SIGLENT®

To Provide Every Engineer Worldwide with Professional T&M Instruments

Content

- Fundamentals of Signal Analysis
- Principle of Spectrum Analyzer
- Performance Index
- Introduction of SSA3000X Series

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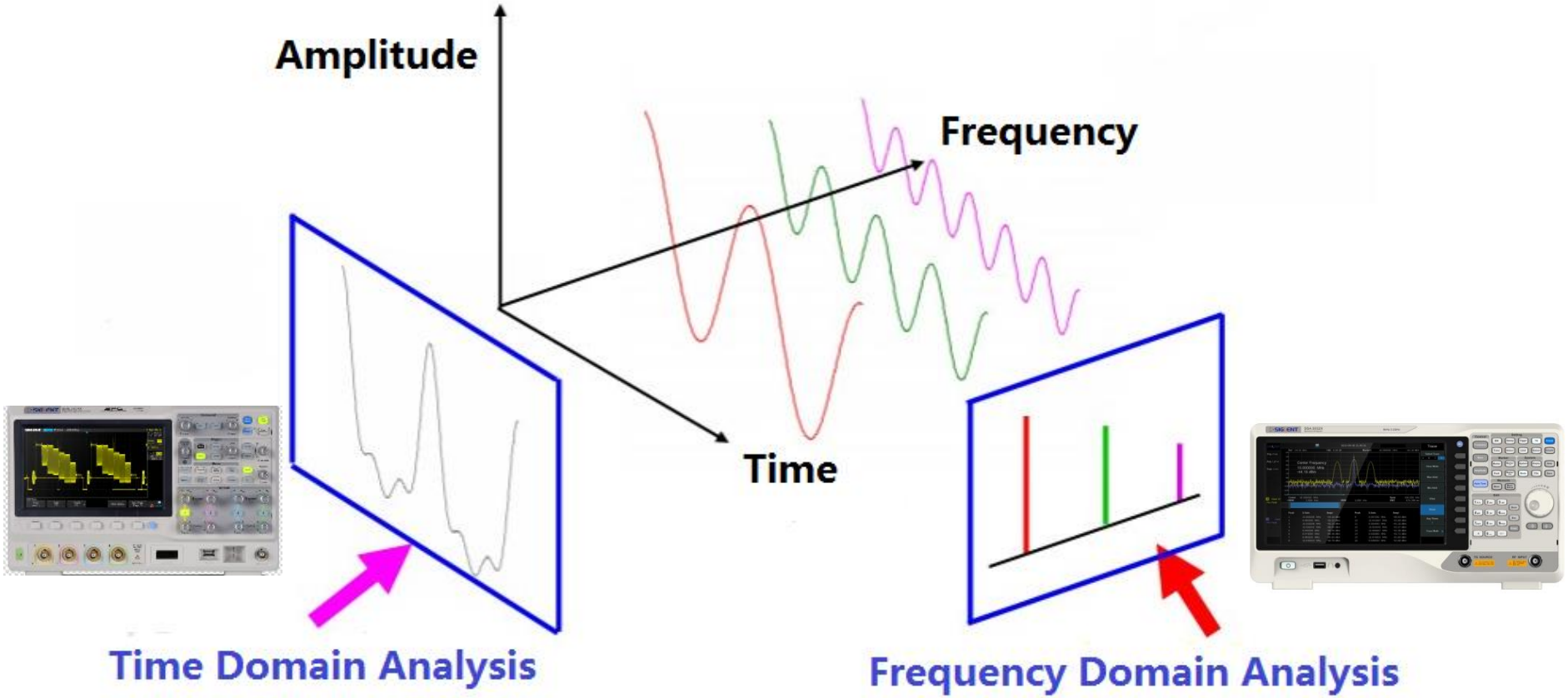
Fundamentals of Signal Analysis

