



# Streamline EMC Testing with Prescan Analysis Tools



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# Efficient EMC Testing Improves Revenue

Benefits both Compliance Test Houses and Manufacturers

## **Compliance testing**

- Chamber time is limited resource
- Reducing test time improves efficiency and profitability

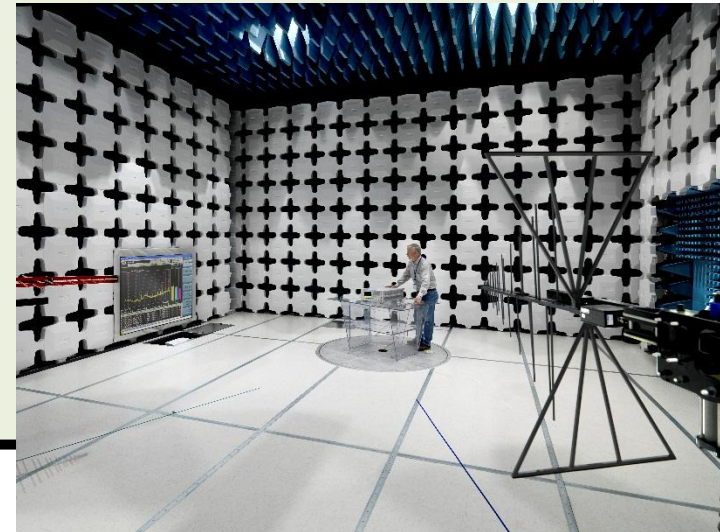
## **Precompliance testing**

- Rapid diagnosis of early designs speeds time-to market, facilitating product sales

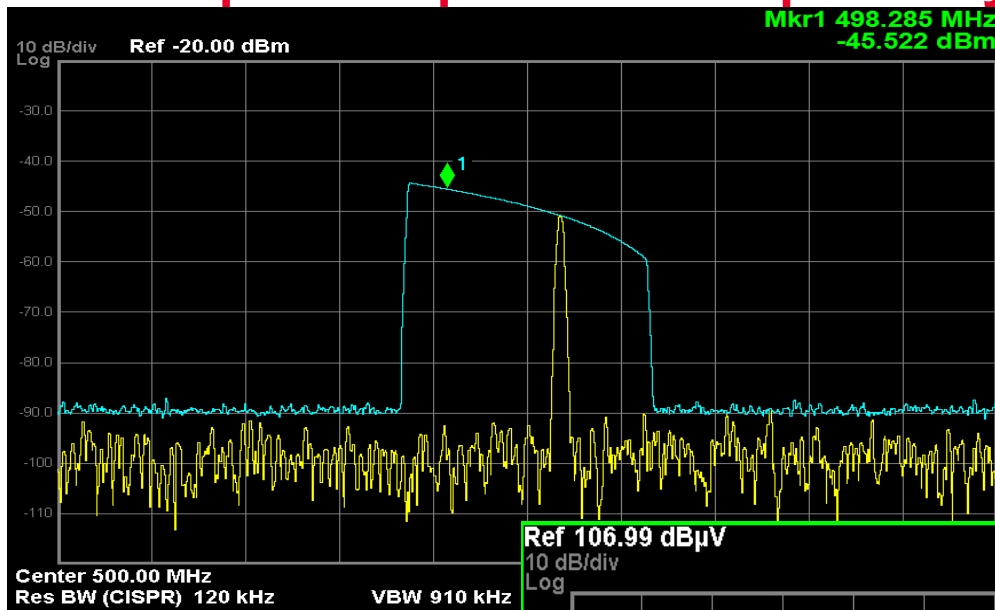
# Factors Affecting EMC Test Times

Many factors affect both Compliance and Precompliance Test times:

- Device Under Test (DUT) setup time
- Receiver/ Spectrum Analyzer Scan times
- Turntable and Antenna movement times
- Suspect frequency analysis
- Final Measurement
- Report Generation

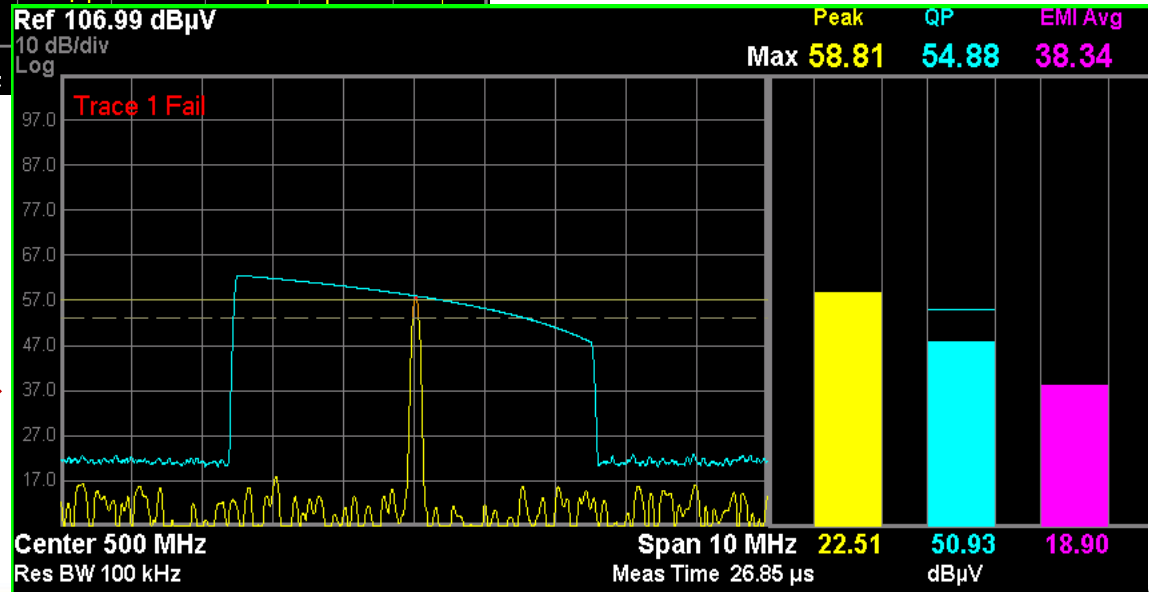


# Presentation Will Discuss Tools Used to Speed up Suspect Frequency Analysis



← Spectrum Analysis

IF Spectrum Monitoring →



# Agenda

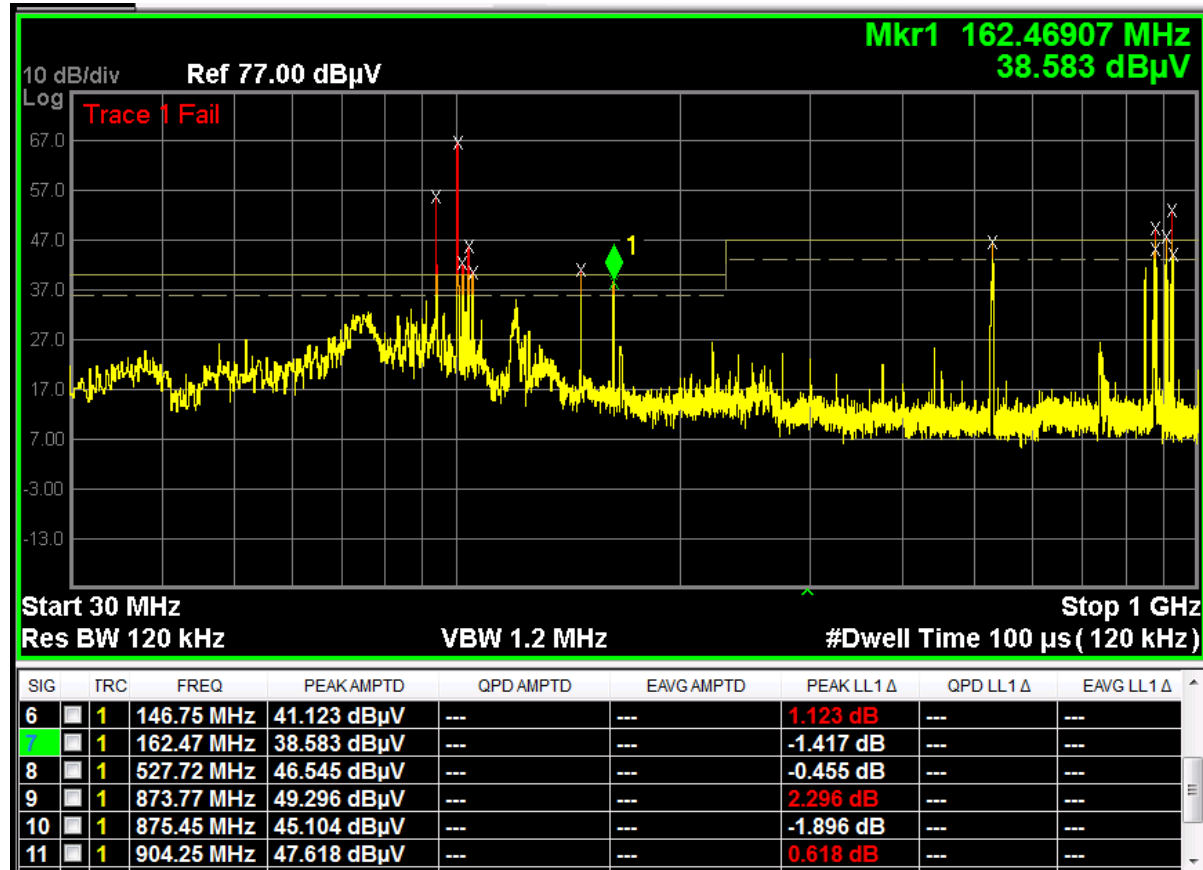
- Suspect List Analysis
  - What are suspect emissions and why do we have to analyze them?
- Emissions Prescan Measurements
  - Benefits - why we make them
  - Challenges – errors associated with prescan
- Solutions to Speed Up Suspect List Analysis
  - Spectrum Analysis
  - IF Spectrum Monitoring

# But First....What are Suspect Frequencies?



- Frequencies measured during fast prescan that may fail final measurements to CISPR limits

Prescan Display



Suspect List

# Why do I Need to Analyze Suspect Frequencies?

- CISPR requirements

- Must maximize the signal and record azimuth and antenna orientation
- Must ensure that you are measuring at the frequency of maximum emission
- Must monitor emission Quasi-Peak (QP) amplitude to capture maximum value
  - If not constant, users must monitor QP value for 15 seconds or more (as per CISPR 16-2-3, section 6.5).

