Agilent
PSA Series Spectrum Analyzers Self-Guided Demonstration for cdmaOne 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 cdmaOne Measurement Personality (Option BAC). 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 Technologies' 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 series 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	502, 503, 504, or 506 – frequency range up to at least 2 GHz 001 or 002 – baseband generator 401 – cdma2000 and IS95A personalities
PSA series spectrum analyzer	E4440A/E4443A/E4445A/ E4446A/E4448A	B7J – Digital demodulation hardware BAC – cdmaOne measurement personality

Instructions	Keystrokes
On the ESG:	
Set the center frequency to 1.93125 GHz. This is channel #25 for ANSI J-STD-008.	[Preset] [Frequency] [1.93125] {GHz}
Set amplitude to -10 dBm.	[Amplitude] [-10] {dBm}
Select cdmaOne mode (IS-95) and assign 23 channels.	[Mode] {CDMA} {Arb IS-95A} {Setup Select} {32 Ch Fwd} {CDMA On}
Turn on RF output.	[RF On]
On the PSA:	
Perform factory preset.	{System} {Power On/Preset} {Preset Type} {Factory}
Enter the cdmaOne mode.	[Preset] [Mode] {cdmaOne}
Set up the analyzer to make J-STD-008 based measurements.	[Mode Setup] {Radio} {Band} {J-STD-008}
Set the center frequency to 1.93125 GHz.	[FREQUENCY] {Center Freq} [1.93125] {GHz}

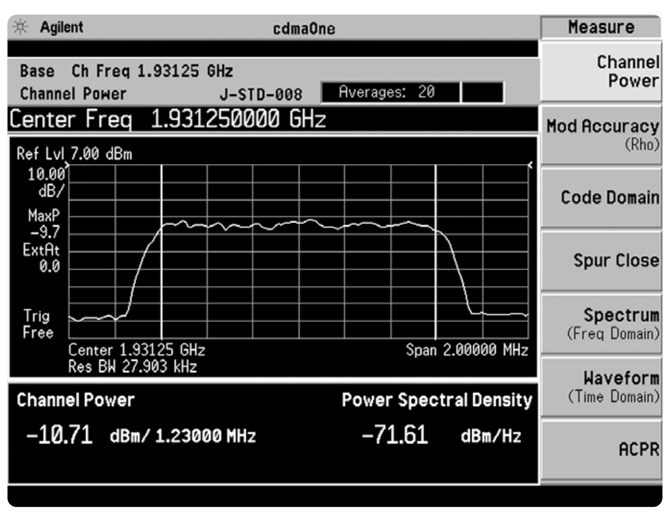
Part 2
Channel power

The limiting factor for cdmaOne system capacity is signal interference, so controlling the power in the system is essential to achieve maximum capacity. The channel power measurement measures the channel power within a specified bandwidth (default of 1.23 MHz) and the power spectral density (PSD) in dBm/Hz.

This exercise demonstrates the one-button channel power measurement on the PSA.

Instructions	Keystrokes
On the PSA:	
Measure the channel power (figure 1).	[MEASURE] {Channel Power}
Adjust averaging.	[Meas Setup] {Avg Number On} [35] [Enter]
Deactivate averaging.	{Avg Number Off}

Figure 1. Channel power measurement



Part 3
Adjacent channel power ratio (ACPR)

Reducing transmitter channel leakage allows for more channels to be transmitted simultaneously, which, in turn, increases base station efficiency. The adjacent channel power ratio is a measure of the power in adjacent channels relative to the transmitted power. The cdmaOne ACPR measurement performed in this exercise can measure up to five adjacent channel pairs.

In this exercise, the ACPR measurement will be made and the customizable offsets and limits explored.

