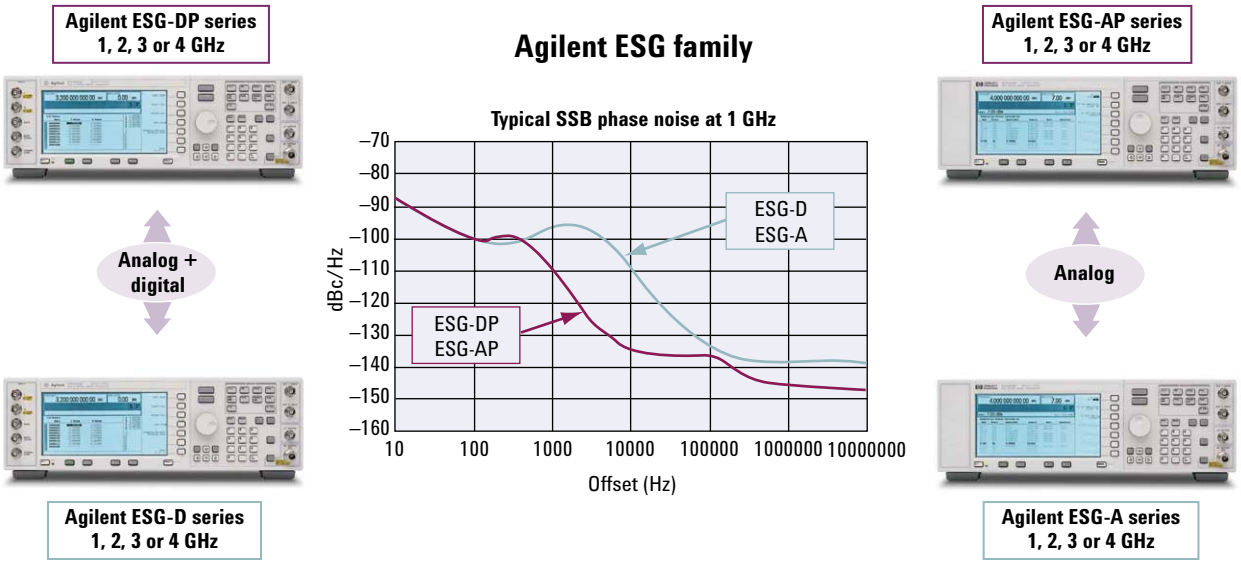
Agilent ESG Family of RF Digital and Analog Signal Generators

BUILDING THE WIRELESS FUTURE...**WITH YOU**

Agilent Technologies

You develop the wireless future…



Sixteen ESG models give you a wide choice of features and performance levels to fit your application.

Meet the ESG family

Agilent Technologies offers a wide range of choices with the ESG family of signal generators.

Choose the **ESG-DP series** for excellent spectral purity and digital capabilities that are ideal for general purpose R&D benchtop use. Choose the **ESG-D series** for the same digital capabilities with slightly lower spectral purity (see the graph above for a comparison).

Choose the **ESG-AP series** for outstanding phase noise performance and analog modulation features for all general purpose test needs. Choose the **ESG-A series** for the same analog capabilities with slightly lower spectral purity (see the graph above for a comparison).

A myriad of analog and digital modulation capabilities

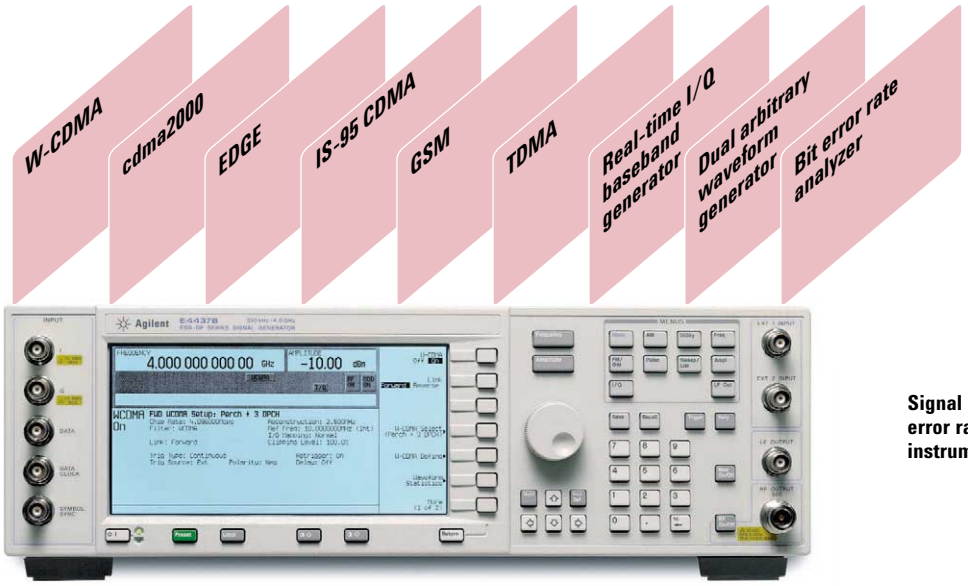
The ESG-AP and ESG-A series provide comprehensive analog modulation capabilities, including AM, FM, ΦM and pulse modulation. They also have built-in step sweep features and a versatile function generator.

The ESG-DP and ESG-D series provide broadband I/Q modulation with all major communications formats, such as W-CDMA, cdma2000, EDGE, GSM, Bluetooth™, and many more. Flexible digital modulation capabilities allow modification of existing standards or creation of new standards. All ESG-DP and ESG-D models include the analog model features, plus many additional digital options.

Key Agilent ESG family features

- Choice of spectral purity performance levels
- Choice of analog and digital, or analog only models
- Choice of frequency coverage: 250 kHz to 1, 2, 3, or 4 GHz
- Expandable, modular architecture
- Superior absolute level accuracy and stability
- Electronic attenuator for outstanding reliability
- Comprehensive suite of optional personalities for specific applications
- Lightweight, portable and mountable in a 5-inch rack space
- IntuiLink PC software included as standard with ESG models.

...we provide the signal generator



Signal generation and bit error rate analysis in one instrument.

Evolving with 3G technology

With the emergence of third-generation (3G) digital communications standards such as **W-CDMA, cdma2000, and EDGE,** test equipment must also keep pace. The ESG easily adapts to changing 3G technologies by continually adding and enhancing personalities. The modular architecture of the ESG makes it simple to upgrade and stay in step with latest standards.

Call your local Agilent Technologies sales office or visit our Web site at **www.agilent.com/find/esg** to get the latest information on features or to download free firmware upgrades.