- Time-domain signal and frequency-domain signal



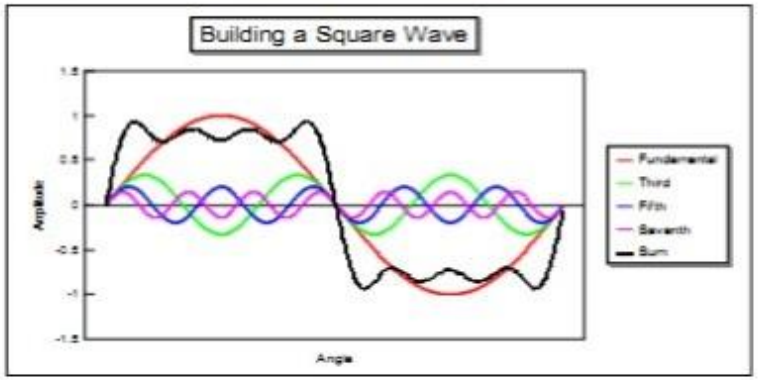
Fundamentals of Signal Analysis

- Transform between time-domain and frequency-domain

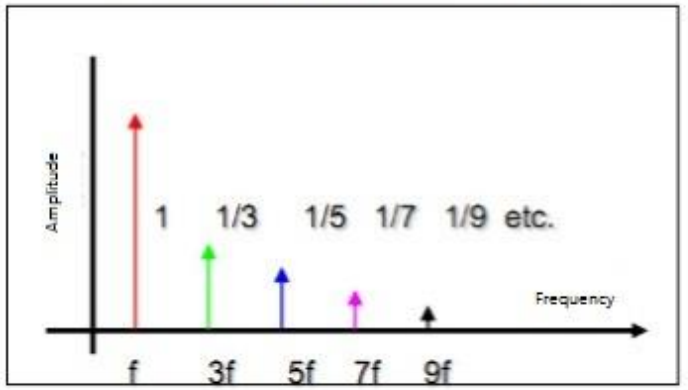
Fourier Transform

$$S(f) = \int_{-\infty}^{+\infty} x(t) e^{-j\omega t} dt$$

Time-domain analysis

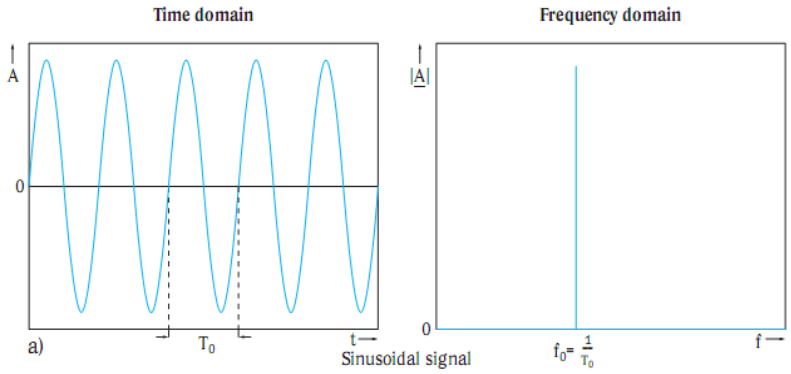


Frequency-domain analysis

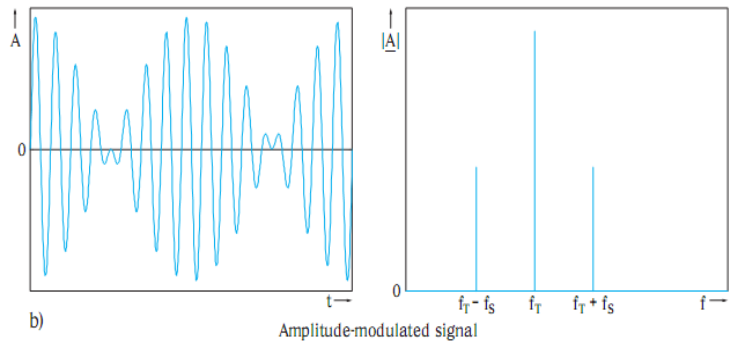


Fundamentals of Signal Analysis

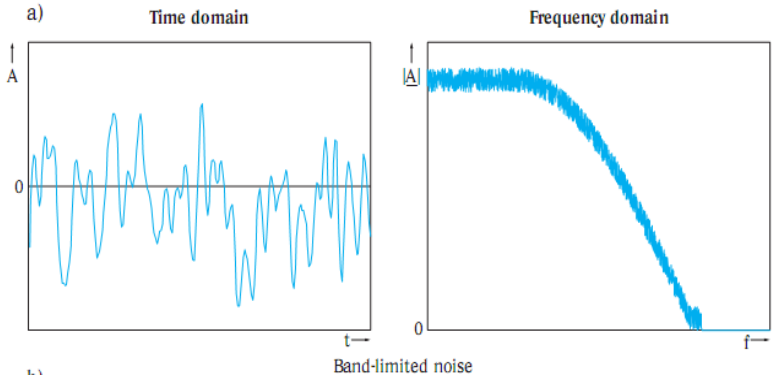
- Several typical signal spectrums



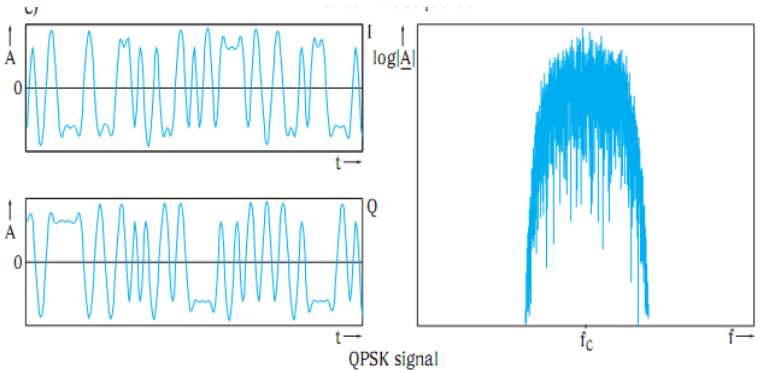
Sine wave



AM signal



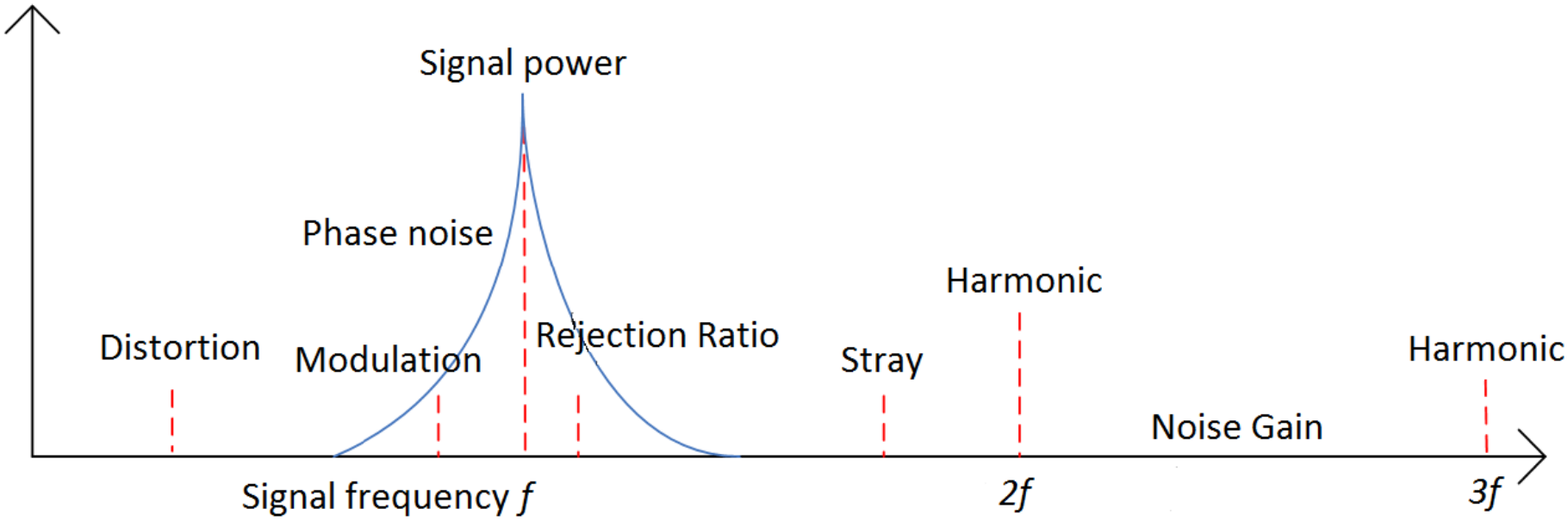
Band-limited noise signal



QPSK signal

Fundamentals of Signal Analysis

- Basic indicators of frequency-domain signals



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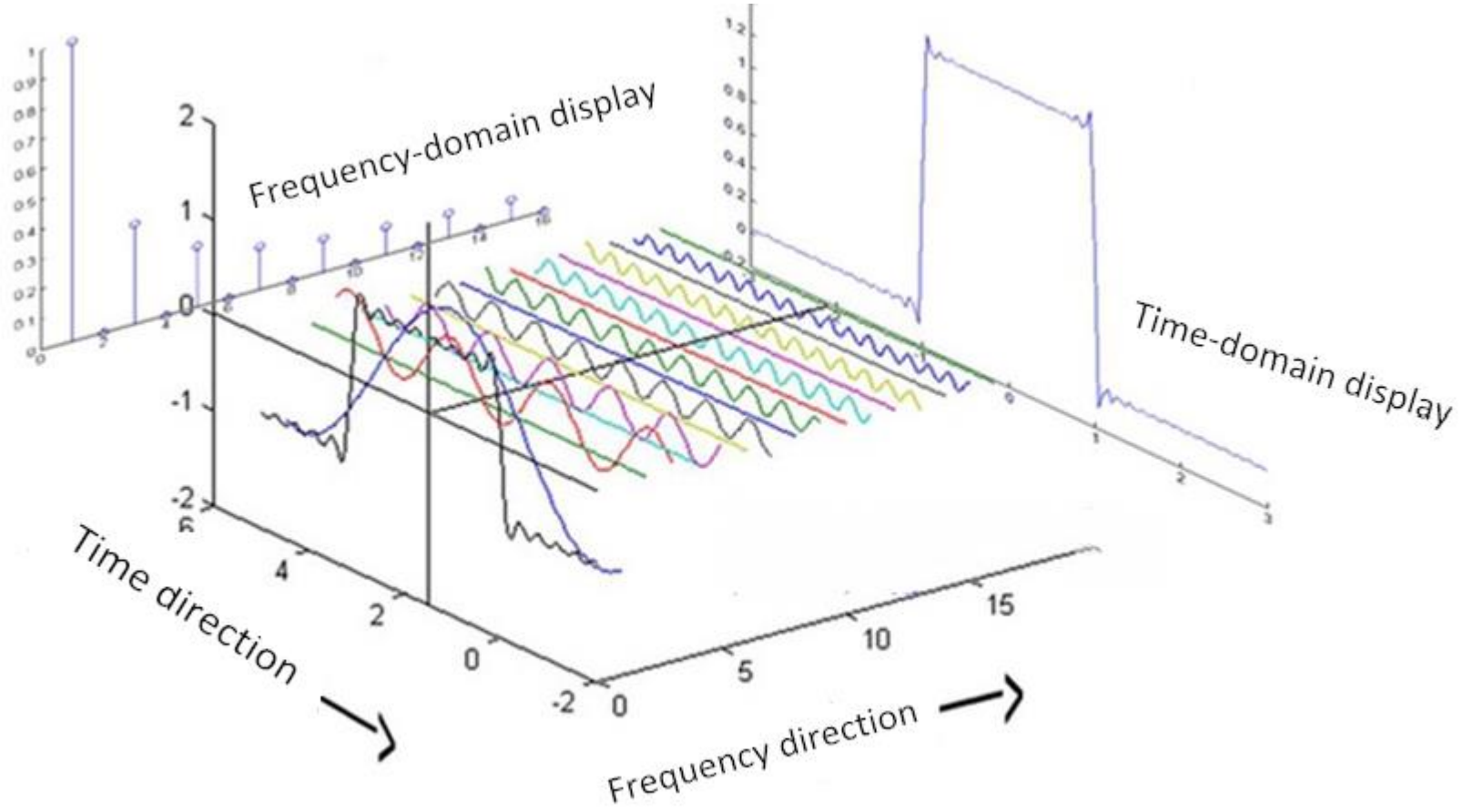
Principle of Spectrum Analyzer

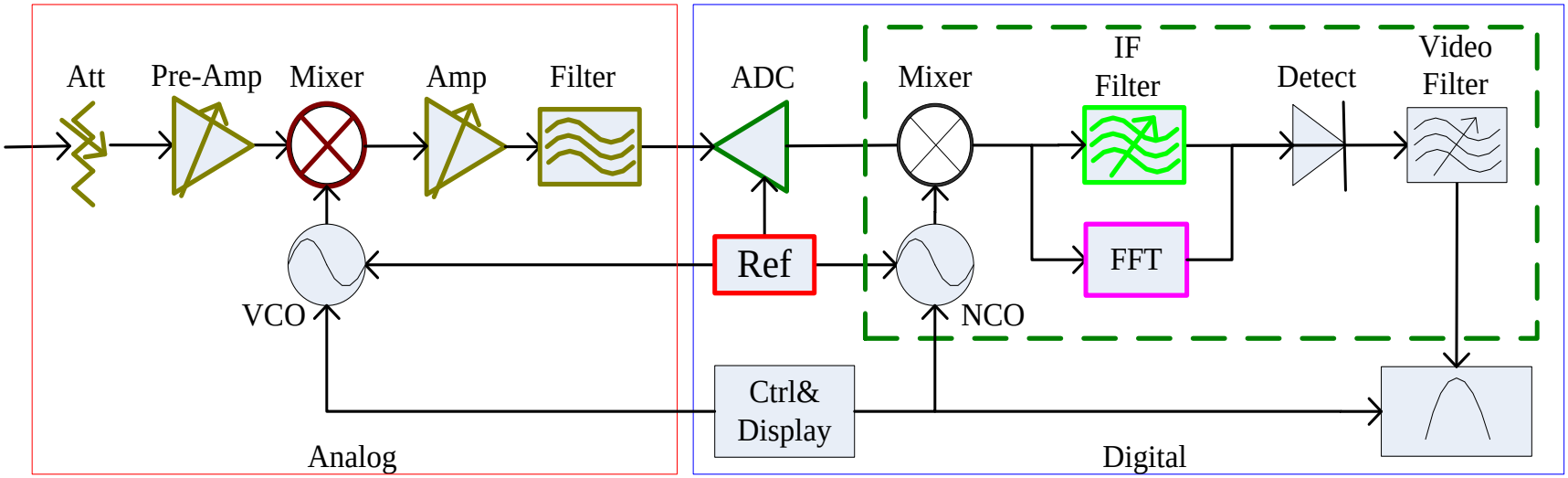
- A spectrum analyzer is a frequency-selective, peak-responding voltmeter, calibrated to display the rms value of a sine wave



Principle of Spectrum Analyzer

Basic structure of spectrum analyzer

- Super heterodyne mixer
- Digital IF
- Sweep and FFT
- Reference oscillator source
- RF front-end circuit



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Performance Index

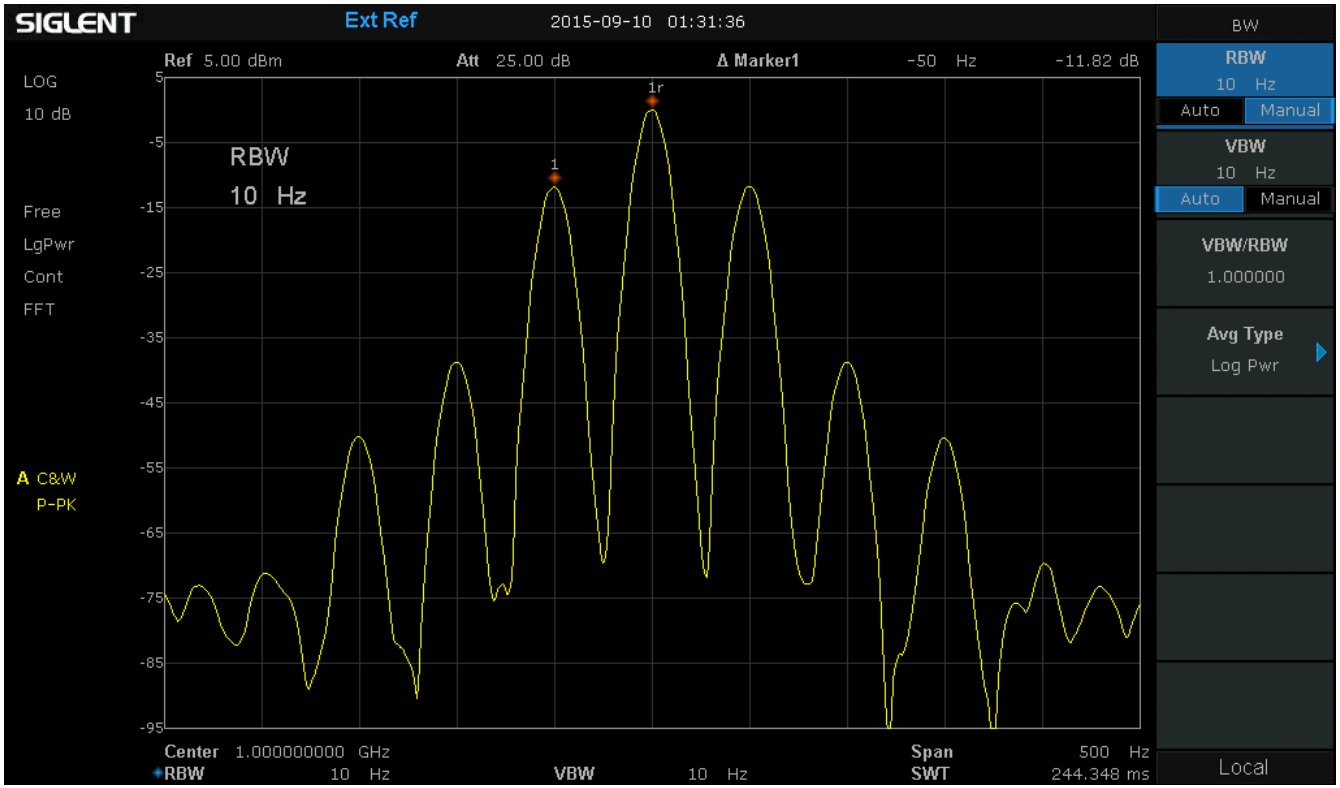
- Horizontal axis - Frequency
  - Frequency range
  - Resolution：RBW, VBW
  - Phase noise - reference oscillator source
  - Sweep Mode

