

# Agilent PSA Series Spectrum Analyzers E4406A Vector Signal Analyzer cdmaOne Measurement Personality

Technical Overview with Self-Guided Demonstration  
Option BAC

The cdmaOne measurement personality, available on the Agilent PSA Series high-performance spectrum analyzers and the E4406A vector signal analyzer (VSA), provides a suite of standard-based measurements with digital modulation analysis to provide the most comprehensive and easy-to-use cdmaOne measurement solution in one analyzer.



Agilent Technologies

# Stay on Track and Make It a Fast Track: Simplify cdmaOne Testing

Evaluating base station and mobile transmitter performance for cdmaOne systems requires a broad series of tests and measurements.

Promote productivity in research and development:

- extensive capability in one analyzer
- robust, repeatable measurements
- intuitive user-interface

Streamline manufacturing with improved yields:

- one-button measurement setups
- superior accuracy minimizes measurement uncertainty resulting in reduced test margins
- SCPI programmable

The Agilent PSA Series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, and a leading-edge combination of flexibility, speed, accuracy, and dynamic range. Expand the PSA to include cdma2000 digital signal analysis capability with the cdmaOne measurement personality (option BAC).

For many manufacturing needs, the E4406A VSA is an affordable platform that also offers the cdmaOne personality.

The cdmaOne measurement personality provides measurement capability in the R&D and manufacturing environments for base stations, mobile devices, and their components based on the IS-95A, J-STD-008, and IS-97D/98D standards.

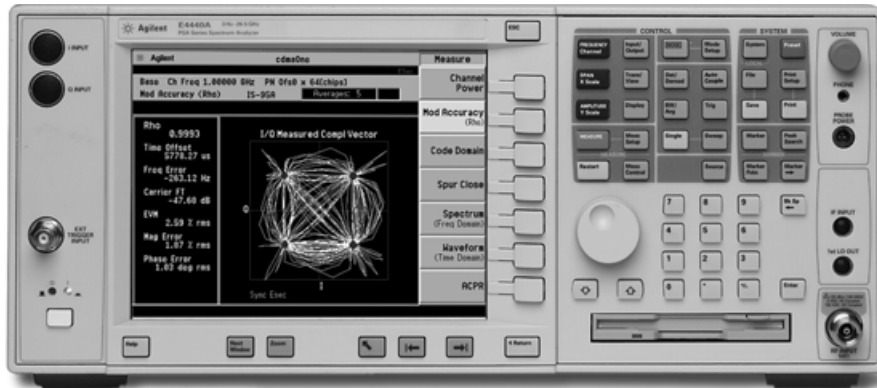
This technical overview includes

- measurement details
- demonstrations
- PSA Series key specifications for cdmaOne measurements
- ordering information
- related literature

All demonstrations utilize the PSA Series and the E4438C ESG vector signal generator; however, they can also be performed with the E4406A VSA. 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.

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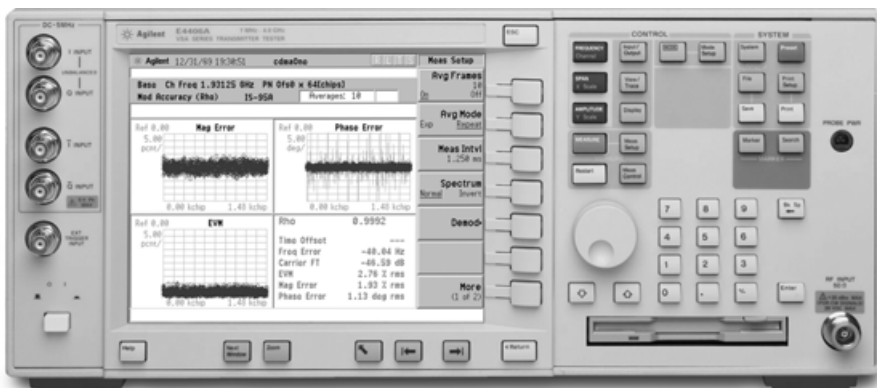


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PSA Series spectrum analyzer

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Modulation accuracy page 8

E4406A vector signal analyzer

## Demonstration preparation

To perform the demonstrations, the ESG and the PSA Series require the following options.

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

To configure the instruments, connect the ESG's 50 Ω RF output to the PSA's 50 Ω RF input with a 50 Ω RF cable. Turn on the power in both instruments.