An investment for your future

The ESG family has evolved with your needs since its introduction. It delivers accurate and repeatable measurements made under real-world conditions, and keeps you current with emerging standards.

As new test requirements emerge, you will find the ESG has again added more capabilities. We designed it to be flexible and modular to simplify product enhancements, and keep your upgrade costs down.

A user-installable hardware kit or firmware upgrade is all you need to give your ESG the latest features, so buy what you need today, knowing you've protected your investment for tomorrow.

Comprehensive signal-generation capabilities

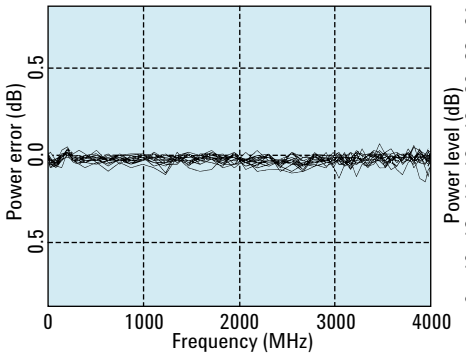
Firmware personalities

- W-CDMA, cdma2000, and EDGE
- IS-95 CDMA
- GSM, NADC, DECT, PDC, PHS, and TETRA
- Bluetooth
- Create or modify formats with flexible modulation capabilities

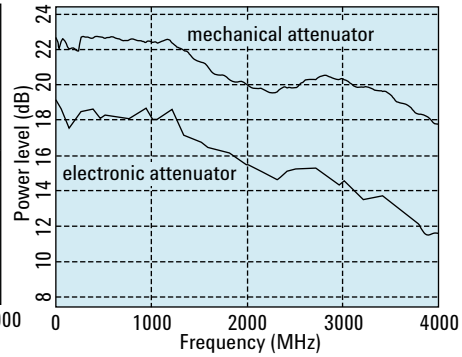
Hardware options

- Create complex digitally modulated signals with a **dual arbitrary waveform generator**
- Create modulation types, data rates, and filter types to build custom signals with a **real-time I/Q baseband generator**
- Measure sensitivity and selectivity with a **bit error rate analyzer**

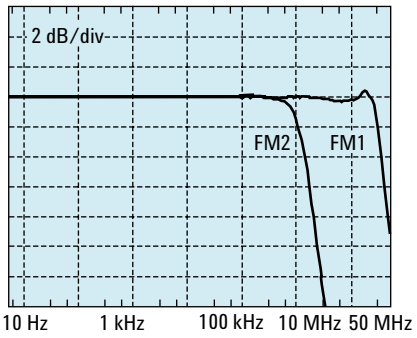
Performance…a family trait



Typical level accuracy.



Typical maximum available power.



Typical FM frequency response (ESG-A and ESG-D series).

Specified superior level accuracy

Superior level accuracy of ±0.5 dB (>–127 dBm, fc <2 GHz) and ±0.9 dB (fc >2 GHz) provides unmatched specified performance and minimizes test uncertainty. Even with digital modulation turned on, level accuracy is better than ±1.05 dB. This unprecedented performance ensures precise measurement of even the most sensitive analog or digital receivers.

Reliable state-of-the-art electronic attenuator

Reliably cycle output power for receiver sensitivity or amplifier compression tests. The patented all electronic attenuator design maximizes dependability. Standard on all Agilent ESG family models, the attenuator easily handles continuous output-power cycling with highly repeatable results up to 4 GHz.

Higher power with optional mechanical attenuator

Increase the output power up to 6 dB for overcoming insertion losses from cabling and switch matrices, or for components that require high drive levels.

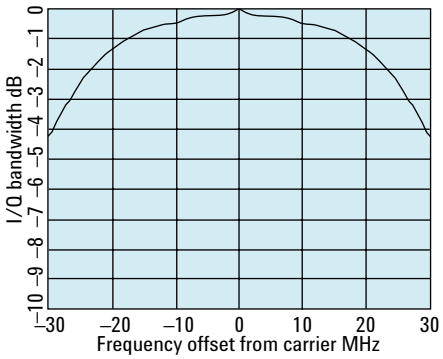
Wideband FM and ΦM

Use the wide FM bandwidth and superior dc FM accuracy and stability to simulate a VCO when you are designing a receiver.

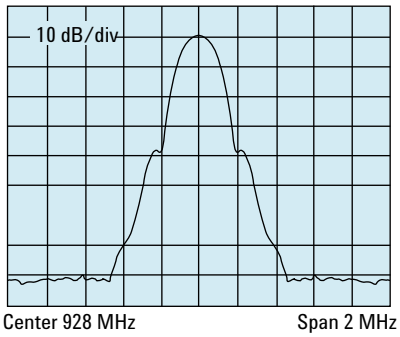
With up to 40 MHz FM deviations and 10 MHz rates, the ESG meets a variety of measurement requirements.

Extremely stable dc FM precisely reproduces digital signaling for FM receivers with selective squelch control. The wideband ΦM capabilities are useful in satellite communications applications and offer deviations up to 360 radians and 4 MHz rates.

Additional advantages in the digital models



Typical I/Q frequency response.



GSM spectrum plot.

Broadband I/Q modulation

Drive the I/Q inputs with analog signals to generate complex modulation formats (such as BPSK, QPSK, and 64 QAM) required for the development and testing of RF digital communications systems.

A built-in quadrature modulator processes the I/Q input signals to provide superior modulation accuracy and stability over a 26 MHz RF bandwidth (13 MHz baseband I/Q). In addition, internal I/Q modulator calibration routines generate precisely controlled and repeatable signals that minimize measurement errors.

Excellent modulation accuracy and stability with internal I/Q calibration

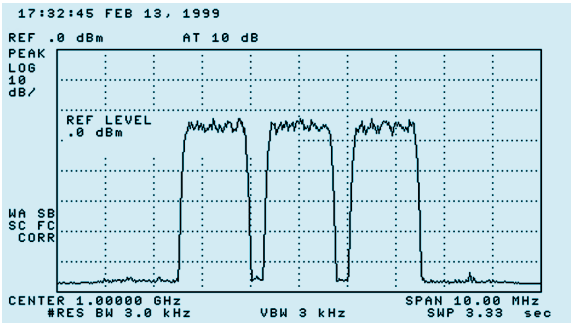
Perform highly repeatable and precise digital measurements. Get an error vector magnitude of better than 2% rms for π/4DQPSK signals, a global phase error of 0.8° rms for GMSK signals and a deviation accuracy of 6.1 kHz for GFSK signals.

Execute an I/Q calibration over the desired test frequencies to maximize measurement accuracy and repeatability. Upon completion, the calibration results typically remain valid for 30 days, when the instrument is operated within ±5 °C of the calibration temperature.

