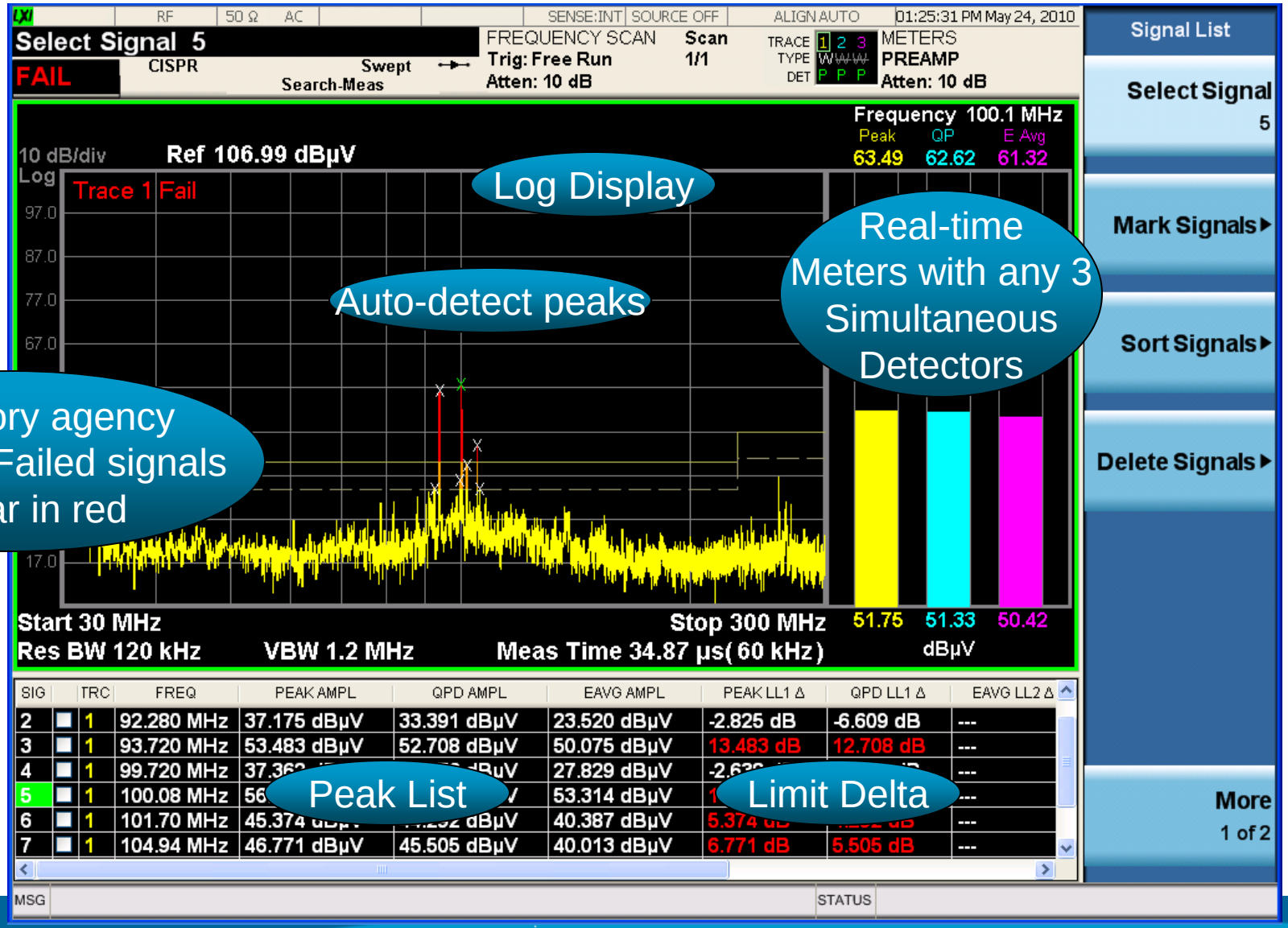
- Automatic testing to limit lines and user-defined margins
- Automated signal list collection
- Automated signal list measurement

……with State of the Art EMI Diagnostic Capability

- **Extensive set of built-in diagnostic tools**
  - Signal Analysis
  - Strip Chart
  - Spectrogram
  - Zone Span
  - Global frequency linkage

More than an EMI receiver….the MXE includes powerful diagnostic capability!

Integrated Display Enhances Usability



Topics

- General Introduction
- HW Architecture Improvements
  - *Digital IF*
  - *Improved Upgradability*
    - *Processor, I/O, storage*
- Latest Features
- Enhanced Diagnostic capability
- Precompliance

Digital IF discussion

- Digital IF: what is it?
- Elements of Receiver accuracy
- Improvements Digital IF offers to EMC labs