- Amplitude and frequency errors associated with prescan methods.

Why can't I just directly scan and measure?



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# Prescanning Reduces Overall EMC Test Time

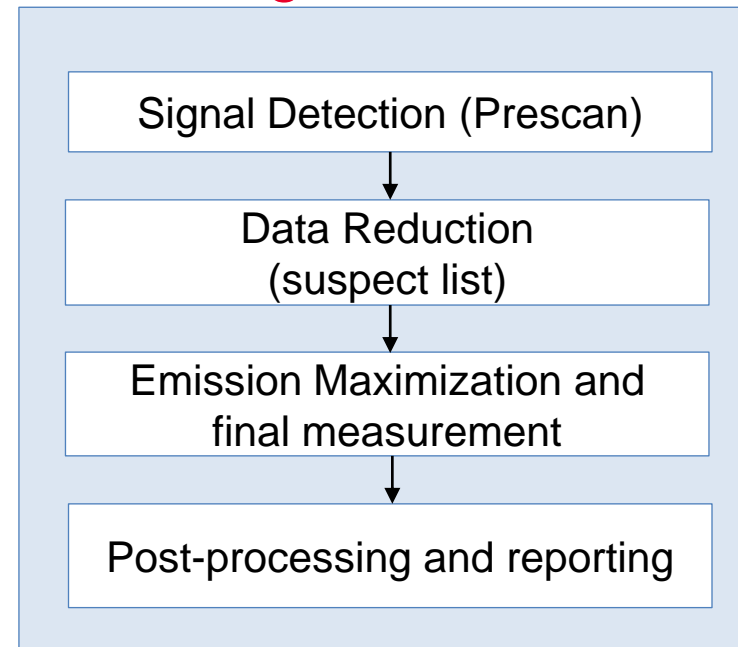
- **What is Prescanning?**

- Methodology used to reduce overall EMC test time
- Scan target frequency range with Peak detector to identify frequencies where emissions exist
- Peak detector significantly faster than weighted detectors

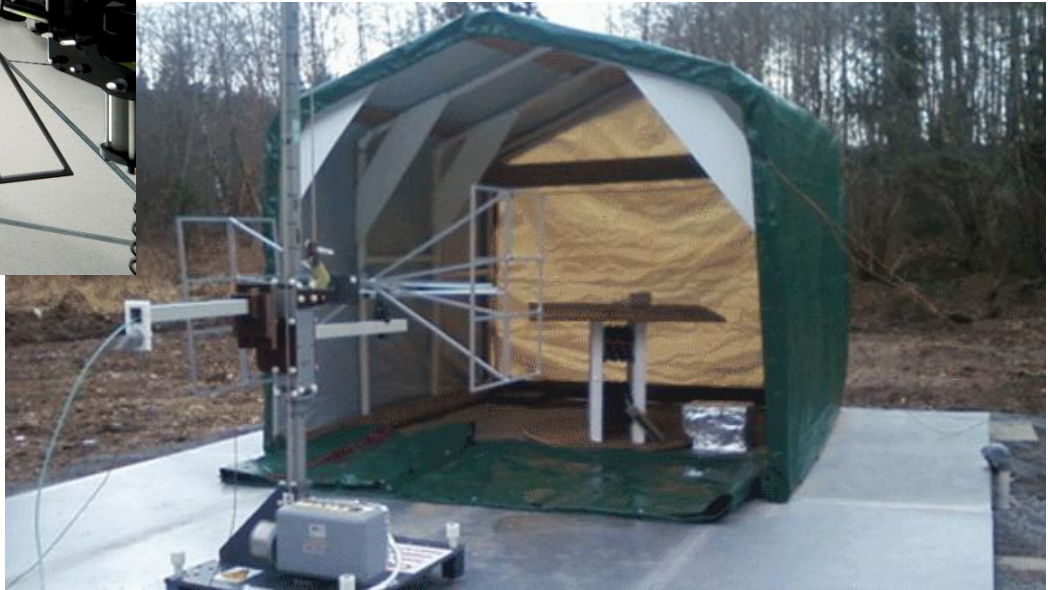
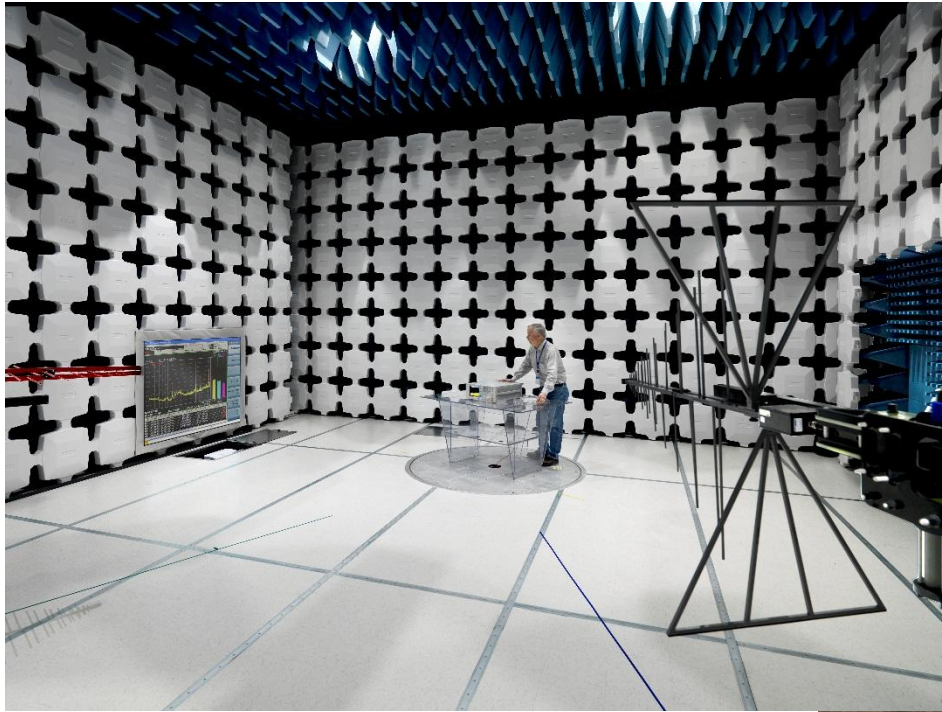
- ***Recommended by CISPR***

