Agilent
ESG Family of RF Signal Generators
Configuration Guide

	Analog only		Digital and analog	
	ESG-A series	ESG-AP series (high spectral purity)	ESG-D series	ESG-DP series (high spectral purity)
250 kHz – 1 GHz	E4400B	E4423B	E4430B	E4434B
250 kHz – 2 GHz	E4420B	E4424B	E4431B	E4435B
250 kHz – 3 GHz	E4421B	E4425B	E4432B	E4436B
250 kHz – 4 GHz	E4422B	E4426B	E4433B	E4437B

Notice

This document is updated as often as once a month. Please contact Agilent Technologies
for the latest
information or check the
ESG family website at
http://www.agilent.com/find/esg

Agilent Technologies

Table of contents

Introduction

Standard Agilent Technologies ESG family RF signal generators incorporate a broad array of capabilities for testing both analog and digital communications systems. Adding flexible options provides a test solution that will evaluate the performance of a communication system to the requirements of nearly all current and proposed air interface standards. Many test functions can be customized to meet the needs of proprietary and other nonstandard wireless protocols as well. This guide describes how you can configure your instrument to address a wide variety of tests— from altering nearly every aspect of a digital signal or signal operating environment to creating experimental signals. This flexibility, along with an architecture that accepts future enhancements, makes the ESG family an excellent choice for wireless communication system testing now and in the future.

ESG family of RF signal generators

The ESG family consists of four series:

ESG-A series: analog instruments

ESG-AP series: analog instruments with high spectral purity.

ESG-D series: digital and analog instruments.

ESG-DP series: digital and analog instruments with high spectral purity.

Refer to table 1 for a list of the model numbers and their associated capabilities including frequency range, spectral purity, and modulation capability.

In keeping pace with ever-changing digital communication standards, Agilent Technologies is the leading-edge supplier of the latest signal-generator technology. To meet your evolving needs, Agilent Technologies constantly enhances the ESG family feature set. The latest released features are available as firmware for you to download online. In most cases, firmware up-grades can be done without any hardware modification. If a hardware modification is required, instructions are given on the Web page. The ESG's address is **www.agilent.com/find/esg**. Here you will find the latest news on the ESG including firmware upgrades, frequently asked questions and new features.

Please consult the Agilent Technologies ESG family RF digital and analog signal generators brochure, and the technical specifications for more information. For your reference, a list of related literature is shown at the end of this profile.
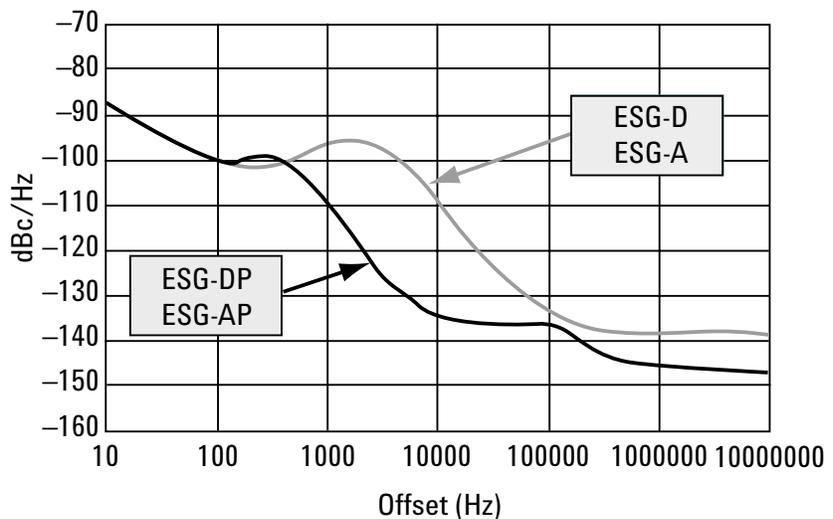
Key standard features
- Expandable architecture
- Broad frequency coverage
- Choice of electronic or mechanical attenuator
- Superior level accuracy
- Wideband FM and ΦM
- Step sweep (frequency, power and list)
- Built-in function generator
- Lightweight, rack-mountable
- 3-year warranty
- 2-year calibration cycle
- IntuiLink PC software[1]

Standard features only in the ESG–D/DP series
- Broadband analog I/Q inputs
- I/Q adjustment capabilities and internal calibration
- Excellent modulation accuracy and stability
- Coherent carrier output

Choosing a model number

	Analog only		Digital and analog	
	ESG-A series	ESG-AP series (high spectral purity)	ESG-D series	ESG-DP series (high spectral purity)
250 kHz – 1 GHz	E4400B	E4423B	E4430B	E4434B
250 kHz – 2 GHz	E4420B	E4424B	E4431B	E4435B
250 kHz – 3 GHz	E4421B	E4425B	E4432B	E4436B
250 kHz – 4 GHz	E4422B	E4426B	E4433B	E4437B

Typical SSB phase noise at 1 GHz (for additional phase noise plots, please refer to *ESG Family of RF Signal Generators,* Data Sheet, literature number 5965-3096E.

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1. IntuiLink software included free. For more information see page 26.

Choosing options for a new purchase

Option availability and compatibility
To add options to a model, use the following ordering scheme:

	Example
Model #	**E4432B**
Model #-option#	**E4432B-UND**
Model #-option#	**E4432B-100**

Hardware options	ESG-A series	ESG-AP series	ESG-D series	ESG-DP series	Requires	Not compatible with
High-stability timebase ❑ **Model#-1E5**	x	Standard	x	Standard		
High power with mechanical attenuator ❑ **Model#-UNB**	x	x	x	x		Options UNA, 300, H03, H98, H99
Alternate time slot level control ❑ **Model#-UNA**			x	x	Option UN8	Option UNB, H03, H98, H99
Improved ACP performance for TETRA, CDMA, WCDMA and cdma2000 ❑ **Model#-H99**			x	x		Option UNB, UNA, H03
High-performance pulse modulation ❑ **Model#-1E6**	x	x				
Internal dual arbitrary waveform generator ❑ **Model#-UND**			x	x		Options 300, H03, H98
Real-time I/Q baseband generator 1M RAM ❑ **Model#-UN8**			x	x		Options H03, H98
Add 7M RAM to Option UN8 ❑ **Model#-UN9**			x	x	Option UN8	Options H03, H98
Internal bit error rate (BER) analyzer ❑ **Model#-UN7**			x	x	Option UN8	Options H03, H98, 300 (or UN3 or UN4)
Firmware options						
Multicarrier, multichannel cdmaOne personality for Option UND ❑ **Model#-UN5**			x	x	Option UND	Options 300, H03, H98
Multicarrier, multichannel W-CDMA personality for Option UND ❑ **Model#-100**			x	x	Option UND	Options 300, H03, H98
Multicarrier, multichannel cdma2000 personality for Option UND ❑ **Model#-101**			x	x	Option UND	Options 300, H03, H98
Real-time 3GPP W-CDMA personality for Option UN8 ❑ **Model#-200**			x	x	Option UN8, revision C	Options H03, H98
Real-time cdma2000 personality for Option UN8 ❑ **Model#-201**			x	x	Option UN8, revision C	Options H03, H98
Real-time EDGE personality for Option UN8 ❑ **Model#-202**			x	x	Option UN8, revision C	Options H03, H98
Base station BERT[1] ❑ **Model#-300**			x		Option UN8, revision C, 202; recommend UNA. Also requires E4406A with options 300 and 202	Options UNB, H99, UND, UN5, 100, 101, H98, H03, UN7

Note: Options UND, UN5, UN7, UN8, 100, 101, 200, 201, and 202 are mutually compatible and can be loaded in the same instrument.

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1. Currently for GSM/EDGE only. Also refer to GSM/EDGE Base Station Test, literature number 5968-8333E.

Internal dual arbitrary waveform generator, Option UND

Adapt quickly to changing market needs with a completely flexible baseband generator. Download waveforms that simulate complex, non-standard or proprietary modulation schemes. Replay complex waveforms to simulate multicarrier CDMA and TDMA signals to easily characterize base station power amplifiers. Generate I/Q files from many different application programs, such as Omnisys, MATLAB™, and Mathcad™, and then download the waveform from an external computer through GPIB or RS-232.

Description

Option UND is one of two internal baseband generator cards for the ESG-D and ESG-DP series. This dual arbitrary waveform generator provides an extremely flexible baseband generation for the most complex RF waveforms.

It is provided on a user-installable card that can be added to the B version of any existing ESG, or any new instrument.

Available personalities

- Multicarrier, multichannel cdmaOne, Option UN5

- Multichannel W-CDMA 1.0, Option 100

- Multichannel cdma2000, Option 101

Key features

**High performance 14-bit digital to analog converters (DAC)**
Improve simulation and reduce noise floor.
The state of the art 14-bit DACs have only 25% of the quantization error of an ordinary 12-bit arbitrary waveform generation.