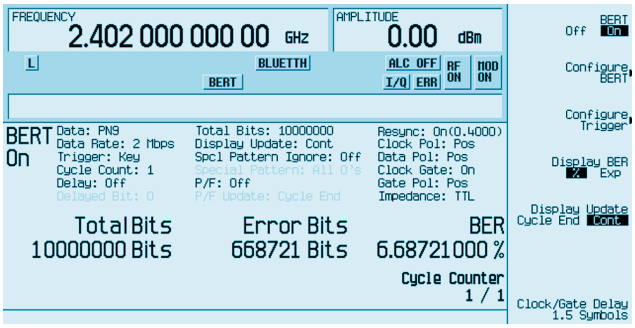
Coherent carrier output

Simplify the coherent detection of digital baseband signals. Using the coherent carrier output as a reference signal eliminates the need for complex demodulation techniques. The coherent carrier output provides frequency and phase information about the transmitted carrier, covering carrier frequencies from 250 MHz to maximum instrument frequency with a 0 dBm (±5 dB) output level.

Built-in functionality saves space, reduces costs



Generate multi-carrier CDMA signals to stress active components.



Make sensitivity measurements with the built-in bit error rate analyzer.

Built-in features eliminate external test equipment and reduce costs

The ESG builds in the multiple functionality that has traditionally required external test equipment or multiple signal generators. For example, you can get an internal dual arbitrary waveform generator that combines flexible baseband generation and I/Q modulation in a single ESG.

Use the multi-carrier CDMA personality to stress active components with multiple CDMA carriers.

Internal bit error rate analyzer

Quickly and efficiently measure sensitivity and selectivity of communications subsystems and components. Economically characterize analog and digital communication systems with the built-in bit error rate test option of the ESG. The BER analyzer efficiently indicates pass or fail conditions by automatically synchronizing to PN9 and PN15 bit sequences.

Loopback BER measurements for GSM

Perform GSM loopback bit error rate base station tests with the optional built-in BER analyzer and the Agilent E4406A VSA series transmitter tester. The ESG/VSA configuration is ideal for both development and manufacture of GSM base stations.

Configurable for your environment

The Agilent ESG has all the functionality needed for general purpose R&D.

The excellent reliability of the Agilent ESG is ideal for manufacturing environments.

Research and development

You've told us you want a flexible signal generator, so we've dedicated ourselves to giving you the perfect general-purpose R&D bench-top tool for the design of analog and digital communication subsystems, components, and devices.

Whether it's TDMA or CDMA, use the wide array of modulation capabilities to generate signals that correspond to today's, and tomorrow's communications standards.

The excellent accuracy and stability of the ESG provide the precise characterizations you'd expect of much more expensive equipment, without the expense.

The **ESG-DP and ESG-AP series** with high spectral purity gives you even higher performance. Get the performance you need for tests requiring stringent phase noise requirements, like local oscillator substitution, system troubleshooting and narrowband digital applications.

Repair and service centers

Agilent will help you pick from a wide range of ESG instrument configurations to develop an economically sound solution for your repair and service center. Plus, the **ESG is easy for anyone to learn.** Lightweight and portable, the ESG signal generators are easily moved to different benches or taken into the field for maintenance tasks.

Manufacturing

The ESG's outstanding reliability and signal generation flexibility makes it ideal for a manufacturing environment. Increase productivity with easy-to-use features that simplify measurement configurations and maximize measurement efficiency.

Perform repetitive measurements quickly and consistently by using the save/recall and sequencing features.

Also, compatibility with Standard Commands for Programmable Instruments (SCPI) provides control of the ESG in an automated test environment.

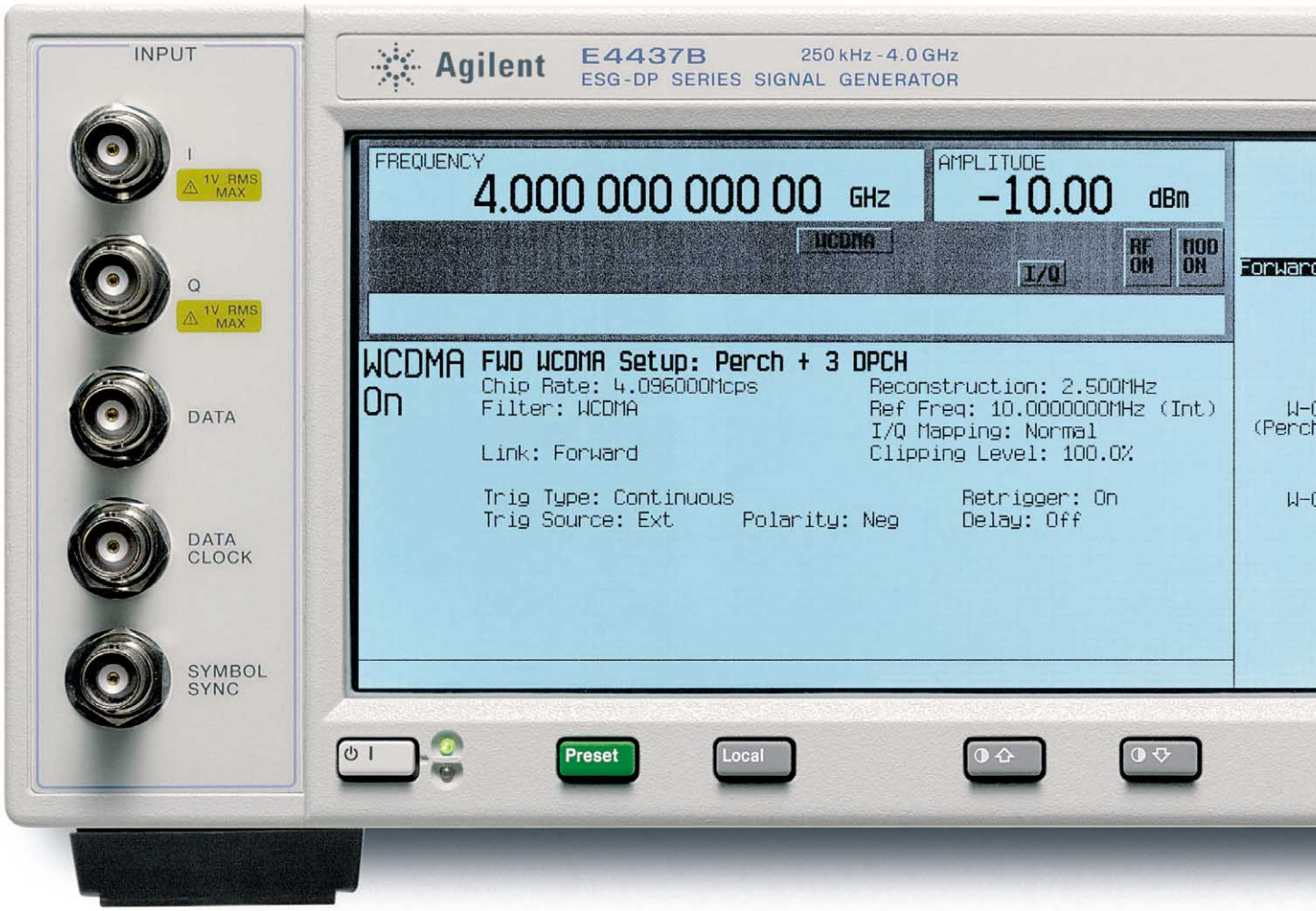
All-around ability for general-purpose test...