- Specifically to reduce test time

Recommended  
CISPR Test Flow

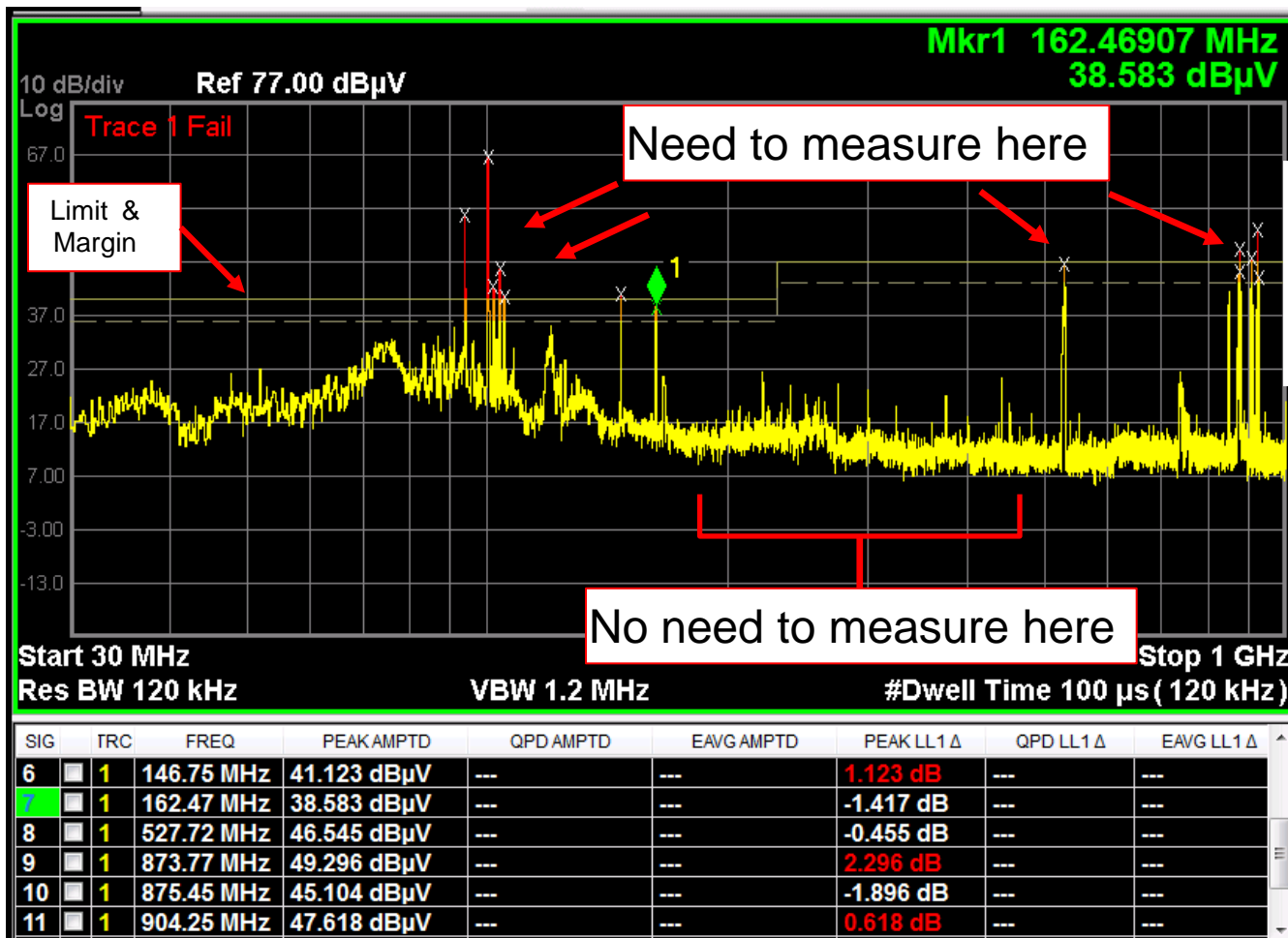


# Prescan Saves Time for Both Compliance and Precompliance Testing



# How Does Prescan Save Test Time?

- Focus final measurement efforts only on frequencies with emissions above or near the limit line



Suspect List

# How Does Prescan Save Test Time?

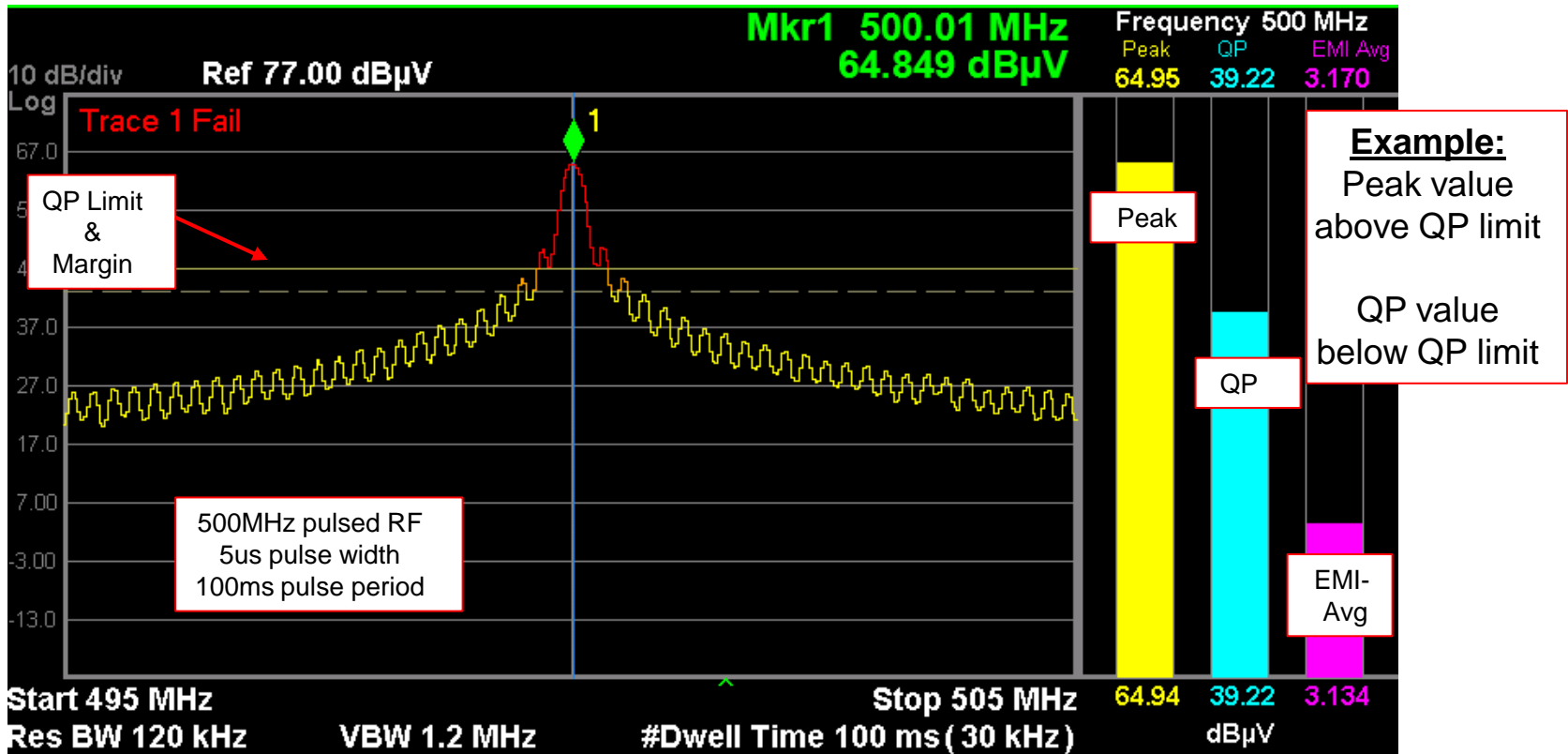
- Identify suspect frequencies more quickly by scanning with a peak detector.
  - Scanning with CISPR weighted detectors (Quasi-Peak, EMI Avg and RMS-Avg) slow due to defined charge and discharge times

Specified minimum scan times, as stated in CISPR 16-2-3

Frequency band		Scan time $T_s$ for peak detection	Scan time $T_s$ for quasi-peak detection
A	9 kHz to 150 kHz	14,1 s	2 820 s = 47 min
B	0,15 MHz to 30 MHz	2,985 s	5 970 s = 99,5 min = 1 h 39 min
C and D	30 MHz to 1 000 MHz	0,97 s	19 400 s = 323,3 min = 5 h 23 min

# Why is Scanning with Peak Detector Allowed?

- Peak values will always be equal to or larger than the Quasi-Peak (QP), EMI-Average or RMS-Avg detected values
- If a peak value is over the limit (or margin), further measurement should be done with CISPR detector

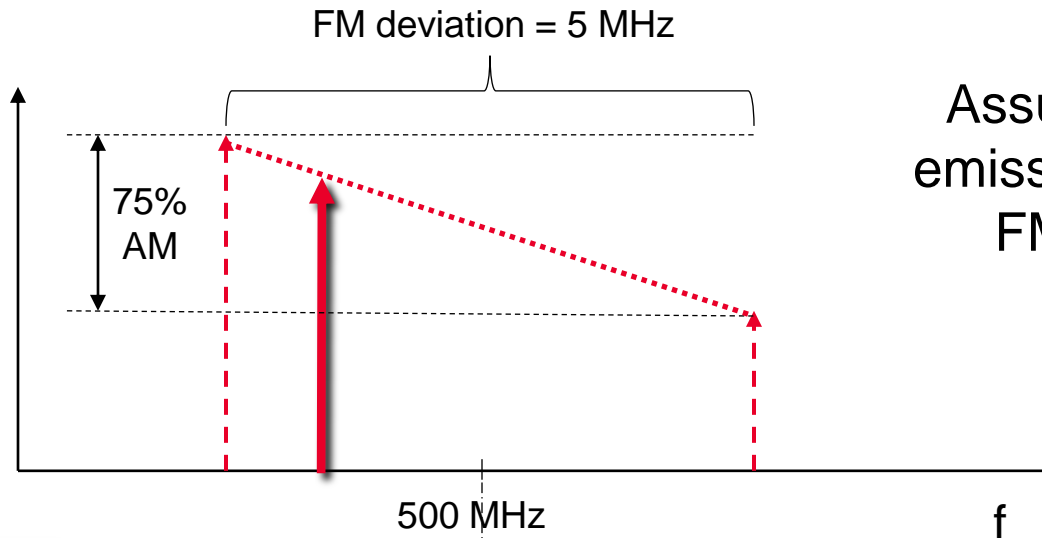


# Challenges with Prescan

- Amplitude and Frequency Errors due to:
  - Amplitude or frequency modulation on detected signals
  - Receiver / Spectrum Analyzer sweeping/stepping

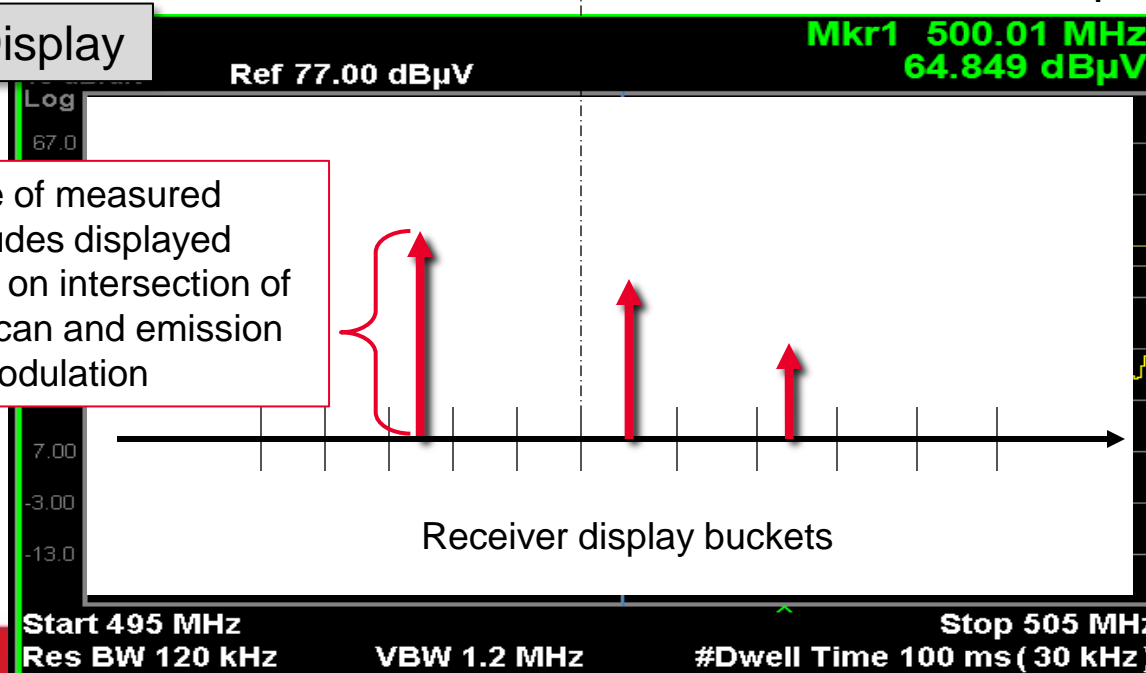
# Signal Modulation Affects Measured Prescan Level