Deep 1 megasample/channel arbitrary waveform memory
Download or store extremely long or numerous waveforms.
Both the volatile and nonvolatile RAM have 1 Megasample of memory per channel. Switch between multiple waveforms instantaneously to minimize valuable download time in a manufacturing environment.
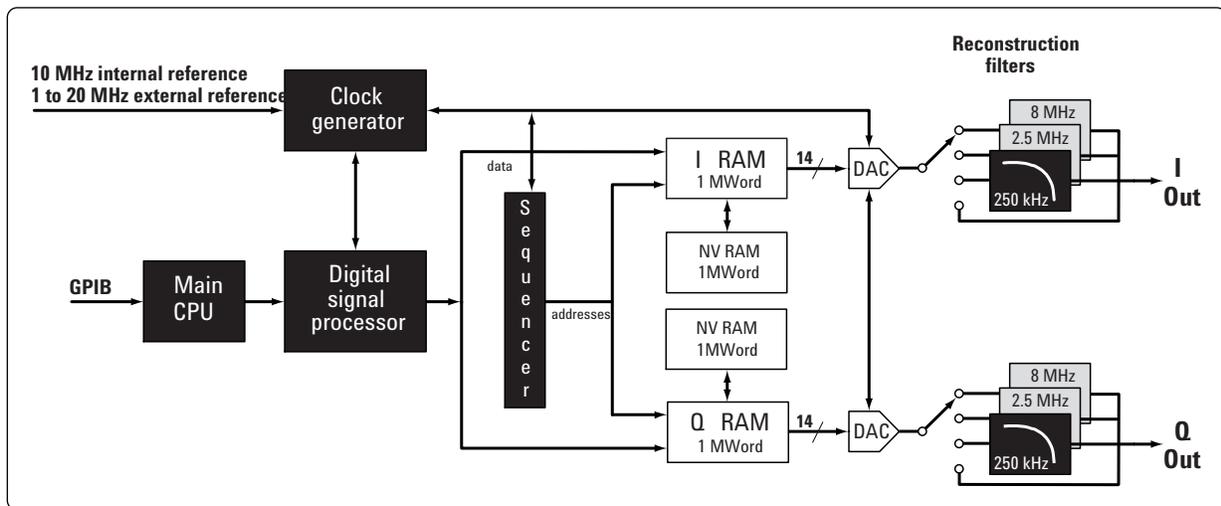
High-performance internal dual arbitrary waveform generator block diagram.

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Option UND (continued)

Multitone[1]

Measure intermodulation distortion of an amplifier by applying a multitone waveform.

Select up to 64 equally spaced tones, with the option of turning off any combination of tones. Adjust the frequency spacing between the tones and the phase of each individual tone to maximize measurement accuracy.

Three reconstruction filters

Minimize D/A spurs by matching reconstruction filters to sample rates.

Select from 250 kHz, 2.5 MHz or 8.0 MHz reconstruction filters, or provide your own external filter.

External triggers[1]

Synchronize the playback of wave-forms with external test equipment.

Select from continuous, single, gated, or segment advance triggering with up to a one-hour delay time.

Markers[1]

Trigger other events at specific points in the playback of a waveform.

Define marker locations in a segment during the waveform-generation process, or from the front panel. Activate or deactivate markers for each segment using the sequence table editor. A marker can also be tied to the RF blanking feature of the ESG to simulate bursted signals.
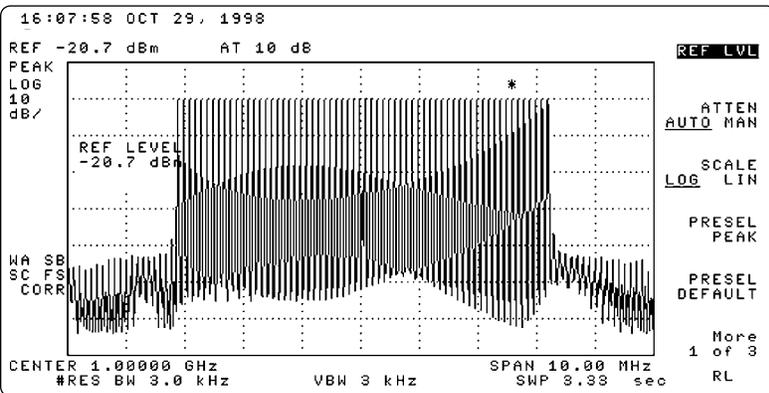
Additive white Gaussian noise[1]

Simulate background noise in a transmission.

Create additive white Gaussian noise waveforms up to 15 MHz in bandwidth with variable waveform lengths.

Multitone editor setup.

Depicts the 64 tone signal resulting from the multitone setup.

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1. New features available with firmware revision B.02.21 and higher. Triggers require a hardware upgrade. For more information consult the ESG Web page at **www.agilent.com/find/esg**.

Option UND (continued)

Bluetooth[1]

Test Bluetooth components and systems with standards-compliant signals. Specify Bluetooth device address, active member address, and payload data for a DH1 packet type. Three payload data formats are available: 8-bit pattern, truncated PN9 sequence, and continuous PN9 sequence. When continuous PN9 is selected, clock and gate signals with delay control are also generated. These signals can be used to extract the continuous PN9 payload data from the DH1 packet when performing receiver bit-error-rate tests using Option UN7 (internal BER analyzer).

The Bluetooth personality offers a variety of impairments to synthesize non-ideal signals for receiver testing. Available impairments include modulation index, symbol timing error, carrier frequency offset, linear and sinusoidal carrier frequency drift, and AWGN. Define the burst shape by specifying the number of symbols per ramp to test a receiver's response to different transmitter burst profiles.

Option UN8 also offers a Bluetooth predefined modulation format, however, Bluetooth packets are not created. Instead a data pattern is selected or downloaded to Option UN8 and that data pattern is then Bluetooth modulated.

For more information, refer to *Performing Bluetooth RF Measurements Today*, Application Note 1333, literature number 5968-7746E.
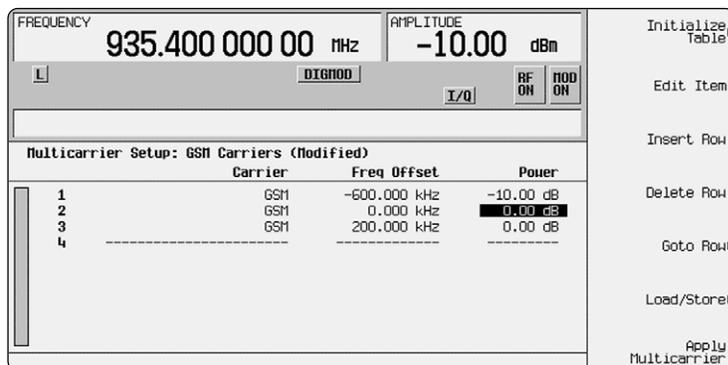
Multicarrier[1]

Characterize multicarrier components by applying multiple digitally modulated carriers. Generate up to 64 modulated carriers in a 15 MHz bandwidth. Adjust the frequency and power offset of each carrier to meet test requirements. Select from pre-defined modulation formats or create a custom format. Define a custom format by choosing the modulation type, filter and symbol rate. Custom modulation types include a variety of PSK, QAM, FSK and MSK. The data used on each carrier is random.
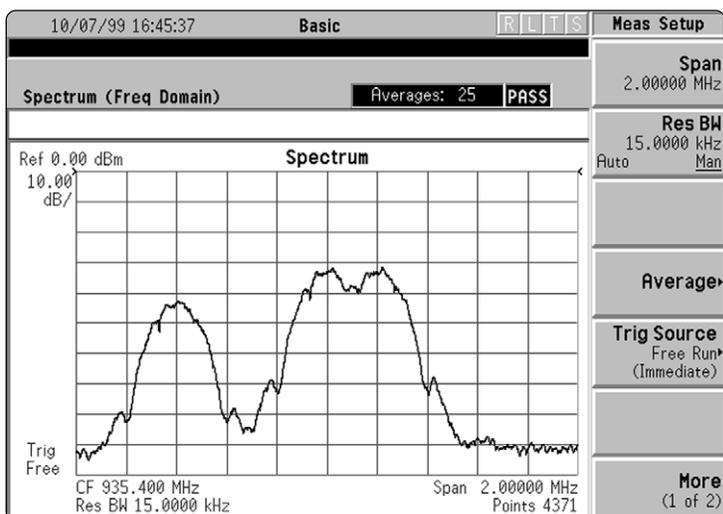
Pre-defined formats include:

NADC	TETRA
PDC	APCO25
PHS	CDPD
GSM	PWT
DECT	EDGE
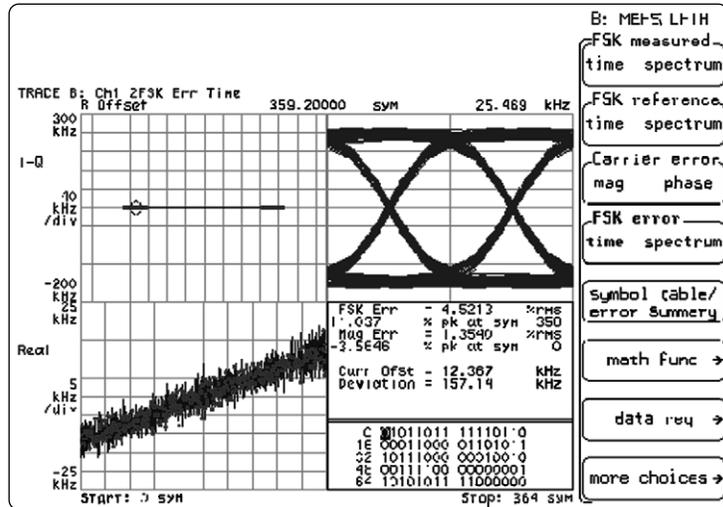
89441A display of modulation quality of a Bluetooth signal generated by an ESG.

Multicarrier GSM setup.

Multicarrier GSM spectrum resulting from the configuration shown in GSM setup.

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1. New features available with firmware revision B.03.20 and higher.