Instructions	Keystrokes
<b>On the ESG:</b>	
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]
<b>On the PSA:</b>	
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}

## Channel power

The channel power measurement determines the total rms power in a user-specified bandwidth. The power spectral density (PSD) is also displayed in dBm/Hz.

Control the following channel power measurement parameters:

- Integration bandwidth (defaults to 1.23 MHz)
- Channel power span (defaults to 2 MHz)
- Number of trace averages (defaults to 20)
- Data points displayed (64 to 65536, defaults to 512)

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

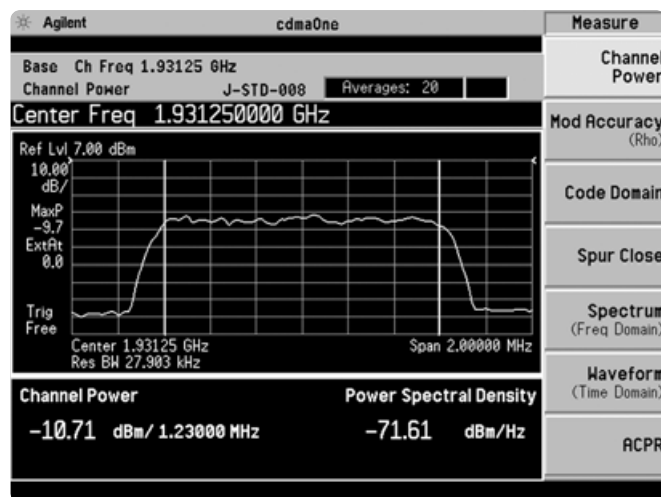
### Instructions

### 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



## Adjacent channel power ratio (ACPR)

To maintain a quality call by avoiding channel interference, it is important to measure and reduce any adjacent channel leakage power transmitted from a base station. The adjacent channel power ratio is a measure of the power in adjacent channels relative to the transmitted power.

- Select fast ACP or high dynamic range.
- Adjust integration BW (defaults to 1.23 MHz).
- Use averaging for rms or maximum values.
- Evaluate up to five adjacent channel pairs.
- Choose adjacent channel offset frequency, reference bandwidth, and limit values.
- Adjust and display both absolute and relative limits.
- Measure the total power in dBm or the PSD in dBm/Hz.
- View bar graph or spectrum.

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

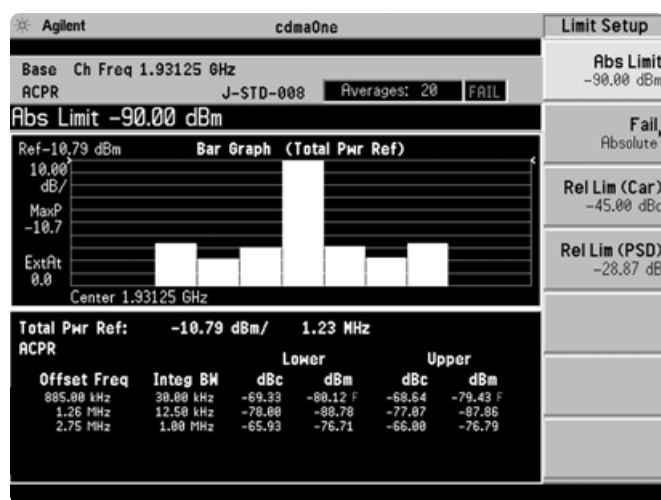
### Instructions

### Keystrokes

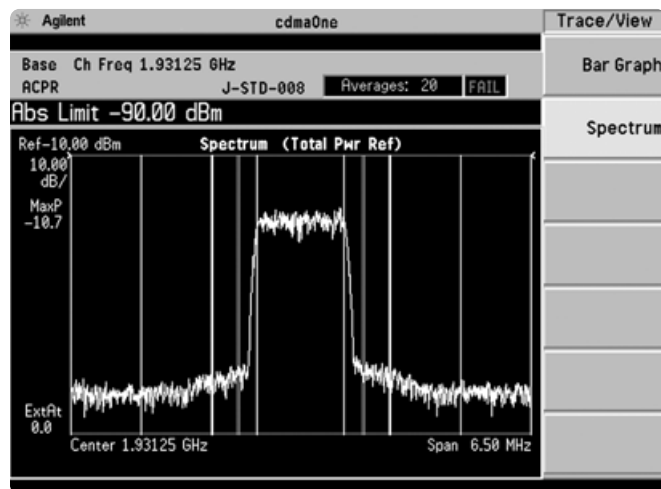
#### On the PSA:

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



## Spur close

This measurement makes it easy to identify spurs that are in the transmitting band. It locates the worst spur and measures its power relative to the limit and relative to the carrier power.