Emission



Assume a 500MHz emission with AM and FM modulation

Receiver Display



Range of measured amplitudes displayed depending on intersection of receiver scan and emission modulation



# Prescan Errors due to Modulation on Emission

Modulation on emissions signal can indicate false peak frequency in signal list

Detail analysis indicates emission measurement really needs to be made here

Prescan indicated peak occurs here

Max emission envelope due to AM and FM modulation

Narrow Span

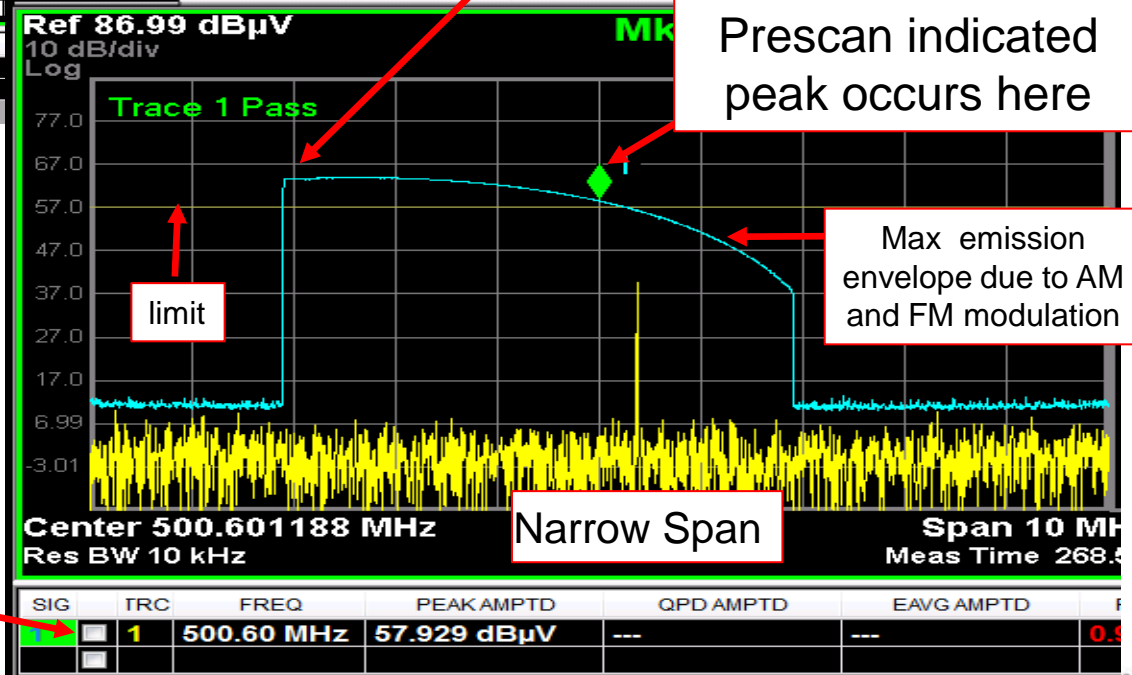
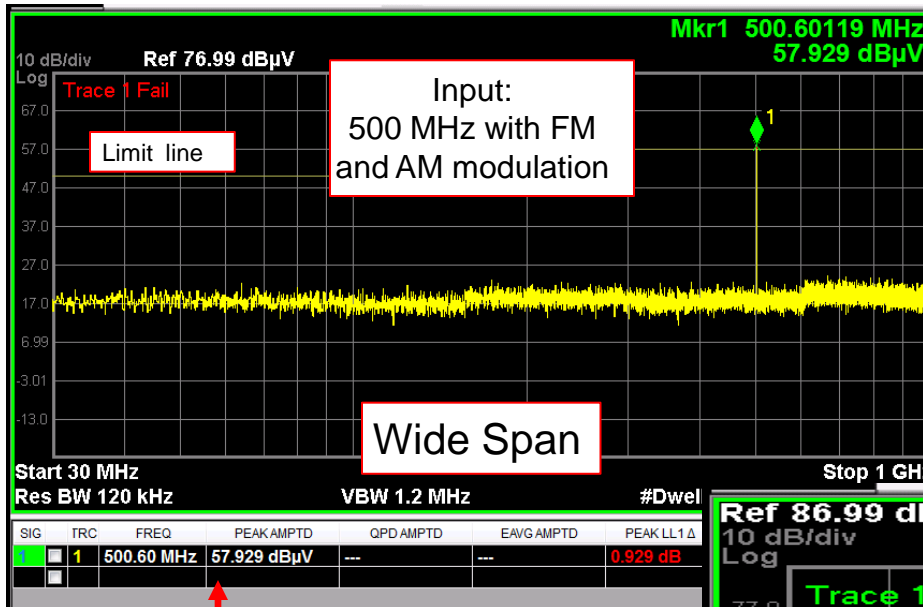
Input:  
500 MHz with FM  
and AM modulation

Limit line

Wide Span

## Frequency List Entry

- w/o addition analysis, measurement would be made at this frequency



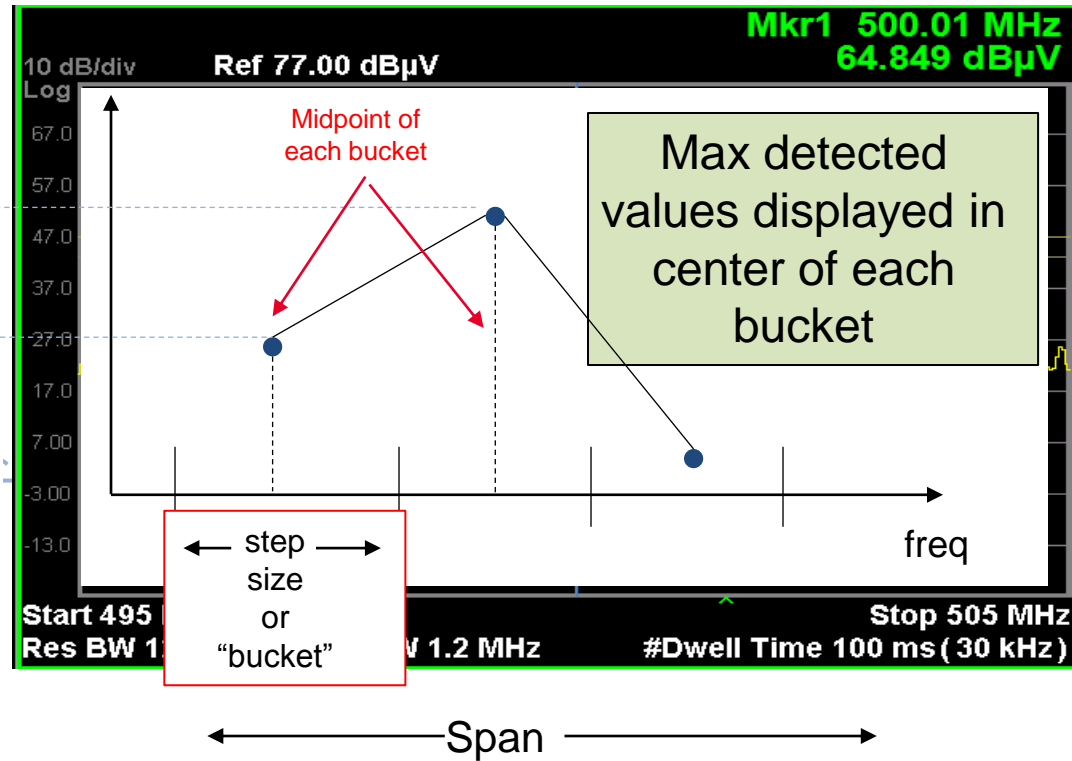
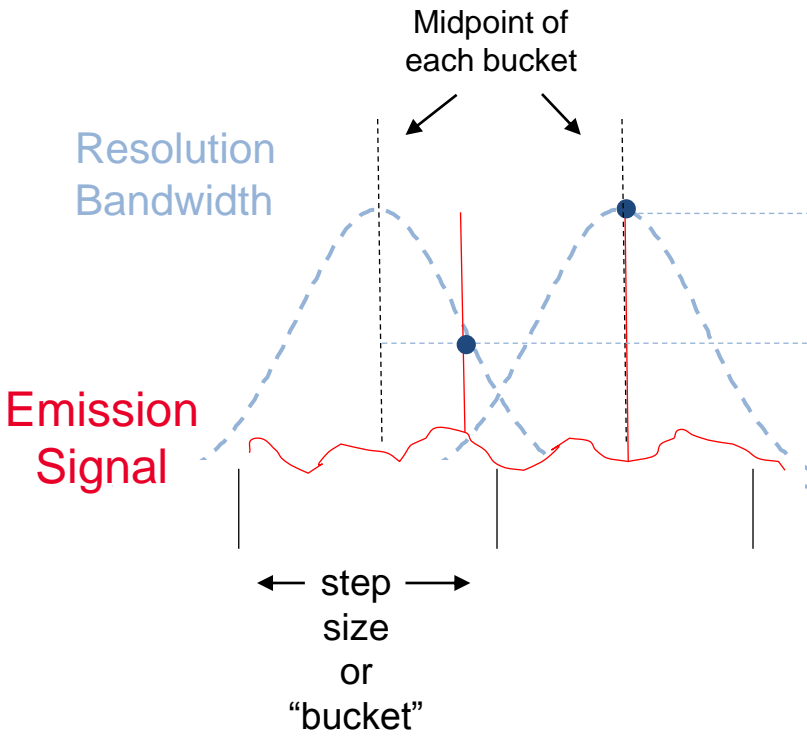


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# How Modern Receivers Display Amplitude Levels per Frequency Step...

