Agilent
PSA Series Spectrum Analyzers Self-Guided Demonstration for NADC and PDC Measurements

Product Note

This demonstration guide is a tool to help you gain familiarity with the basic functions and important features of the Agilent PSA series spectrum analyzers. Because the PSA series offers expansive functionality, the demonstration guide is available in several pieces. This portion introduces the advanced, one-button power measurements and digital demodulation capability of the NADC and PDC measurement personality (Option BAE). All portions of the self-guided demonstration are listed in the product literature section at the end of this guide and can also be found at

http://www.agilent.com/find/psa

All exercises in this demonstration utilize the E4438C ESG vector signal generator. Keystrokes surrounded by [ ] indicate *hard* keys located on the front panel, while key names surrounded by { } indicate *soft* keys located on the right edge of the display.

Agilent Technologies

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About the PSA series

The Agilent PSA series is a family of modern, high-performance spectrum analyzers with digital demodulation and one-button measurement personalities for 2G/3G applications. It offers an exceptional combination of dynamic range, accuracy, and measurement speed. The PSA delivers the highest level of measurement performance available in Agilent spectrum analyzers. An all-digital IF section includes fast Fourier transform (FFT) analysis and a digital implementation of a swept IF. The digital IF and innovative analog design provide much higher measurement accuracy and improved dynamic range compared to traditional spectrum analyzers. This performance is combined with measurement speed typically 2 to 50 times faster than spectrum analyzers using analog IF filters.

The PSA series complements Agilent's other spectrum analyzers such as the ESA series, a family of mid-performance analyzers that cover a variety of RF and microwave frequency ranges while offering a great combination of features, performance, and value.

Part 1
Demonstration preparation

The following options are required for the ESG and the PSA series.

Begin by connecting the 50 Ω RF output of the ESG vector signal generator to the 50 Ω RF input of the PSA series spectrum analyzer with a 50 Ω RF cable. Turn on the power in both instruments.

Product type	Model number	Required options
ESG vector signal generator	E4438C	001 or 002 – baseband generator 402 – TDMA personalities
PSA series spectrum analyzer	E4440A/E4443A/E4445A/ E4446A/E4448A	B7J – Digital demodulation hardware BAE – NADC, PDC measurement personality

Part 2
NADC measurements

NADC (North American Dual-mode Cellular) uses time division multiple access (TDMA) with π/4-DQPSK modulation. Adjacent channel power (ACP) and error vector magnitude (EVM) are two essential measurements for NADC transmission characterization. In this section, you will explore these measurements on the PSA series.

Instructions	Keystrokes
On the ESG:	
Set the center frequency to 870.03 MHz and the amplitude to -10 dBm.	[Preset] [Frequency] [870.03] {MHz} [Amplitude] [-10] {dBm}
Set the ESG to generate a NADC signal.	[Mode] {Real Time TDMA} {NADC} {NADC <u>On</u>} [RF <u>On</u>]
On the PSA:	
Perform factory preset.	[System] {Power On/Preset} {Preset Type} {Factory}
Enter the NADC mode. If {NADC} does not appear in the Mode menu, try the {More} key.	[Preset] [Mode] {NADC}
Verify mode setup for full traffic base station test.	[Mode Setup] {Radio} {Traffic Rate <u>Full</u>} {Device <u>BS</u>}
Set the center frequency to 870.03 MHz (this is channel #1 for NADC 800 MHz system).	[FREQUENCY] [870.03] {MHz}

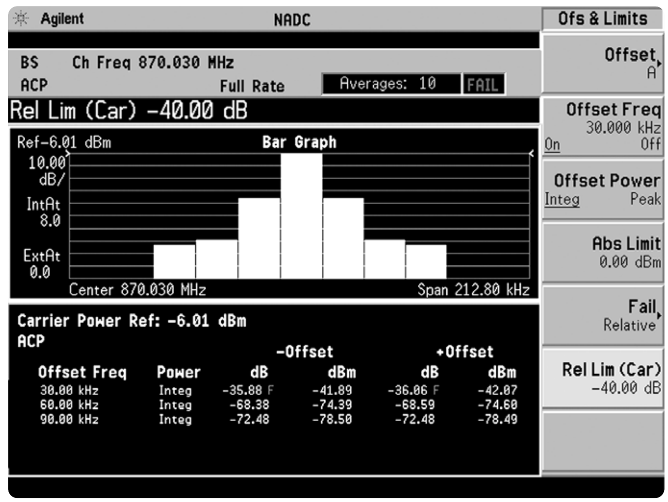
Adjacent channel power (ACP)

ACP is the ratio of in-channel power to out-of-channel power. The IS-136 specifications have ACP limits at frequency offsets of 30, 60, and 90 kHz. The PSA series defaults to these offsets, but they can be easily customized.