Powerful standard features

Analog
- Modular structure
- Simple user interface
- Built-in function generator
- Choice of electronic or mechanical attenuator
- Broadband frequency coverage
- Superior level accuracy
- AM, FM, ΦM
- Pulse modulation
- Excellent spectral purity

Digital
All standard analog features plus:
- Broadband analog I and Q inputs
  - Internally or externally generated I/Q
- I and Q adjustments
  - Gain adjustment ±4 dB
  - DC offsets 0 to 100%
  - Quadrature 0° to 10°
- Excellent modulation accuracy and stability with internal I/Q calibration

IntuiLink software
- Provides easy transfer of ESG screen images directly into Microsoft® Excel and Microsoft Word for training, archiving, and printing
- Save and restore instrument states
- Download arbitrary waveform files/data over GPIB



All-around talent for evolving with your needs

Add options for versatile signal generation

- Built-in communications standards
- Mobile or base station transmission simulation
- Flexible digital modulation
- Alternate timeslot power-level control
- Fast pulse modulation (analog models only)
- Internal bit error rate analyzer

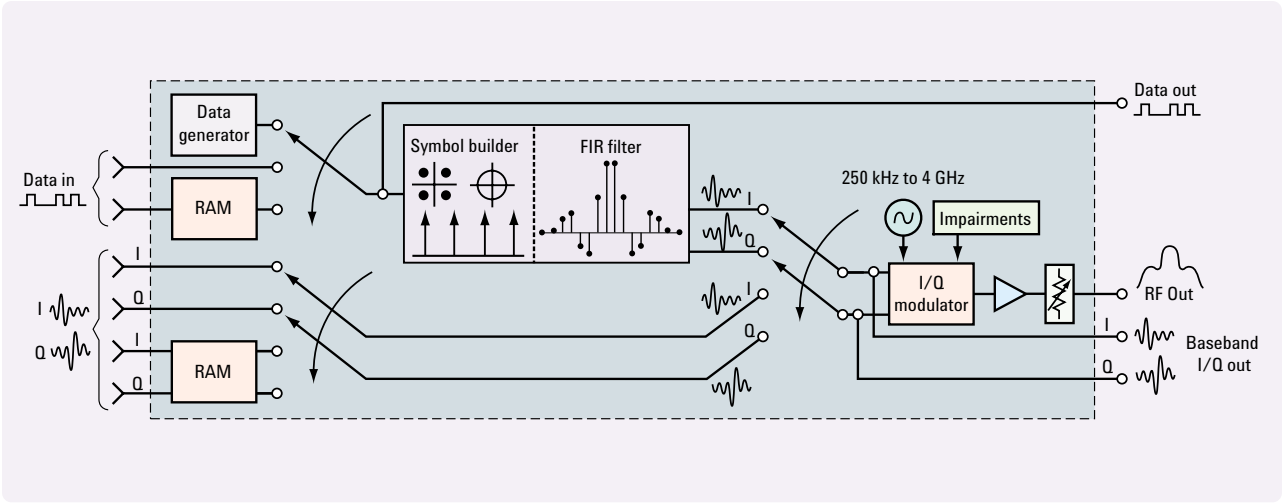
For receiver functional test

- Real-time I/Q baseband generator
  - GSM, EDGE, and others
  - Custom modulation capabilities
- Fully coded, continuous cdma2000 personality
- Fully coded, continuous W-CDMA personality
- Fully coded Bluetooth

For component test

- Internal dual arbitrary waveform generator
- Multi-carrier, multi-channel IS-95 CDMA personality
- Multi-channel W-CDMA personality
- Multi-channel cdma2000 personality

Flexible digital modulation generation keeps pace...



Option UN8 real-time I/Q baseband generator.

Simulate any block of a digital transmitter

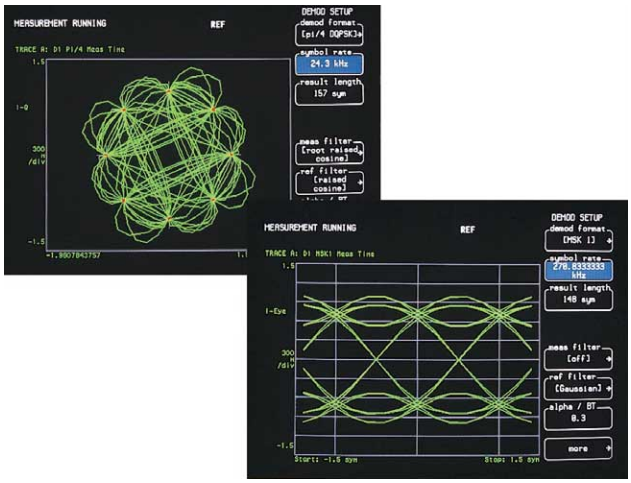
The Agilent ESG-DP and ESG-D series optional built-in flexible baseband generators provide complete control over a transmitted signal. You can supply data, I/Q modulation waveforms, or no input at all, and generate digitally modulated RF signals, I and Q baseband outputs, or data streams. Now you can tap into an arbitrary digital transmitter for inputs and outputs at any of the major interfaces to test anything from components to full receivers.