Instructions	Keystrokes
On the PSA:	
Make the ACPR measurement.	[MEASURE] {ACPR}
Change the first offset limit to make it fail (figure 2). Observe the green "PASS" change to a red "FAIL" and red "F" that marks each parameter that fails.	[Meas Setup] {Offsets/Limits} {Limit Setup} {Abs Limit} [-90] {dBm} {Fail} {Absolute}
Look at the spectrum view and zoom in on that part of the display (figure 3).	[Trace/View] {Spectrum}, [Next Window] until the upper part of the display is highlighted in green, [Zoom]
Return to multi-view.	[Zoom]

Figure 2.
ACPR with failure in first offset channel

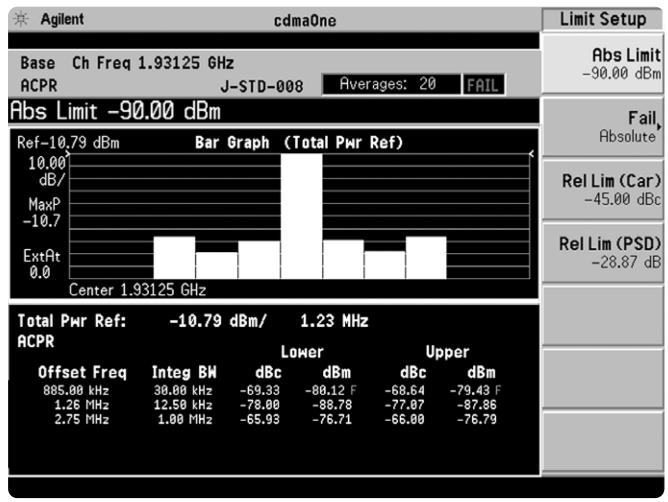
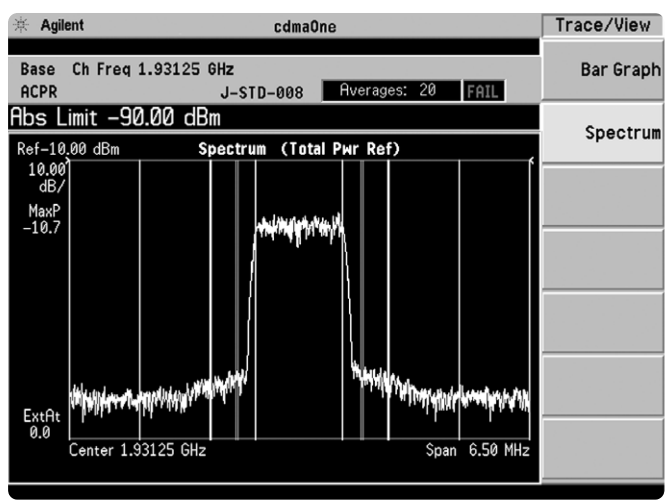


Figure 3.
Spectrum view



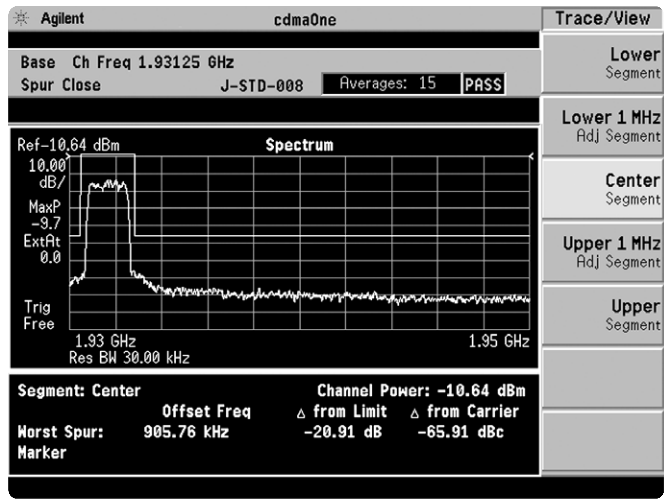
Part 4
Spur close

This measurement makes it easy to identify spurs that are in the transmitting band. It gives the option to measure the entire band or examine a single segment.

In this exercise, make the spur close measurement.

Instructions	Keystrokes
On the PSA:	
Measure for close-in spurious.	[MEASURE] {Spur Close}
Examine just the center segment (figure 4).	[Meas Setup] {Meas Type Examine} [Trace/View] {Center}

Figure 4. Examining the center segment for close-in spurs



Part 5
Code domain analysis

Walsh codes are the fundamental channelization mechanism for cdmaOne. To analyze the cdmaOne multichannel composite waveform, the analyzer receives the signal and decodes each channel using a Walsh code correlation algorithm. Channels with high correlation factors are determined to be active channels and are indicated as such on the display. Once the channels are decoded, the analyzer determines the power in each channel relative to the total signal power.