Modern EMI Receivers can Improve Test Lab Efficiency and Throughput

Performance

Accuracy

Usability

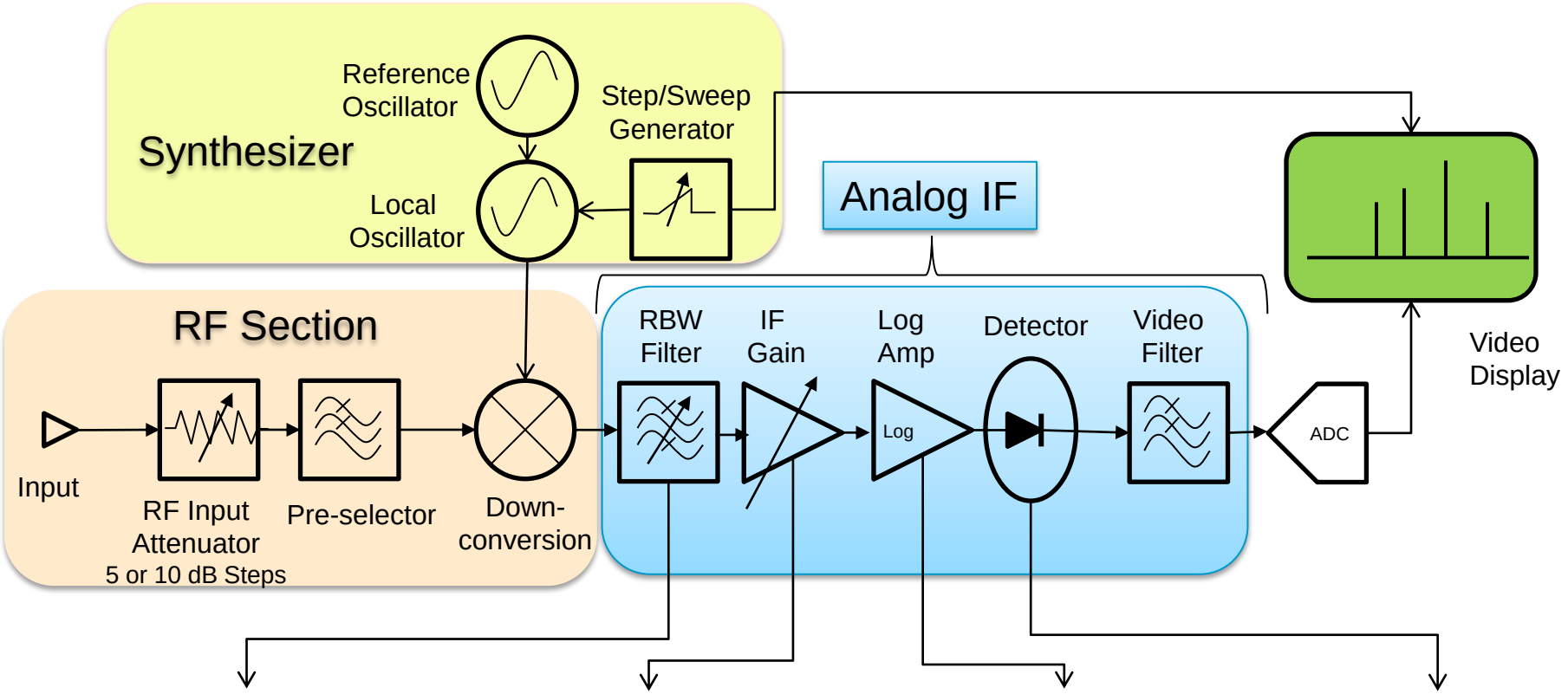
Feature Set

Programmability

Reliability

Digital Intermediate Frequency (Digital IF) Architecture offers improvements

Classic Super Heterodyne Receiver Architecture



Resolution BWs

Variable bandwidth filters used for analysis

IF Gain Stages

Variable linear gains used to set current display reference levels

Logarithmic Amps

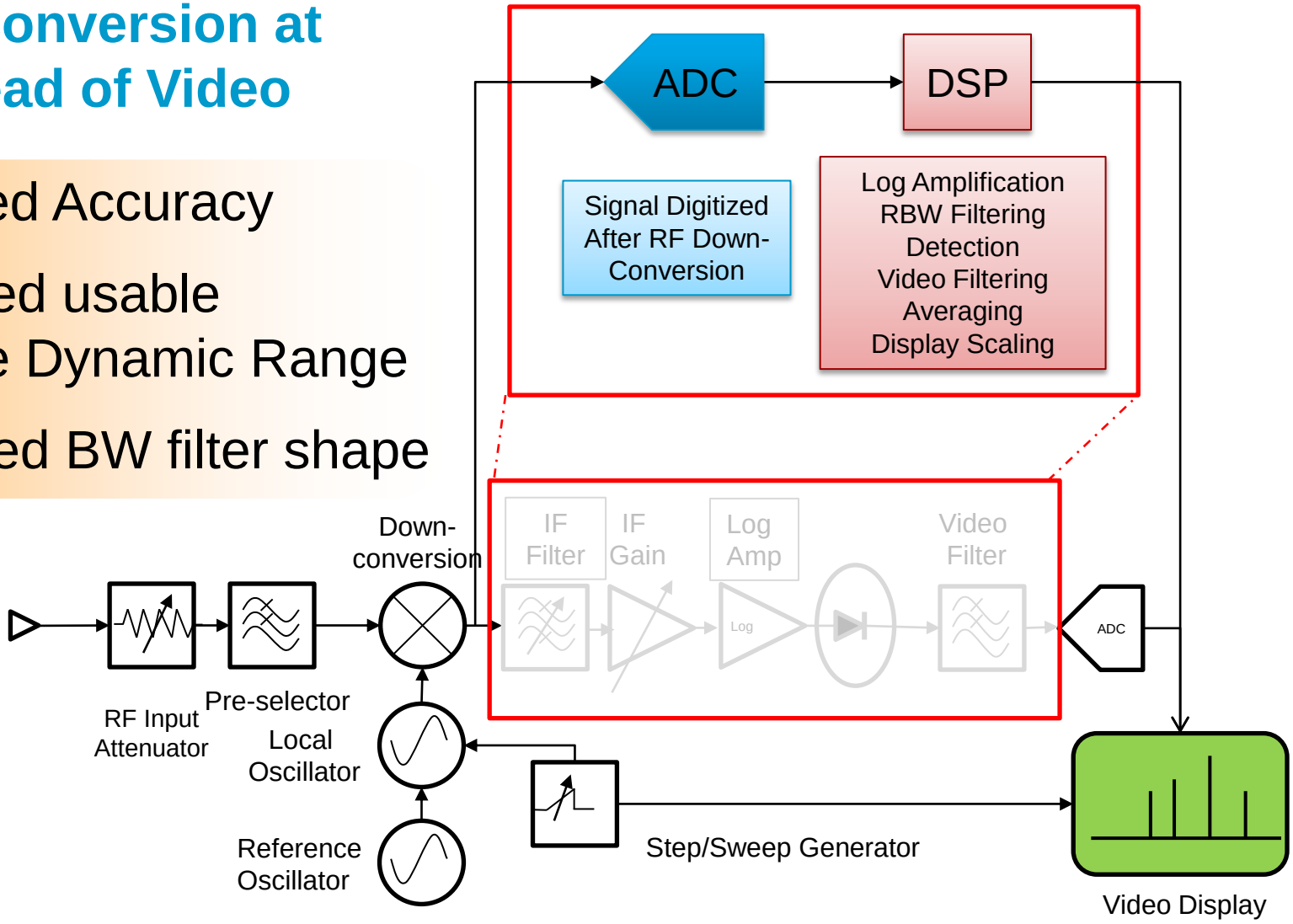
Provide measurement dynamic range

Detector

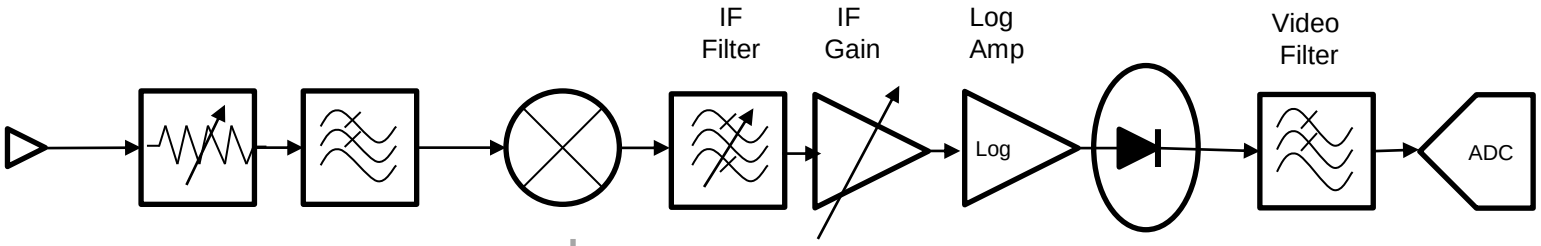
Receiver Architecture w/ Digital IF

Digital Conversion at IF instead of Video

- Improved Accuracy
- Increased usable effective Dynamic Range
- Improved BW filter shape



Circuit elements affecting Receiver Accuracy



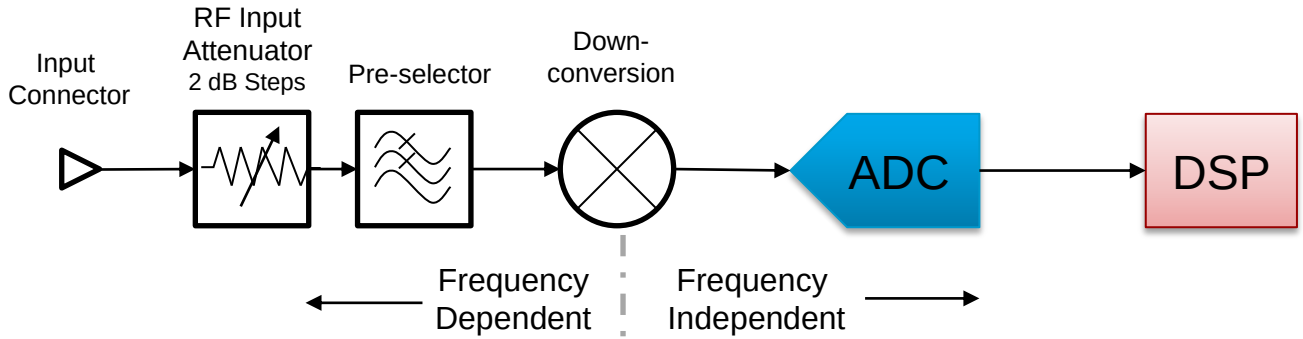
Frequency Dependent

- Input connector (mismatch)
- Calibrator
- RF input attenuator
  - frequency response and switching
- Preselector filter response
  - frequency response
- Downconversion frequency response

Frequency Independent

- Ref Level switching uncertainty
  - IF gain
- RBW filter switching uncertainty
- Display scale fidelity (Log Amp)
  - Log response & display scaling digitally synthesized

Digital IF Improves Amplitude Accuracy



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Digital IF improves Amplitude Accuracy:

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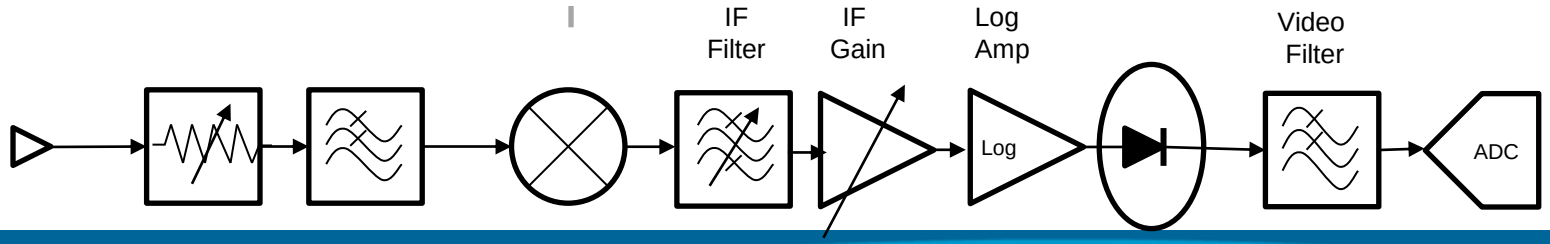


Digital IF Benefits for EMI Laboratories

Improved Measurement Accuracy

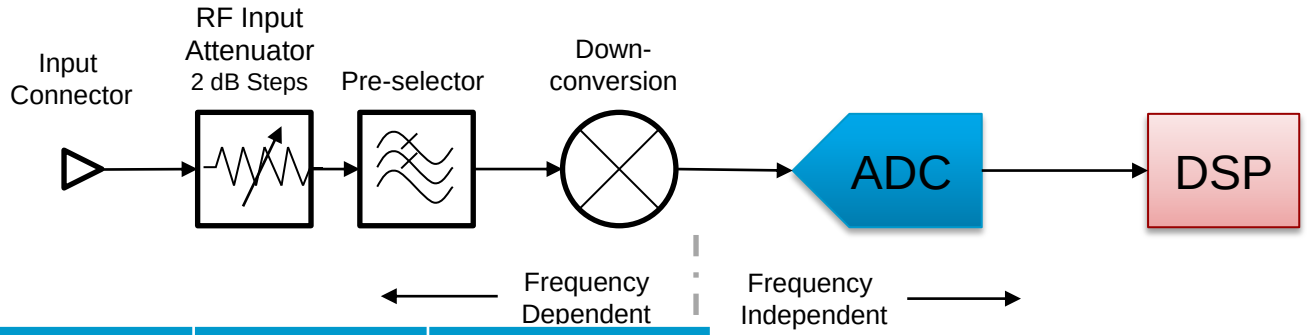
Improved Throughput

- less dependence on optimizing IF signal level for best accuracy

Reduced Dependence on Operator Experience

- less opportunity for measurement overload

Digital IF Improves Amplitude Accuracy



Amplitude Uncertainty	Digital IF	Analog IF
Ref Level Switching	0dB	<= +/- 1dB
RBW Switching	+/- .05dB	<= +/- .5dB
Display Scale Fidelity	+/- .15dB	<= +/- .85dB

Digital IF improves Amplitude Accuracy:

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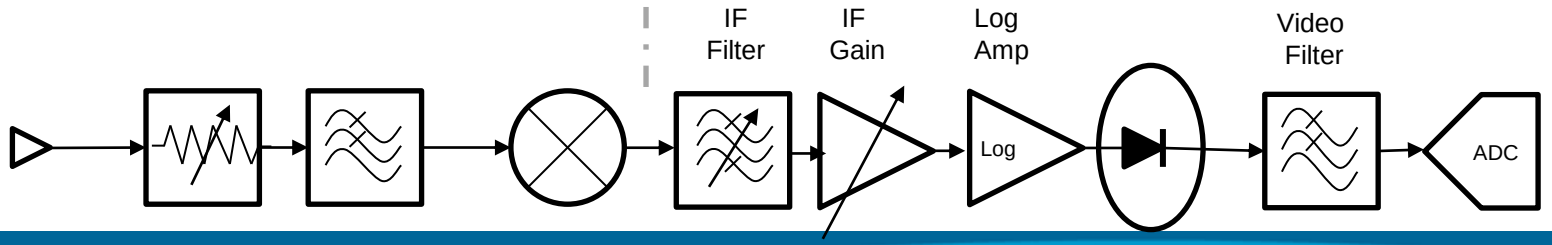
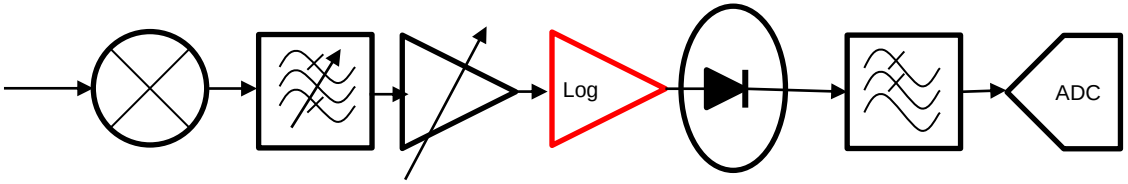
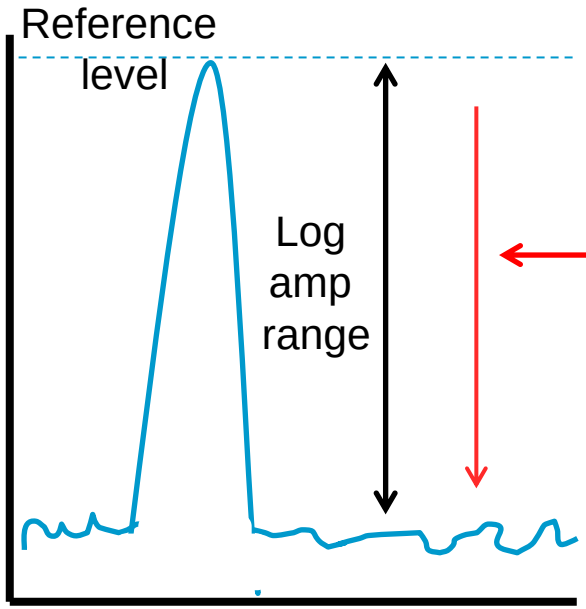


Digital IF Improves Throughput (1)

Analog Log Amp - must adjust signal to ref level to achieve best accuracy

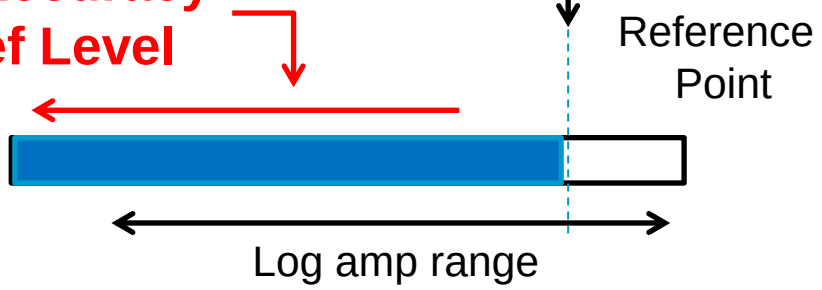


Spectrum display



Best accuracy achieved here

Reduced Accuracy Below Ref Level

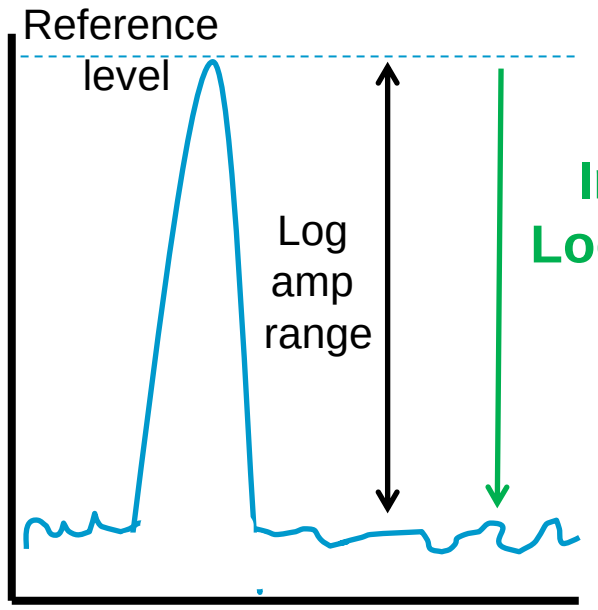


Bar graph display

Digital IF Improves Throughput (2)

Digital IF – improved log accuracy reduces dependence on adjusting signal level to calibrated reference level

Spectrum display

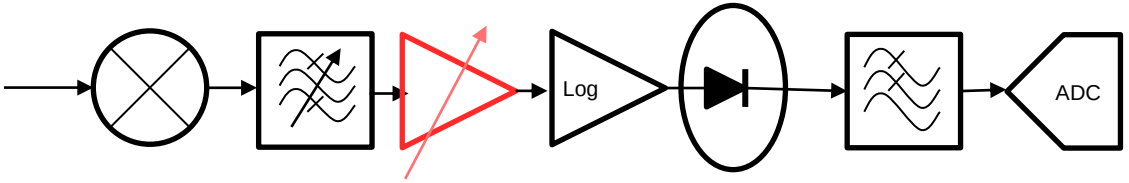


Improved Log Accuracy

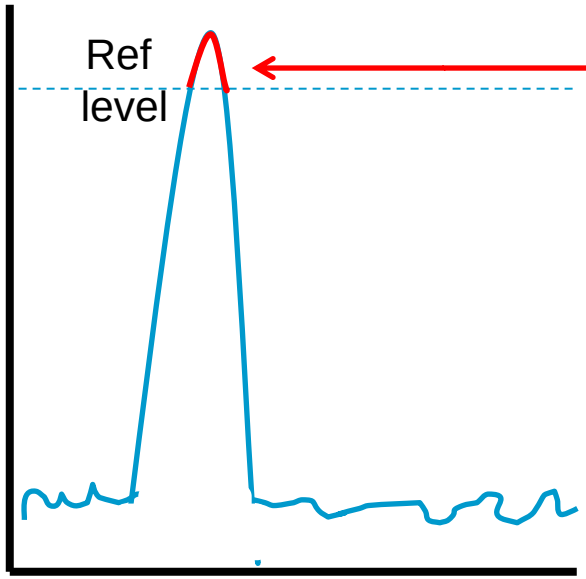
Amplitude Uncertainty	Digital IF	Analog IF
Display Scale Fidelity	+/- .15dB	<= +/- .85dB

Digital IF Reduces Dependence on Operator Experience

Analog IF Gain - best accuracy achieved at reference level
- need to adjust signal to ref level for best accuracy