Real-time I/Q baseband generator, Option UN8

Option UN8 simulates mobile or base station transmissions of common digital communication standards. The real-time I/Q baseband generator supports DECT, GSM, NADC, PDC, PHS, TETRA, and CDMA communication standards. Data for these standards can be generated internally or supplied externally. After setting the frequency and amplitude of your signal, TDMA standards are available with the touch of one button. Alternatively, you can mix and match modulation types, symbol rates and filters to create custom platforms for developing new or proprietary communication standards.

Description

Option UN8 is one of two internal baseband generator cards for the ESG family. This real-time I/Q baseband generator builds digitally modulated signals by mixing and matching modulation types, symbol rates and filters. It is provided on a user-installable card that can be added to the B version of any existing ESG or any new instrument.

Different personalities may be purchased separately to provide specific modulation formats.

Option UN8 is a standard option with 1 Megabyte of RAM to store custom data. To increase the RAM to 8 Megabytes, Option UN8 can be ordered in conjunction with Option UN9 (Option UN8 consists of two cards). Option UN9 replaces one of these cards to provide 8 Megabytes of RAM.

Key features

Intuitive menu
Easy selection of predefined standards.
Common communication standards (NADC, GSM, PDC, PHS, DECT, TETRA) are introduced at the first menu level. The second level provides flexible access for basic configuring of data, timeslots, and framing.

Mix and match modulation types, symbol rates and filters
Create custom platforms for developing new or proprietary communication standards.
The real-time I/Q baseband generator (Option UN8) enables simple generation of complex signals. It is easy to mix and match a modulation type from one standard with a filter type from another. For example, generate a CDPD signal by selecting an NADC format and substitute a 0.5 GMSK modulation instead of the standard p/4 DQPSK modulation or generate PWT, a DECT variant, by substituting $\pi/4$ DQPSK modulation in the DECT standard. Implement and recall non-standard solutions easily.

### Unlimited modulation types using FSK, I/Q and differential table editors
Define modulation formats specific to application needs or impair the standard modulation formats for stress testing.
Select modulations from a menu of PSK, MSK, QAM or FSK modulation types.

Define the constellation of your choice with up to 16 values of I and Q. Add impairments such as origin offset, EVM, phase error, and quadrature error to the I/Q definition to test design robustness. Before generating the modulated signal, display the I/Q state map for a quick visual check.
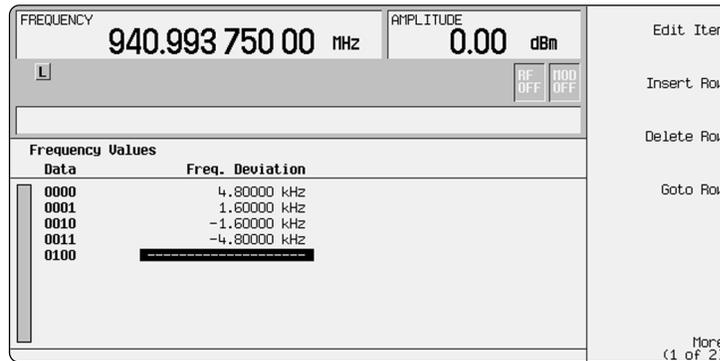
You can build asymmetric FSK formats such as FLEX with the FSK table editor.
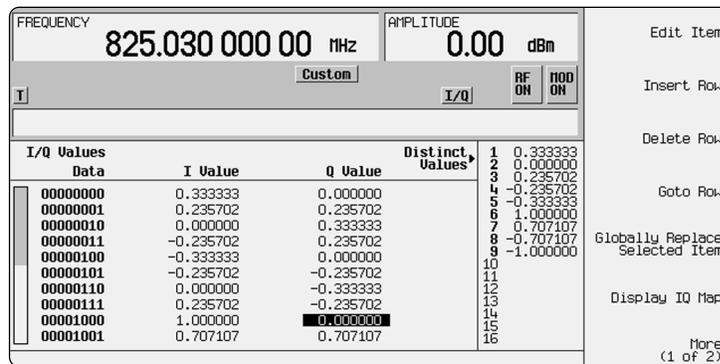
Customize modulations or perform margin testing with the I/Q table editor.

Option UN8 (continued)

Symbol rates up to 12.5 MHz
Specify rates to cover the existing communications systems and new third-generation systems.
If you want to create a new modulation scheme, the real-time I/Q baseband generator symbol rate can be specified from 50 Hz to 12.5 MHz. This range covers existing communications systems such as GSM at 270.833 Ksps and NADC at 24.3 Ksps and new emerging wideband communication systems.

Internal data generator
Generate PN (pseudo-random noise) sequences or repeating patterns.
Internally generate PN9, PN11, PN15, PN20 and PN23 (pseudo-random noise) sequences or fixed 4- to 64-bit repeating patterns. Other data patterns can be downloaded into memory or generated in real-time, through the data/clock/sync inputs.

Burst shaping
Create custom burst to simulate unique traffic patterns.
Adjust burst rise/fall time and delay through softkeys under the chosen TDMA protocol. Customized or standard bursts may also be provided externally through the external 1 input.
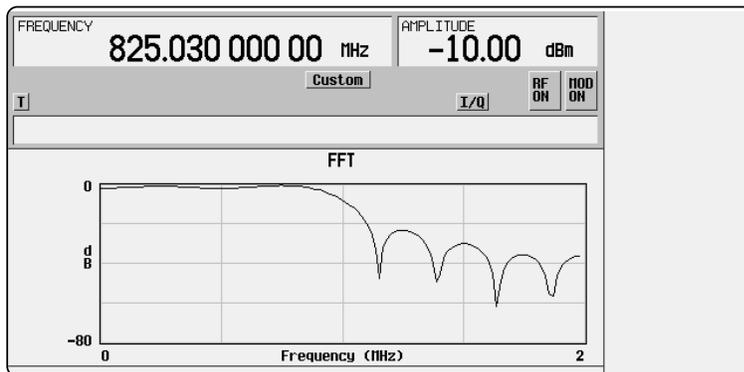
Unlimited baseband filtering
Select or build your own filters to control bandwidth and modulation quality.
Nyquist, root Nyquist, Gaussian and IS-95 FIR filters are all available. Specify the filter alpha from 0 to 1 or the BT (bandwidth time product) for a Gaussian filter from 0.1 to 1.

The FIR table editor enables you to build your own filters or add impairments such as static fading in the channel. Test new designs in the manufacturing environment by using the same filter and signal impairments. Changing the filter factor can also be used to intentionally change signal characteristics such as EVM. This is a useful tool to test receivers under real-life conditions.

Implement custom FIR filters via the FIR table editor.

Displayed FFT response of custom filter.

Option UN8 (continued)

Flexible frames and timeslots
Stimulate real TDMA transmissions.
You can independently configure and enable each timeslot, adjust timeslot type, data type and control field information. You may also customize a timeslot by downloading a specific data sequence into memory and then inserting the user file into a custom timeslot.
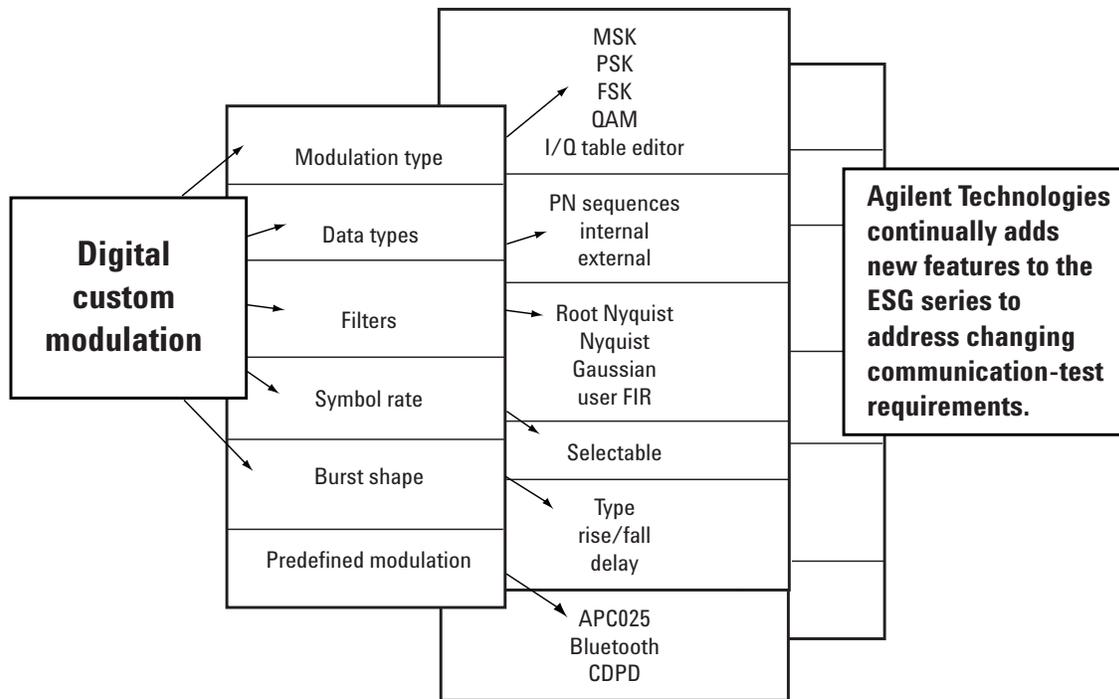
Block diagram
Option UN8 provides a flexible way to access digital modulation building blocks for building custom signals or to impair standard signals.