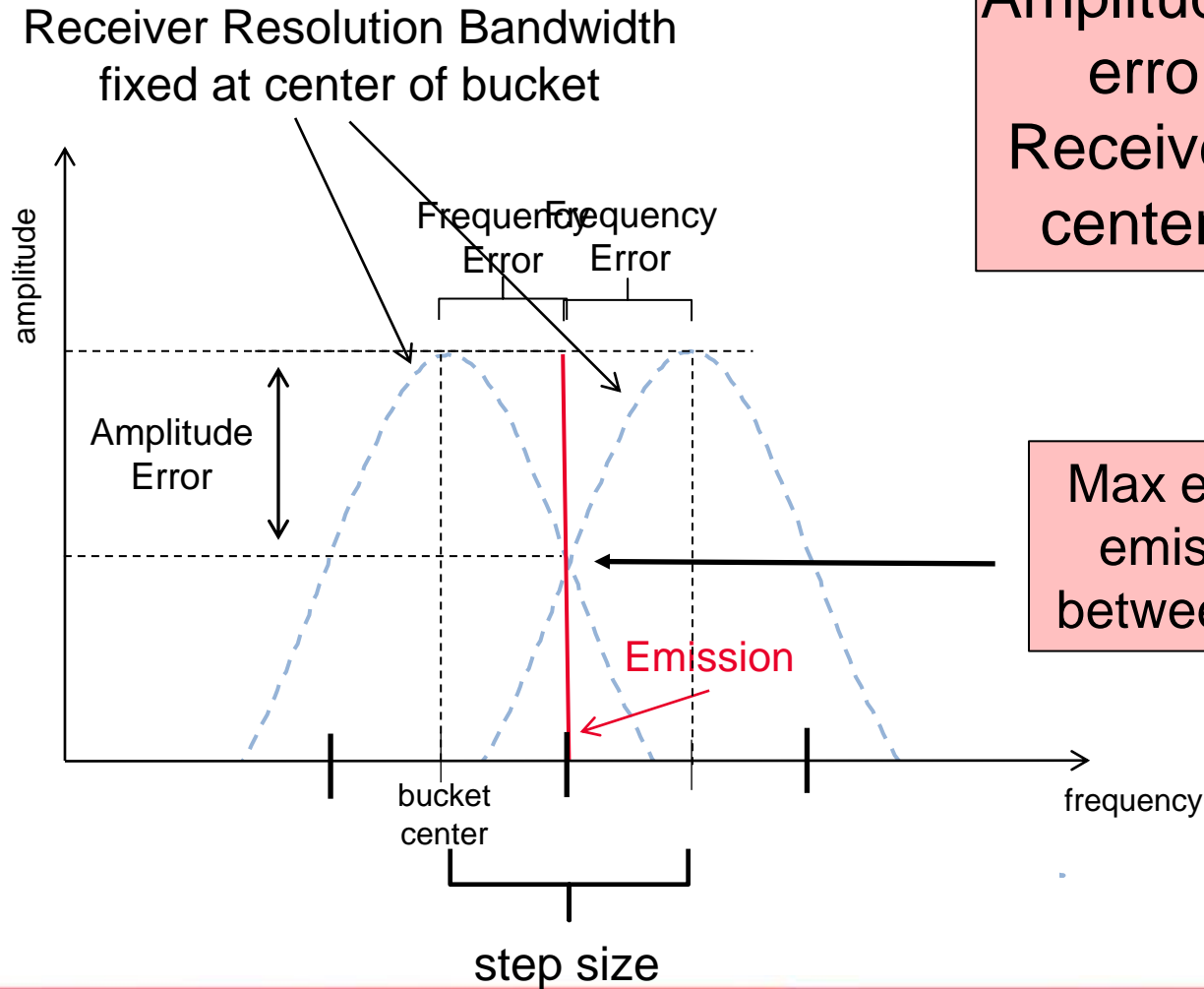
Receiver Display



Receivers display amplitudes and frequencies in display "buckets"

Number of measurement points =  $(\text{Span} / \text{step size}) + 1$

# Prescan Amplitude and Frequency Errors When Using a Stepping Receiver

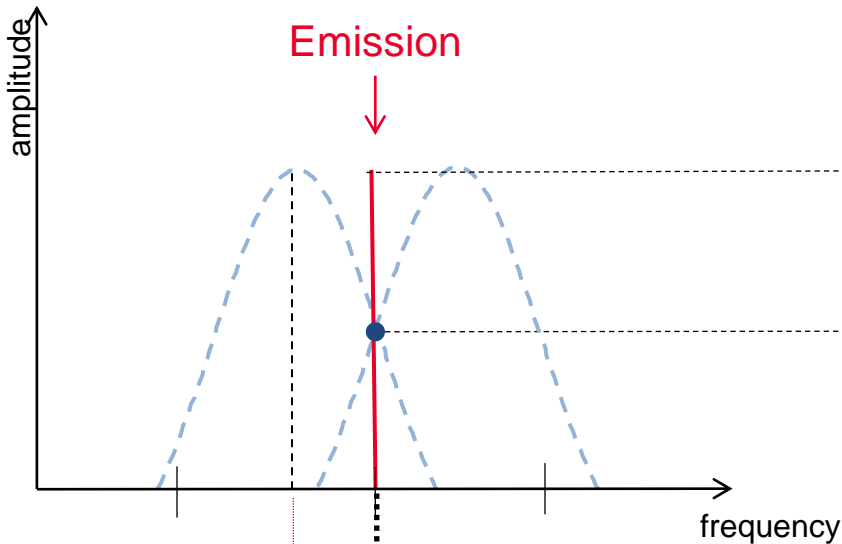


Amplitude and Frequency errors occur when Receiver Bandwidth not centered on emission

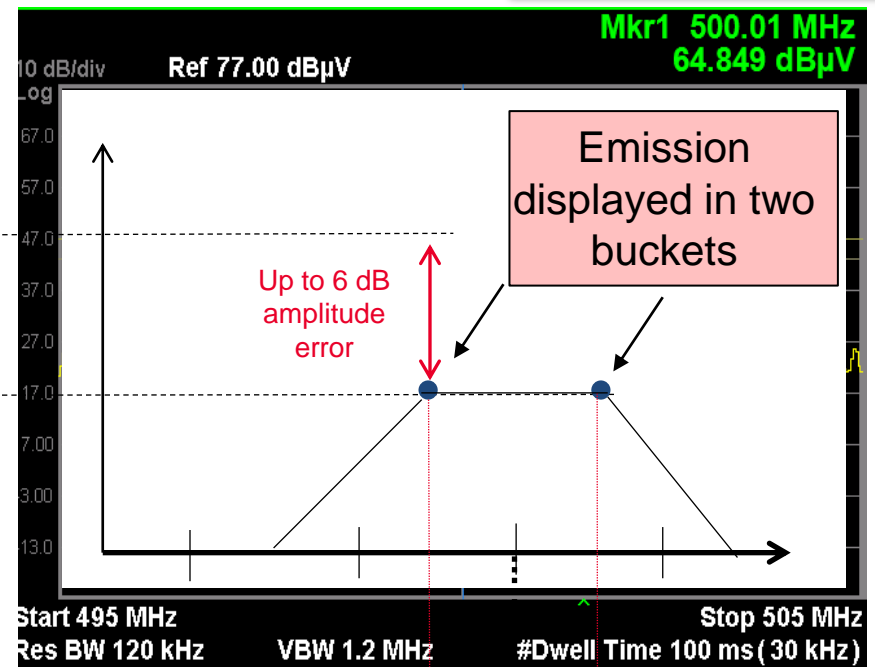
Max errors occur when emission is half-way between bucket centers

