Agenda

Introduction

Overview:

• What is Spectrum and Signal Analysis?
• What Measurements are available?

Theory of Operation

Specifications

Modern Signal Analyzer Designs & Capabilities

• Wide Bandwidth Vector Measurements

Wrap-up

Appendix
Analyzer Definitions

Spectrum Analyzer

– “A spectrum analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument. The primary use is to measure the power of the spectrum of known and unknown signals.”

Vector Signal Analyzer

– “A vector signal analyzer measures the magnitude and phase of an input signal at a single frequency within the IF bandwidth of the instrument. The primary use is to make in-channel measurements, such as error vector magnitude, code domain power, and spectral flatness, on known signals.”

Signal Analyzer

– “A signal analyzer provides the functions of a spectrum analyzer and a vector signal analyzer.”
Overview

Frequency versus Time Domain

Amplitude (power)

Time domain Measurements
(Oscilloscope)

Frequency Domain Measurements
(Spectrum Analyzer)
Overview
What is Spectrum Analysis?

**Spectrum Analysis**

- Display and measure amplitude versus frequency for RF & MW signals
- Separate or demodulate complex signals into their base components (sine waves)
Overview

Different Types of Analyzers

FFT Analyzer

Parallel filters measured simultaneously

LCD shows full spectral display

A

\[ f_1 \quad f_2 \quad f \]
Overview
Different Types of Analyzers

Swept Analyzer

Filter 'sweeps' over range of interest

LCD shows full spectral display

A

f

f_1 f_2

Agilent Technologies
Overview
Types of Measurements Available

Frequency, power, modulation, distortion noise

- Spectrum monitoring
- Spurious emissions
- Scalar network analysis
- Noise figure & phase noise
- Harmonic & intermodulation distortion
- Analog, digital, burst & pulsed RF Modulation
- Wide bandwidth vector analysis
- Electromagnetic interference

- Measurement range (-172 dBm to +30 dBm)
- Frequency range (3 Hz to 750 GHz)
Agenda

Introduction
Overview
Theory of Operation:
  • Swept Spectrum Analyzer Hardware Specifications
Modern spectrum analyzer designs & capabilities
  – Wide Bandwidth Vector Measurements
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Theory of Operation
Swept Spectrum Analyzer Block Diagram

- Input signal
- RF input attenuator
- Pre-Selector Or Low Pass Input Filter
- IF gain
- IF filter (RBW)
- Log Amp
- Envelope detector
- Video filter
- ADC, Display & Video Processing
- Sweep generator
- Crystal Reference Oscillator
- Local oscillator
- mixer
- ADC, Display & Video Processing
- Anticipate Accelerate Achieve
- Agilent Technologies
Theory of Operation
Display terminology

Amplitude

Start Freq.

Stop Freq.

Freq. Span

Center Freq.

Reference Level

Freq. Span

Stop Freq.

Start Freq.

Reference Level

Figures:

1. Display terminology:
   - **Freq. Span**: The range between the start and stop frequencies.
   - **Stop Freq.**: The frequency at which the measurement is stopped.
   - **Center Freq.**: The frequency at which the measurement is centered.
   - **Reference Level**: The reference level for the measurement.

Graphical representation:

- **Amplitude**: The vertical axis indicating the level of signal strength.
- **Freq. Span**: The horizontal axis showing the frequency range.
- **Start Freq.**: The starting frequency of the sweep.
- **Stop Freq.**: The stopping frequency of the sweep.
- **Center Freq.**: The frequency around which the sweep is centered.
- **Reference Level**: The reference point for measuring signal levels.

Technical details:

- **Marker 1**: 300.000 MHz
- **Trig**: Free Run
- **Attenuation**: 2 dB
- **Reference**: -20.00 dBm
- **Stop Freq.**: -26.77 dBm
- **Sweep**: 1.00 ms (1001 pts)
Theory of Operation

Mixer

1.5 GHz

3.6 GHz

6.5 GHz

f_{\text{LO}}

f_{\text{sig}}

f_{\text{LO}} - f_{\text{sig}}

f_{\text{LO}} + f_{\text{sig}}
Theory of Operation

IF Filter (Resolution Bandwidth – RBW)

Display

Input Spectrum

IF Bandwidth (RBW)

Display

A  B  C
Theory of Operation
Envelope Detector

Before detector

Envelope Detector

After detector
Theory of Operation

Envelope Detector and Detection Types

Negative detection: smallest value in bin displayed
Positive detection: largest value in bin displayed
Sample detection: middle value in bin displayed