Frame triggering and delay
Synchronize multiple signal generators and other test equipment to simulate a complex TDMA environment.
Frame externally generated real-time data by multiplexing the signal with the internally generated framing. When frame triggering is selected, you can choose whether to respond immediately upon receipt of a trigger or delay the response.

Digital custom modulation

- Modulation type
  - MSK
  - PSK
  - FSK
  - QAM
  - I/Q table editor
- Data types
  - PN sequences
    - internal
    - external
- Filters
  - Root Nyquist
  - Nyquist
  - Gaussian
  - user FIR
- Symbol rate
  - Selectable
- Burst shape
  - Type
  - rise/fall
  - delay
- Predefined modulation
  - APC025
  - Bluetooth
  - CDPD

Agilent Technologies continually adds new features to the ESG series to address changing communication-test requirements.

Option UN8 conceptual menu structure block diagram.

Internal bit-error-rate analyzer, Option UN7

Option UN7 simplifies hardware configurations and measurement procedures. Minimize benchtop equipment and expense with the optional built-in BER analysis capabilities of the ESG-D series signal generators. The straight-forward user interface makes it easy to quickly setup measurements.

Description

Option UN7 offers generic analysis capabilities for demodulated data sequences. It is provided on a user-installable card that can be added to the B version of any existing ESG or any new instrument.

Key features

Data rates up to 10 Mbps
Choose the data rate that meets your test requirements.
Use the 2 Mbps data rate to test BER of common wireless communications systems, subsystems and components. Offering continuous update of total bits measured, bit count and BER, the 2 Mbps mode provides constant feedback on measurement status. Select the 10 Mbps mode for higher data rate digital communications applications.

Pass/fail indicators
Quickly and consistently determine pass/fail conditions.
Use the 2 Mbps mode of operation to continuously display pass or fail status according to a user-defined maximum BER limit.

Long 4 Gbit measurement capability
Test BER of continuously repeating PN sequences.
With the capability of testing bit sequences up to 4 Gbits long, the ESG-D series can measure a PN15 sequence that has been repeated over 100,000 times. In addition, this capability allows measurement of data sequences with bit error rates < 0.001 ppm.

Automatic check of data and clock validity
Avoid erroneous measurements caused by invalid data or clock inputs.
The BER analyzer will automatically indicate when either the data and/or clock signals are lost or not valid.

Standalone BERT capabilities
Test any PN9 or PN15 sequence, whether internally or externally generated.
Use Option UN7 to measure BER of externally generated PN sequences. The ESG-D with the BER analysis option will automatically synchronize on PN9 or PN15 sequences clocked in at the appropriate data rate.

Continuously updated BERT results
Instantly determine the current status of the bit-error-rate test.
Efficiently measure BER with a continuous update of total bits counted, total bit errors detected and the current bit-error-rate ratio.

**Automatic measurement re-synchronization**
Increase measurement productivity in noisy test environments.
Noisy test conditions can cause loss of synchronization during a measurement, thus generating incorrect results. A user-defined re-synchronization limit is available to reset all counters and restart the measurement automatically when synchronization is lost.

TTL or 75 Ω impedance
Select the impedance that meets your measurement needs.
Set the CLOCK IN, DATA IN and CLOCK GATE IN to either TTL compatible or 75 ohm to match (or replace) other test equipment.
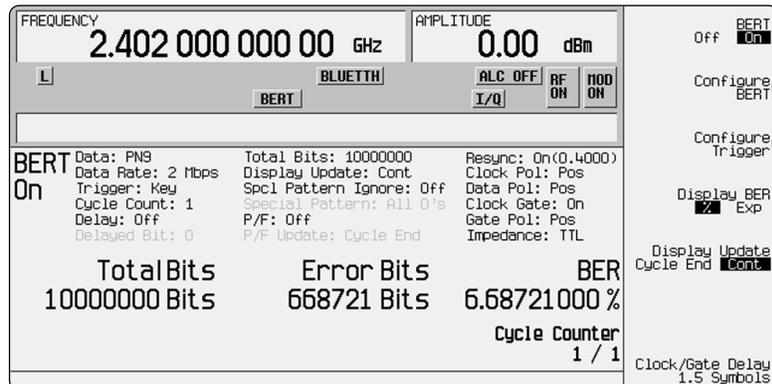
Bit-error-rate user interface.

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Block diagram

Since Option UN7 cannot demodulate RF, loopback measurements are not supported. For GSM loopback BER testing, please consult the information for Option 300, a BER extension for GSM base station receiver test.

Note the signal generator must have an internal I/Q baseband generator (Option UN8) installed to support the BER analysis option.

Two input signals are required for BER measurements:

• Data: the demodulated PN9 or PN15 bit stream from the device under test.
• Clock: used to clock in data at the appropriate rate.

The clock gate is needed for bursted data or when analyzing demodulated framed (data and control) bit sequences.

A user-supplied interface box is also required when the device under test does not output the correct TTL signal levels or to generate synchronized data and clock signals for framed transmissions.
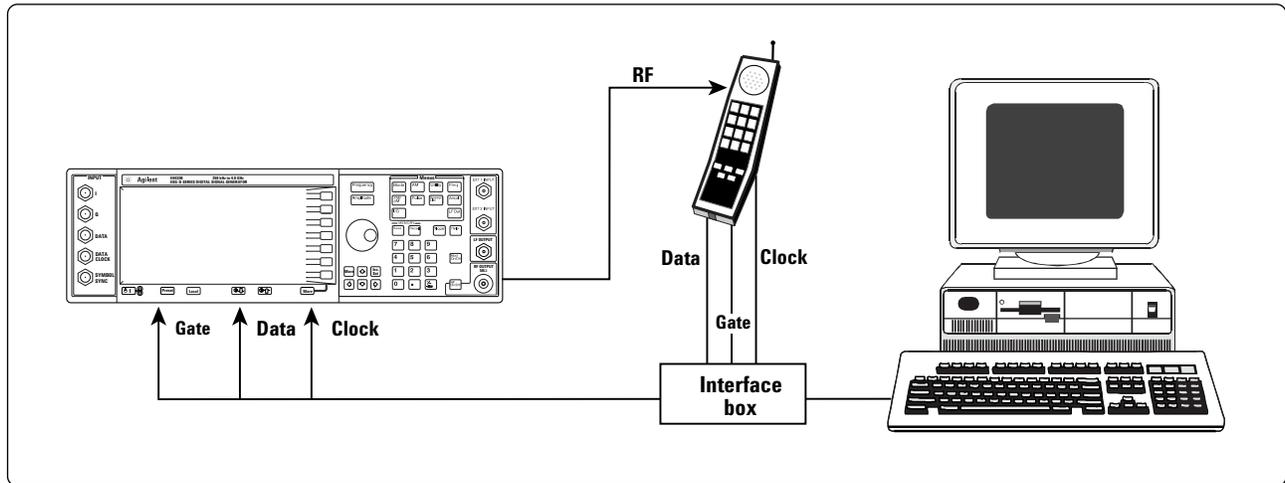
Common setup for bit-error-rate measurement of mobile phones.

GSM/EDGE base station BERT Option 300 (includes baseband BER testing)

ETSI compliant receiver testing for GSM/EDGE base stations is now available on the ESG platform. Option 300 provides basic measurement modes for GSM base station test, such as BER and sensitivity search.

Option 300 also provides basic measurement modes for EDGE/EGPRS base station test, such as, BER/BLER and sensitivity measurements.

The E4406A VSA transmitter tester conveniently provides the required external down conversion while fulfilling the transmitter test needs. The chosen implementation of RF loop back permits device independent test of base station and base transceiver modules.

Description

Option 300 requires UN8 revision C, real-time I/Q baseband generator. Option 202, EDGE personality, is required for EDGE BTS test functions. Option UNA, alternate time slot level control, is highly recommended. Option 300 also requires an external down converter. The E4406A VSA can provide this requirement. An ordering convenience bundle combines the E4406A VSA and ESG configured for GSM and GSM/EDGE base station transmitter and receiver tests. These numbers are as follows:

Bundle Contents:

GSM BTS test: E4433Z Option 301
E4433B ESG (4 GHz)
#UN8 (real-time I/Q baseband generator)
#300 (includes baseband BER tester)
#UNA (alternate time slot level control)
#1CP (rackmount and handle kit)
#1E5 (high-stability timebase)
E4406A VSA
#BAH (GSM measurement personality)
#300 (321.4 MHz output)
#1CP (rackmount and handle kit)

GSM/EDGE BTS test: E4433Z Option 302
E4433B ESG (4 GHz)
#UN8 (real-time I/Q baseband generator)
#300 (includes baseband BER tester)
#202 (EDGE personality)
#UNA (alternate time slot level control)
#1CP (rackmount and handle kit)
#1E5 (high-stability timebase)
E4406A VSA
#202 (GSM and EDGE measurement personality)
#300 (321.4 MHz output)
#1CP (rackmount and handle kit)

Key features for GSM BTS test
BTS Bit Error Rate Testing (BERT)
Complete residual BER measurements of class Ib and class II bits and FER measurements. The VSA/ESG BERT solution provides the user control of the resolution and the length of the measurement, by selecting the number of frames.

Sensitivity search
Quickly establish the level at which a specified class II RBER occurs. The user can set the specified level from 20 dBm to –136 dBm, and the number of frames measured. Search times are typically less than 15 seconds for 100 speech frames. The results can be reported as a number or as a pass/fail.