# Prescan Amplitude and Frequency Errors When Using a Stepping Receiver (cont.)

Max errors occur when emission is half-way between bucket centers

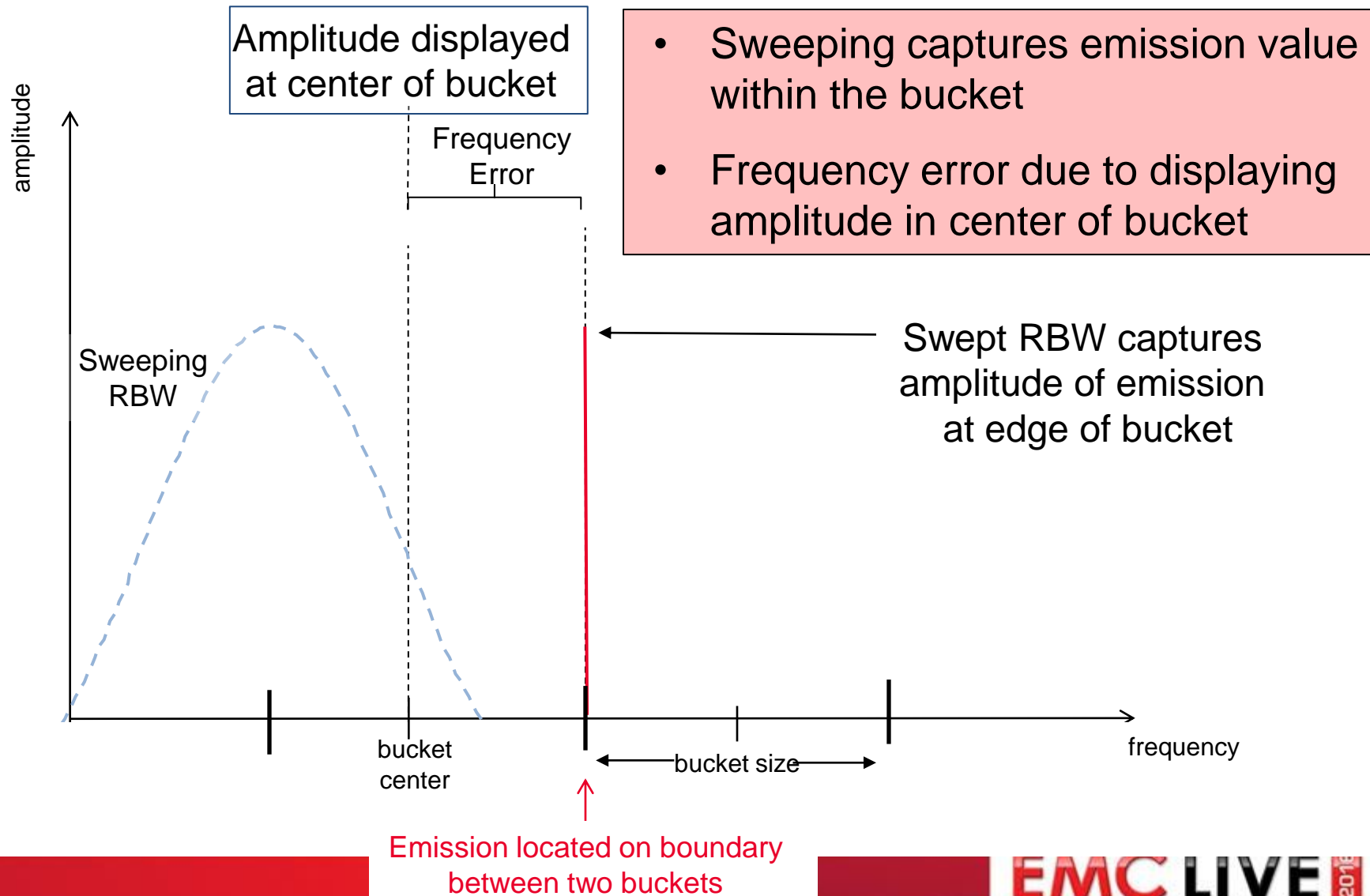


Receiver Display

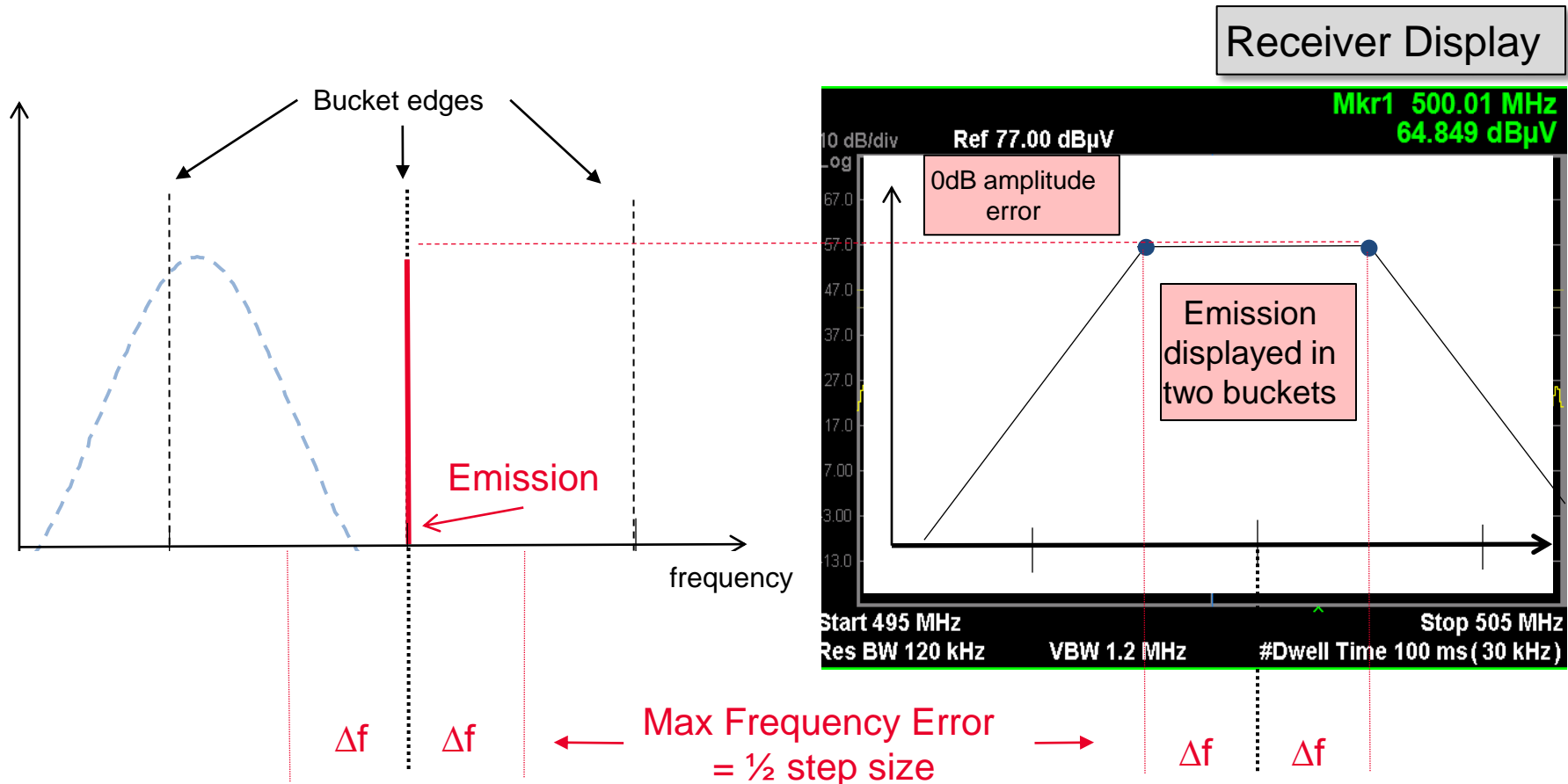


$\Delta f$  ← Max Frequency Error =  $\frac{1}{2}$  step size →  $\Delta f$   $\Delta f$

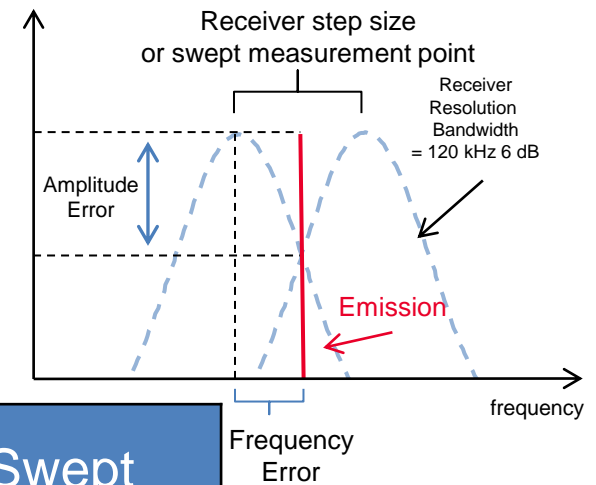
# Prescan Amplitude and Frequency Errors When Using a Swept Receiver



# Prescan Amplitude and Frequency Errors When Using a Swept Receiver



# Example: Amplitude and Frequency Errors using 120kHz CISPR RBW



		Stepped and Swept	Stepped	Swept
# Meas. per RBW	<u>Step Size</u>	<u>Max Frequency Error</u>	<u>Max Amplitude Error</u>	<u>Max Amplitude Error</u>
1	120 kHz	60kHz	6 dB	0 dB
2	60 kHz	30 kHz	1.2 dB	0 dB
3	40 kHz	20 kHz	0.5 dB	0 dB
4	30 kHz	15 kHz	0.3 dB	0 dB

# Tradeoff Between Error Magnitude and Test Time

## Decreasing Step Size:

- improves accuracy
- adds data points
- increases scan time  
( # of points x dwell time)

		Stepped and Swept	Stepped	Swept	30MHz – 1 GHz
# Meas. per <u>RBW</u>	Step <u>Size</u>	Max Frequency <u>Error</u>	Max Amplitude <u>Error</u>	Max Amplitude <u>Error</u>	Scan_Time using <u>10ms dwell</u>
1	120 kHz	60kHz	6 dB	0 dB	80 sec
2	60 kHz	30 kHz	1.2 dB	0 dB	160 sec
3	40 kHz	20 kHz	0.5 dB	0 dB	242 sec
4	30 kHz	15 kHz	0.3 dB	0 dB	320 sec