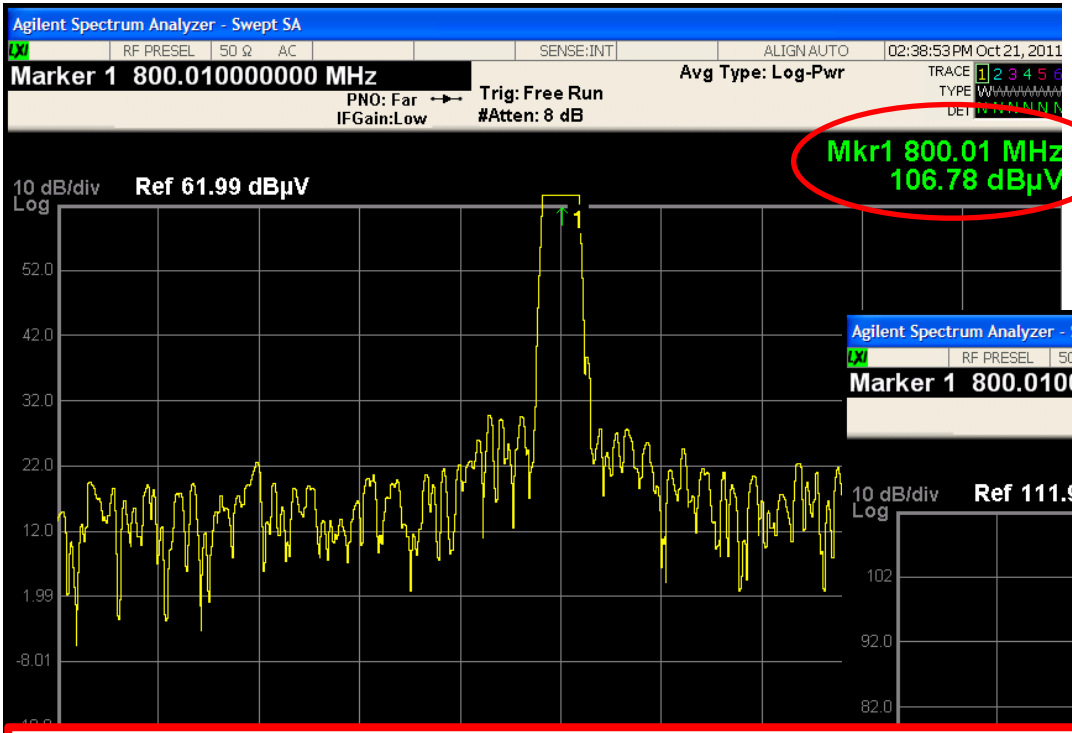
Spectrum display



Exceeding Ref point causes IF distortion, measurement error

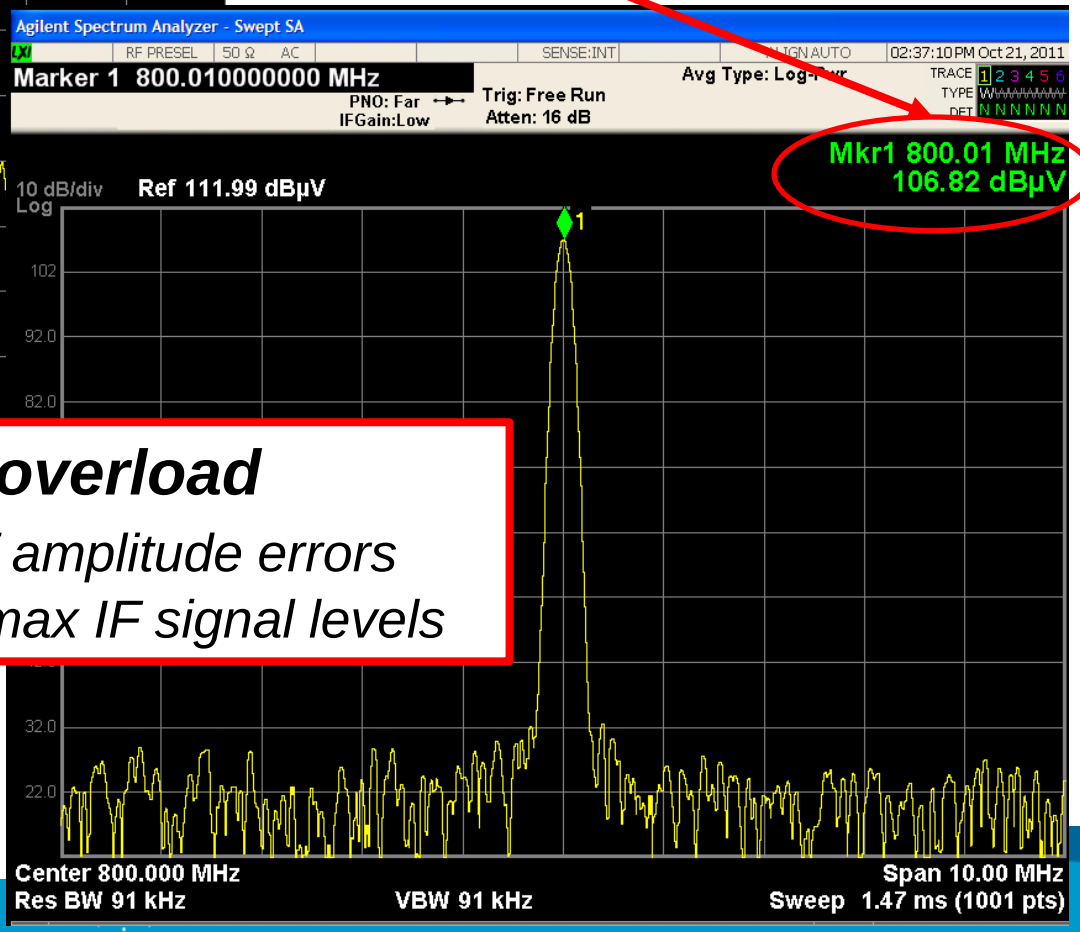
Bar graph display

Digital IF Gain reduces dependence on operator experience



50dB change in Reference Level

- virtually no change in measured value

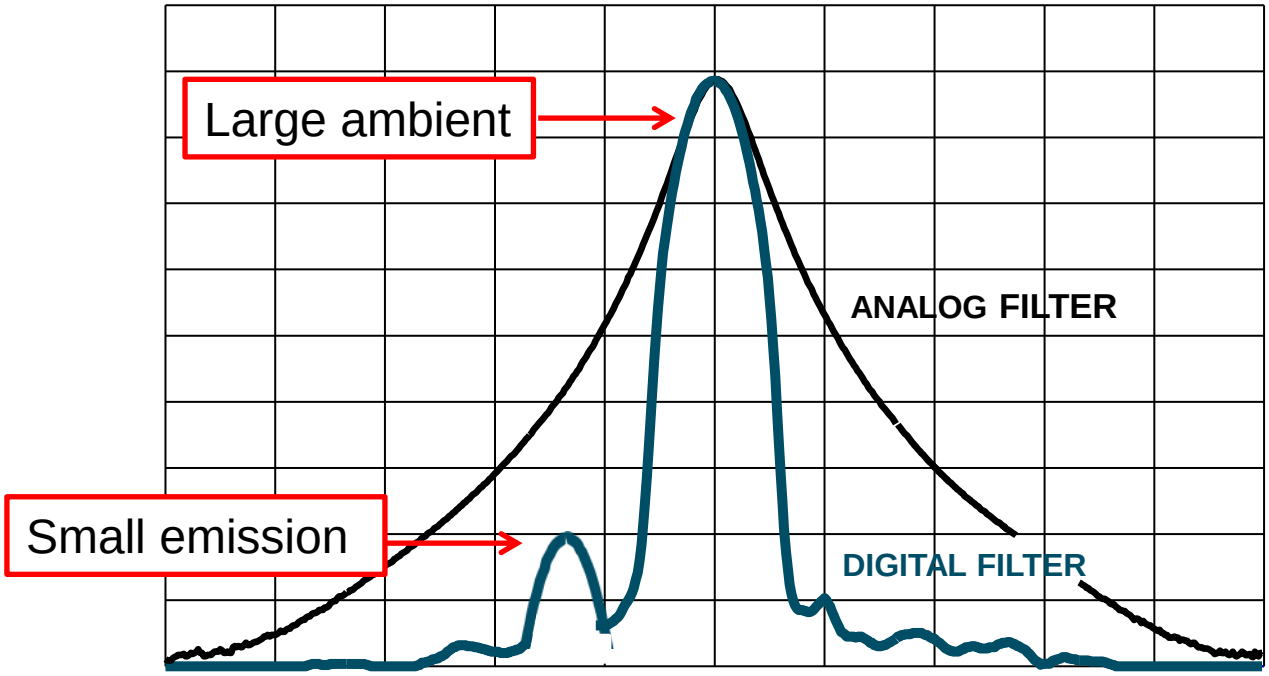


Reduces incidences of IF overload

- *minimizes occurrence of amplitude errors*
- *overloads occur only at max IF signal levels*

Other Benefits: Digital IF RBWs Offer Higher Selectivity

Improves signal identification in high-ambient environments (OATS)



Typical Selectivity

Analog ~12:1

Digital ≤ 5:1

Keep Test Assets Current

Extend instrument longevity with upgradeable platform

- Stay current with upgradeable CPU, memory, disk drives, and I/O ports
- Add functionality and applications with license key upgrades
- Rely on proven platform, worldwide support, and 3-year standard warranty
- Keep data secure with removable solid-state drive

Topics

- General Introduction
- HW Architecture Improvements
- Latest Features
  - 44GHz Frequency Coverage
  - Time Domain Scan
  - Monitor Spectrum
  - Amplitude Probability Distribution
- Enhanced Diagnostic capability
- Precompliance

Now Offering 44 GHz Frequency Coverage

- **Three frequency ranges**
  - 20 Hz to 8.4 GHz
  - 20 Hz to 26.5 GHz
  - 20 Hz to 44 GHz

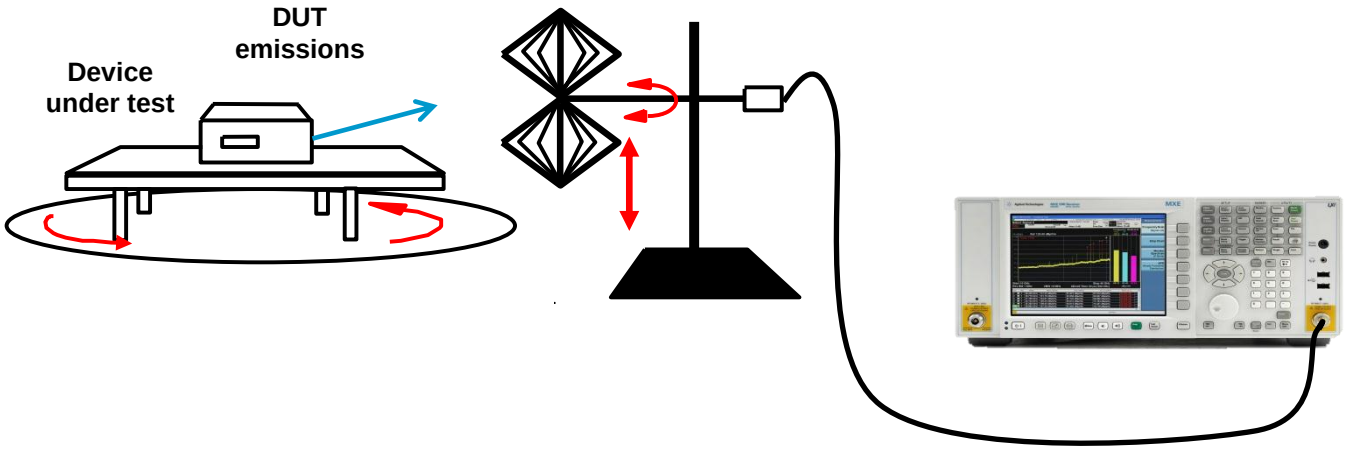
New!