Now make the ACP measurement and change an offset limit to make the signal fail its limit.

Instructions	Keystrokes
On the PSA:	
Activate the ACP measurement.	[MEASURE] {ACP}
Set the first offset to fail at -40 dB below the carrier (figure 1). Observe the PASS indicator change to FAIL in the upper right corner and notice the fail indicators appear in the table.	[Meas Setup] {More} {Ofs & Limits} {Rel Lim (Car)} [-40] {dB}
View the results in spectrum format.	[Trace/View] {Spectrum}

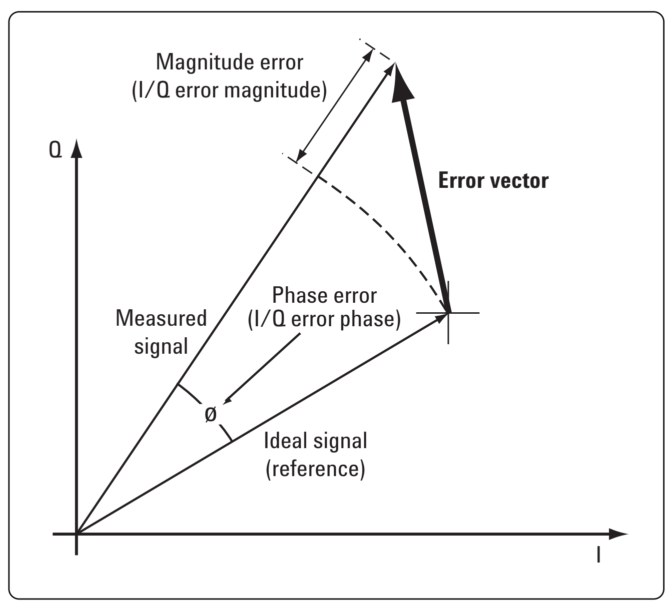
Figure 1.
ACP measurement



Error vector magnitude (EVM)

Figure 2 defines the error vector, a measure of the amplitude and phase differences between the ideal modulated signal and the actual modulated signal. The root-mean-square (rms) of the error vector is computed and expressed as a percentage of the square root of the mean power of the ideal signal. This is the error vector magnitude. EVM is a common modulation quality metric widely used in digital communications.

Figure 2.
The error vector



The PSA series' EVM measurement for NADC allows you to set the rms and peak EVM limits. It also provides a constellation diagram and plots for magnitude and phase errors.

Instructions	Keystrokes
On the PSA:	
Make the EVM measurement.	[MEASURE] {EVM}
View the limits menu (figure 3).	[Meas Setup] {More} {Limits}
Examine the error plots.	[Trace/View] {I/Q Error}
Run a single measurement and use the marker to find the highest phase error value in this data capture.	[Single] {Marker} {Trace} {Phase Error} {Peak Search}
Zoom in on the phase error plot (figure 4).	[Next Window] until phase error plot is highlighted in green, [Zoom]

Figure 3. Constellation diagram and EVM data

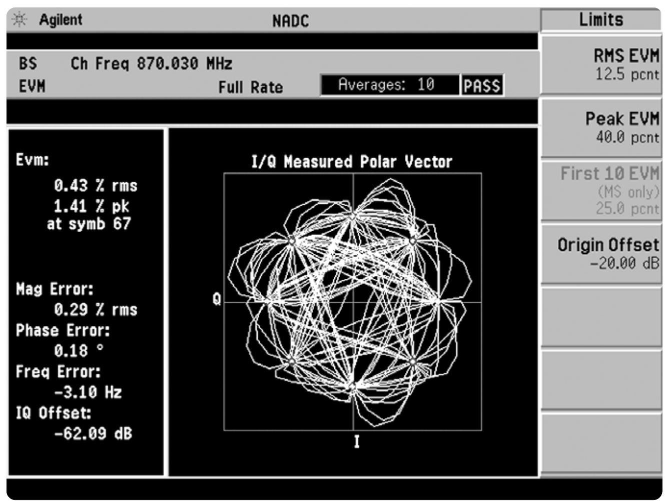
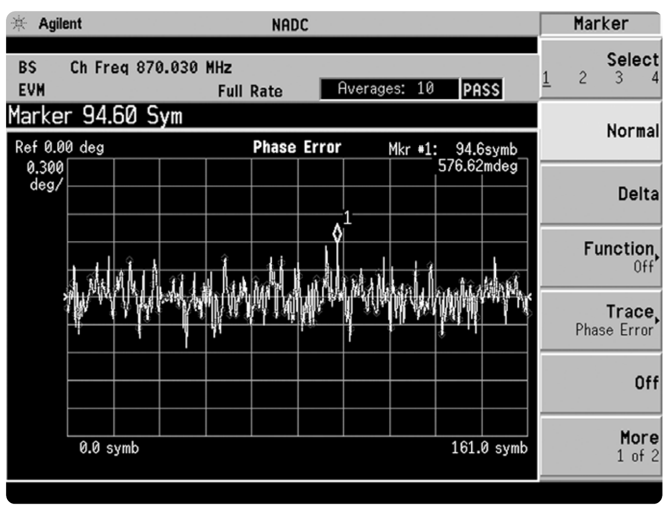