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  - IF Spectrum Monitoring

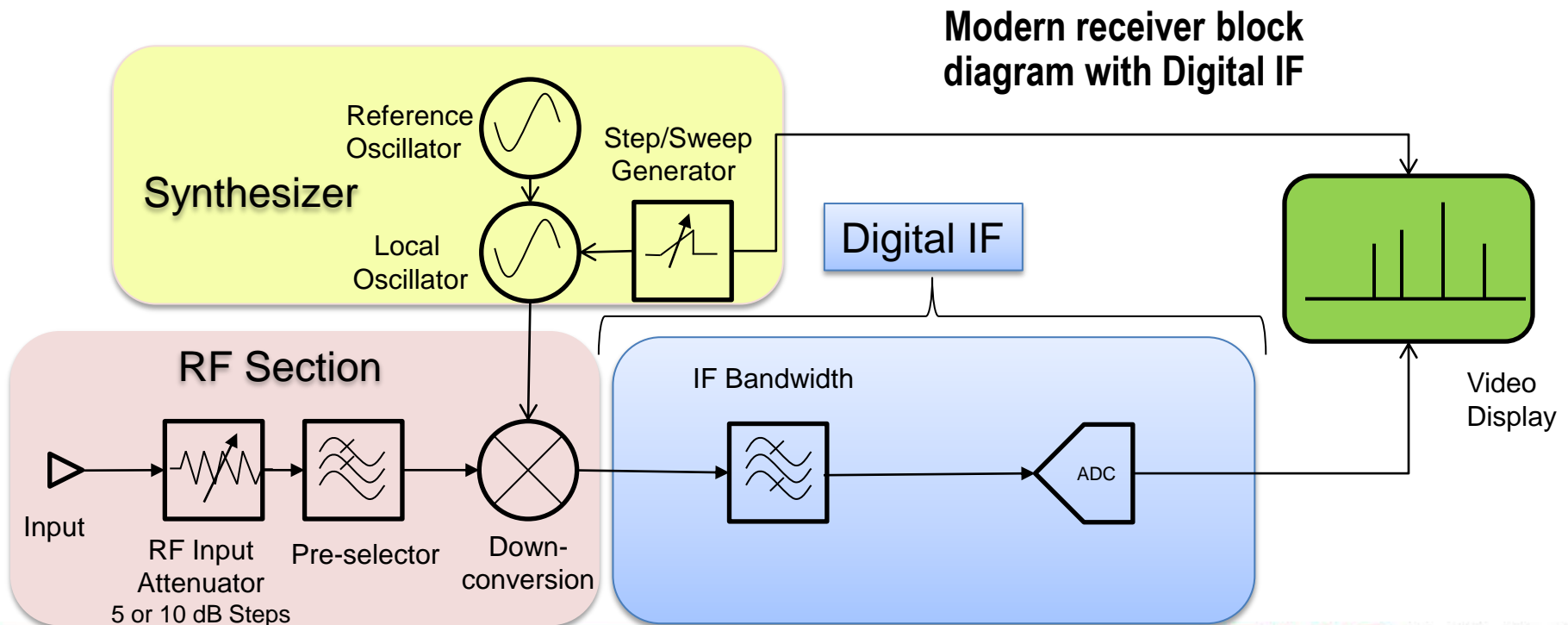
# Swept Spectrum Analysis versus IF Spectrum Monitoring

## Swept Spectrum Analysis:

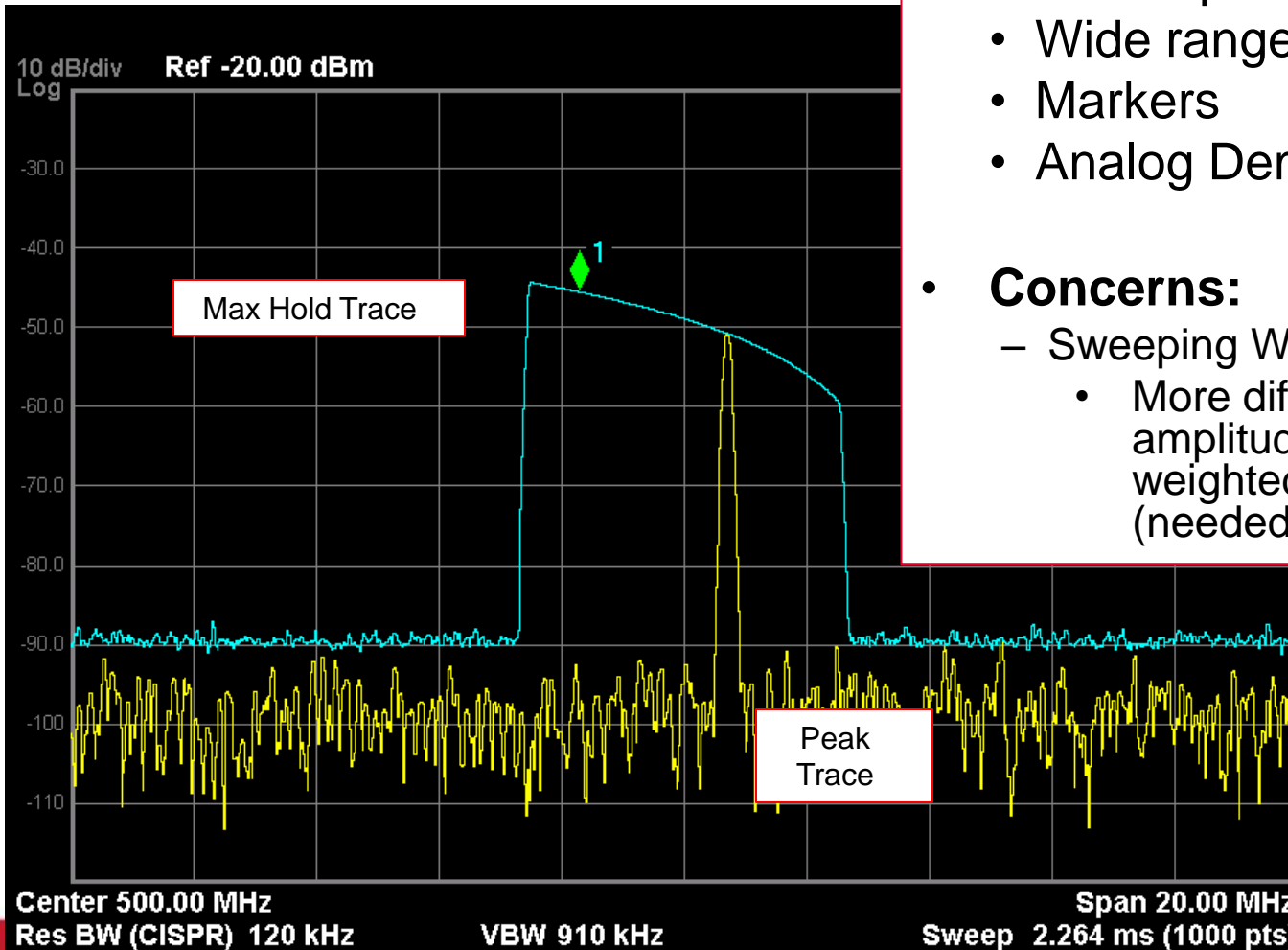
- Local Oscillator (LO) swept to generate spectral display

## IF Spectrum Monitoring:

- LO fixed at display center frequency
- spectrum generated using FFT



# Spectrum Analysis Offers Excellent Flexibility



## – Benefits

- Multiple Traces
- Broad range of resolution bandwidths, including CISPR RBWs
- Wide Spans available
- Wide range of detectors
- Markers
- Analog Demodulation

## • Concerns:

- Sweeping Weighted detectors is slow
  - More difficult to identify max amplitude and frequency of weighted detector response (needed for limit testing)