Supply data bits for digital modulation

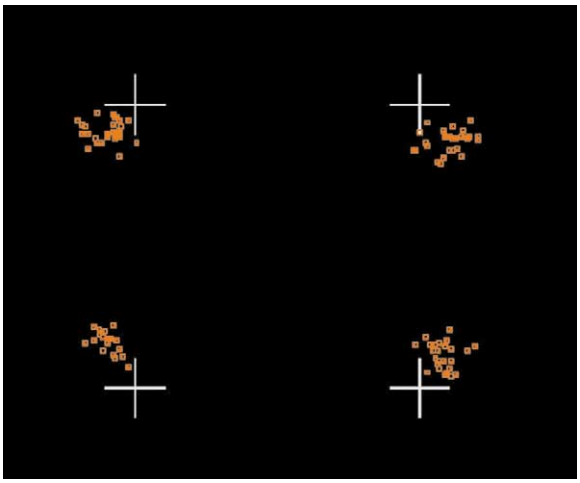
Use externally generated real-time data or internally generated and downloaded bit sequences to drive the optional real-time I/Q baseband generator. A proprietary application-specific integrated circuit (ASIC) performs symbol building and FIR filtering. The resulting I and Q waveforms can drive the internal I/Q modulator or an external I/Q modulator by using the baseband outputs.

The ASIC gives the user complete flexibility in modulation by providing access to custom I/Q and FSK mappings. Standard modulation formats, such as QPSK, MSK and 256 QAM, are provided. In addition, custom filtering and variable symbol rates up to 12.5 MHz give complete control of digital modulation.

...with changing communications standards



Two optional baseband architectures provide unsurpassed and complementary features for generating complex digitally modulated signals.



Add impairments or correct baseband deficiencies by adjusting I/Q gain, dc offset and quadrature skew.

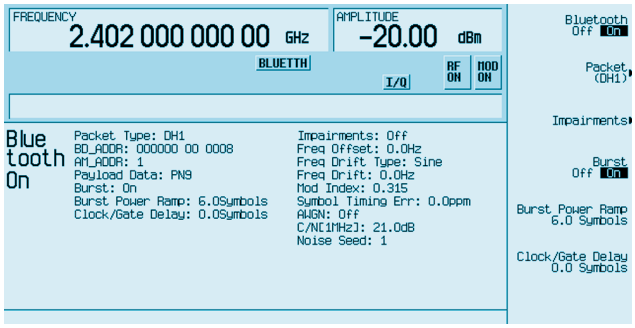
Supply your own digital baseband signals

For added flexibility, users can supply I and Q signals in either real time or by downloading data to the optional internal arbitrary waveform generator. By generating or simulating I and Q waveforms externally, you can expand the capabilities of the ESG to include multi-channel and multi-carrier signals such as orthogonal frequency division multiplexing (OFDM).

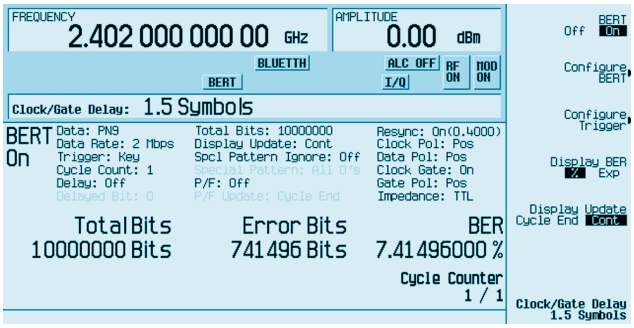
Impair, or improve, baseband signals

Adjust for defects in baseband I/Q signals, or add impairments to test components under real-world conditions. By adjusting parameters such as I/Q gain, dc offset and quadrature skew, simulate and correct for a wide range of baseband deficiencies.

Create and analyze Bluetooth signals



Arbitrary waveform generator Bluetooth personality user interface



Internal bit error rate analyzer user interface

The ESG-D series signal generator offers a flexible solution for Bluetooth development. Generate standard compliant Bluetooth signals for both transmitter and receiver testing. Use the internal bit error rate analyzer to test receiver performance.

Generate standard compliant signals

One type of Bluetooth personality is included with the purchase of the optional arbitrary waveform generator. Easily generate Bluetooth DH1 packets with various signal and impairment characteristics. Choose among three payload data formats, including a user defined 8-bit pattern and a continuous PN9 sequence. The Bluetooth personality boasts five signal impairment parameters including sinusoidal carrier frequency drift, symbol timing error, and AWGN with adjustable carrier to noise ratio. Also create your own custom Bluetooth waveforms using a variety of programming languages and download them to the instrument for playback.

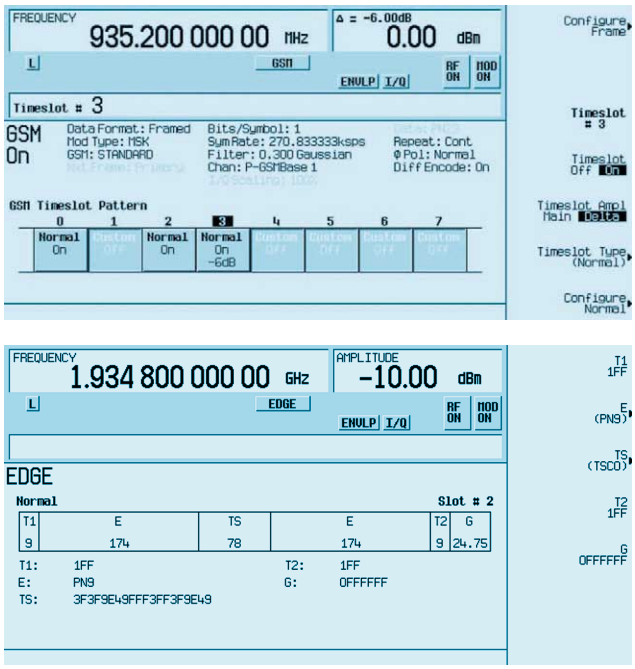
Verify receiver performance

The optional internal bit error rate analyzer and arbitrary waveform generator Bluetooth personality offer a convenient solution for Bluetooth receiver testing. The ESG provides a Bluetooth modulated signal with a continuous PN9 payload to the receiver. The receiver demodulates the signal and presents the demodulated data to the bit error rate tester for analysis. Use the internally generated clock and gate signals to extract the continuous PN9 payload from the DH1 packet for analysis.

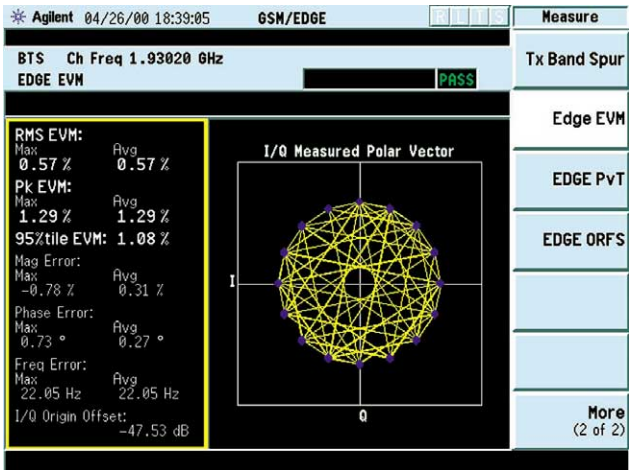
Input external data

A second type of Bluetooth personality is included with the purchase of the optional real-time baseband generator. This option offers an external data input for users who want to modulate their own Bluetooth baseband signal in real-time. Furthermore, select between an assortment of built-in data patterns to modulate including PN9, PN15, PN23, and a variety of bit patterns, or create your own data files and download them to the ESG. Easily modify filter, modulation and burst characteristics through the intuitive user interface.