- Vertical axis - Amplitude
  - Display detection and average
  - Sensitivity : DANL; A measure of the ability to measure small signals
  - Distortion: P1dB, SHI, TOI; A measure of the ability to measure large signals
  - Dynamic Range

Performance Index

RBW (Resolution Bandwidth)

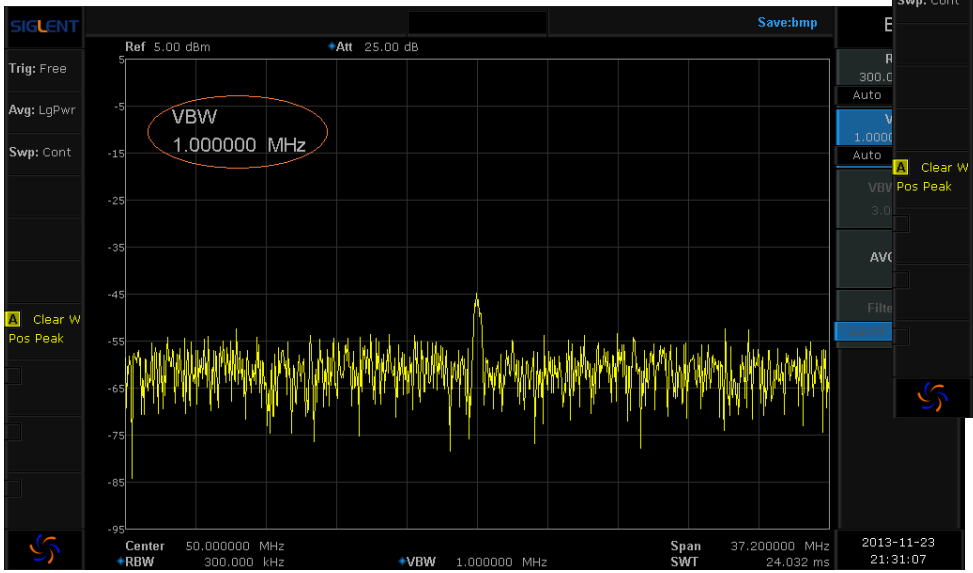
- RBW shows the capability to clearly separate the two input signals on the display
- RBW is the 3dB bandwidth of the IF filter
- Gaussian, The equivalent noise bandwidth, Shape factor, Sweep speed

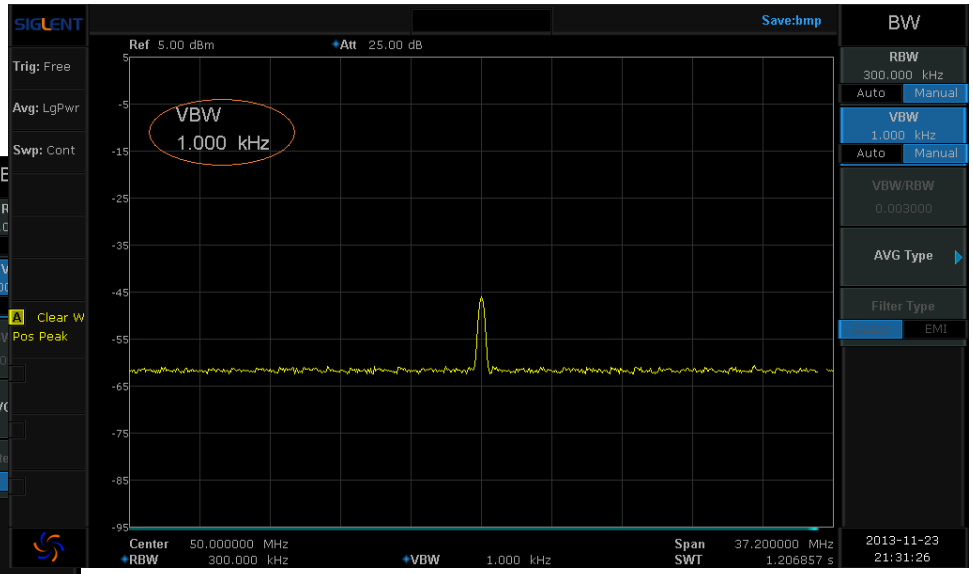


Performance Index

VBW（Video Bandwidth）

- Signals displayed in the screen shows the measured signal plus its own internal noise; in order to reduce the effect of noise on the measurement of small signals, it is essential to use a video filter to smooth the trace and obtain a stable displayed signal.
- Video filter bandwidth reflects the degree of smoothness, and using VBW combined with RBW can allow the user to view a cleaner signal.

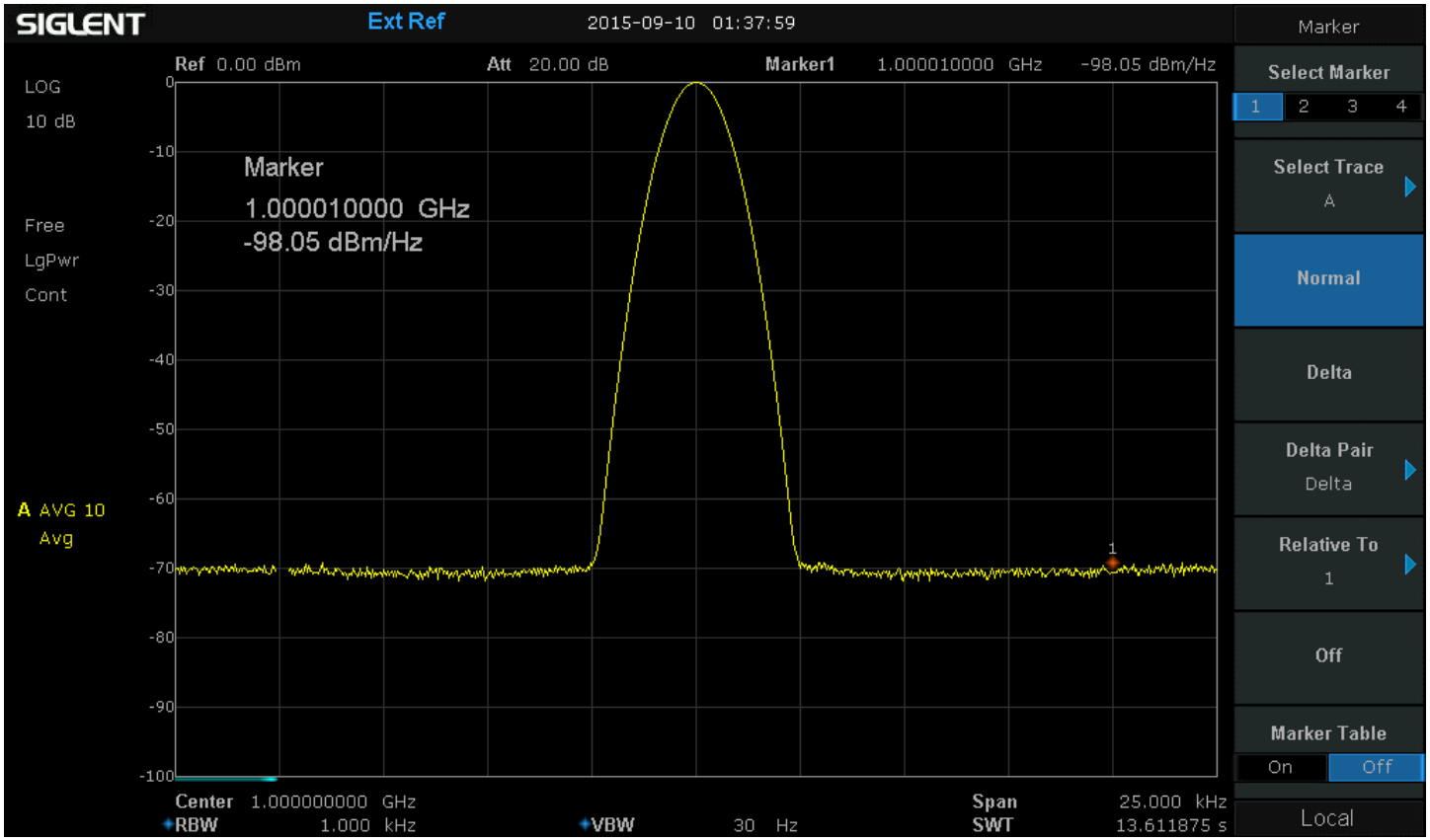




Performance Index

Phase Noise

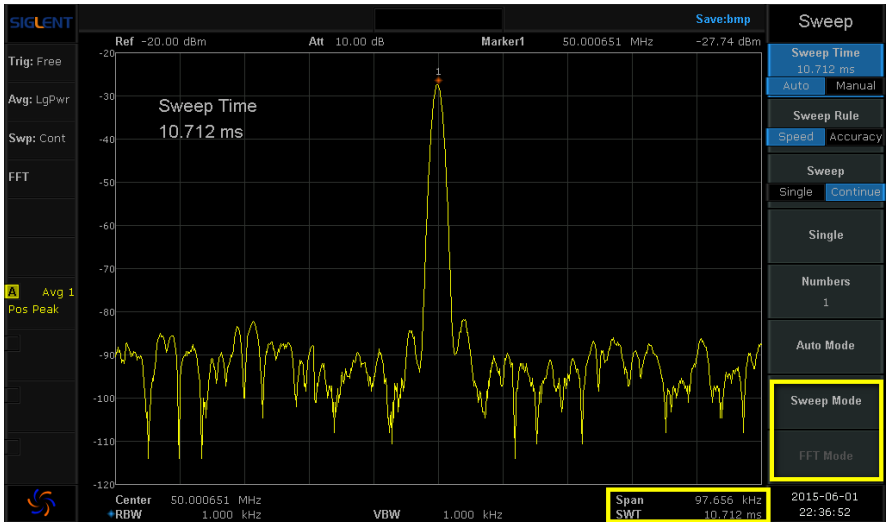
- The phase noise of reference oscillator source appears as signal noise sidebands on the spectrum displayed on screen
- Phase noise can effect the proximal end noise and the minimum resolution of RBW

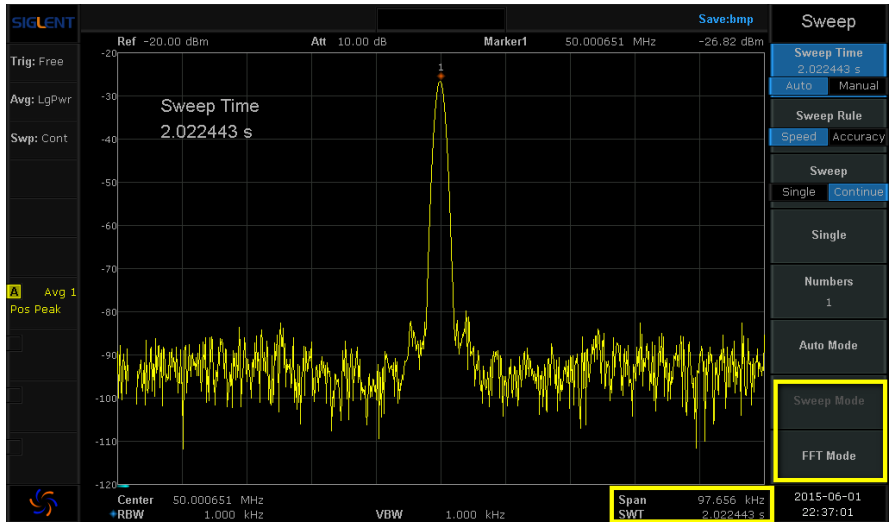


Performance Index

Measurement speed : Sweep and FFT

- T_sweep=k*SPAN/(RBW^2)，shows that the sweep time is inversely proportional to the square of RBW.
- When the RBW in switched to a larger setting, the displayed sweep speed is faster than FFT mode.
- When RBW switch to a smaller setting, FFT is equivalent to parallel sweeping which can greatly speed up the measurement.