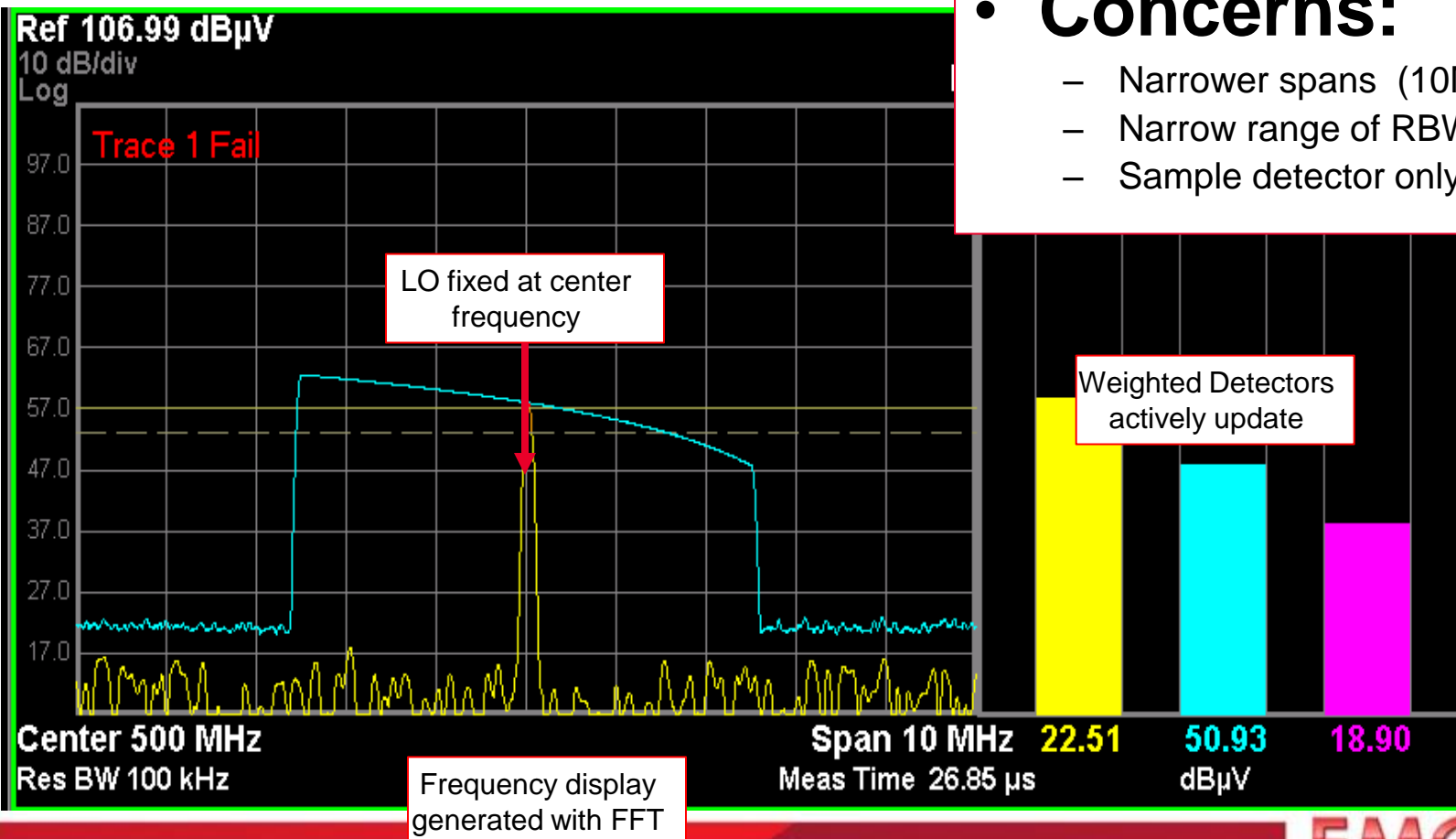
# IF Spectrum Monitors Offer Both Active Span and Weighted Detector Display

## – Benefits:

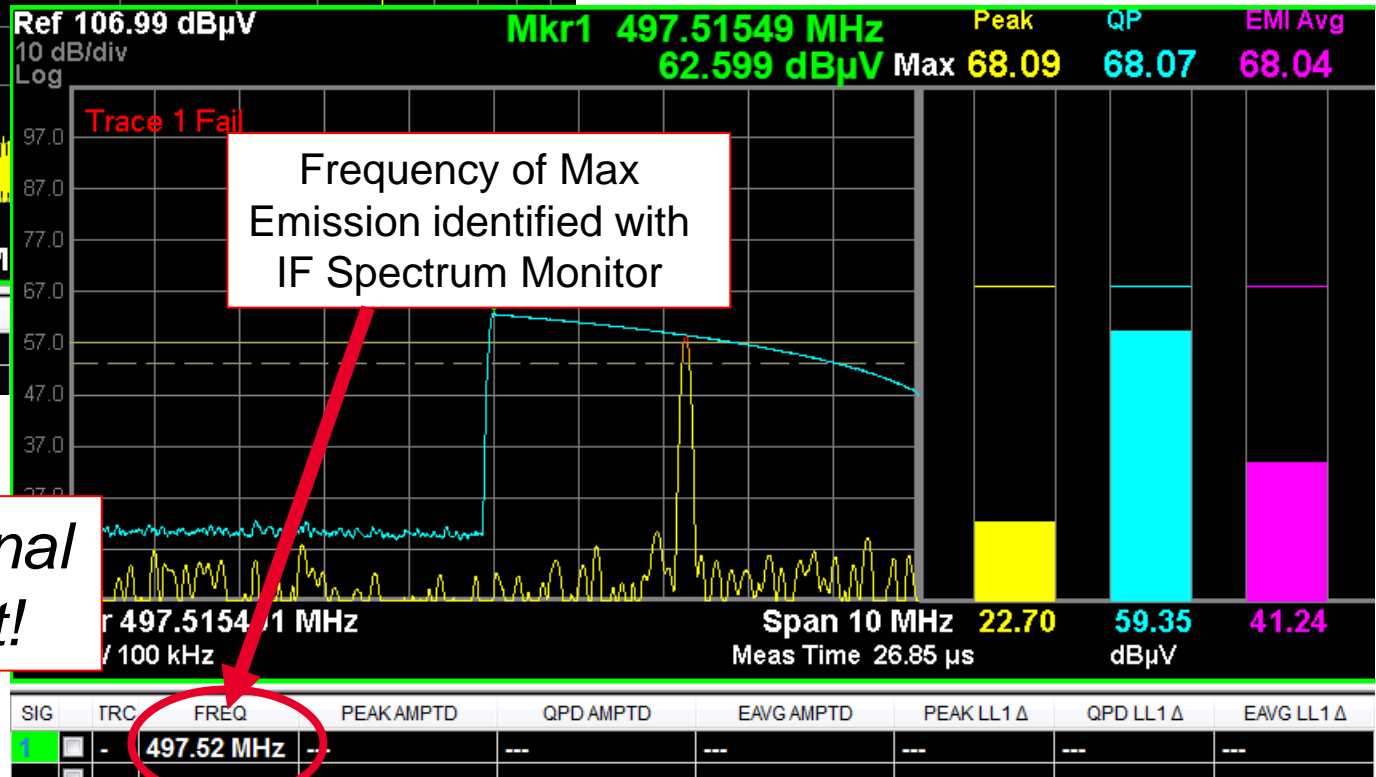
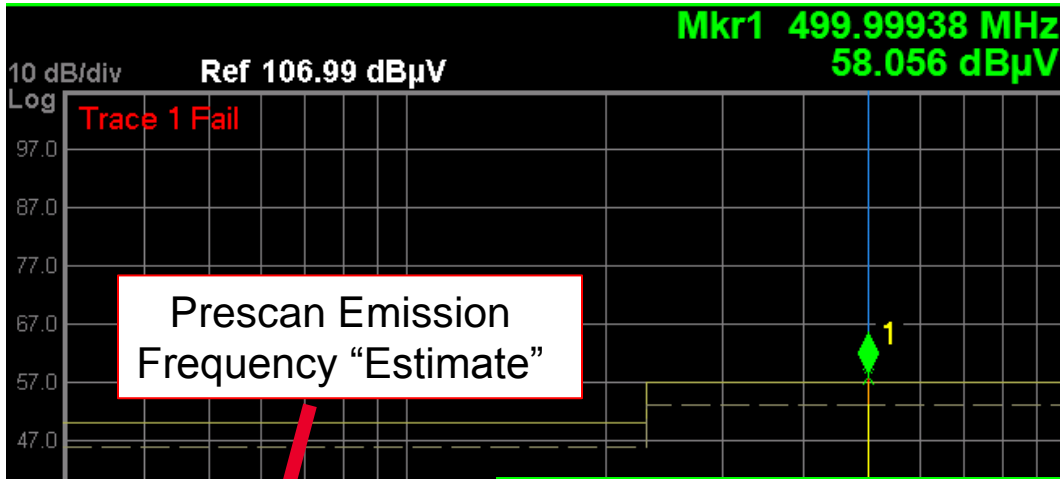
- Active span and weighted detector amplitudes simplifies maximization
- Multiple Traces
- Markers
- Analog Demodulation

## • Concerns:

- Narrower spans (10MHz typically)
- Narrow range of RBWs (no CISPR)
- Sample detector only



# Use Tools to Update Frequency List Prior to Final Measurement



List ready for final measurement!

# Modern EMI Measurement Tools Contain Both

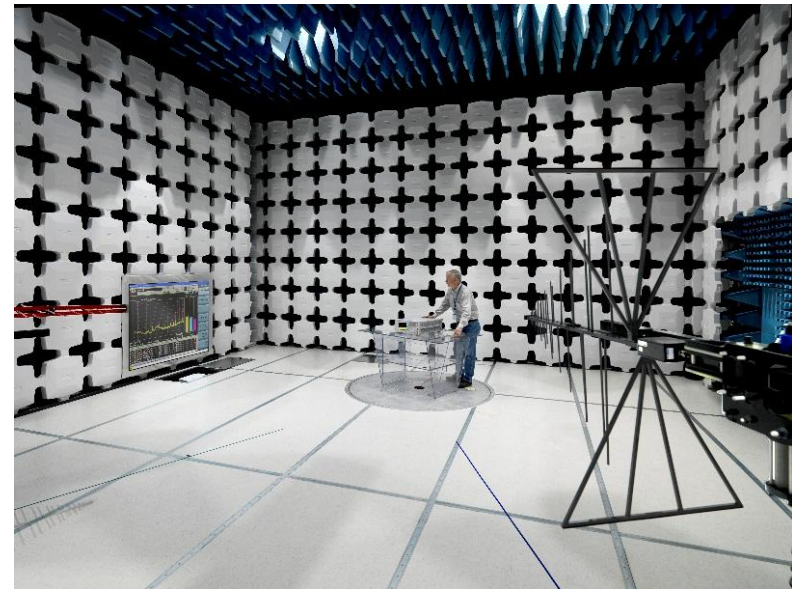
## Prescan analysis tools widely available

- Compliance Receivers
  - spectrum analysis built-in
  - IF analysis tool available standard or as option
- Precompliance Spectrum Analyzers
  - IF analysis tool available as option

# Prescan Analysis Tools Improve EMC Lab Efficiency

## Prescan Analysis Tools:

- Facilitate suspect list analysis
- Enhance measurement accuracy
  - Identify frequency of maximum emission
- Improve testing quality
- Reduce overall test time





**Thanks for attending!**

**Don't miss our Test Bootcamp!**

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