- Choose number of averages (defaults to 15).
- Measure the entire band or examine a single segment.

In this exercise, make the spur close measurement.

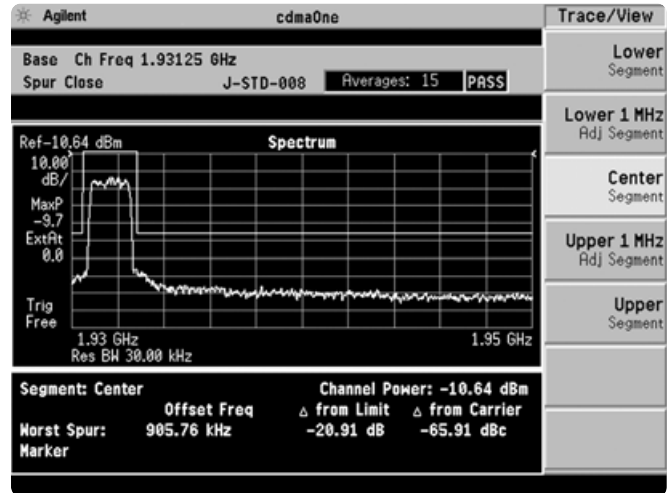
### Instructions

### 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



## 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.

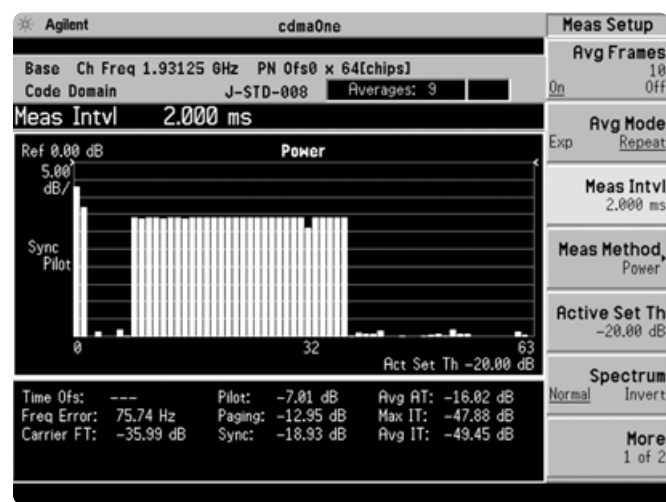
This measurement helps to verify that each code channel is operating at its proper level and helps to identify problems throughout the transmitter design from the coding to the RF section. System imperfections, such as amplifier non-linearity, will present themselves as an undesired distribution of power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

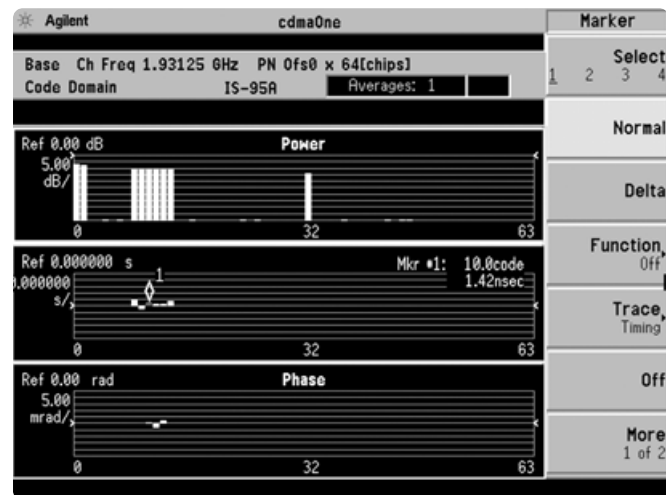
Now make these code domain measurements using the PSA.

Instructions	Keystrokes
<b>On the PSA:</b>	
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).	[Marker] {Trace} {Timing} [10] {Enter}
Observe the marker data that appears in the timing window.	