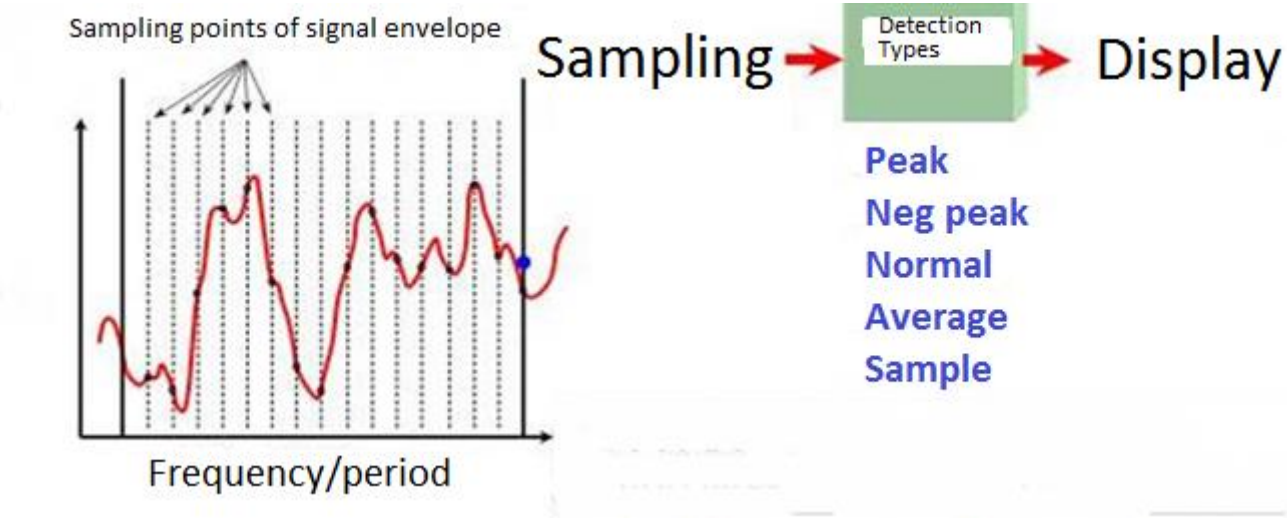




Performance Index

Detection and Display

- Bucket=Span/750
- Detection Types
  - Peak
  - Neg-peak
  - Sample
  - Normal
  - Average



Performance Index

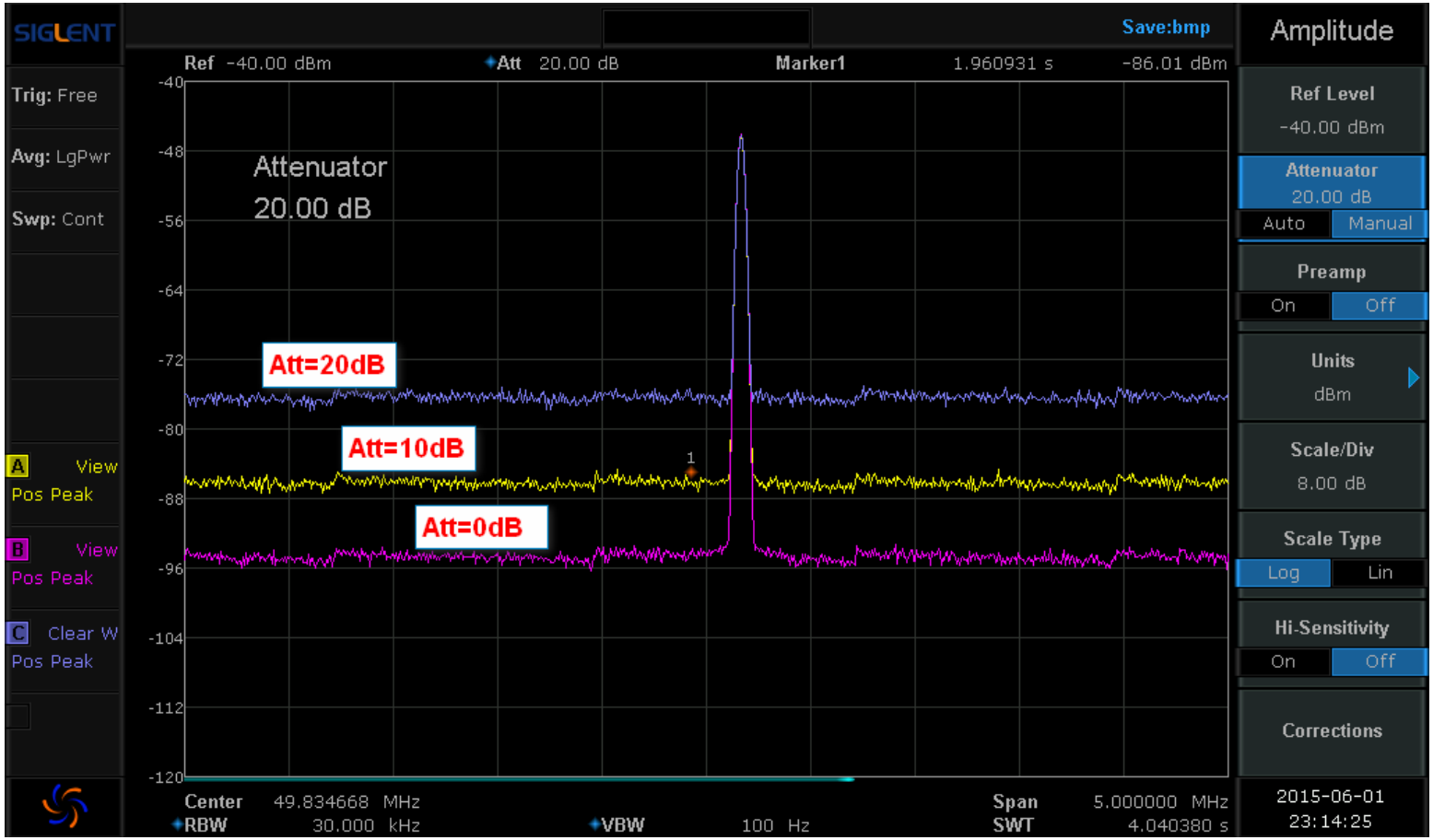
Sensitivity

- We can determine the DANL simply by noting the noise level indicated on the display when the spectrum analyzer input is terminated with a 50-ohm load.
- Spectrum displayed on the screen= Input signal + Internal noise
- DANL indicates the ability of an analyzer to display low-level signals. Signals below the level of DANL are masked by the noise and cannot be seen.
- Enhanced sensitivity of analyzer
  - Hardware : Decrease the attenuation ; Turn on the preamplifier
  - Software : Decrease the RBW and VBW

Performance Index

Sensitivity——Setting attenuator

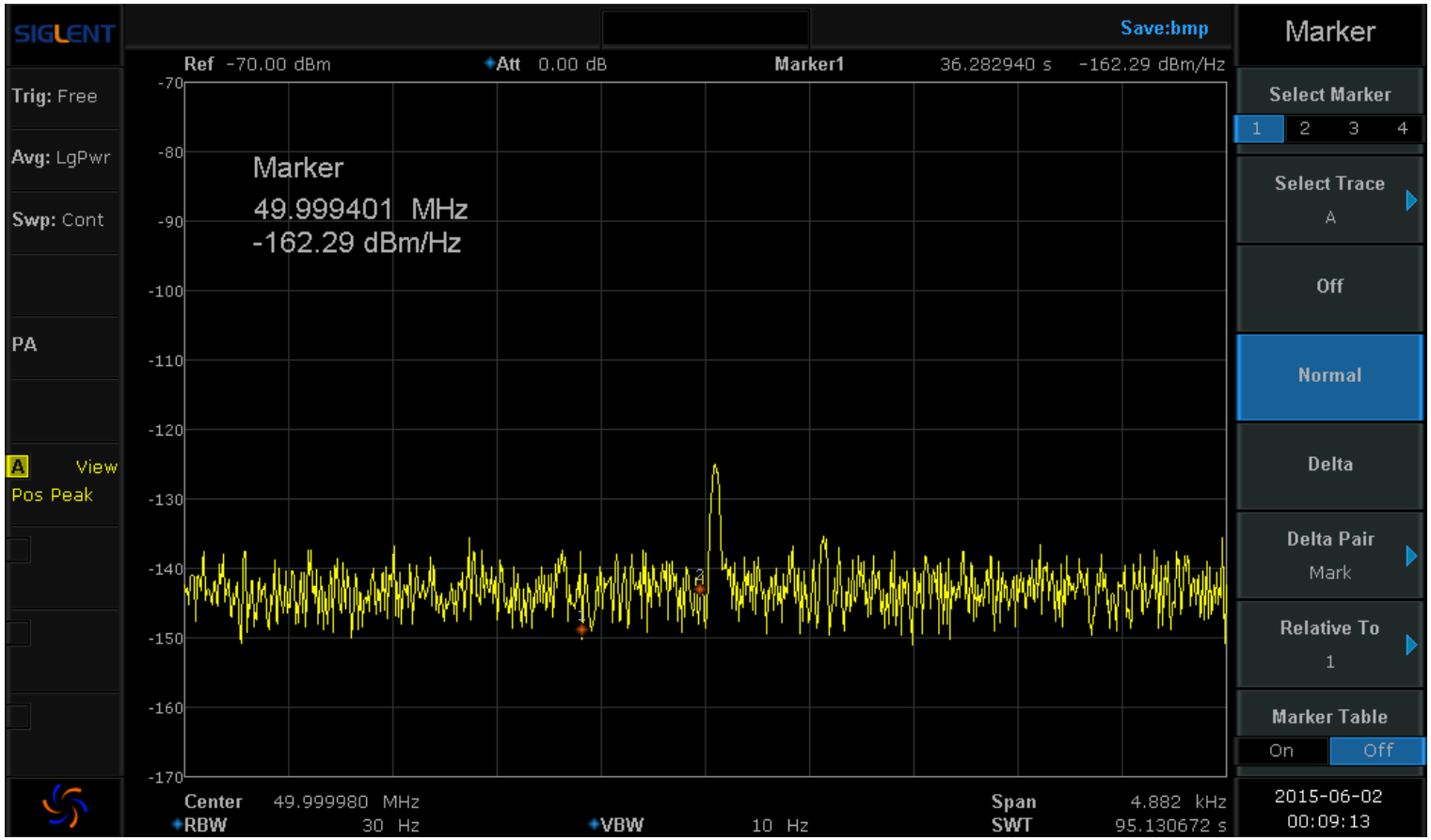
- Attenuator affects the sensitivity : the larger the attenuation, the higher the noise.