Other Detectors: Normal (Rosenfell), Average (RMS Power)

Digitally Implemented Detection Types

Positive detection: largest value in bin displayed
Negative detection: smallest value in bin displayed
Sample detection: middle value in bin displayed

Other Detectors: Normal (Rosenfell), Average (RMS Power)
**Power Average Detection (rms)** = Square root of the sum of the squares of **ALL** of the voltage data values in the bin / 50Ω
Theory of Operation

Video Filter (Video Bandwidth – VBW)
Theory of Operation

Video Filter vs. Trace/Video averaging

- **Video Filter** operates as the sweep progresses, sweep time may be required to slow down by the transient response of the VBW filter.

- **Trace/Video Average** takes multiple sweeps, sweep time for each sweep is not affected

- Many signals give the same results with either video filtering or trace averaging

Trace averaging for 1, 5, 20, and 100 sweeps, top to bottom (trace position offset for each set of sweeps)
Agenda

Overview

Theory of Operation

Specifications:
  • Which are important and why?

Modern spectrum analyzer designs & capabilities
  – Wide Bandwidth Vector Measurements

Wrap-up

Appendix
Key Specifications

- Frequency Range
- Accuracy: Frequency & Amplitude
- Resolution
- Sensitivity
- Distortion
- Dynamic Range
Specifications? A Definition

Specifications describe the performance of parameters covered by the product warranty (temperature = 0 to 55°C, unless otherwise noted).

Typical values describe additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80 % of the units exhibit with a 95 % confidence level over the temperature range 20 to 30°C. Typical performance does not include measurement uncertainty.

Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
## Specifications
### Frequency Range

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Mixing Bands</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3 Hz to 3.6 GHz</td>
</tr>
<tr>
<td>1</td>
<td>3.5 to 8.4 GHz</td>
</tr>
<tr>
<td>2</td>
<td>8.3 to 13.6 GHz</td>
</tr>
<tr>
<td>3</td>
<td>13.5 to 17.1 GHz</td>
</tr>
<tr>
<td>4</td>
<td>17 to 26.5 GHz</td>
</tr>
<tr>
<td>5</td>
<td>26.4 to 34.5 GHz</td>
</tr>
<tr>
<td>6</td>
<td>34.4 to 50 GHz</td>
</tr>
</tbody>
</table>
Specifications

Accuracy: Frequency Readout Accuracy

• From the PXA Data Sheet:

\[ \pm (\text{marker frequency} \times \text{freq reference accuracy} + 0.1\% \times \text{span} + 5\% \times \text{RBW} + 2\text{Hz} + 0.5 \times \text{Horiz. Res.})* \]

*Horizontal resolution is span/(sweep points – 1)
Specifications

Accuracy: Frequency Readout Accuracy Example

- **Frequency:** 1 GHz
- **Span:** 400 kHz
- **RBW:** 3 kHz
- **Sweep points:** 1000

**Calculation:**

\[
(1 \times 10^9 \text{Hz}) \times (\pm 1.55 \times 10^{-7}/\text{Year ref. Error}) = 155 \text{Hz}
\]

\[
400\text{kHz Span} \times 0.1\% = 400 \text{Hz}
\]

\[
3\text{kHz RBW} \times 5\% = 150 \text{Hz}
\]

\[
2\text{Hz} + 0.5 \times 400\text{kHz}/(1000-1) = 202 \text{Hz}
\]

**Total uncertainty**

\[
\pm 907 \text{Hz}
\]

*Utilizing internal frequency counter improves accuracy to ±155Hz

** The Maximum # of sweep points for the X-Series is 40,001 which helps to achieve the best frequency readout accuracy
Components which contribute to uncertainty are:

- Input mismatch (VSWR)
- RF Input attenuator (Atten. switching uncertainty)
- Mixer and input filter (frequency response)
- IF gain/attenuation (reference level accuracy)
- RBW filters (RBW switching uncertainty)
- Log amp (display scale fidelity)
- Calibrator (amplitude accuracy)
Specifications
Amplitude Accuracy: Reference Level Switching

Uncertainty applies when changing the Ref. Level

Also called IF Gain Uncertainty

Decision: Do I change the reference level or live with the display fidelity uncertainty in my measurements?