Limits and threshold testing
To minimize manufacturing test time, both BERT and sensitivity search can be tested to limits, or abandoned after a set threshold.

Key features for GSM/EDGE BTS test
Includes all of GSM measurement capabilities, plus EDGE/EGPRS features.

BER/BLER and sensitivity testing
Verify the demodulation and decoding of receivers with fully coded MCS-5 and MCS-9 signals.

Measure payload bit error rate and total burst count for uncoded BER. Coded channels may be measured for erased data block count/rate. User may set block count, bit count, pass/fail limits, and threshold number of events to stop measurements.

Perform sensitivity measurements. User may set radio block count, target BLER%, pass amplitude, and high and low amplitudes.

GSM base station bit error rate test.

Baseband BER testing

Option 300 includes baseband BER testing (cannot be ordered separately). BER simplifies hardware configurations and measurement procedures. Minimize benchtop equipment and expense with the optional built-in BER analysis capabilities of the ESG-D series signal generators. The straight-forward user interface makes it easy to quickly setup measurements.

Description

BER offers generic analysis capabilities for demodulated data sequences.

Key features

Data rates up to 10 Mbps
Choose the data rate that meets your test requirements.
Use the 2 Mbps data rate to test BER of common wireless communications systems, subsystems and components. Offering continuous update of total bits measured, bit count and BER, the 2 Mbps mode provides constant feedback on measurement status. Select the 10 Mbps mode for higher data rate digital communications applications.

Pass/fail indicators
Quickly and consistently determine pass/fail conditions.
Use the 2 Mbps mode of operation to continuously display pass or fail status according to a user-defined maximum BER limit.

Long 4 Gbit measurement capability
Test BER of continuously repeating PN sequences.
With the capability of testing bit sequences up to 4 Gbits long, the ESG-D series can measure a PN15 sequence that has been repeated over 100,000 times. In addition, this capability allows measurement of data sequences

Automatic check of data and clock validity
Avoid erroneous measurements caused by invalid data or clock inputs.
The BER tester will automatically indicate when either the data and/or clock signals are lost or not valid.

Standalone BER testing capabilities
Test any PN9 or PN15 sequence, whether internally or externally generated.
Use the baseband BER tester to measure BER of externally generated PN sequences. The ESG-D with the BER tester will automatically synchronize on PN9 or PN15 sequences clocked in at the appropriate data rate.

Continuously updated BER test results
Instantly determine the current status of the bit error rate test.
Efficiently measure BER with a continuous update of total bits counted, total bit errors detected and the current bit error rate ratio.

Automatic measurement re-synchronization
Increase measurement productivity in noisy test environments.
Noisy test conditions can cause loss of synchronization during a measurement, thus generating incorrect results. A user-defined re-synchronization limit is available to reset all counters and restart the measurement automatically when synchronization is lost.
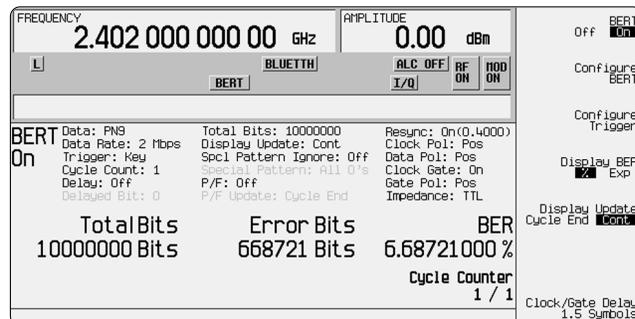
TTL or 75 impedance
Select the impedance that meets your measurement needs.
Set the CLOCK IN, DATA IN and CLOCK GATE IN to either TTL compatible or 75 ohm to match (or replace) other test equipment.
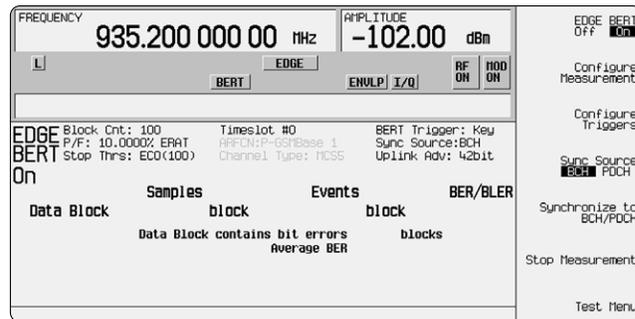
EDGE base station bit error rate test.

Baseband BER tester user interface.

cdmaOne multichannel, multicarrier personality, Option UN5

Generate multichannel cdmaOne signals with Option UN5. These cdmaOne signals can be used for base station and mobile tests at system or component level. Testing with Walsh-coded channels accurately simulates the actual signal power a component experiences. View the power statistics of the IS-95 waveforms produced by the ESG-D series compared to additive Gaussian white noise (AWGN).

Description

Option UN5 is a firmware personality built upon the internal dual arbitrary waveform generator (Option UND). The firmware can be activated or downloaded by purchasing a license key. Firmware updates can be found on the ESG web page: **http://www.agilent.com/find/esg**

Key features
Pre-configured channel setups
Easily perform cdmaOne measurements.
Choose from five channel configurations including:

• pilot channel
• 9 channel forward (IS-97)
• 32 channel forward
• 64 channel forward
• reverse channel

Use the pilot for performing mobile turn-on or waveform quality tests. The nine-channel arrangement is configured according to IS-97 specifications. The 32-channel configuration provides a realistically loaded base station for typical base station testing. Simulate a fully loaded base station by choosing the 64 forward-channel configuration. This Walsh-coded signal simulates a maximum capacity transmission for an IS-95 CDMA base station. Use the reverse-channel selection to characterize CDMA mobile components.

256 configurable channels
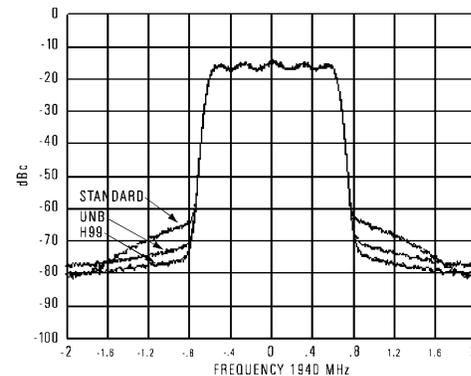*Customize channel setup to realistically test components.*
Define channel type, Walsh code, power, PN offset, and data for each specified channel. Channel power level can be set individually, adjusted to meet the IS-97 standard, or set to equal power.

The configuration limits are:

Channel type	pilot, paging, traffic, sync up to 256 channels
Walsh Code	0 to 63
PN offset	0 to 511
Data	0, repeating pattern, random
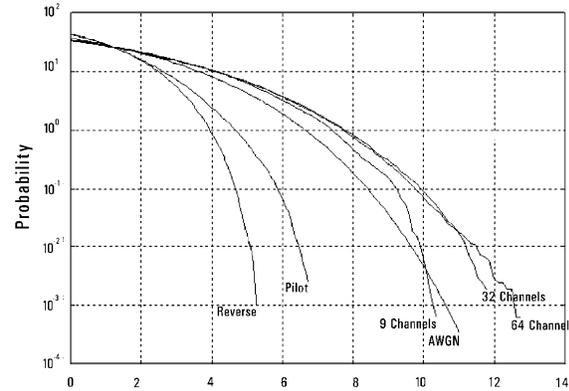
Peak/average cumulative distribution function of IS-95 waveforms.

Simulate a fully loaded base station by choosing the 64 forward-channel configuration .

CDMA channel editor increases flexibility by providing individual channel settings.

Option UN5 (continued)

Multicarrier cdmaOne
Stress active components by generating multicarrier CDMA configurations.
Place up to 12 carriers within a 15 MHz bandwidth, each with a custom configuration of channels.

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

Definable custom filters
Define your unique filter.
Choose from IS-95 (standard or modified, with or without equalization) filters, Nyquist, Root Nyquist or Gaussian filters. Define your own FIR filter to meet specific (non-standard) test requirements.