Performance Index

Sensitivity——Setting Preamplifier

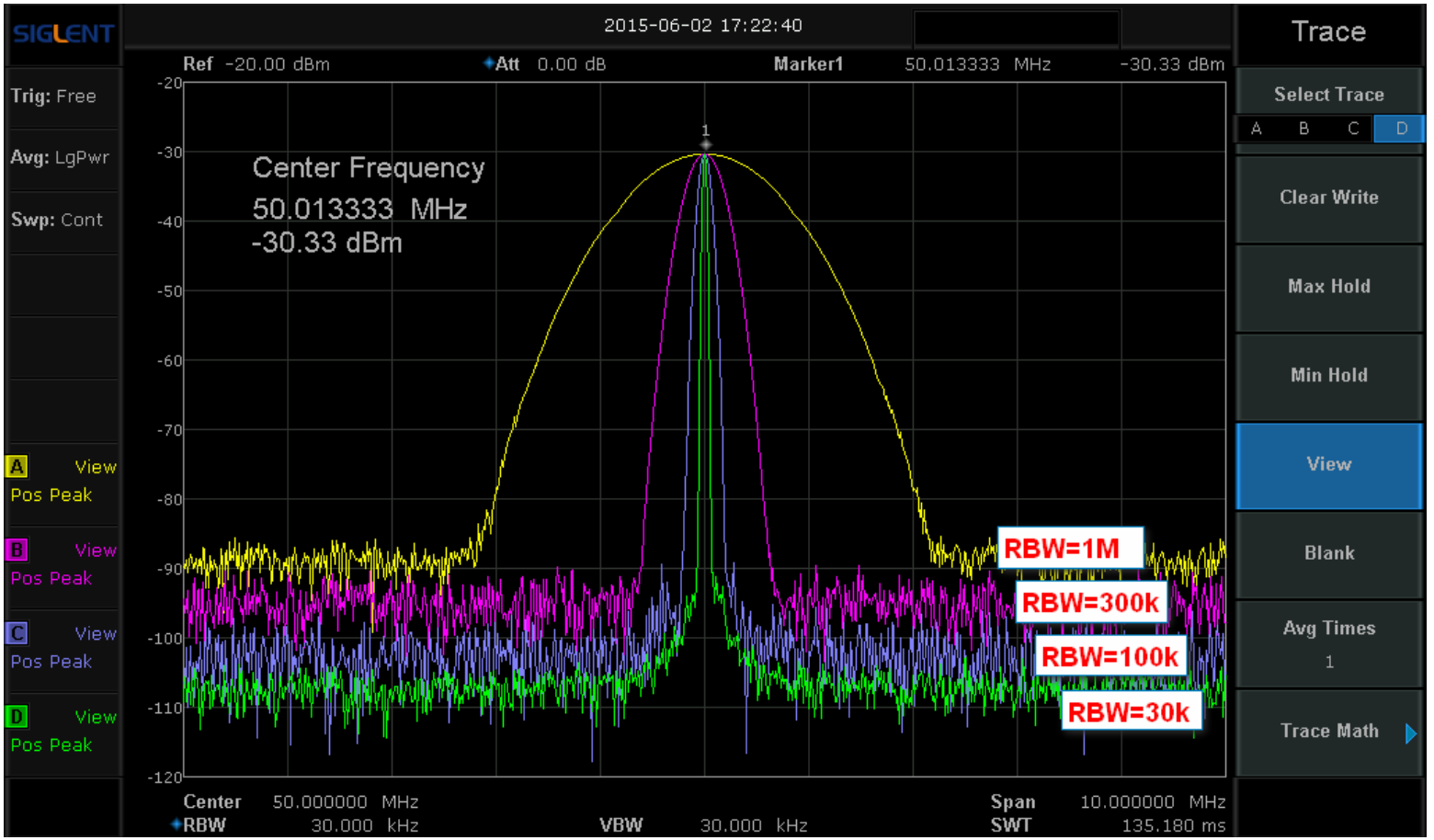
- Preamplifier can reduce system noise figure to improve system sensitivity.
- SSA3000X：Att=0dB，PreAmp=On，RBW=30Hz，DANL down to -144dBm，Normalized to 161dBm/Hz and even lower.



Performance Index

Sensitivity——Setting RBW

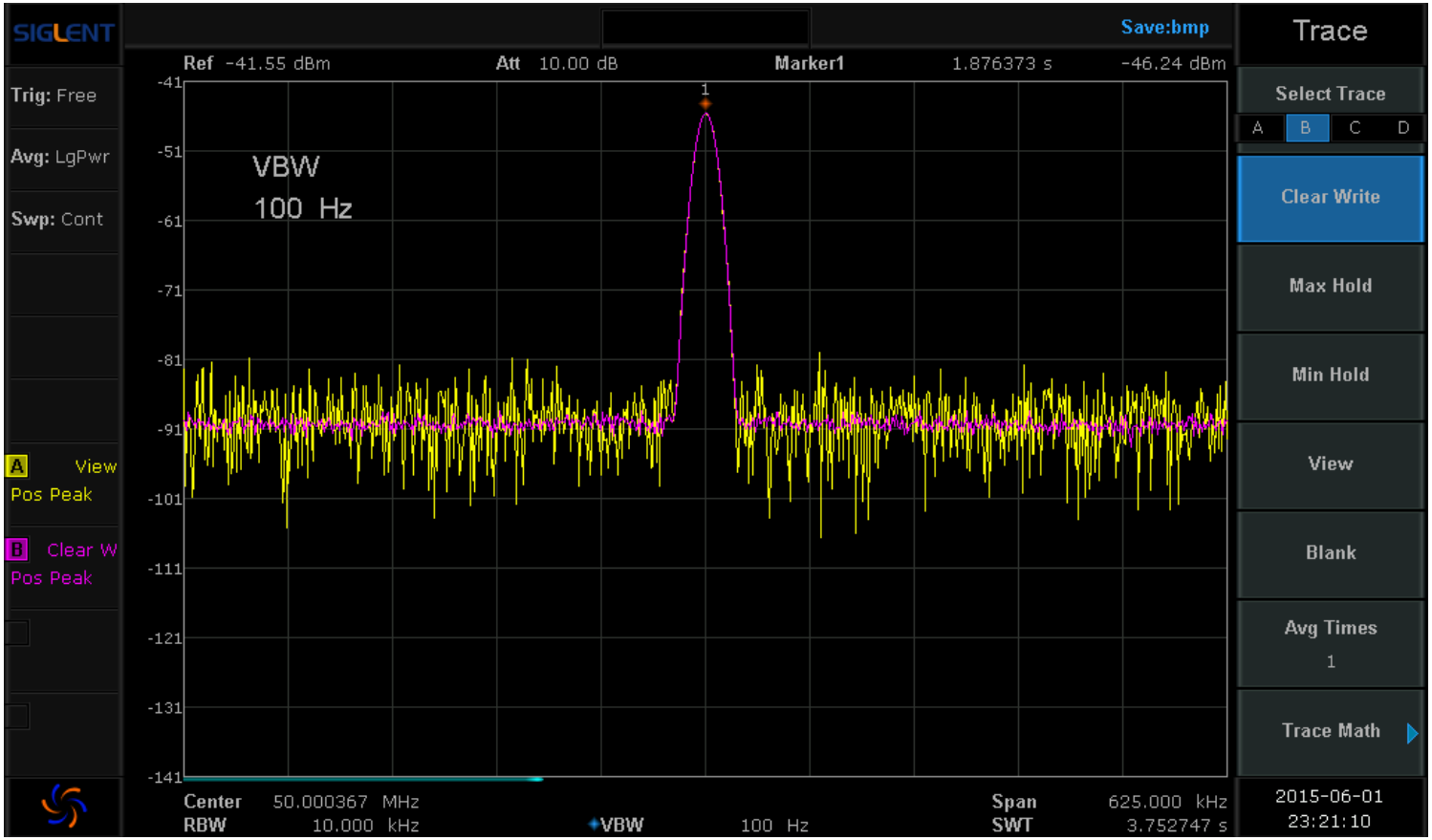
- Noise changes follow 10log (RBW 1 / RBW 2)



Performance Index

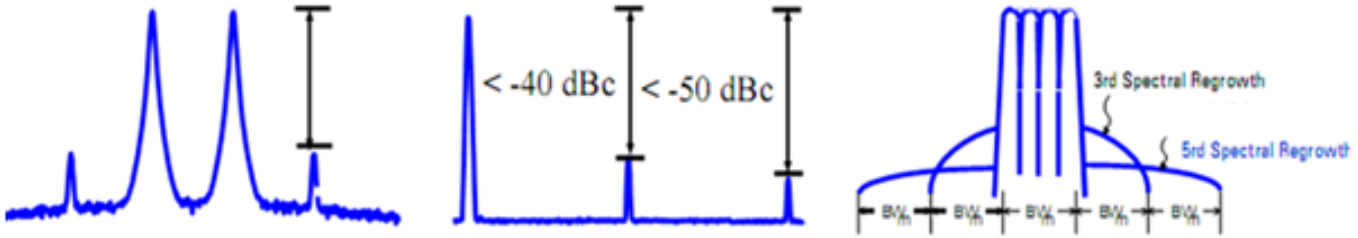
Sensitivity——Setting VBW

- Strictly speaking, VBW has no effect on the average noise level and can not improve analyzer sensitivity either.
- VBW affects the variance of display level and reducing the VBW contribute to measuring continuous stable signal under noisy background.