**Figure 5.**  
Code domain power measurement



**Figure 6.**  
Power graph with timing and phase error graphs



## 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. This measurement offers a multi-carrier filter that enables demodulation in the presence of multiple and adjacent cdmaOne signals.

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.

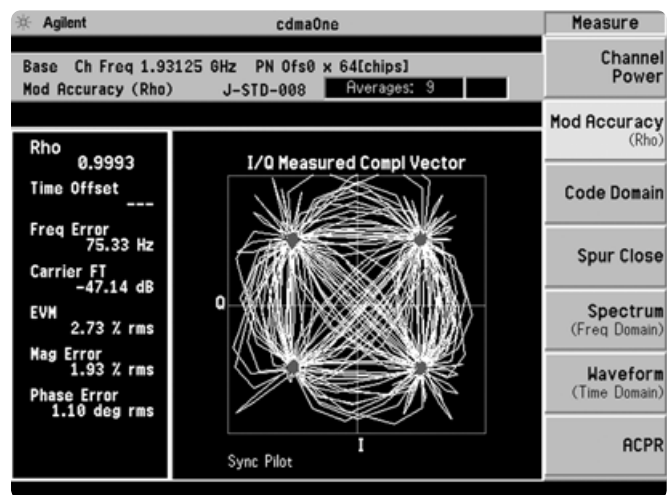
There are two ways to view the cdmaOne signal constellation. The polar vector constellation diagram gives the data of the signal as it occurs during transmission. The complementary vector constellation applies a filter to the natural signal to "clean up" the diagram and make errors more evident.

- Specify PN (pseudonoise sequence) offset.
- Set the measurement interval (defaults to 1.25 ms).
- View magnitude error, phase error, and EVM plots.
- Complimentary filtered constellation diagram available for zero-ISI analysis
- Parametric results based on IS-95 filtering standard.

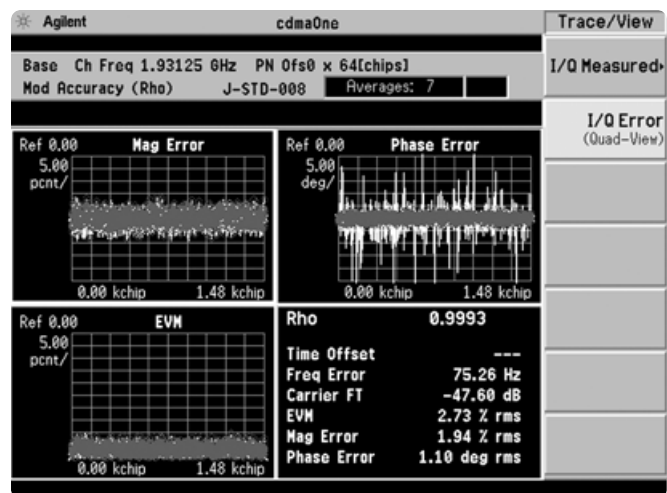
In this exercise, measure rho, examine the constellation diagrams, and look at magnitude and phase error plots.

Instructions	Keystrokes
<b>On the ESG:</b>	
Change to a single channel signal.	{Setup Select} {Pilot}
<b>On the PSA:</b>	
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.	[Meas Setup] {Meas Intvl} [↑], [↓]
Observe the time axes of the plots changing with the changing measurement interval.	or rotate KNOB

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



**Figure 8.**  
Magnitude and  
phase error and  
EVM plots





# PSA Series Key Specifications<sup>1</sup>

## cdmaOne measurement personality (7 MHz to 3 GHz)

The following specifications apply to models E4440A/43A/45A only.  
Models E4446A and E4448A have similar but not warranted performance.

### Channel power

Minimum RF input	-75 dBm (nominal)
Absolute power accuracy: (20 to 30°C)	
Manual attenuator setting	±0.67 dB (±0.18 dB typical)
Automatic attenuator setting	±0.76 dB (±0.24 dB typical)
Relative power accuracy: (between two different power level signals, mixer level -52 to -12 dBm)	±0.08 dB (±0.03 dB typical)

### Code domain (base station)

Minimum power at RF input	-40 dBm (nominal)
Code domain power:	
Dynamic range	50 dB (nominal)
Accuracy (Walsh channel power within 20 dB of total power)	±0.3 dB
Frequency error accuracy	±10 Hz + (transmitter frequency x frequency reference accuracy)
Pilot time offset accuracy	± 300 ns
Code domain timing accuracy	±10 ns
Code domain phase accuracy	± 10 mrad