However with today’s X-series analyzers, provided the attenuation remains unchanged, the signal no longer needs to be at the reference level for the most accurate measurement.
Specifications
Accuracy: Display Fidelity

Display Fidelity includes:
- Log Amp Fidelity
- Envelope Detector Linearity
- Digitizing Circuit Linearity

Display fidelity error applies when signals are not at the same reference level amplitude when measured.

In the past, technique for best accuracy was to move each measured signal to the reference line, eliminating display fidelity error.

Display Scale Fidelity of analyzers with digital IF are superior to those with analog IF i.e. X-series analyzers have +/- 0.1 db vs. ESA, 856xEC +/- 1.0 db
Specifications
Resolution: Resolution BW

Determines resolvability of equal amplitude signals
Specifications
Resolution BW Selectivity or Shape Factor

Selectivity = \frac{60 \text{ dB BW}}{3 \text{ dB BW}}

Determines resolvability of unequal amplitude signals
Specifications
Resolution BW Selectivity or Shape Factor

RBW = 1 kHz
Selectivity 15:1

RBW = 10 kHz
distortion products

60 dB BW = 15 kHz

3 dB

60 dB

10 kHz 10 kHz

7.5 kHz

10 kHz
Specifications
Resolution: RBW Type and Selectivity

* The X-series RBW shape factor is 4.1:1
Specifications

Resolution: Noise Sidebands

Noise Sidebands can prevent resolution of unequal signals
Specifications

Resolution: RBW Determines Sweep Time

Penalty For Sweeping Too Fast
Is An Uncalibrated Display
Specifications
Resolution: RBW Type Determines Sweep Time

8563E Analog RBW

PXA Swept RBW

PXA FFT RBW

START 1.000GHz
STOP 2.000GHz
*RBW 3.0kHz
VBW 3.0kHz
SWP 280sec

ATTEN 0dB
MKR -102.0dBm
RL -40.0dBm
10dB/
1.867GHz

280 sec
134 sec
10.7 sec
A Spectrum Analyzer Generates and Amplifies Noise Just Like Any Active Circuit
Specifications

Sensitivity/DANL

Sensitivity is the Smallest Signal That Can Be Measured

Signal

Equals

Noise

~ 2.2 dB

2.2 dB
Specifications
Sensitivity/DANL

Effective Level of Displayed Noise is a Function of RF Input Attenuation

Signal To Noise Ratio Decreases as RF Input Attenuation is Increased
Specifications

Sensitivity/DANL: IF Filter (RBW)

Displayed Noise is a Function of IF Filter Bandwidth

100 kHz RBW
10 kHz RBW
1 kHz RBW

Decreased BW = Decreased Noise
Specifications

Sensitivity/DANL: Video BW filter (or Trace Averaging)

Video BW or Trace Averaging Smoothes Noise for Easier Identification of Low Level Signals
Specifications

Sensitivity/DANL:

Signal-to-Noise Ratio Can Be Graphed

Displayed Noise in a 1 kHz RBW

Displayed Noise in a 100 Hz RBW

POWER AT MIXER = INPUT - ATTENUATOR SETTING dBm
Specifications
Sensitivity/DANL: Summary

For Best Sensitivity Use:

- Narrowest Resolution BW
- Minimum RF Input Attenuation
- Sufficient Averaging (video or trace)
- Using the Preamp also improves sensitivity
- Low Noise Path (PXA only)
- Noise Floor Extension (PXA only)
Specifications
Distortion

Mixers Generate Distortion

Signal To Be Measured

Frequency Translated Signals

Mixer Generated Distortion

Resultant
Specifications
Distortion

Most Influential Distortion is the Second and Third Order

Two-Tone Intermod

Harmonic Distortion

< -50 dBc

< -40 dBc

< -50 dBc
Specifications
Distortion

Distortion Products Increase as a Function of Fundamental's Power

Second Order: $\Delta 2 \text{ dB/dB of Fundamental}$
Third Order: $\Delta 3 \text{ dB/dB of Fundamental}$
Specifications

Distortion

Distortion is a Function of Mixer Level

POWER AT MIXER = INPUT - ATTENUATOR SETTING dBm

TOI

SHI

DISTORTION, dBc

Second Order

Third Order
Specifications
Distortion – Internal or External?