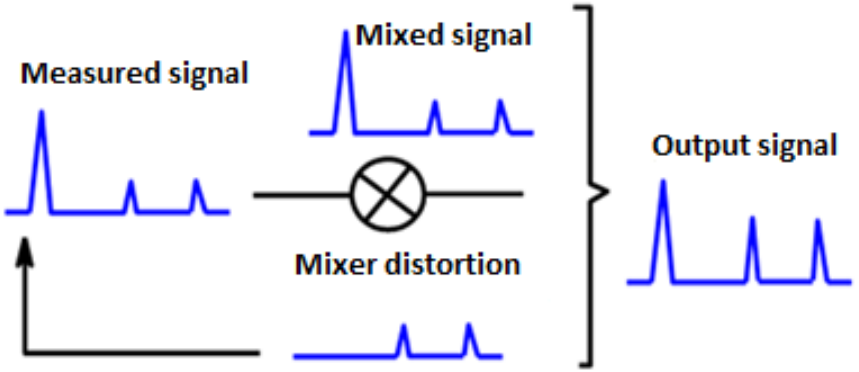
Performance Index

Distortion



Third-order Intermodulation test Harmonic test Adjacent channel power ratio test

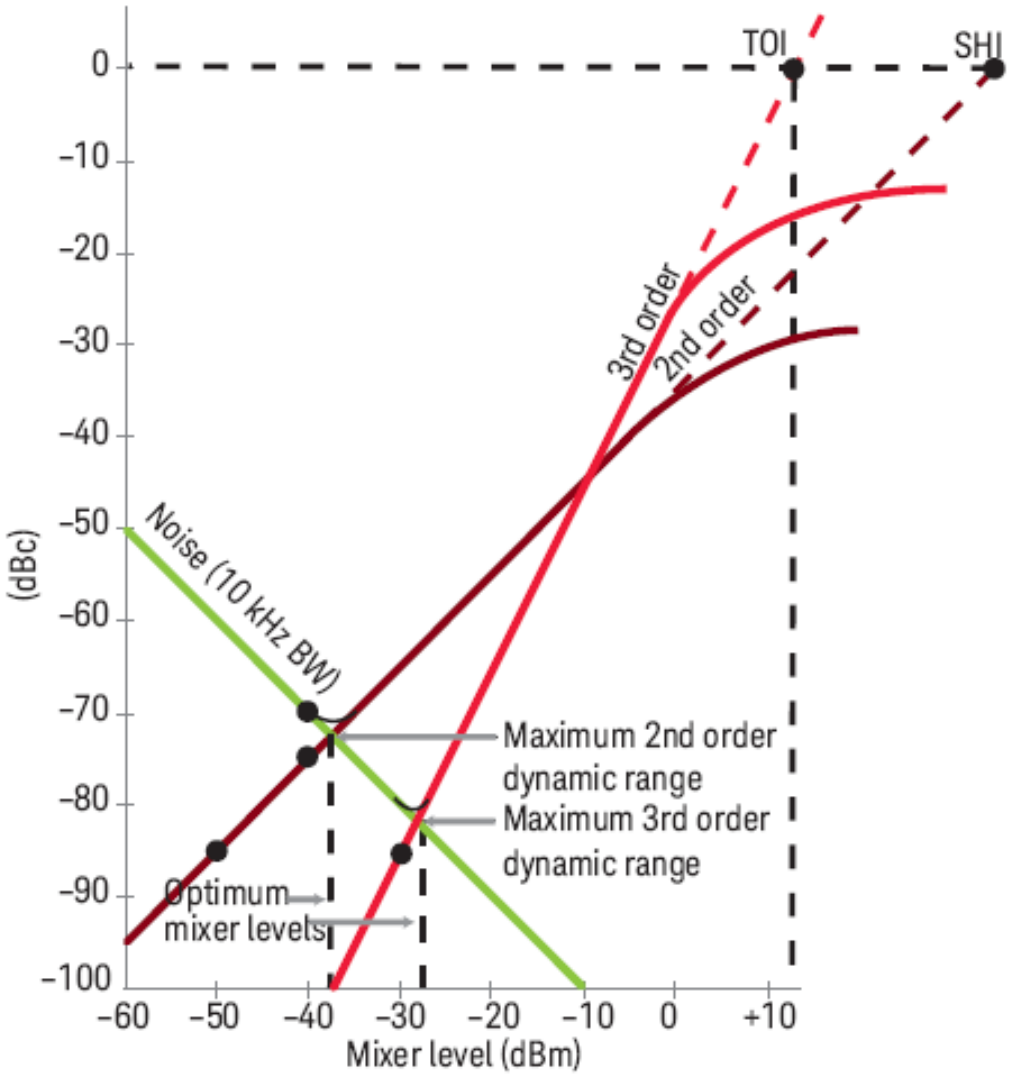
The nonlinearity in the process of spectrum analyzer will cause the distortion of input signal



Performance Index

Dynamic Range

- Dynamic range depends on the signal level into the mixer
- TOI : The mixer level at which the internally generated third-order distortion would be equal to the fundamental(s), or 0 dBc. The higher the TOI, the better the anti-distortion performance of the mixer.



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Introduction of SSA3000X Series

- All-Digital IF Technology
- Frequency Range from 9 kHz up to 3.2 GHz
- -161 dBm/Hz Displayed Average Noise Level (Typ.)
- -98 dBc/Hz @10 kHz Offset Phase Noise (1 GHz, Typ.)
- Total Amplitude Accuracy < 0.7 dB
- 10 Hz Minimum Resolution Bandwidth (RBW)
- Standard Preamplifier
- Up to 3.2 GHz Tracking Generator Kit (Opt.)
- Reflection Measurement Kit (Opt.)
- Advanced Measurement Kit (Opt.)
- EMI Pre-compliance Measurements Kit (Opt.)
- 10.1 lnch WVGA（1024x600）Display

Introduction of SSA3000X Series

Front Panel

10.1 inch widescreen display

Keyboard operating area

Introduction of SSA3000X Series

Rear panel

USB DEVICE

LAN

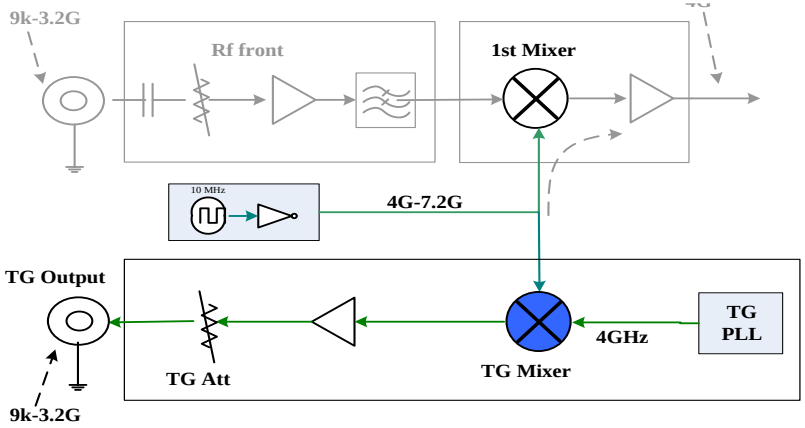
REF IN 10MHz

REF OUT 10MHz

TRIG IN

Introduction of SSA3000X Series

TG : Tracking generator



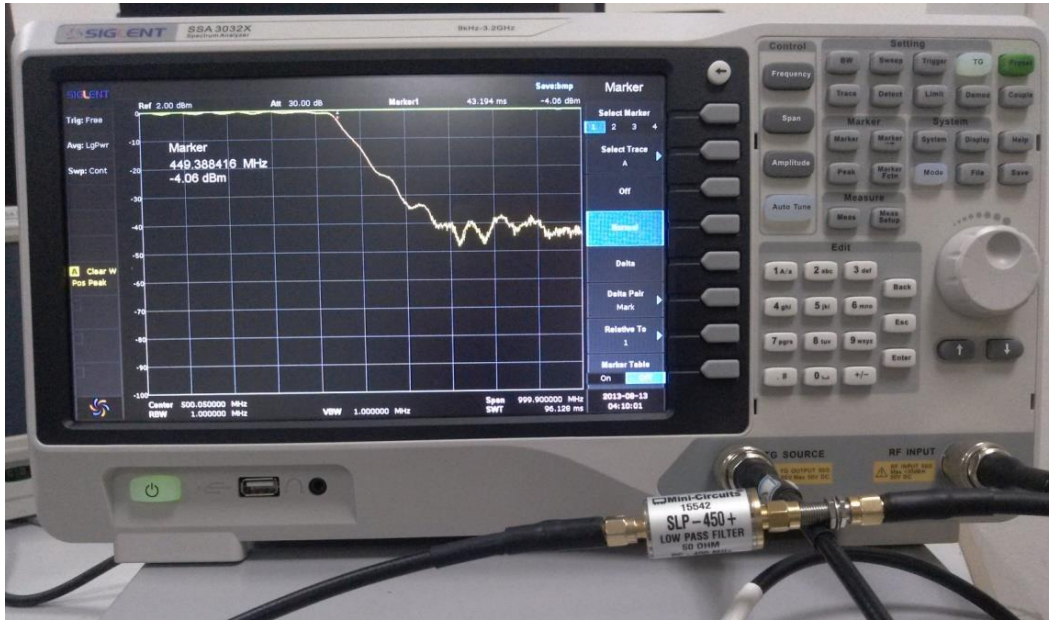
- TG output sweeps signal from 100KHz to 2.1G/3.2GHz

- Using TG to get amplitude-frequency response curve

  Figure on the right side shows the amplitude-frequency curve of the filter with 450M

- TG Normalized

  Eliminate measurement errors caused by line loss



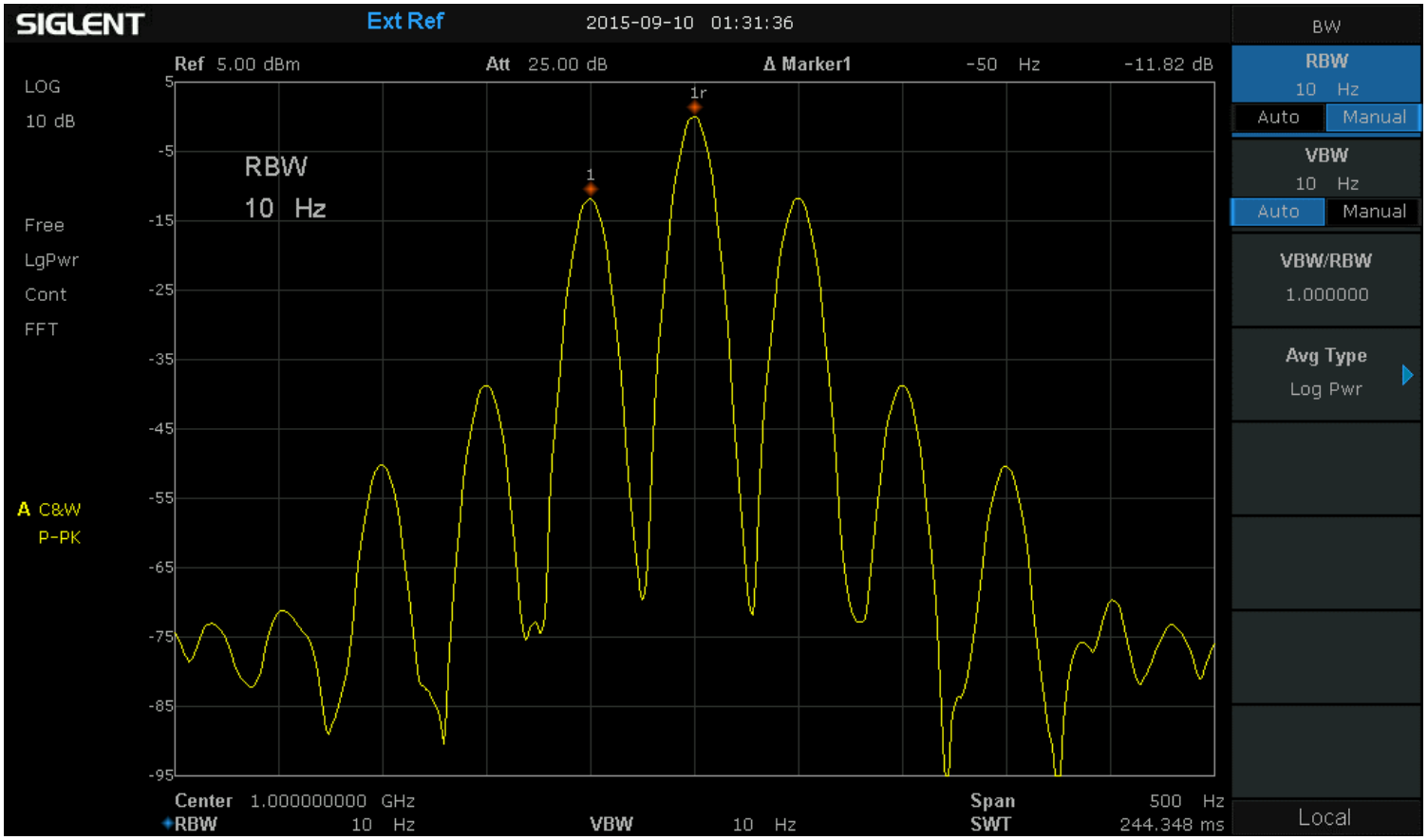
Introduction of SSA3000X Series

Friendly Design :