### Modulation accuracy

Minimum power at RF input	-40 dBm (nominal)
Measurement interval range	0.5 ms to 30 ms
Rho (waveform quality) accuracy	±0.001
Frequency error accuracy	±10 Hz + (transmitter frequency x frequency reference accuracy)
Base station pilot time offset accuracy (from even second signal to start of PN sequence)	±300 ns
EVM accuracy	±0.5%
Carrier feed-through accuracy	±2.0 dB

### ACPR

Minimum power at RF input	-39 dBm (nominal)
ACPR relative accuracy	±0.09 dB

### Spur close

Minimum power at RF input	-35 dBm (nominal)
Amplitude accuracy:	
Absolute accuracy	±0.89 dB
Relative accuracy	±0.09 dB

1. For specifications on the E4406A VSA, please refer to the E4406A VSA data sheet, literature number 5968-3030E.

# Ordering Information

## PSA Series spectrum analyzers

E4443A	3 Hz to 6.7 GHz
E4445A	3 Hz to 13.2 GHz
E4440A	3 Hz to 26.5 GHz
E4446A	3 Hz to 44 GHz
E4448A	3 Hz to 50 GHz

### Options

To add options to a product, use the following ordering scheme:

Model	E444xA (x = 0, 3, 5, 6 or 8)
Example options	E4440A-B7J E4448A-1DS

### Digital demodulation hardware

E444xA-B7J	Digital demodulation hardware (required for digital demodulation measurement personalities)
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### Digital demodulation measurements

E444xA-BAF	W-CDMA measurement personality
E444xA-202	GSM w/ EDGE measurement personality
E444xA-B78	cdma2000 measurement personality
E444xA-204	1xEV-DO measurement personality
E444xA-BAC	cdmaOne measurement personality
E444xA-BAE	NADC, PCD measurement personality

### General purpose measurements

E444xA-226	Phase noise measurement personality
E444xA-219	Noise figure measurement personality

### Amplifiers

E444xA-1DS	100 kHz to 3 GHz built-in preamplifier
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### Inputs and outputs

E4440A-BAB	Replaces type-N input connector with APC 3.5 connector
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### Connectivity software

E444xA-230	BenchLink Web Remote Control Software
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### Warranty and service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B	Return-to-Agilent warranty and service plan
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### Calibration<sup>1</sup>

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001	Standard calibration
R-50C-002	Standards compliant calibration

## E4406A vector signal analyzer

E4406A 7 MHz to 4 GHz

### Options

To add options to a product, use the following ordering scheme:

Model	E4406A
Example options	E4406A-BAH

### Digital demodulation measurements

E4406A-BAF	W-CDMA measurement personality
E4406A-B78	cdma2000 measurement personality
E4406A-202	EDGE with GSM measurement personality
E4406A-204	1xEV-DO measurement personality
E4406A-BAH	GSM measurement personality
E4406A-BAC	cdmaOne measurement personality
E4406A-BAE	NADC, PDC measurement personality
E4406A-HN1	IDEN measurement personality

### Inputs and outputs

E4406A-B7C	I/Q inputs
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### Connectivity software

E444xA-230	BenchLink Web Remote Control Software
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### Warranty and service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B	Return-to-Agilent warranty and service plan
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### Calibration<sup>1</sup>

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001	Standard calibration
R-50C-002	Standards compliant calibration



## Product Literature

*Selecting the Right Signal Analyzer for Your Needs*, selection guide, literature number 5968-3413E

### PSA Series literature

*PSA Series*, brochure, literature number 5980-1283E

*PSA Series*, data sheet, literature number 5980-1284E

### E4406A VSA literature

*E4406A VSA*, brochure, literature number 5968-7618E

*E4406A VSA*, data sheet, literature number 5968-3030E

### Application literature

*Testing and Troubleshooting Digital RF Communications Transmitter Designs*, application note, literature number 5968-3578E

*Testing and Troubleshooting Digital RF Communications Receiver Designs*, application note, literature number 5968-3578E

For more information on the E4406A VSA or the PSA Series, please visit:

[www.agilent.com/find/vsa](http://www.agilent.com/find/vsa)

[www.agilent.com/find/psa](http://www.agilent.com/find/psa)

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