Figure 4. Phase error plot with marker



Part 3
PDC measurements

PDC (Personal Digital Cellular) is very similar to NADC in that it uses TDMA with π/4-DQPSK modulation. However, there are some differences, which are listed in table 1.

Table 1. Overview of NADC and PDC systems

	NADC	PDC
Access scheme	TDMA	TDMA
Modulation	π/4-DQPSK	π/4-DQPSK
Channel spacing	30 kHz	50 kHz (25 kHz interleaving)
Channels/carrier	3 (full rate), 6 (half rate)	3 (full rate), 6 (half rate)
Modulation data rate	48.6 kbps (2 bits/symbol)	42 kbps (2 bits/symbol)
Data rate	13 kbps (full), 6.5 kbps (half)	11.2 kbps (full), 5.6 kbps (half)
Filter	SQRT raised cosine (α = 0.35)	SQRT raised cosine (α = 0.35)

The PSA offers the ACP and EVM measurements for PDC and includes the occupied bandwidth measurement. Since the ACP and EVM measurements are very similar to those for NADC, they will not be explored in this exercise. However, the occupied bandwidth measurement will be performed.

Instructions	Keystrokes
On the ESG:	
Set the center frequency to 810 MHz and the amplitude to -10 dBm.	[Preset] [Frequency] [810] {MHz} [Amplitude] [-10] {dBm}
Set the ESG to generate a PDC signal.	[Mode] {Real Time TDMA} {PDC} {PDC On} [RF On]
On the PSA:	
Enter the PDC mode. If {PDC} does not appear under the Mode menu, try the {More} key.	[Preset] [Mode] {PDC}
Verify mode setup for full traffic base station test.	[Mode Setup] {Radio} {Traffic Rate Full} {Device BS}
Set the center frequency to 810 MHz (this is code #0 for PDC 800 MHz system).	[FREQUENCY] [810] {MHz}

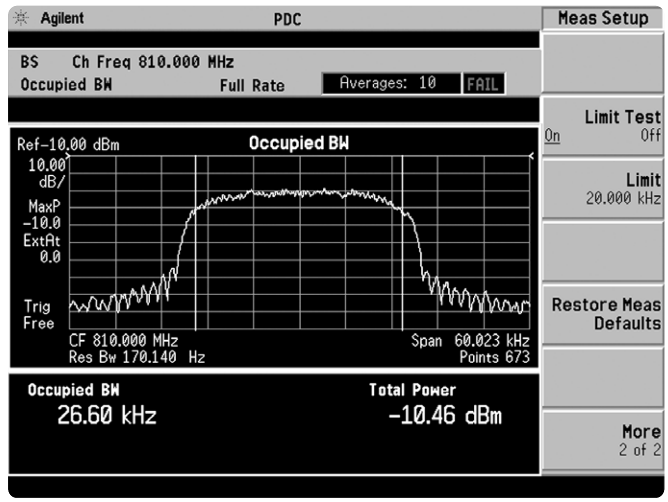
Occupied bandwidth

Occupied bandwidth is a measure of the frequency range that has 0.5 percent of the total radiated power above and below it. In other words, it determines the frequency bandwidth that that contains 99 percent of the total radiated power. The PSA has an optional, adjustable limit that defaults to 32 kHz.

In this exercise, you will make the occupied bandwidth measurement and change the limit to make the signal fail.

Instructions	Keystrokes
On the PSA:	
Activate the occupied bandwidth measurement.	[MEASURE] {Occupied BW}
Change the limit to 20 kHz (figure 5). Notice the PASS indicator change to FAIL.	[Meas Setup] {More} {Limit} [20] {kHz}

Figure 5.
PDC occupied bandwidth measurement



Product literature

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PSA Series, data sheet, literature number 5980-1284E
Phase Noise Measurement Personality, product overview, literature number 5988-3698EN
W-CDMA Measurement Personality, product overview, literature number 5988-2388EN
GSM with EDGE Measurement Personality, product overview, literature number 5988-2389EN
cdma2000 Measurement Personality, product overview, literature number 5988-3694EN
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IntuiLink Software, Data Sheet, Literature Number 5980-3115EN

For more information on the PSA series, please visit:

www.agilent.com/find/psa

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