**Attenuator Test:**

**Change power to the mixer**

1. Change input attenuator by 10 dB
2. Watch distortion amplitude on screen

*No change in amplitude:* distortion is part of input signal (external)

*Change in amplitude:* at least some of the distortion is being generated inside the analyzer (internal)
Specifications

Spectrum Analyzer Dynamic Range

The ratio, expressed in dB, of the largest to the smallest signals simultaneously present at the input of the spectrum analyzer that allows measurement of the smaller signal to a given degree of uncertainty.
Specifications

Dynamic Range

Dynamic Range Can Be Presented Graphically

Optimum Mixer Levels

Maximum 2nd Order Dynamic Range

Maximum 3rd Order Dynamic Range

POWER AT MIXER = INPUT - ATTENUATOR SETTING dBm
Specifications
Dynamic Range

Dynamic Range for Spur Search Depends on Closeness to Carrier

- Dynamic Range Limited By Noise Sidebands (dBc/Hz)
- Noise Sidebands
- Dynamic Range Limited By Compression/Noise
- Displayed Average Noise Level
- 100 kHz to 1 MHz
Specifications
Dynamic Range vs. Measurement Range

**MAXIMUM POWER LEVEL**

- **DISPLAY RANGE**: 100 dB @ 10 dB/Div (200 dB @ 20 dB/Div)

**MEASUREMENT RANGE**

- MAXIMUM POWER LEVEL: +30 dBm
- MIXER COMPRESSION: +3 dBm
- THIRD-ORDER DISTORTION: -40 dBm (Dynamic Range)
- SECOND-ORDER DISTORTION: -50 dBm (Dynamic Range)
- SIGNAL/NOISE RANGE: 158 dB
- SIGNAL/3rd ORDER DISTORTION: 115 dB range
- SIGNAL/2nd ORDER DISTORTION: 105 dB RANGE
- SIGNAL/NOISE SIDEBANDS: -129 dBc @ 10kHz OFFSET

**SIGNAL/NOISE SIDEBANDS**

- MINIMUM NOISE FLOOR (DANL): 0 dBc

**INCREASING RBW OR ATTENUATION**

- -155 dBm (1 Hz BW & 0 dB ATTENUATION)
- -165 dBm with preamp
Specifications

Summary: Optimizing Dynamic Range

• **What settings provide the best sensitivity?**
  • Narrowest resolution bandwidth
  • Minimal input attenuation
  • Sufficient averaging

• **How do you test for analyzer distortion?**
  • Increase the input attenuation and look for signal amplitude changes
  • Then set the attenuator at the lowest setting without amplitude change

• **What determines dynamic range?**
  • Analyzer distortion, noise level, and sideband/phase noise
Agenda

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Modern spectrum analyzer designs & capabilities
  • Wide Analysis Bandwidth Measurements
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Modern Spectrum Analyzer Block Diagram

Pre-amp → Attenuation → YIG → ADC → Analog IF Filter → Digital IF Filter → FFT → Swept vs. FFT → Digital Log Amp → Digital Detectors

Replaced by

Back to Basics

Agilent Technologies
Modern Spectrum Analyzer - Specifications
Digital IF provides improved accuracy

<table>
<thead>
<tr>
<th>Specification</th>
<th>PXA</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input impedance mismatch</td>
<td>±0.13</td>
<td>±0.29 dB</td>
</tr>
<tr>
<td>Input attenuator switching uncertainty</td>
<td>±0.14</td>
<td>±0.6 dB</td>
</tr>
<tr>
<td>Frequency response</td>
<td>±0.35</td>
<td>±1.8 dB</td>
</tr>
<tr>
<td>Reference level accuracy</td>
<td>±0.0</td>
<td>±1.0 dB</td>
</tr>
<tr>
<td>RBW switching uncertainty</td>
<td>±0.03</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>Display scale fidelity</td>
<td>±0.07</td>
<td>±0.85 dB</td>
</tr>
<tr>
<td>Calibrator accuracy</td>
<td>±0.24</td>
<td>±0.34 dB</td>
</tr>
</tbody>
</table>

Total accuracy (up to 3 GHz) 95% Confidence
±0.59 dB vs. ±1.8 dB
±0.19 dB
Modern Spectrum Analyzer Features
Built-in One-Button Power Measurements

Power Measurements:
- Occupied Bandwidth
- Channel Power
- ACP
- Multi-carrier ACP
- CCDF
- Harmonic Distortion
- Burst Power
- TOI
- Spurious Emissions
- Spectral Emissions Mask

Format Setups include:

<table>
<thead>
<tr>
<th>Format Setup</th>
<th>Measurement Type</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>cdma2000 1x</td>
<td></td>
<td></td>
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<tr>
<td>IS-95A</td>
<td></td>
<td></td>
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<tr>
<td>DVB-T</td>
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<td>L/SECAM/NICAM</td>
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<tr>
<td>NADC</td>
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<td></td>
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<td>J-STD-008</td>
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<td>FCC Part 15</td>
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<td>Subpart F</td>
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<tr>
<td>PDC</td>
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<tr>
<td>IS-97D/98D</td>
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<tr>
<td>S-DMB System E</td>
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<td></td>
</tr>
<tr>
<td>Bluetooth DH1</td>
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<tr>
<td>GSM/EDGE</td>
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<tr>
<td>UWB Indoor</td>
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<tr>
<td>TETRA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3GPP W-CDMA</td>
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<tr>
<td>W-LAN 802.11a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Modern Spectrum Analyzer Features

**Application Focused Internal Software (one-button measurements)**

<table>
<thead>
<tr>
<th>General purpose applications</th>
<th>Flexible digital modulation analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase noise</td>
<td>ACPR, Multi-carrier Power</td>
</tr>
<tr>
<td>Ext. source control</td>
<td>Occupied Bandwidth (OBW)</td>
</tr>
<tr>
<td>Noise figure</td>
<td>Spectral Emissions Mask</td>
</tr>
<tr>
<td>Code compatibility suite</td>
<td>Phase and Freq. (PFER)</td>
</tr>
<tr>
<td>EMI pre-compliance</td>
<td>Mod Accuracy (Rho)</td>
</tr>
<tr>
<td>Analog demod</td>
<td>Code Domain Power</td>
</tr>
<tr>
<td>Flexible demod</td>
<td>ORFS (GSM/EDGE)</td>
</tr>
<tr>
<td>LTE FDD, TDD</td>
<td>Spurious Emissions</td>
</tr>
<tr>
<td>W-CDMA/HSPA/HSPA+</td>
<td>Power vs Time</td>
</tr>
<tr>
<td>GSM/EDGE/EDGE Evo</td>
<td>Channel power</td>
</tr>
<tr>
<td>cdma2000 &amp; 1xEV-DO</td>
<td>IM distortion</td>
</tr>
<tr>
<td>cdmaOne</td>
<td>CCDF</td>
</tr>
<tr>
<td>DVB-T/H/C/T2</td>
<td>ACPR</td>
</tr>
<tr>
<td>TD-SCDMA/HSPA</td>
<td>EVM</td>
</tr>
<tr>
<td>WLAN (802.11a/b/g/p/j)</td>
<td>SEM</td>
</tr>
<tr>
<td>802.16 OFDMA</td>
<td></td>
</tr>
<tr>
<td>Bluetooth</td>
<td></td>
</tr>
</tbody>
</table>
Enhanced Display Capabilities
Spectrogram

• Allows you to see time history in bottom window
• Amplitude displayed using color
• Great for finding intermittent signals
Enhanced Display Capabilities

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
Analog BB inputs

16-bit ADC, 100 MS/s

Baseband to 40 MHz (for 1ch/2ch)
10, 25 or 40 MHz BW
500 MSa memory
Who needs wide analysis BW?

Modern designs demand more bandwidth for capturing high data rate signals and analyzing the quality of digitally modulated bandwidths

Aerospace and Defense

- **Radar** – Chirp errors & modulation quality
- **Satellite** – Capture 36/72 MHz BW’s w/high data rates
- **Military communications** – Capture high data rate digital comms & measure EVM

Emerging communications

- **W-LAN, 802.16 (wireless last mile), mesh networks**
  - Measure EVM on broadband, high data rate signals

Cellular Communications

- **W-CDMA ACPR & Multi-carrier Pre-Distortion**
  - High dynamic range over 60 MHz BW to see low level 3rd order distortion for 4 carrier pre-distortion algorithms
PXA Wideband analysis

PXA Simplified Block Diagram (160 MHz BW)