Chip rates to 10 Msps
Support W-CDMA applications and experimentation.
Chip rates up to 10 Mega-symbols/sec support W-CDMA applications as well as many other unique applications.
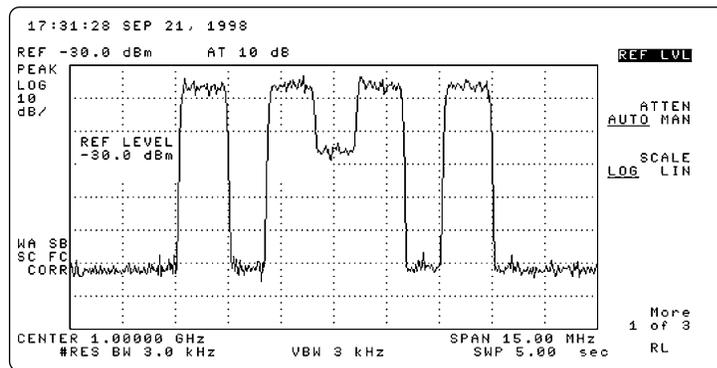
Baseband clipping
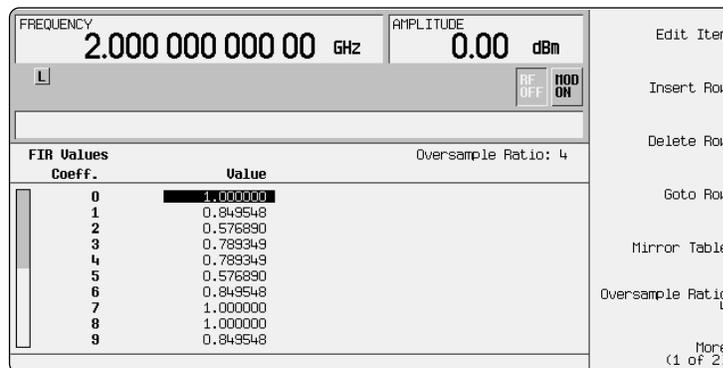*Reduce signal stress on power amplifiers.*
Clip the peak-to-average power of signals before or after baseband FIR filtering. Clipping may be applied individually to I and Q or to the composite I/Q vector.
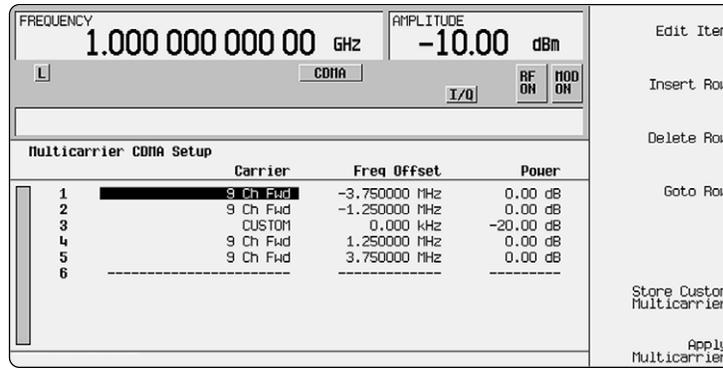
Multicarrier CDMA custom configuration setup.

Multicarrier spectrum corresponding to the custom configuration.

FIR table allows custom modulation filtering.

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Option UN5 (continued)

Code domain power display

Visually check channel configuration.
Prevent mistakes and costly delays
by checking the expected channel
setup before producing the RF signal.

Block diagram

Option UN5 partially coded IS-95
provides the highlighted section of
the physical layer for forward traffic
channels. Option UN5 also includes
a single reverse channel beginning
with short code spreading.
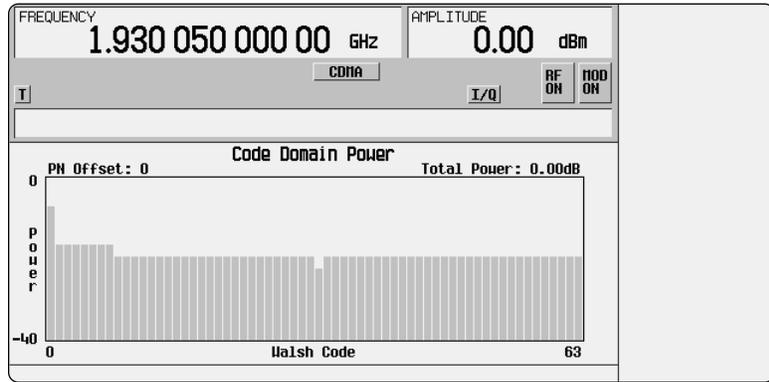
Code domain power view.
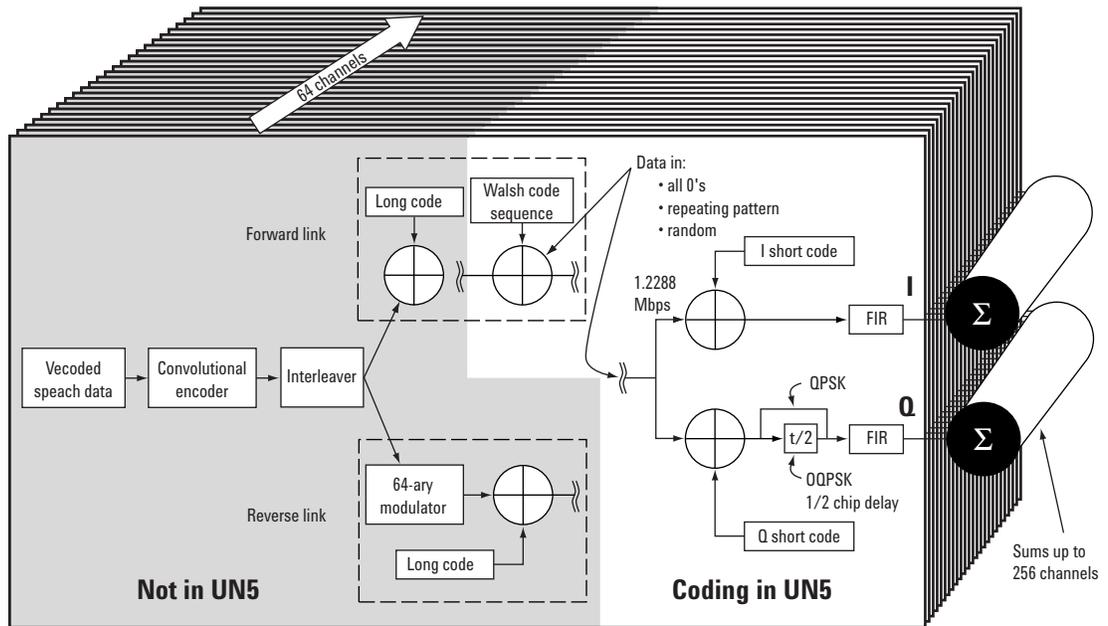
Physical layer of CDMA standard block diagram.

3GPP W-CDMA multi-channel, multicarrier personality, Option 100

Description

Option 100 is a firmware personality built on the internal dual arbitrary waveform generator (Option UND). Users can generate both uplink and downlink signals that conform with 3GPP standards. These W-CDMA signals are suitable for component, subsystem, mobile, and base station tests.

Key features

Conforms with 3GPP. In addition, this new feature set coexists with the earlier ARIB (1.0-1.2) feature set, so users have access to either set.

Supports the 3.84 Mcps chip rate. In addition, it is possible to vary this rate by +/-10%, in order to simulate clock drift between systems.

Offers new channel types and configurations. Downlink physical channels include PCCPCH, PSCH, SSCH, DPCH, CPICH, PICH, and OCNS. These channels are simulated with the slot structures defined by the 3GPP standard. Refer to the Technical Specifications, 5965-3096E for a complete description. In addition to user control of individual channel configurations, test models 1, 2, 3, and 4 defined by the 3GPP standard, can be set up at the press of a button. This option also offers multicarrier capability on the downlink, and up to six Dedicated Physical Data Channels (DPDCH) plus a Dedicated Physical Control Channel (DPCCH) on the uplink.

Provides individual channel rates based on a 7.5 ksps base for the downlink, and a 15 ksps for an uplink. The number of bits per timeslot is changed to reflect new data rates and channel configurations.

Option 100 offers the ability to modify predefined setups, or to define and store custom user states, using the built-in table editor. Choose spread code, scramble code, power, symbol rate, tDPCH offset, data pattern, TFCI, FBI, TPC pattern, number of pilot symbols and pilot power offsets.

This firmware personality upgrade supports user-defined I/Q baseband clipping either before or after the baseband FIR filter. Clipping may be applied individually to I and Q or to the composite I/Q vector.

Hardware and firmware requirements

Existing owners of Option 100 may download the new firmware free of charge from: www.agilent.com/find/esg; the current license key will still function correctly. Existing owners of an ESG digital signal generator without Option 100 can download the new revision of firmware free from the web, then activate the option by purchasing a separate license key through normal sales channels. The serial number of the unit as well as the Host ID number must be supplied. Option UND hardware is also required before installing option 100. New customers can order this firmware personality installed in a new ESG.

Use the flexible table editor to fully configure a W-CDMA signal waveform.

cdma2000 multichannel, multicarrier personality, Option 101

Generate multichannel forward and reverse link signals according to the developing cdma2000 standard with Option 101. These 1X or 3X chip rate, direct or multicarrier spread signals can be used for base station, mobile, component, and subsystem tests. A table based channel editor maximizes flexibility.

Description

Option 101 is a firmware personality built on the internal dual arbitrary waveform generator (Option UND). The firmware can be activated or downloaded by purchasing a license key for users who already own UND.

Key features

- Multichannel cdma2000 forward and reverse link signals, either 1X or 3X chip rate

- Choose multicarrier or direct spreading type in forward link

- HPSK spreading/modulation type used in reverse link for IS95C radio configuration

- Select from predefined channel configurations or use the table editor to fully configure a cdma2000 channel configuration per your requirements

- Forward link channel types include, pilot, paging, synchronization, fundamental code and supplemental code channels

- Reverse link channel types include, pilot, dedicated control channel, fundamental code and supplemental code channel

- Each channel can be set to a separate code domain power level

- Baseband clipping; clip the peak-to-average power of signals before or after FIR filtering

Table editor features

The table editor allows you to:
- Modify the cdma2000 forward link by choosing data rate, Walsh code, power, PN offset and data pattern for each channel

- Modify the cdma2000 forward link by choosing data rate, power and data pattern for each channel

- Use your own FIR filters or select from predefined filters. Filtering consists of Gaussian, IS-95, IS-95 modified ACP filters, Nyquist, and root Nyquist

Multicarrier cdma2000

Generate up to 12 individually configured SR1, SR3, or combination of SR1 and SR3 carriers within a 15 MHz bandwidth. Adjust frequency spacing and power offset of each carrier to meet test requirements.