Flexible generation of TDMA standards…



Customize TDMA signals for specific test requirements by configuring frames and timeslots.



EVM measurement of the EDGE configuration (see figure to left) made on the Agilent E4406A VSA series transmitter tester.

Simulate common TDMA communications standards

The optional real-time I/Q baseband generator allows easy access to DECT, GSM, NADC, PDC, PHS and TETRA communications standards. In addition, EDGE, Option 202, can be added to the real-time I/Q generator. Frames and timeslots can be configured as different types of traffic and control channels. In addition, a timeslot's data field can accept internally or externally generated data. The flexible architecture of the real-time I/Q baseband baseband generator lets the user adjust the symbol rate, modulation format and filter to adhere to evolving standards.

Adapt to changing market needs with custom TDMA signal creation

The optional built-in flexible baseband generators of the ESG provide the power to adapt to changing market needs.

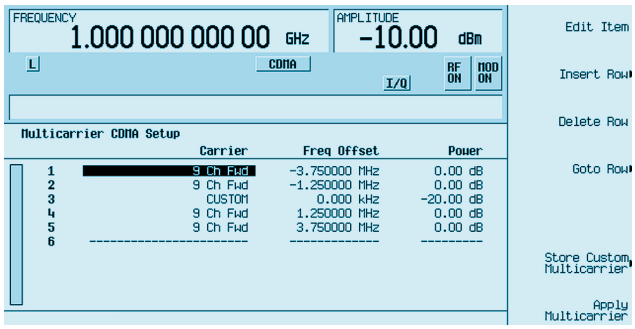
With the real-time I/Q baseband generator, create custom TDMA signals by downloading data and control bits to memory or providing external data and control from the front panel connectors. Also, build modulation formats, symbol rates and filters to create nonstandard TDMA platforms for developing new or proprietary communications standards.

With the dual arbitrary waveform generator, download waveforms that simulate complex, non-standard or proprietary modulation schemes. Replay complex waveforms to simulate multi-carrier signals to easily characterize base station power amplifiers.

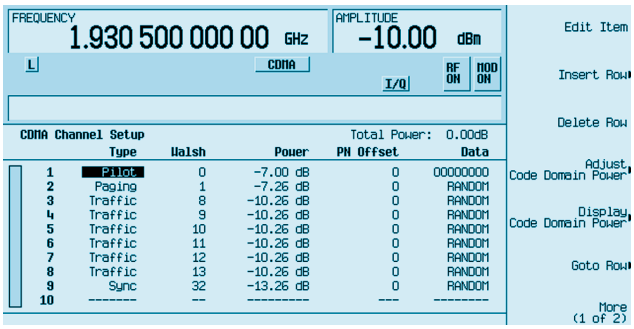
Alternate timeslot power-level control

Test TDMA receiver designs by varying the power level of transmitted digital data in a frame's timeslot. Simulate a TDMA mobile or base station for reference sensitivity or switching transient measurements.

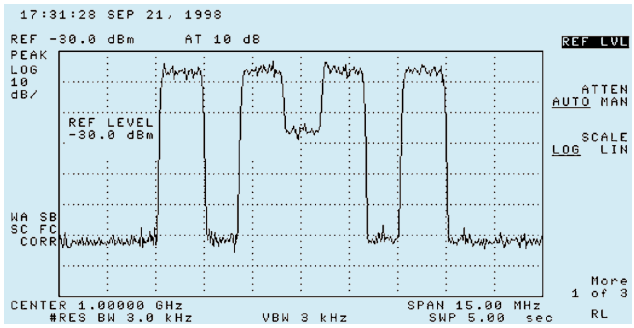
...and IS-95 CDMA



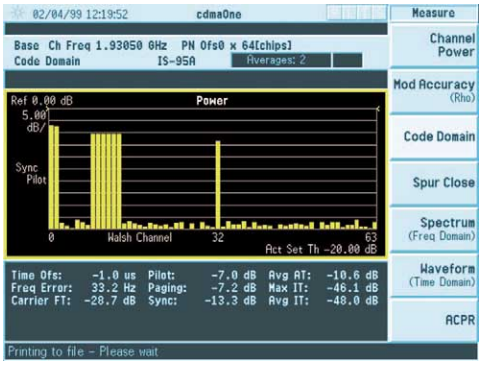
Generate multiple Walsh coded CDMA carriers for component testing.



CDMA channel editor increases flexibility by providing individual channel settings.



Multi-carrier CDMA spectrum corresponding to the configuration above.



Code-domain power as measured on an Agilent E4406A VSA series transmitter tester.

Comprehensive CDMA base station and mobile testing

Generate multi-carrier CDMA signals with multiple channels in each carrier for base station and mobile tests at system or component level.

Tailor a test to specific requirements like the complementary cumulative distribution function (CCDF) by selecting pre-defined multi-carrier CDMA configurations or by explicitly defining the characteristics of each channel on each carrier.

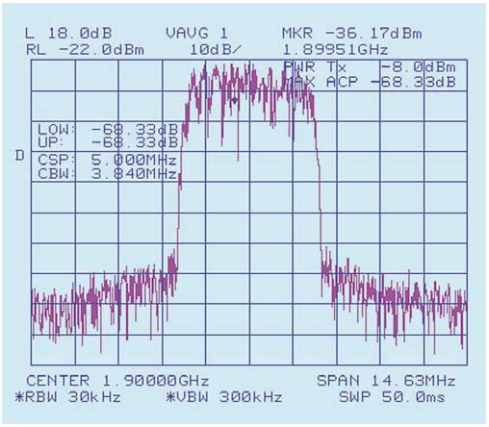
Custom CDMA configuration

When an application requires a specific test configuration, you can easily modify the multi-channel and multi-carrier setup. Simulate fully loaded cells by generating up to 256 Walsh coded channels, each individually configurable with power, data and PN offset. Additionally, vary the chip rate and filter to conform to the required test.