- **44 GHz ideal for testing to MIL-STD-461F and USA FCC Part 15 requirements**

New Time Domain Scan

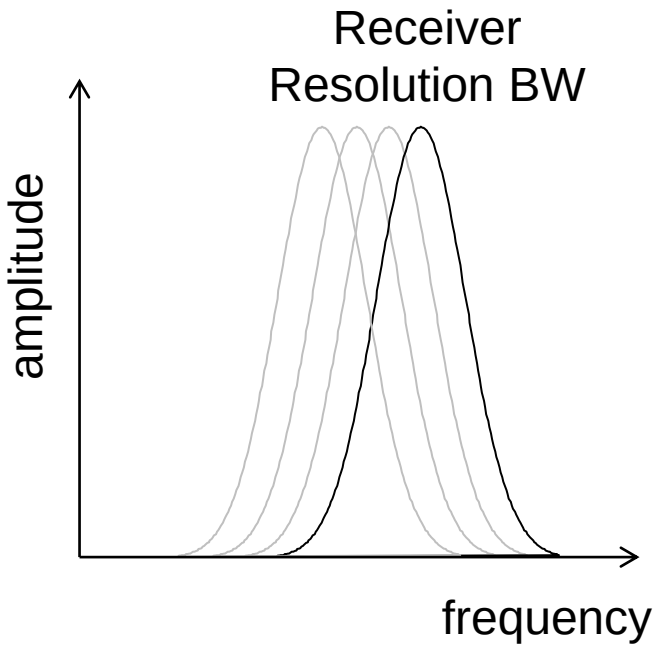
Accelerate suspect list creation

- Shortens EMI pre-scan collection time, reducing overall test time by several hours
- High-overlap FFT scanning provides fast and accurate signal capture
- Faster than frequency domain scanning when using CISPR and MIL STD 461 dwell times



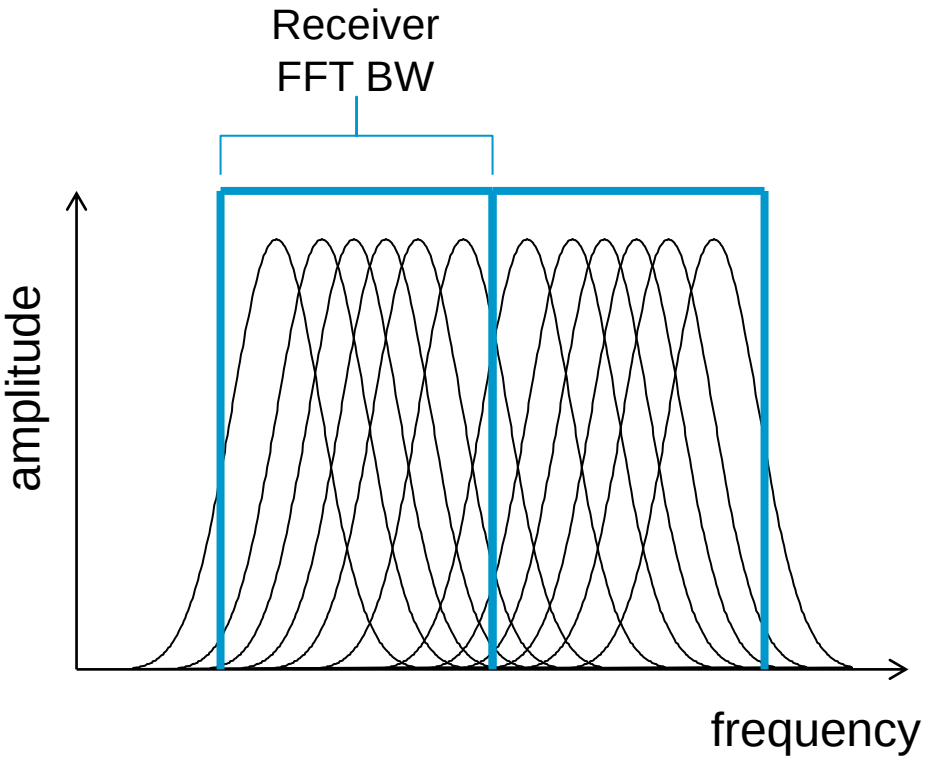
How Time Domain Sweep Saves Time

Have to dwell at each RBW



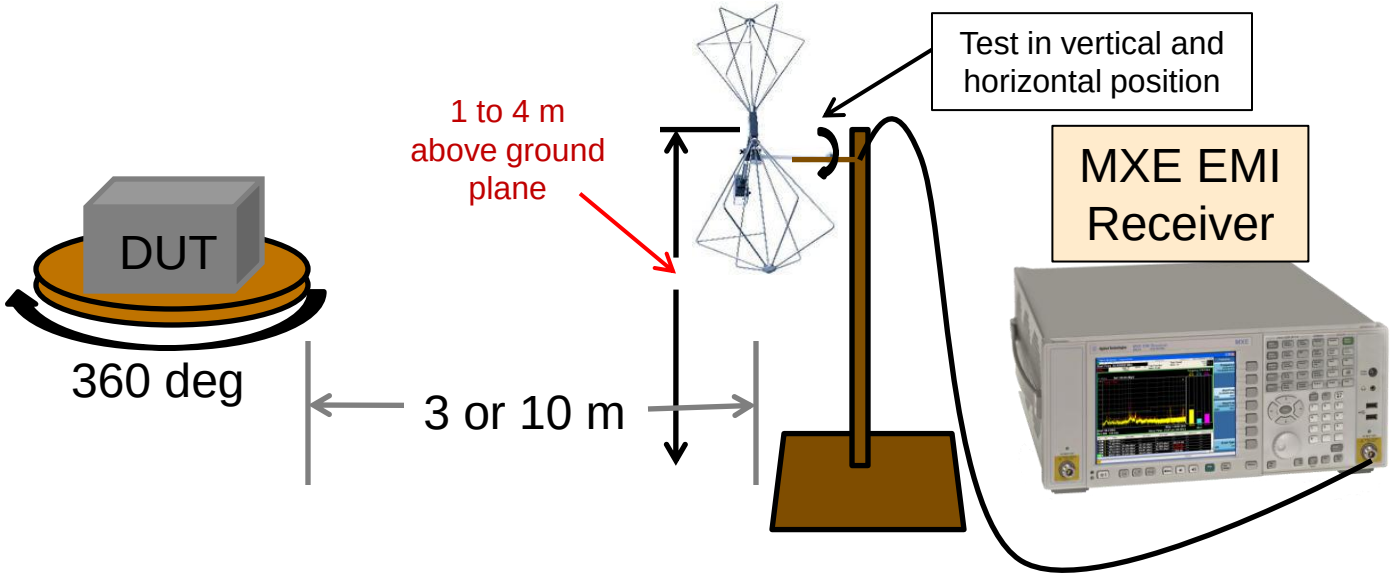
Swept or Stepped Frequency Scan

Only have to dwell for each FFT BW (multiple RBWs)!!!



Time Domain Frequency Scan

Time Domain Scan Can Reduce Overall Test Time



CISPR Band	Frequency Domain	Time Domain
30MHz–1GHz Peak det. 10ms. dwell RBW =120kHz 3 pts/RBW	242 sec smooth scan	12 sec
150kHz–30 MHz Peak det 100ms. dwell RBW = 9kHz 2 pts/RBW	664 sec smooth scan	13 sec

144 scans

13 seconds/scan

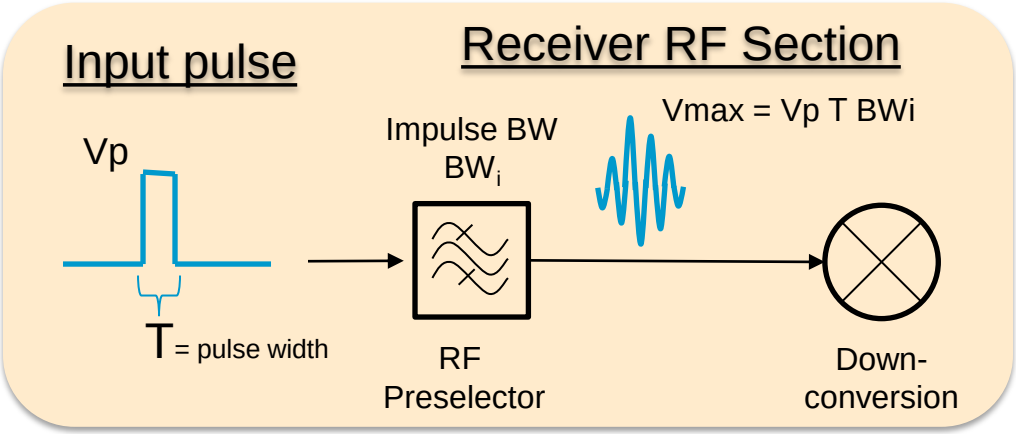
x ~~250~~ seconds/scan

~ 31 minutes

~~10 hours~~

Not counting antenna and turntable positioning time

MXE offers TDS Speed AND Strong Preselection



RF preselection reduces overload from impulsive signals

Narrower BW_i = better impulse overload protection

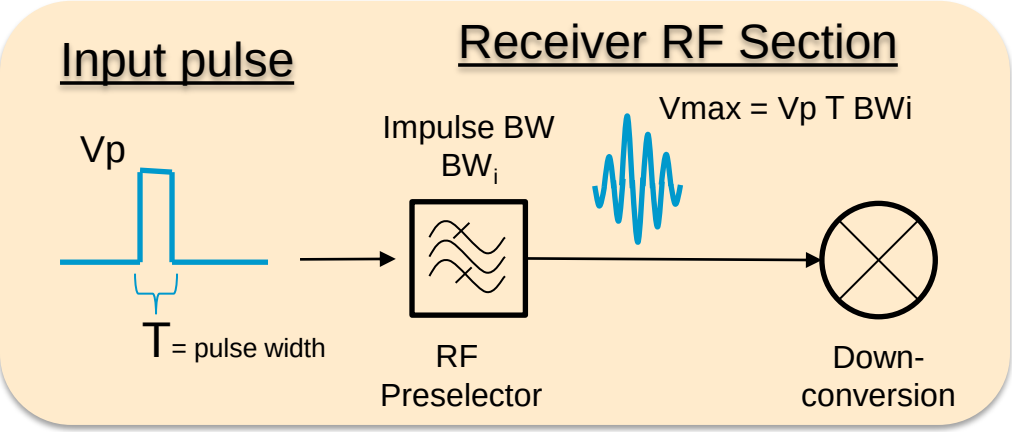
Tradeoff: Narrow bandwidths increase TDS scan times.