Baseband clipping

Reduce signal stress on power amplifiers.
Clip the peak-to-average power of signals before or after baseband FIR filtering. Clipping may be applied individually to I and Q or to the composite I/Q vector.

The table editor allows you to modify cdma2000 forward and reverse links.

3GPP W-CDMA personality for the real-time baseband generator, Option 200

Description

Option 200 is a firmware personality that generates a fully coded multi-channel W-CDMA signal compliant with the latest 3GPP standards. By utilizing the real-time I/Q baseband generation, 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. This option complements the existing Option 100, which provides a partially coded multi-carrier W-CDMA signal used primarily for component testing.
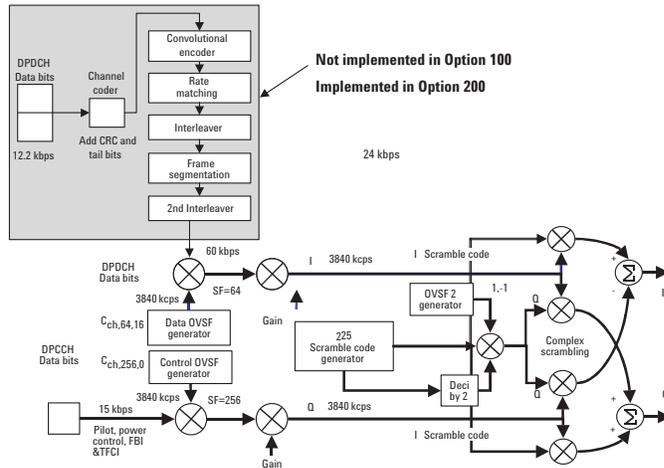
Key features

- Fully coded downlink signal with continuous PN sequences for BLER/BER testing

- User adjustable coding parameters from the front panel (convolutional/ turbo coding, rate matching, interleaving, etc.)

- 12.2, 64, 144, 384 kbps reference measurement channels with data selection of continuous PN9, 4-bit repeating pattern, and user defined files

- Data insertion at the transport layer (DCH) or the physical layer (DPDCH), which allows different stages of testing

- Up to six DCH transport channels on one DPCH

Downlink

- Fully coded channels include: CPICH, P-SCH, S-SCH, PCCPCH, DPCH, OCNS, and PICH

- 64 k UDI (ISDN)

- AMR 12.2 kbps

Uplink

- Supports DPDCH and DPCCH

- Supports 64 k UDI, AMR 12.2 k channel

- Synchronization to system frame number reset or frame trigger

This figure outlines the difference in coding between Option 100 and Option 200.

One button reference measurement channel setup.

Choose up to six transport channels for DPCH data.

Hardware and firmware requirements

Option 200 can be ordered with a new ESG, or downloaded and activated by purchasing a license key. The serial number and the model of the unit, as well as the Host ID number, must be supplied.

This personality requires enhanced UN8 revision C or higher. If the installed firmware revision is below B.03.00, UN8 will need to be upgraded.

If the firmware is B.03.00 or higher, verify the UN8 revision by pressing the following keys: Utility, Instrument Info, Options Info. A hardware upgrade is available for customers with older UN8 revisions. To upgrade an existing ESG with Option UN8, please contact Agilent Technologies. Firmware updates for the ESG can be downloaded from www.agilent.com/find/esg.

cdma2000 personality for the real-time baseband generator, Option 201

Description

Option 201cdma2000 personality adds a fully coded, multi-channel, real-time stimulus for cdma2000 mobiles and base stations to Agilent ESG-D and ESG-DP (high spectral purity) series RF signal generators. 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 backwards compatible with IS–95A in both the basestation and mobile simulation modes through support of Radio Configuration 1 and 2.

Forward link simulation

The forward link mode simulates a basestation transmitter to test a mobile. It supports Radio Configuration (RC) 1–5 with Spreading Rate (SR) 1. An example of the personality generating 4 forward channels is shown, each of which can be configured independantly. IS–95A receivers (RC1 or RC2) can be tested using a single ESG. For IS-2000, fully coded channels can be generated including pilot, synchronization, quick paging, fundamental and supplemental traffic channels. Convolutional and turbo coding are supported. A single ESG can be used to transmit a partial IS–2000 signal with a limited number of channels. Two ESG's are required for complete testing of IS-2000 receivers. In addition to providing up to eight IS-95 channels, the forward link two-ESG system configuration provides an IS-2000 solution in situations where more real-time CDMA channels, power levels, or higher radio configurations are required. The two-ESG setup provides the following forward link channel types: pilot, sync, paging, OCNS (optional), RC1-5 fundamental and RC3-5 supplemental traffic channels.

Reverse link simulation

The Option 201 reverse link simulates a mobile station transmitter for testing a base station. It supports RC1–4 with SR1, allowing base station test using either a single or a two ESG solution. The single ESG solution is viable for both IS-95A and IS-2000. In addition to having the same capabilities as the single ESG for IS-2000, the Option 201 reverse link two-ESG configuration allows for a fully coded signal to be transmitted with up to five channels, four on ESG 1 and an additional R-SCH on ESG 2.

The IS-2000 features of the two-ESG system use RC3 and RC4 which allows for higher data rates and turbo coding. This complex signal structure allows for a more thorough testing of base station functionality. An example of the personality generating four reverse channels is shown, each of which can be configured independandly. In this example, the ESG is generating an R-PICH, R-DCCH, R-FCH and an R-SCH simultaneously.

Reverse link channel setup.

Forward link channel setup.

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1.   IS-2000 capabilities require two ESG signal generators (each with option 201) working in tandem.

Agilent's cdma2000 solutions

Agilent provides a range of test solutions for cdma2000. Option 201 is intended for receiver functional and parametric test at the physical layer because it allows user data to be inserted and fully encoded. Option 101 multichannel cdma2000 personality is intended for component test. It provides more code channels from a single box so the peak to average statistics are better for stressing components. It also offers multicarrier capability and SR3, however it is not fully coded. Shown are the differences between the two solutions, Options 101 and 201.

Models and hardware requirements

Option 201 is a firmware personality that requires Option UN8, (hardware revision C or greater), real-time baseband generator to be installed in the ESG. The firmware can be activated by purchasing a license key. Firmware updates can be found on the Agilent ESG Web page at, http://www.agilent.com/find/esg. Option 201, cdma2000 personality is available with all the Agilent ESG-D and ESG-DP (high spectral purity) series models:

E4430B   1 GHz ESG-D series RF signal generator

E4431B   2 GHz ESG-D series RF signal generator

E4432B   3 GHz ESG-D series RF signal generator

E4433B   4 GHz ESG-D series RF signal generator

E4434B   1 GHz ESG-DP series RF signal generator

E4435B   2 GHz ESG-DP series RF signal generator

E4436B   3 GHz ESG-DP series RF signal generator

E4437B   4 GHz ESG-DP series RF signal generator

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

EDGE personality for the real-time baseband generator, Option 202

Description

Option 202 is a firmware personality built on the internal real-time I/Q baseband generator (Option UN8). The firmware can be activated or downloaded by purchasing a license key for users who already own UN8.

Key features

- Real-time signals using internally or externally generated data

- Uses $3\pi/8$-rotating 8PSK, and "linearized" Gaussian Tx filter

- Generate continuous or framed and bursted signals

- For frame data, all fields are editable to keep pace with the evolving EDGE definition

- Synchronize two ESGs to combine EDGE (8PSK) and GSM (GMSK) timeslots

- Upload externally defined burst shape waveforms

- Use custom filtering and editable framing fields to keep pace with the evolving definition of EDGE

Hardware and firmware requirements

Option 202 firmware personality can be ordered with a new ESG, or downloaded and activated by purchasing a license key. The serial number of the unit as well as the Host ID number must be supplied.