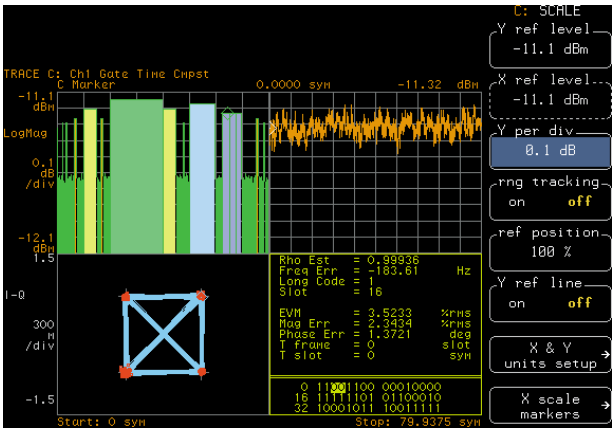
Fully featured CDMA personality

- One-button generation of IS-95 Walsh coded signals
- Up to 256 configurable channels for each carrier
- Up to 12 carriers
- Pre-defined pilot channel, 9 channel, 32 channel, 64 channel and reverse channel
- Definable custom filters
- Code-domain power display
- Calculation of CCDF

Building a 3G future with you



Generate signals conforming to evolving 3G standards, such as W-CDMA.



Generate statistically correct multi-channel signals that accurately stress active components.

Committed to evolving with 3G technology

The ESG keeps pace with emerging third-generation (3G) wireless standards by providing optional W-CDMA, cdma2000 and EDGE personalities.

Whether you need the versatility of the ESG for in-channel or out-of-channel analysis or for real-time data on multiple-coded channels for testing the sensitivity of your 3G receivers, the ESG is designed to help you accomplish your great design and test goals. To help you in this time of phenomenal growth, Agilent also provides design software and consulting services for 3G product development, manufacturing, system deployment and operation, all evolving with the latest in 3G technology.

W-CDMA and cdma2000

Generate correctly coded signals according to developing international standards. Simulate fully coded channels for base station and mobile receiver test, or partially coded, statistically correct multi-channel signals that accurately stress active components for the developing international 3G standards.

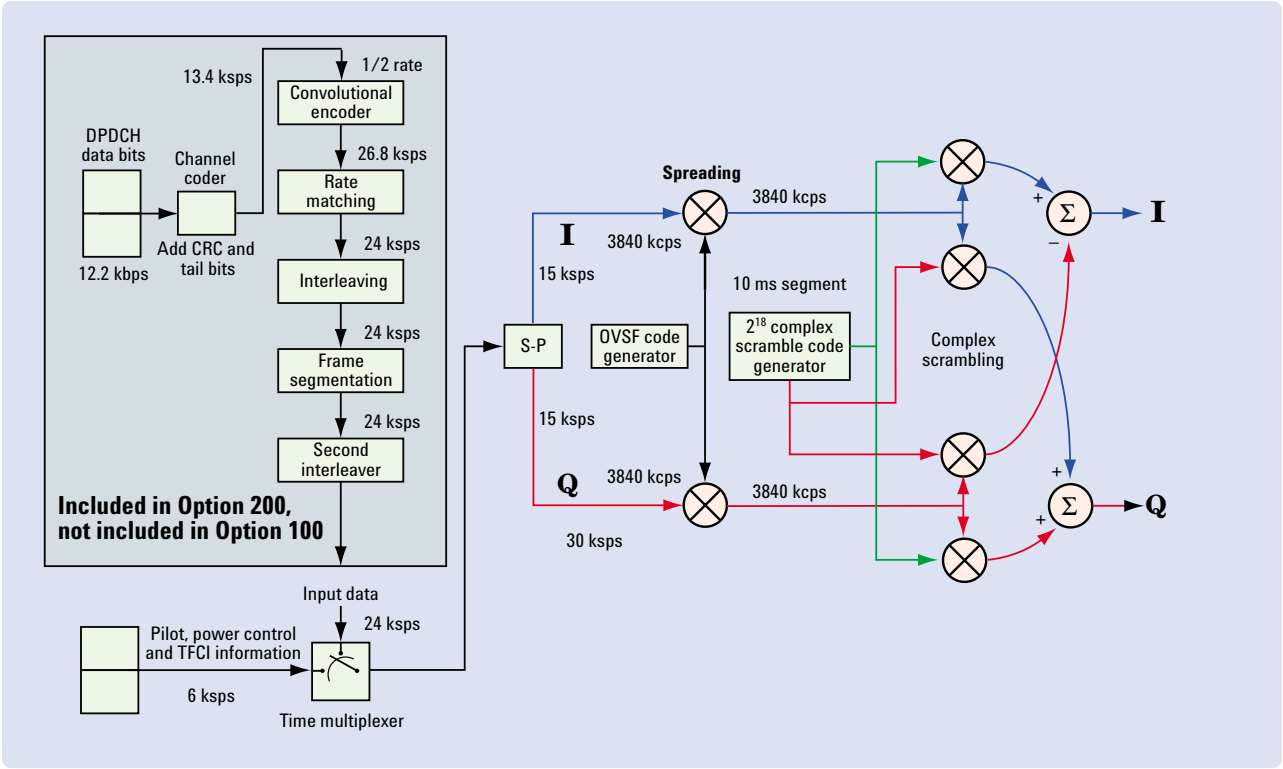
EDGE

Simulate framed EDGE signals to evaluate developing systems. Configure each timeslot in the frame with externally or internally generated data sequences to test receiver designs.

Keeping your future in mind

As new testing requirements for the 3G standards emerge, Agilent Technologies is committed to adding more capabilities to the ESG family. We've designed the architecture to be flexible and modular to simplify product enhancements. With the customer-installable hardware kits or firmware upgrades (most firmware upgrades are free and downloadable from the ESG Web site), your ESG can have the latest features to support the most current standards. Buy what you need today, while protecting your investment for tomorrow.

Solutions for W-CDMA test



Choose Option 100 or 200 depending on the level of coding required.

Component testing

The multi-channel W-CDMA personality, Option 100 is an arbitrary waveform based solution for W-CDMA testing to the harmonized specification. It provides a partially coded multi-carrier W-CDMA signal used primarily for component testing. Users can generate both uplink and downlink signals that conform with 3GPP version 3.4 standards.