- additional switching and processing time

MXE balances impulse filtering and TDS speed

- uses narrow RF preselector filters
- offers significant scan time improvement

Tradeoff: TDS Speed vs. Overload Protection



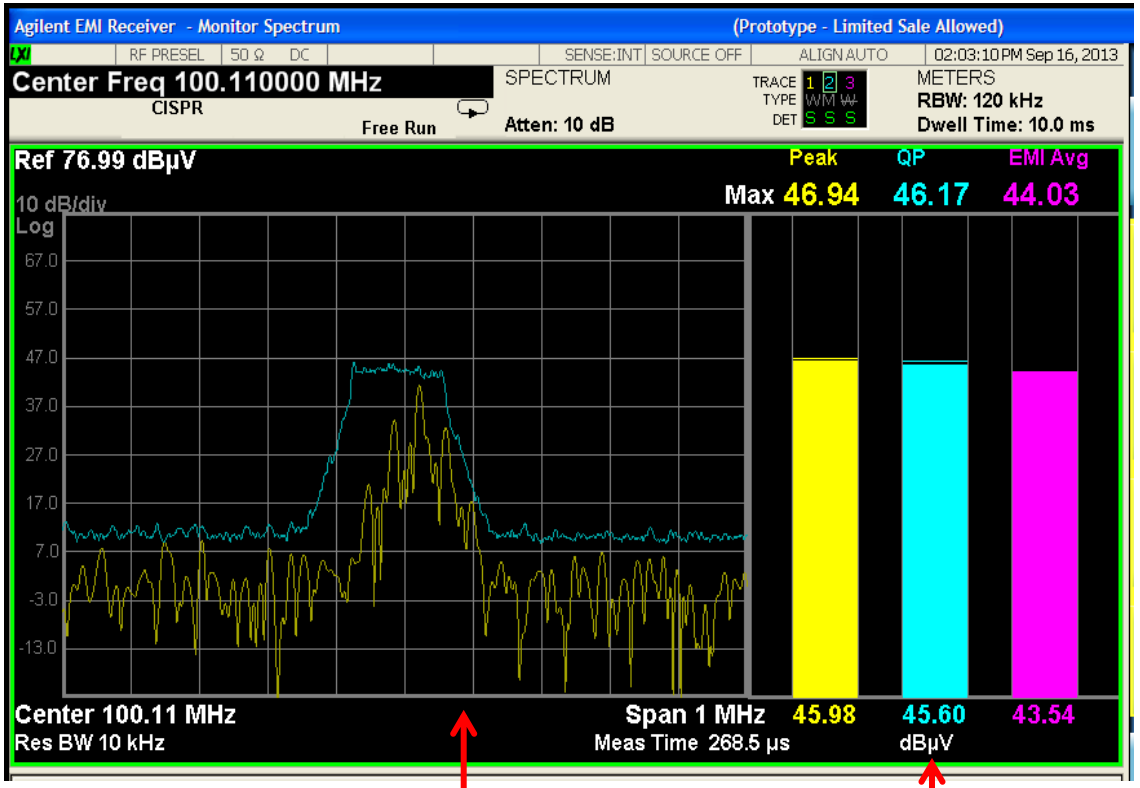
Wider BW_i = worse impulse overload protection

Other receivers widen filters to increase TDS speed, BUT:

- more attenuation required for impulse overload protection
- ***more attenuation = worse measurement sensitivity***

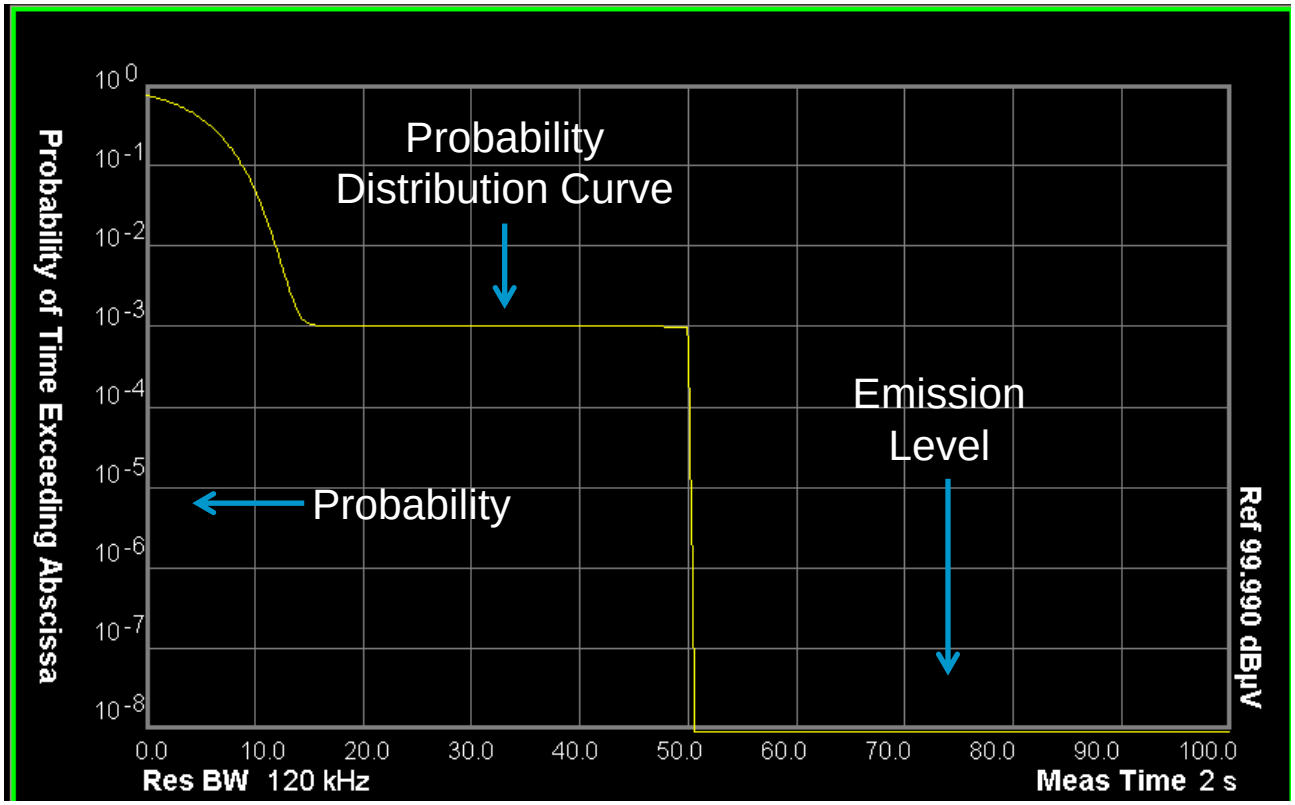
Simplify Testing with the New Monitor Spectrum Feature

- Simplifies identifying frequency of maximum emission
- Convenient to use – linked to signals list
- Easy to update suspect frequency list prior to final measurement



Trace display and meters active simultaneously!

Prepare for Proposed CISPR Microwave Oven Testing with the Amplitude Probability Distribution (APD) Function



- New (optional) measurement being considered by CISPR for testing microwave ovens
- Measures the probability an emission will exceed a specified level

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- HW Architecture Improvements
- Enhanced Diagnostic capability
- Precompliance

Enhanced Diagnostic Capability: Spectrum Analysis

8572A

8546A/8542A

N9038A

Agilent has a long history of blending the diagnostic capability of Spectrum Analysis with Compliance Receivers

Spectrum Analysis increases Receiver value to EMC community:

- Receiver to measure Compliance
- Spectrum Analysis to diagnose cause of Compliance failure