This measurement helps to verify that each code channel is operating at its proper level and helps to identify problems throughout the transmitter design from the coding to the RF section. System imperfections, such as amplifier non-linearity, will present themselves as an undesired distribution of power in the code domain.

The PSA also makes code domain timing and phase measurements. Timing is important because traffic channels can interfere with each other if they are not time aligned. Timing errors are typically due to problems with base station ASIC time adjustment parameters, delays in baseband signal paths, or intermodulation between Walsh codes. Having phase alignment with the local oscillator (LO) is also important. Phase errors can result in a loss of orthogonality between I and Q, thereby making it difficult to demodulate data from the traffic channels.

Now make these code domain measurements using the PSA.

Instructions	Keystrokes
On the PSA:	
Activate the code domain measurement.	[MEASURE] {Code Domain}
Program the analyzer to use the pilot sequence for synchronization (figure 5).	[Meas Setup] {More} {Demod} {Sync Type} {Pilot Seq}
View timing and phase error graphs.	[Meas Setup] {Meas Method} {Timing Phase} [Trace/View] {Power Timing & Phase}
Identify the timing error value for channel 10 (figure 6). Observe the marker data that appears in the timing window.	[Marker] {Trace} {Timing} [10] {Enter}

Figure 5.
Code domain power measurement

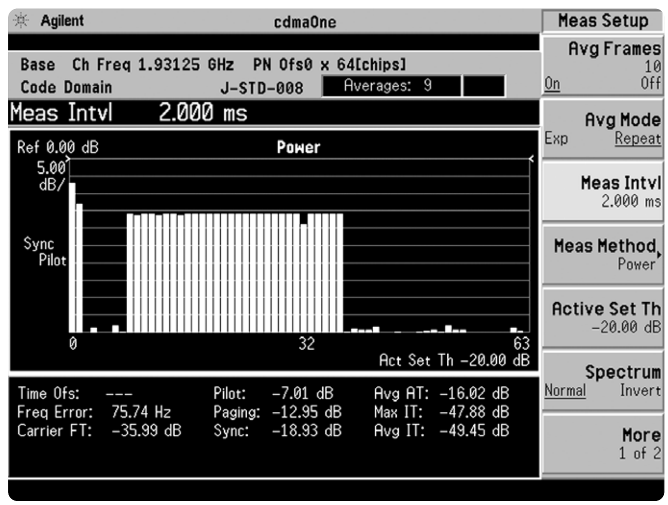
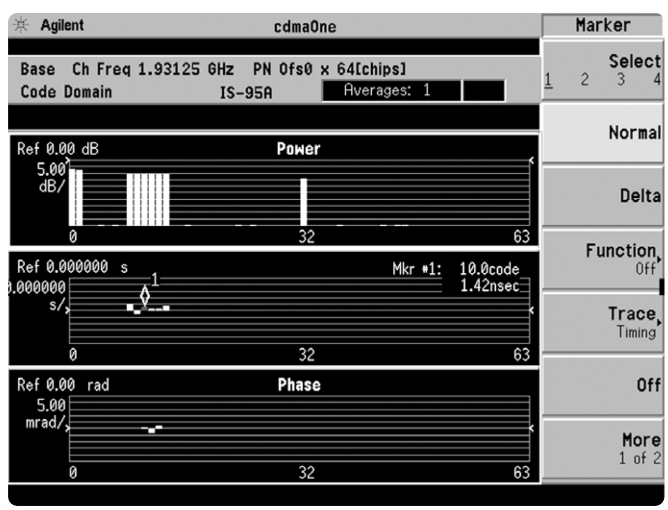


Figure 6.
Power graph with timing and phase error graphs



Part 6
Modulation accuracy (rho)

An important measure of modulation accuracy for cdmaOne signals is rho. Rho is the ratio of the correlated power to the total power. The correlated power is computed by removing frequency, phase, and time offsets and performing a cross correlation between the corrected signal and an ideal reference. The TIA/EIA-97-C specifications require rho to be greater than 0.912 for a pilot-only signal. In a single command, the PSA is able to measure rho.