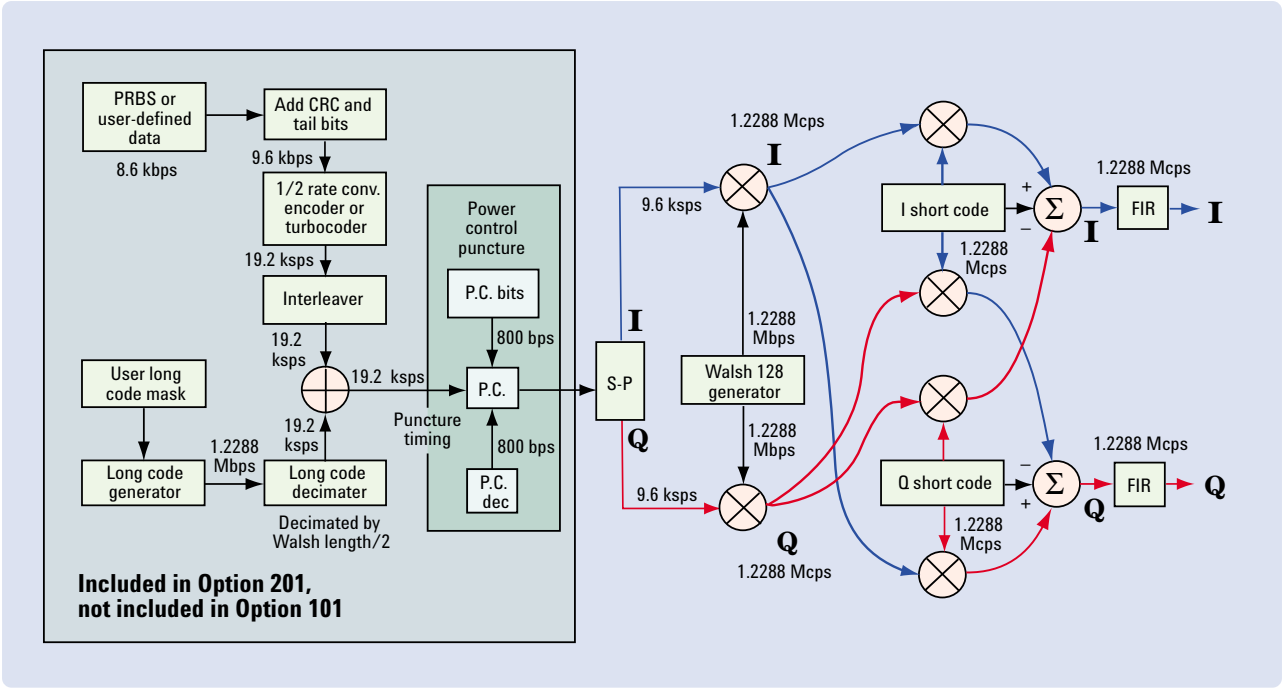
Special Option H99 provides improved ACP performance for multi-channel W-CDMA (Option 100). This is especially important for verifying the ACP of power amplifiers.

Receiver testing

Option 200 W-CDMA personality for the real-time baseband generator, generates a fully coded multi-channel W-CDMA signal compliant with the latest 3GPP standards. By utilizing the real-time I/Q baseband generation of Option UN8, this firmware option provides the capability to perform mobile and base station receiver tests (e.g. BERT), baseband tests, and some component tests.

The fully coded signals generated by Option 200 simulate a base station to test a mobile. It allows the user to measure Bit Error Rate (BER) during the following tests: adjacent channel selectivity, spurious response, intermodulation response rejection, reference sensitivity level, maximum input level, and blocking. Continuous pseudorandom number sequences simulate real-world conditions.

Solutions for cdma2000 test



Choose Option 101 or 201 depending on the level of coding required.

Component testing

Generate multi-channel forward and reverse link signals according to the developing cdma2000 standard with Option 101. These 1X or 3X chip rate, direct or multi-carrier spread signals are ideal for component and subsystem tests. A table based channel editor maximizes flexibility. Option 101 is a firmware personality built on the internal dual arbitrary waveform generator (Option UND).

Receiver testing

Option 201 is intended for receiver functional and parametric test at the physical layer. It offers fully coded, multi-channel, real-time stimulus for cdma2000 mobiles and base stations. It is ideally suited for bit level tests of cdma2000 receivers in R&D, sub-system module testing and RF parametric test. The fully coded nature of this solution in both forward and reverse mode supports long and short codes, cyclic redundancy checks, convolutional or turbo encoding, interleaving, power control, and complex scrambling.

Additional capabilities allow flexible channel configurations with individually adjustable power levels and data rates, customizable user data, and variable chip rates. The option is backward compatible with IS-95A in both the base station and mobile simulation modes through support of radio configuration 1 and 2.

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Additional information

Web site

For the latest information on the Agilent ESG family see our Web page at: **www.agilent.com/find/esg**

ESG family application and product information

Please visit the ESG Web site for on-line access to literature including the ESG option literature and ESG signal generator application and product notes, or contact your Agilent Technologies' sales office.

- *Agilent ESG Family of RF Signal Generators*, Data Sheet, literature number 5965-3096E
- *IntuiLink Software,* Data Sheet, literature number 5980-3115EN
- *Agilent ESG Family of RF Signal Generators*, Configuration Guide, literature number 5965-4973E
- *RF Source Basics, a self-paced tutorial* (CD-ROM), literature number 5980-2060E.
- *Generating and Downloading Data to the ESG-D RF Signal Generator for Digital Modulation*, Product Note, literature number 5966-1010E.
- *Customize Digital Modulation with the ESG-D Series Real-Time I/Q Baseband Generator, Option UND*, Product Note, literature number 5966-4096E.
- *Using the ESG-D RF Signal Generator's Multi-carrier, Multi-channel CDMA Personality for Component Test, Option UN5*, Product Note, literature number 5968-2981E.
- *Generating Digital Modulation with the ESG-D Series Dual Arbitrary Waveform Generator, Option UND*, Product Note, literature number 5966-4097E.
- *Using the ESG-D series of RF signal generators and the 8922 GSM Test Set for GSM Applications*, Product Note, literature number 5965-7158E.
- *ESG Series RF Signal Generators Option 200 W-CDMA*, Product Overview, literature number 5988-0369EN.
- *ESG Series RF Signal Generators Option 201 cdma2000*, Product Overview, literature number 5988-0371EN.
- *Understanding GSM Transmitter Measurements for Base Transceiver Stations and Mobile Stations*, Application Note 1312, literature number 5968-2320E.
- *Digital Modulation in Communications Systems—An Introduction*, Application Note 1298, literature number 5965-7160E.
- *Understanding CDMA Measurements for Base Stations and their Components*, Application Note 1311, literature number 5968-0953E.
- *Testing and Troubleshooting Digital RF Communications Receiver Designs*, Application Note 1314, literature number 5968-3579E.

1. For more information about IntuiLink software, please visit: **www.agilent.com/find/IntuiLink**

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