- Single-page menu, easy to use, intuitive controls, supports 4 traces and cursors

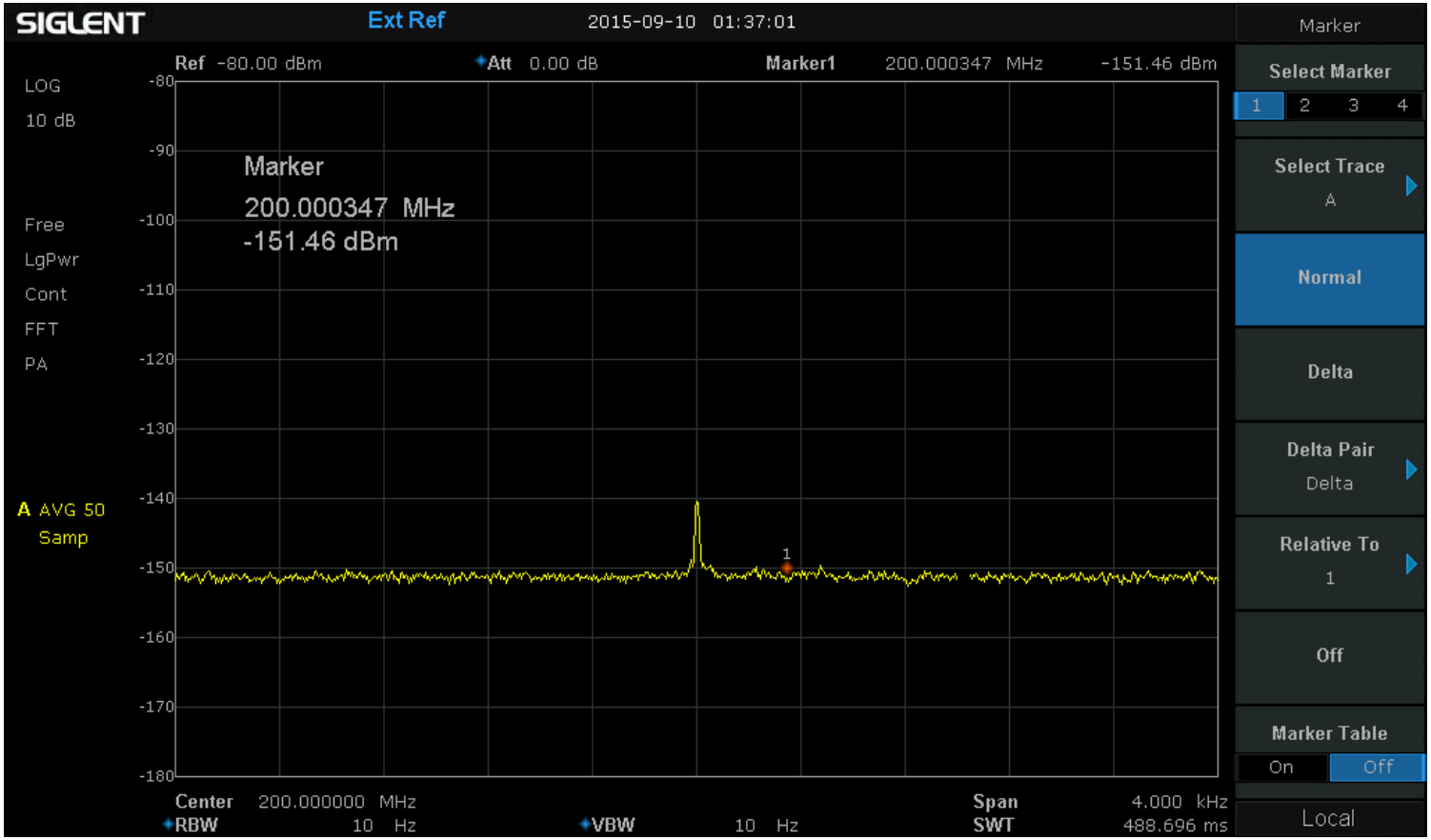
Introduction of SSA3000X Series

10 Hz Minimum Resolution Bandwidth (RBW)



Introduction of SSA3000X Series

Measure small signals down to -151dBm



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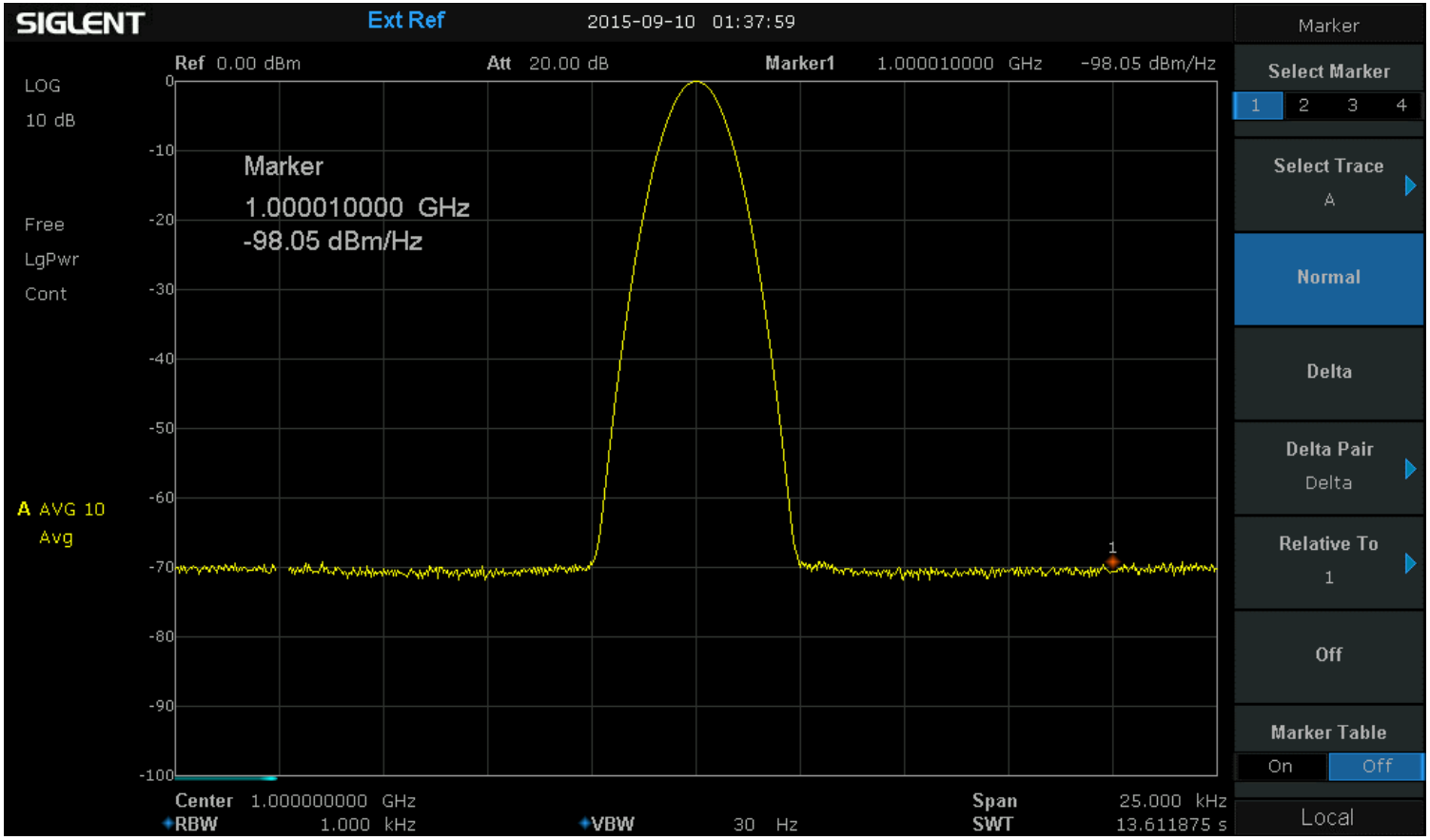
Phase noise -98 dBc/Hz @1 GHz / offset 10 kHz



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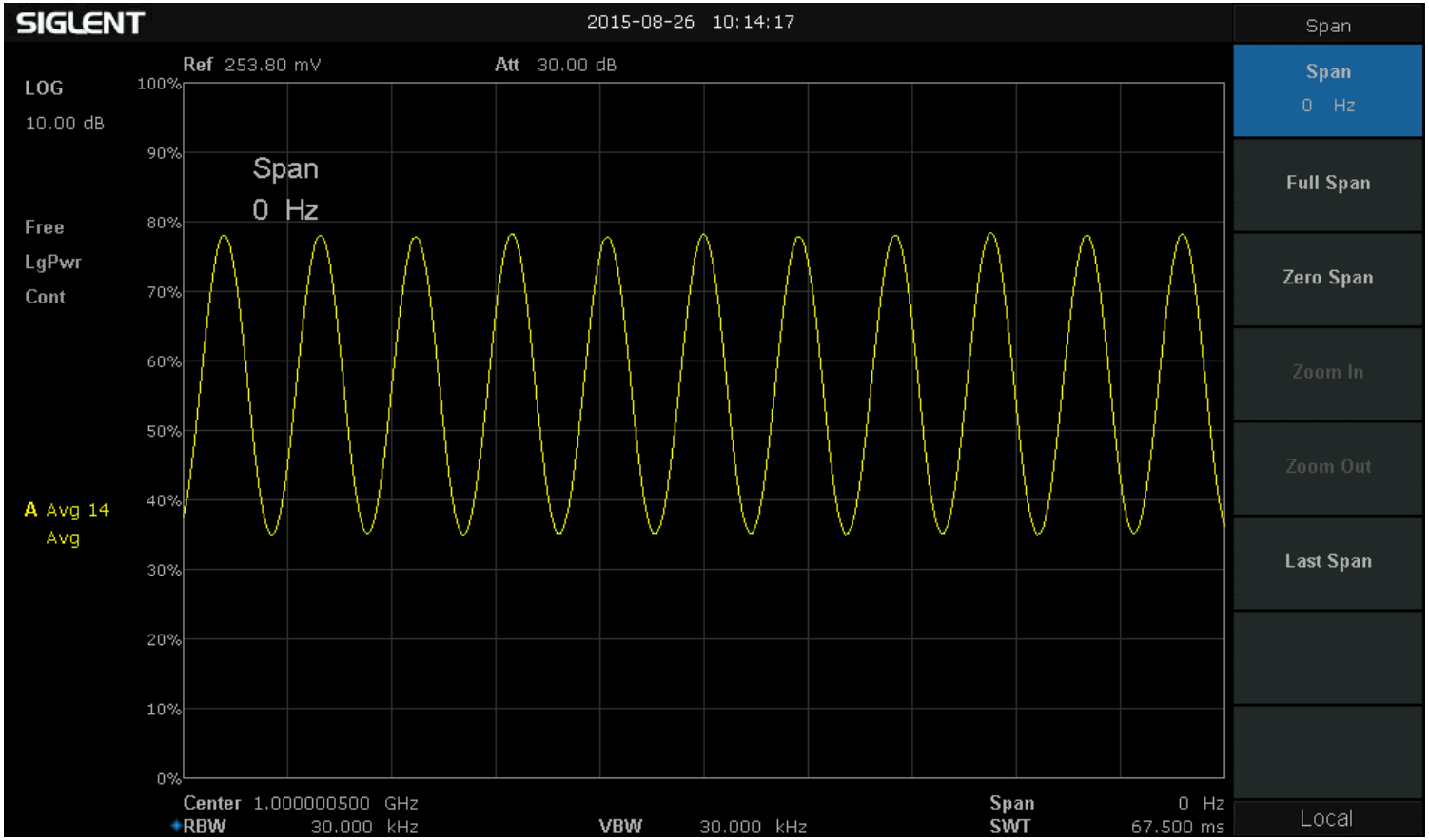
Demodulation at the zero span setting