Front End

3.5-50 GHz high band

3 Hz-50 GHz

Input

Electronic Preamp, e-attenuator and calibrator switches

Cal input

4 GHz

1 dB5-step electronic attenuation

RF preamp

RF converter

4.8 GHz LO

140 MHz

Linearity Corrections

2nd converter

4 GHz

8.3-14 GHz LO

10.9 M

3 M

100 MHz CK

Switched filters, F0=322.5 MHz

2Gbyte SDRAM

DAC

FPGA

ASIC

160 MHz Path

ADC Nominal bits: 14
ADC Effective bits: 11.2
SFDR: up to 75 dBc

160 MHz BW (option B1X)

160 MHz

ADC

FPGA

ASIC

2Gbyte SDRAM

40 MHz BW (option B40)

40 MHz

ADC

FPGA

ASIC

2Gbyte SDRAM

DAC

FPGA

ASIC

160 MHz Path

ADC Nominal bits: 14
ADC Effective bits: 11.2
SFDR: up to 75 dBc

160 MHz BW (option B1X)

160 MHz

ADC

FPGA

ASIC

2Gbyte SDRAM

40 MHz BW (option B40)

40 MHz

ADC

FPGA

ASIC

2Gbyte SDRAM

DAC

FPGA

ASIC
Agilent Real-time spectrum analyzer (RTSA)

Spectrum analysis goes real-time

- Gap-free data acquisition: 292,968 FFT’s/sec
- High-speed measurements and display
- Frequency mask trigger (FMT) to capture events

Measurement Contributions

- Short 100% POI duration: 3.57 μs
- 160 MHz wide real-time BW
- Real-time frequency coverage to 50 GHz
- 75 dBC spurious-free dynamic range

License-key upgradable to PXA

- Option RT1 (up to 85 MHz real-time BW)
- Option RT2 (up to 160 MHz real-time BW)
- Purchased with a new PXA or upgrade to existing one
- Requires wide BW option B1X
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Agilent Technologies’ Signal Analysis Portfolio

- **N9320B**
  - Basic performance
  - 9 kHz to 3 GHz
- **N9922C BSA**
  - 9 kHz to 7 GHz
- **N9935/36/37/38A**
  - 5 kHz to 9/14/18/26.5 GHz
  - Handhelds
- **N9340B, N9342/43/44C**
  - 100 kHz to 3/7/13.6/20 GHz
  - Handhelds

- **CXA**
  - Low-cost
  - 9 kHz to 26.5 GHz
- **MXA**
  - X-Series
  - Mid-performance
  - 10 Hz to 26.5 GHz
- **EXA**
  - X-Series
  - Economy-class
  - 10 Hz to 26, 32, 44 GHz
- **CSA**
  - Low cost portable
  - 100 Hz to 26 GHz
- **PSA**
  - Market leading performance
  - 3 Hz to 50 GHz
- **8560EC**
  - Mid-performance
- **PXA**
  - X-Series
  - High-performance
  - 3 Hz to 26.5 GHz
  - 3 Hz to 43/44/50 GHz

**X-Series Code Compatibility**
- ✓ Backward CC with legacy
- ✓ Inherent X-Series CC
Agilent Vector Signal Analysis Software

**89600B VSA Software**

- FFT-based spectrum, time-domain & bit-level modulation analysis
- Support for more than 70 signal standards and modulation types
- Unlimited trace/marker capability and arbitrary window arrangement
- Digital persistence and cumulative history displays

- Wireless networking: 802.11a/b/g/n, 802.16 OFDMA, WiMAX, 802.11ac
- Cellular: LTE (FDD/TDD), W-CDMA HSPA+, LTE Advanced
- Custom OFDM modulation analysis for proprietary signals

- Links to over 30 hardware platforms including: X-series signal analyzers, 16800 logic analyzers, 90000 X-series scopes, Infiniium scopes, VXI, N7109A Multi Channel Signal Analyzer
- Runs on external PC linked to hardware or embedded operation on instruments with Windows OS
Basic Spectrum Analyzer Application & Product Notes

A.N. 150 – Spectrum Analysis Basics: #5952-0292EN
A.N. 150-15 - Vector Signal Analysis Basics: #5989-1121EN

Spectrum Analyzer & Signal Analyzer Selection Guide: #5968-3413E

N9030A PXA Brochure: 5990-3951EN
N9020A MXA Brochure: 5989-5047EN
N9010A EXA Brochure: 5989-6527EN
N9000A CXA Brochure: 5990-3927EN
89600B VSA Brochure: 5990-6553EN
N9342,43,44C Brochure: 5990-8024EN
N9935,36,37,38A Brochure: 5990-9779EN

www.agilent.com/find/sa
THANK YOU!