MXE Includes Spectrum Analysis Power of the X-series Family

Detectors

Peak, Neg Peak, Log/Lin/RMS Average, Sample, Normal

6 Traces

Clear/Write, Max hold, Min hold for each

12 Markers

Delta markets, Peak search

Built-in Preamp standard

Save and Recall

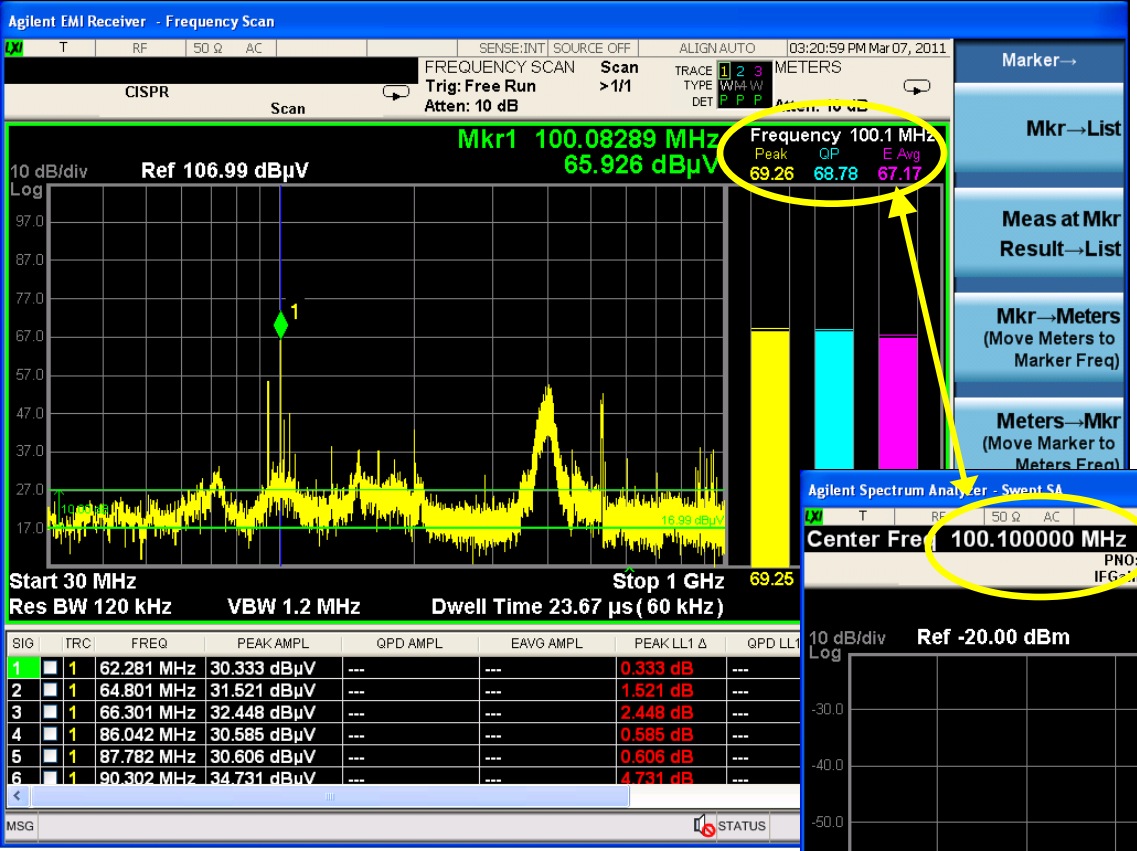
States, traces, data, Screen capture

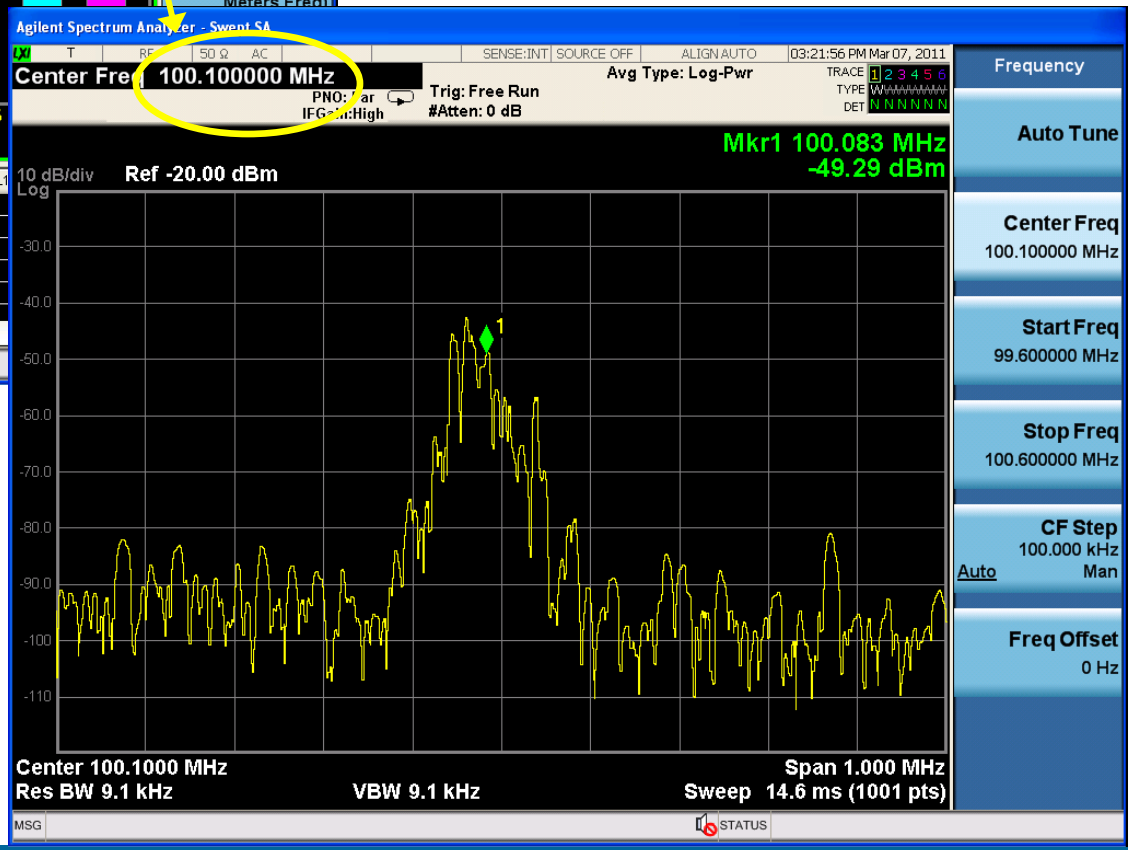
Power Suite

Channel power, Occupied BW, ACP, CCDF, more

I/Q analysis

Extensive built in diagnostic tools: *Global Center Frequency*





Move seamlessly between Receiver and SA by *maintaining Center Frequency*

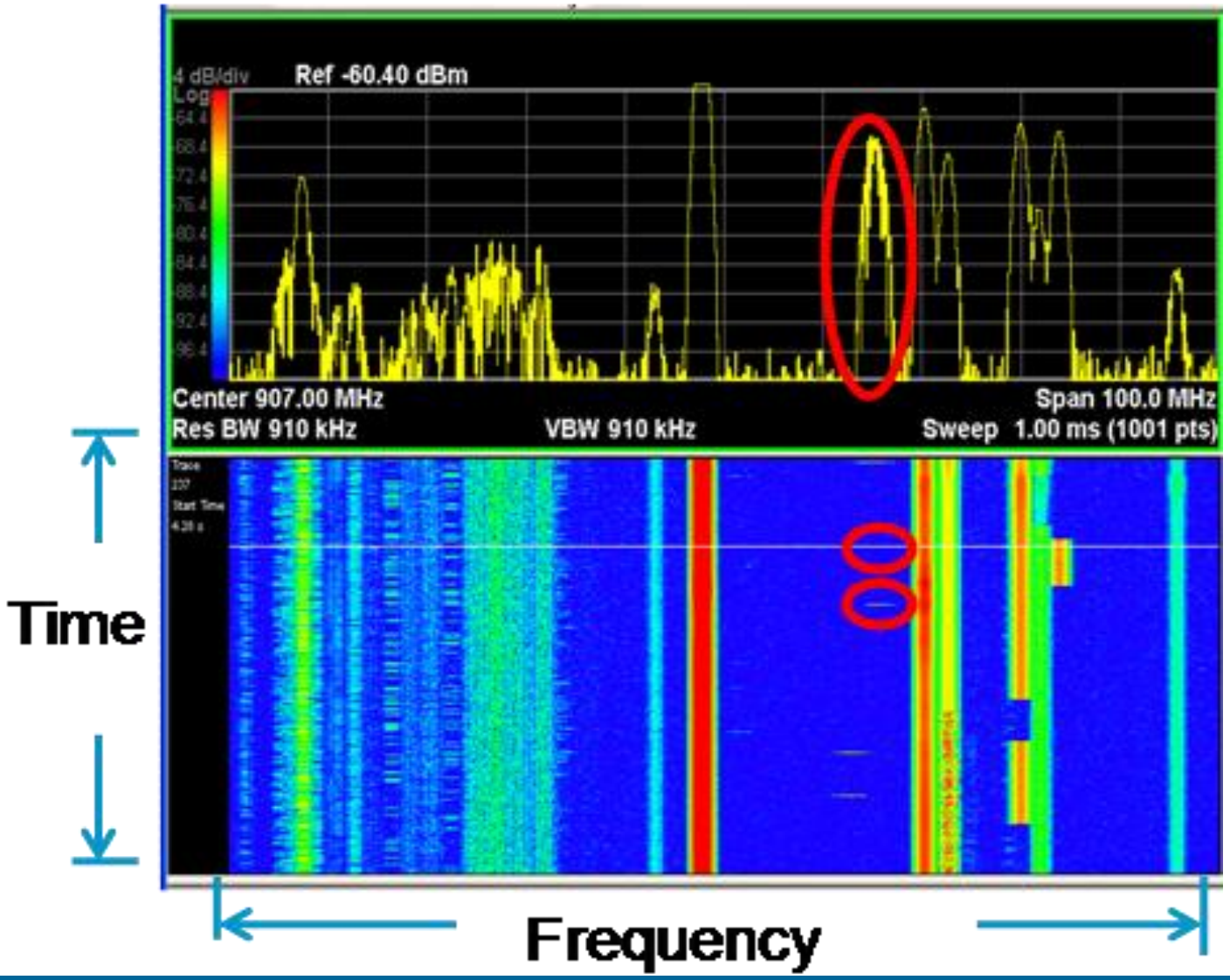
-Enhanced troubleshooting

- Gain insight about signals

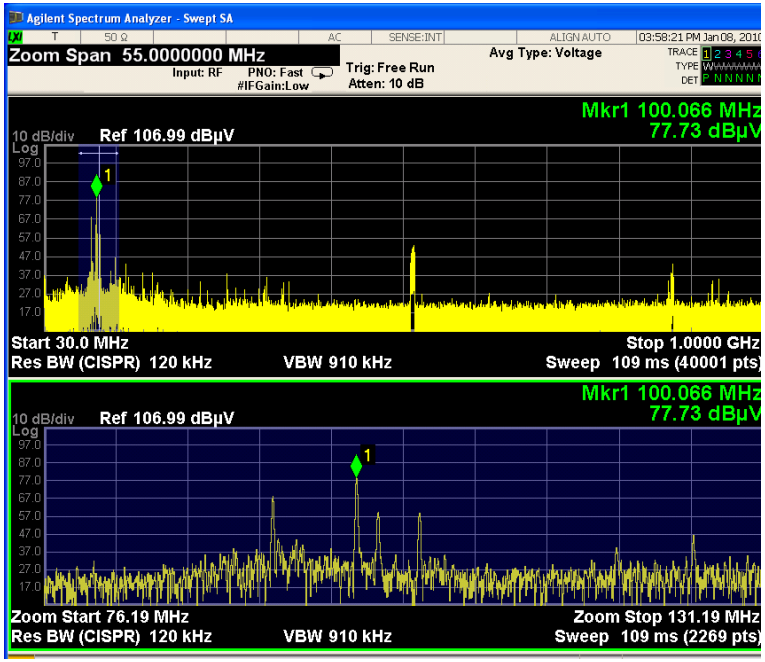
Extensive built-in diagnostic tools:
Industry-exclusive strip chart