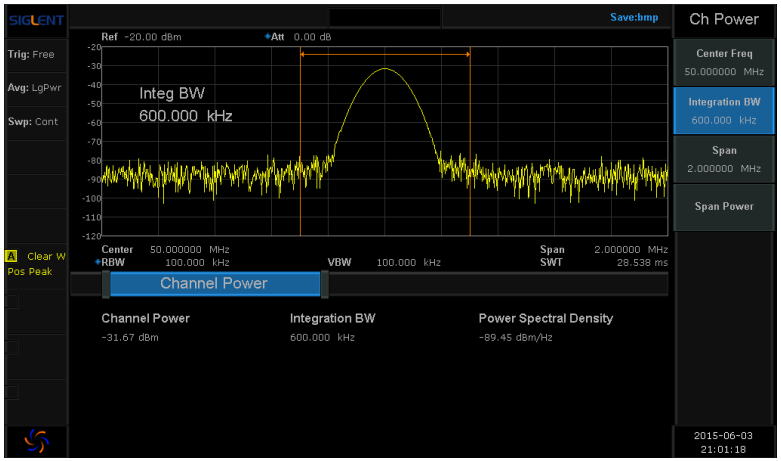


Introduction of SSA3000X Series

Advanced Power Measurement

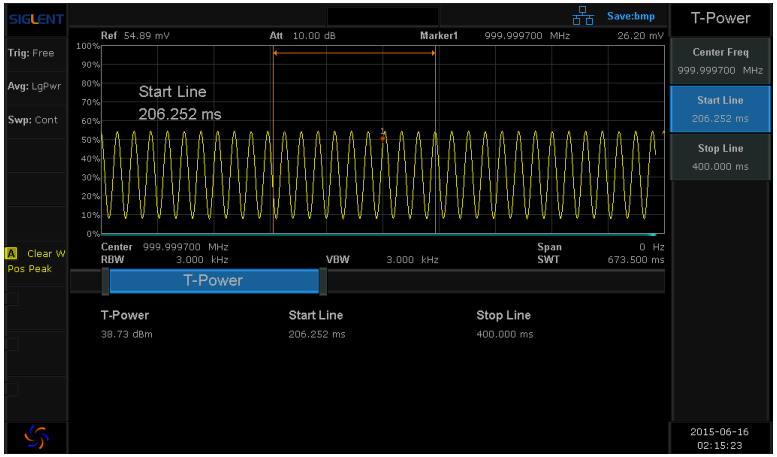
ACPR

Channel Power



Occupied Bandwidth

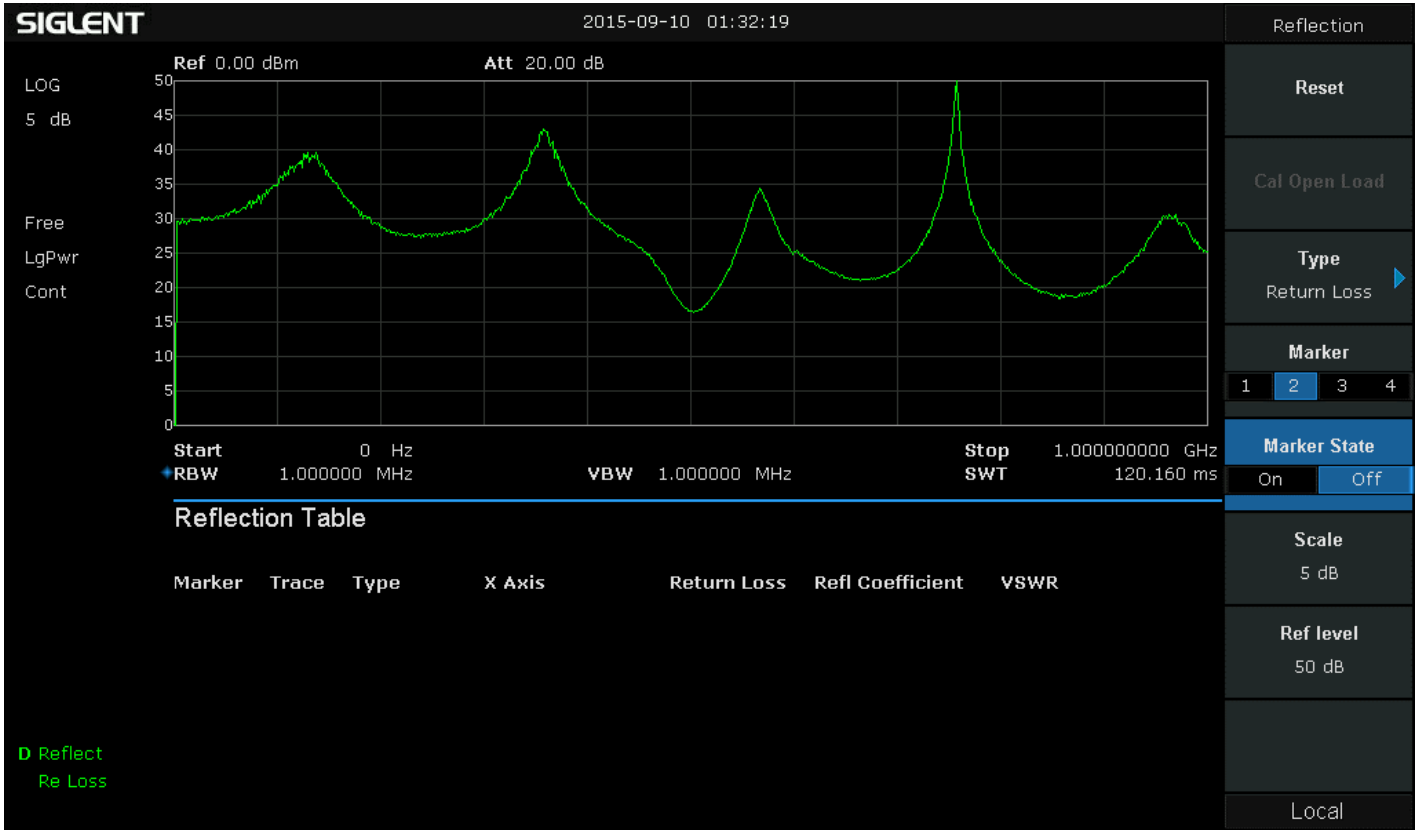
Time-Domain Power



Introduction of SSA3000X Series

Reflection measurement

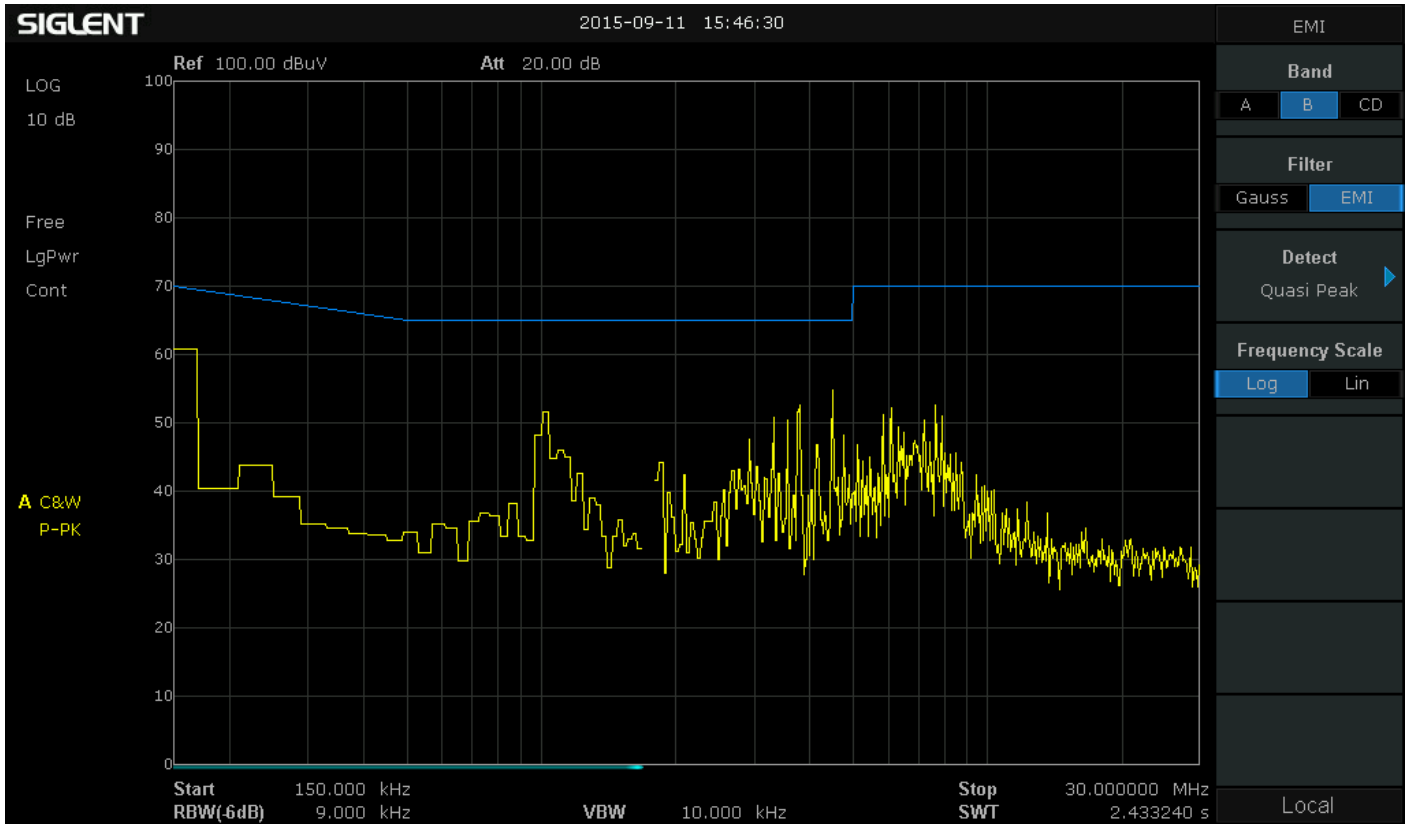
- Using tracking generator and reflection measurement kit to get VSWR and Return Loss curves.



Introduction of SSA3000X Series

EMI Pre-compliance Measurement

- EMI filter (-6dB)
- Quasi-peak detector
- Follow CISPR 16
- Stored limited template



Thank You!

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