Though rho is an excellent metric for modulation quality, it gives little insight into what might be causing poor modulator performance. More useful troubleshooting tools are the PSA's quadrature phase shift keying (QPSK) diagrams. They make it possible to visualize compression in linear amplifiers, magnitude and phase errors in the I/Q modulator, and carrier feedthrough.

There are two ways to view the cdmaOne signal constellation. The polar vector constellation diagram gives the data of the signal as it occurs during transmission. The complementary vector constellation applies a filter to the natural signal to "clean up" the diagram and make errors more evident.

In this exercise, measure rho, examine the constellation diagrams, and look at magnitude and phase error plots.

Instructions	Keystrokes
On the ESG:	
Change to a single channel signal.	{Setup Select} {Pilot}
On the PSA:	
Measure the modulation accuracy (figure 7).	[MEASURE] {Mod Accuracy}
View the I/Q measured polar vector plot.	[Trace/View] {I/Q Measured} {Polar Vector}
Look at magnitude and phase error plots (figure 8).	[Trace/View] {I/Q Error}
Change the measurement interval. Observe the time axes of the plots changing with the changing measurement interval.	[Meas Setup] {Meas Intvl} [⇑], [⇓] or rotate KNOB

Figure 7.
rho with I/Q measured complex vector plot

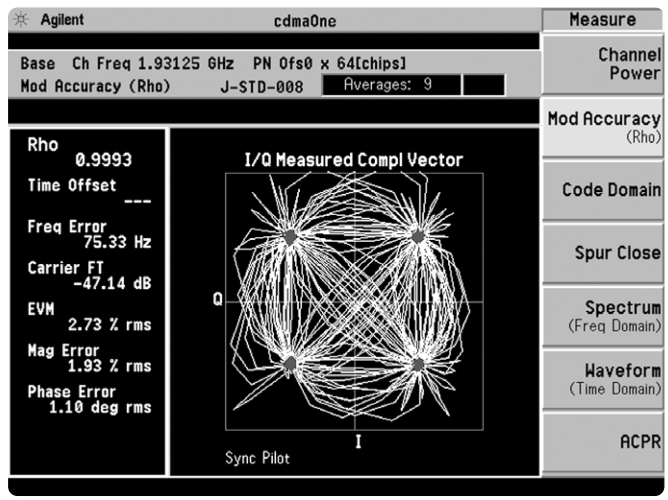
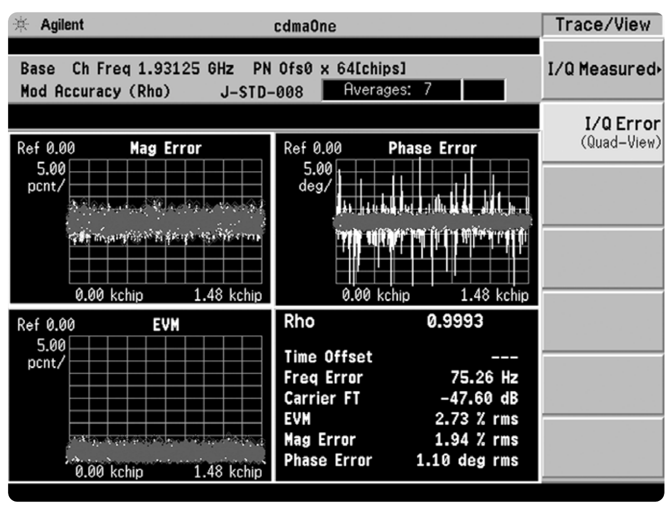


Figure 8.
Magnitude and phase error and EVM plots



Product literature

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

For more information on the PSA series, please visit:

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Europe:
(tel) (31 20) 547 2323
(fax) (31 20) 547 2390

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (82 2) 2004 5004
(fax) (82 2) 2004 5115

Latin America:
(tel) (305) 269 7500
(fax) (305) 269 7599

Taiwan:
(tel) 080 004 7866
(fax) (886 2) 2545 6723

Other Asia Pacific Countries:
(tel) (65) 375 8100
(fax) (65) 836 0252
Email: asia@agilent.com

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