Capture up to 2 hours of continuous data

Extensive built-in diagnostic tools: *Spectrogram*



Enhanced Diagnostic Capability: Multi-View Displays

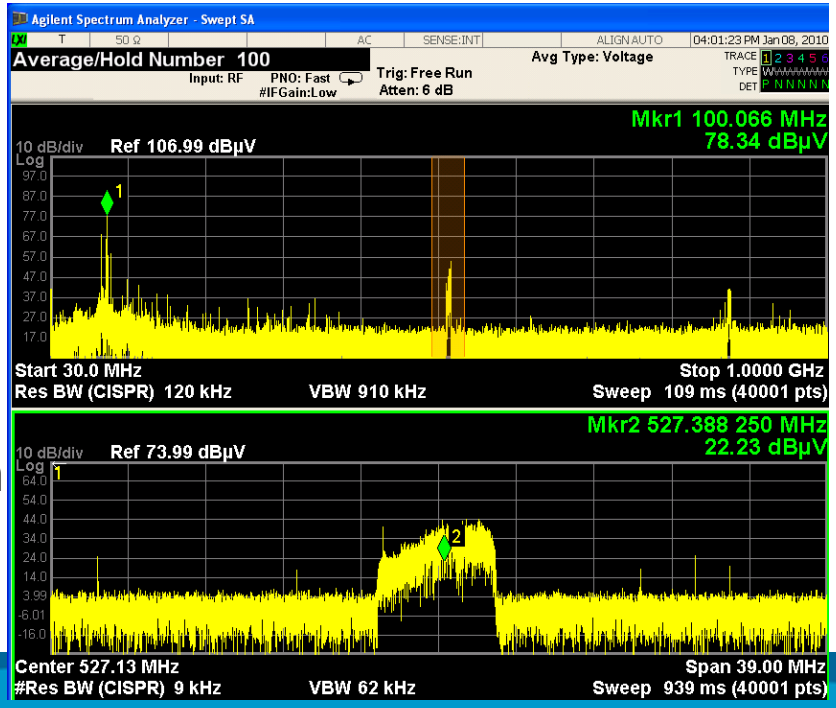


Trace Zoom

- Allows you to zoom in on your trace data
- Same trace in both screens but bottom screen shows “close up” view with fewer points
- Great to look more closely at high-density traces

Zone Span

- Two different sweeps in the two windows
- Bottom window provides detail view of span indicated in top window



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Precompliance Testing Helps Reduce Design Costs

- Gives confidence design meets Compliance specs *before* final measurement
  - Compliance testing is expensive
  - Reduces need for retest and extra cost
- Not usually done in a Compliance facility
  - Lower cost, but greater uncertainly
- Typically done with a Spectrum Analyzer
  - lower cost than an EMI receiver

N6141A EMI Measurements for Pre-compliance

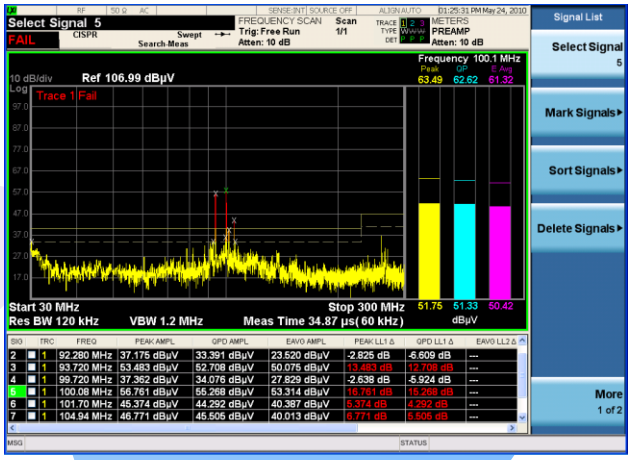
PXA

MXA

Pre-compliance

EXA

CXA



Compliance

Agilent MXE N9038A

Benefits of Agilent Precompliance Solution

PXA

MXA

EXA

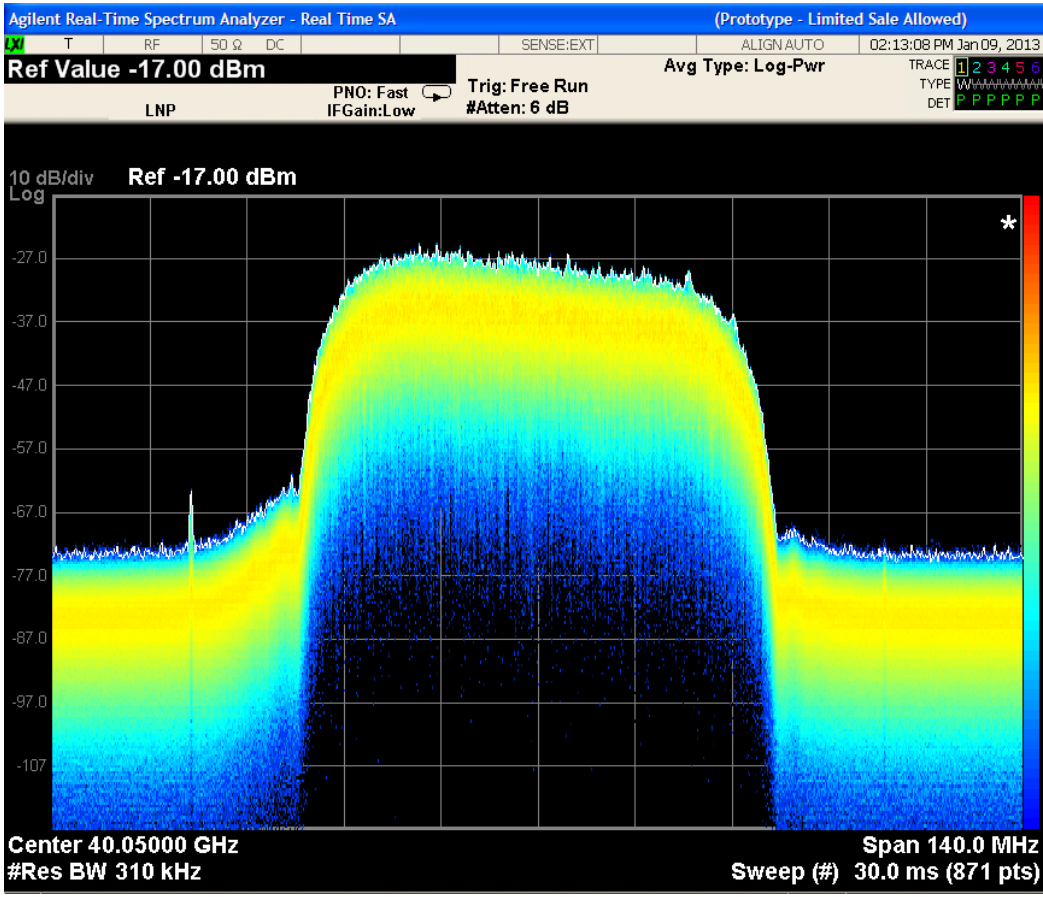
CXA

- Lower cost than a Compliance Receiver
  - broad range of price points and performance levels
- Common user interface with MXE Receiver
  - only need to learn one instrument
- Can be used for other design/test work
  - variety of test applications available in the X-series spectrum analyzers
  - Leverage instrument cost across multiple applications

Optional Real-Time Capability

Real-Time capability

- useful diagnostic tool for diagnosing fast-transient EMC problems
- not required for any compliance requirement
- Most useful in machine used for diagnosing problems



Agilent N9038A MXE EMI Receiver

- **CISPR and MIL-STD Compliant**
  - 20 Hz to 8.4 GHz
  - 20 Hz to 26.5 GHz
  - 20 Hz to 44 GHz
- **Top Performance**
- **Enhanced EMI Measurements**
- **Advanced Diagnostic Capability**

Keep the Test Queue Flowing

Additional New Features

500k Sweep Points - allows scanning over broad frequency ranges in narrower RBWs
(example: 30MHz to 1 GHz in 9kHz RBW, 4 pts/RBW)

LISN Support - front panel control for 2 automatic LISNs

Couple Meters to Marker - simplifies tuning the meters to a selected marker frequency

Mark Lower Duplicates - simplifies removing duplicate frequencies from the suspect list

Reports in PDF format

Upgrading Older MXEs to New Capabilities

Upgrade Number	Description	Upgrade
N9038AK-HL4	Hardware to enable Time Domain, APD and Monitor Spectrum	Hardware upgrade *Includes Agilent installation and recalibration*
N9038AK-TDS	Time Domain Sweep Capability	Software Upgrade only ***requires HL4 Hardware***
N9038AK-LSN	LISN control	Hardware upgrade *Customer or Agilent install*