This personality is only compatible with enhanced UN8 revision C or higher. If the installed firmware revision is below B.03.00, UN8 will need to be upgraded. If the firmware is B.03.00 or higher, check the ESG utility menu, Instrument Info, Options Info to verify the UN8 revision. A hardware upgrade is available for customers with older UN8 revisions. Firmware updates for the ESG can be downloaded from: www.agilent.com/find/esg.
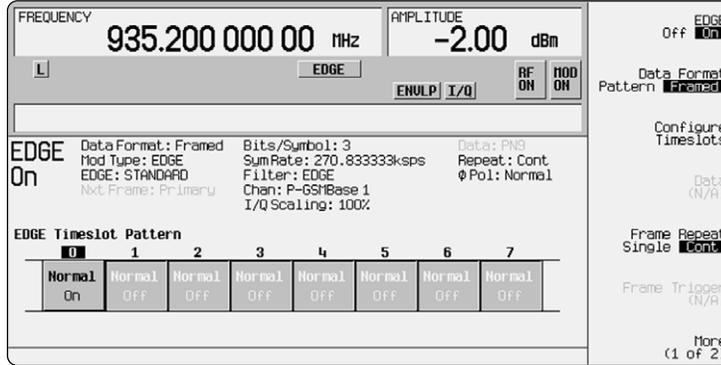
Generate continuous or framed and bursted signals.
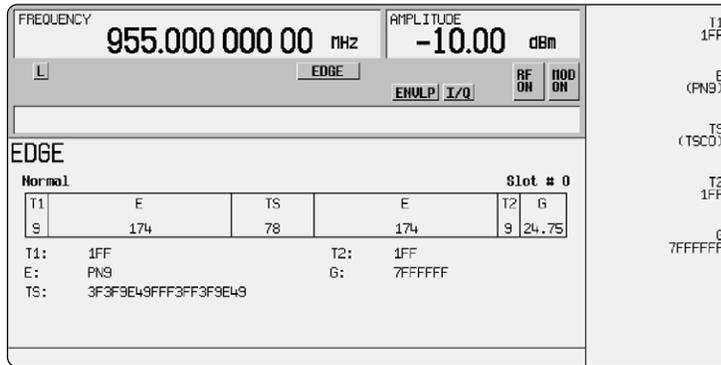
For framed data, all timeslot fields are editable.
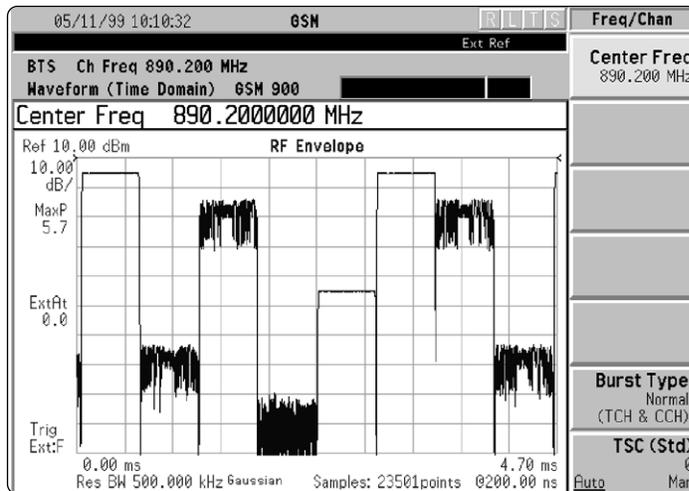
Synchronize two ESGs to combine EDGE (8PSK) and GSM (GMSK) timeslots.

Attenuators, Options UNA, UNB and H99

Choose the performance that best meets your application needs. The ESG family has four choices to optimize performance; standard electronic attenuator, optional mechanical attenuator, optional timeslot control, optional improved ACP (Adjacent Channel Power) performance.

Description

The ESG family has three options for attenuators in addition to its standard attenuator. The standard attenuator is an electronic attenuator. Option UNB is a mechanical attenuator that provides approximately 4 dB more output power than the electronic attenuator. Option UNA is also an electronic attenuator but it is optimized for controlling alternate timeslots in TDMA frames. Option H99 is an attenuator and output board combination optimized for ACP a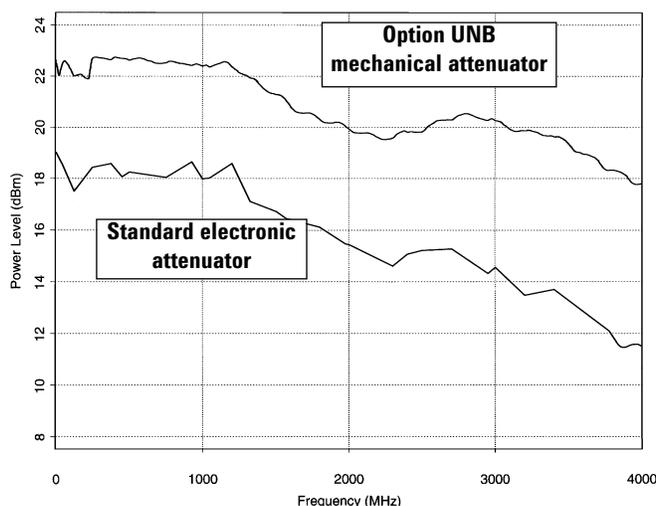nd out-of-channel measurements in CDMA, W-CDMA and TETRA applications. Each of these attenuators is mutually exclusive and must be specified at the time of ordering. Some attenuators do not have upgrade paths. Consult your Agilent sales representative for more information if you would like to change attenuators.

Key features

State-of-the-art electronic attenuator (standard)

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

Higher power (Option UNB)

Increase the output power up to 6 dB for higher power applications.
An optional mechanical attenuator provides increased output power for overcoming insertion losses from cabling and switching matrices, or for components requiring high drive levels. Option UNB also has up to 7 dB improved ACP performance over the standard electronic attenuator in CDMA applications.

Vary timeslots power levels (Option UNA)

Simulate a TDMA mobile or base station for reference sensitivity or switching transient measurements.
Test TDMA designs by varying the power level of transmitted digital data in timeslot of a frame. This control is required in GSM receiver and transmitter design.

Optimize ACP (Option H99)

Meet W-CDMA and CDMA performance requirements.
Option H99 offers up to 10 dB improvement over the standard electronic attenuator in ACP performance for CDMA and W-CDMA applications. It is the recommended choice for CDMA and W-CDMA component test environments.

High-performance pulse modulation, Option 1E6

High-performance pulse modulation (available on the ESG-A and ESG-AP) will give you confidence in your radar or pulsed carrier measurements. Improved pulse rise and fall times, plus excellent on/off ratios provide the performance you need.

Mechanical and electronic attenuator performance.

Documentation, support and mechanical hardware options (available with any ESG model)

Mechanical options
❐ Model#-1CN Handle kit
❐ Model#-1EM Moves all connectors to the rear panel
❐ Model#-1CP Rack mount and handle

Operating and service documentation options
❐ Model#-0B0 Deletes manual set
❐ Model#-0B1 Adds manual set
❐ Model#-0BV Service documentation (component level)
❐ Model#-0BW Service documentation (assembly level)
❐ Model#-0BX Service documentation (assembly and component level)
❐ Model#-UK6 Commercial calibration certificate with test data

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

Calibration plan[1]
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

Localization options
❐ Model#-ABO Chinese (Taiwan) manuals
❐ Model#-ABD German manuals
❐ Model#-AB1 Korean manuals
❐ Model#-ABE Spanish manuals
❐ Model#-AB2 Chinese manuals
❐ Model#-ABF French manuals
❐ Model#-ABJ Japanese manuals

Accessories
❐ 9211-1296   Transit case
❐ 83300A   Remote interface

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1. Options not available in all countries.

Agilent application and product information

- *RF Source Basics*, a self-based tutorial (CD ROM),
  literature number 5980-2060E.
- *Digital Modulation in Communications Systems—An Introduction*, Application Note 1298,
  literature number 5965-7160E.
- *Generating and Downloading Data to the ESG-D RF Signal Generator for Digital Modulation*,
  Product Note, literature number 5966-1010E.
- *Using Vector Modulation Analysis in the Integration, Troubleshooting and Design of
  Digital RF Communications Systems*, Product Note 89400-8, literature number 5091-8687E.
- *Controlling TDMA Timeslot Power Levels Using the ESG-D Series*, RF Signal Generators, Product Note,
  literature number 5966-4472E.
- *Testing CDMA Base Station Amplifiers*, Application Note 1307, literature number 5967-5486E.
- *Customize Digital Modulation with the ESG-D Series Real-Time I/Q Baseband Generator, Option UN8*,
  Product Note, literature number 5966-4096E.
- *Using the ESG-D RF Signal Generator's Multicarrier, Multichannel 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.
- *Understanding GSM Transmitter Measurements for Base Transceiver Stations and Their Components*,
  Application Note 1312, literature number 5968-2320E.
- *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.
- *Performing Bluetooth RF Measurements Today,* Application Note 1333, literature number 5968-7746E.
- *Designing and Testing 3GPP W-CDMA Base Stations,* Application Note 1355, literature number 5980-1239E.
- *Designing and Testing 3GPP W-CDMA User Equipment,* Application Note 1356, literature number 5980-1238E.
- *Designing and Testing cdma2000 Base Stations,* Application Note 1357, literature number 5980-1303E.
- *Designing and Testing cdma2000 Mobile Stations,* Application Note 1358, literature number 5980-1237E.
- *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.
- *Using the ESG-D Series of RF Signal Generators and the 8922 GSM Test Set for GSM Applications,* Product Note,
  literature number 5965-7158E

Product literature
- *ESG Family RF Digital and Analog Signal Generators*, Brochure, literature number 5968-4313E.
- *ESG Family RF Signal Generators,* Data Sheet, literature number 5965-3096E.
- *ESG Family RF Signal Generators,* Configuration Guide, literature number 5965-4973E.
- *RF and Microwave Signal Generators*, Catalog, literature number 5965-3094E.
- *IntuiLink Software,* Data Sheet, literature number 5980-3115EN.

See the ESG Web page
Get the latest news, product and support information, application literature and more. The Agilent Technologies
Internet address for the ESG family is: **http://www.agilent.com/find/esg**

New trade-up program
Ask your local sales representative about instrument trade-up opportunities for all ESG models.

IntuiLink PC software
Transfer screen data and images easily into Microsoft® Excel and Microsoft® Word. Save and restore instrument
states. Download arbitrary waveform files. For more information visit our website at:
http//www.agilent.com/find/IntuiLink

For further information

Related literature:
Agilent ESG Family of RF Signal
Generators, Data Sheet,
literature number 5965-3096E

IntuiLink Software, Data Sheet,
literature number 5980-3115EN

Agilent Technologies' Test and Measurement Support, Services, and Assistance
Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By internet, phone, or fax, get assistance with all your test and measurement needs.

Online assistance:
www.agilent.com/find/assist

Phone or Fax
United States:
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Canada:
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(fax) (905) 282 6495

China:
(tel) 800 810 0189
(fax) 1 0800 650 0121

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

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

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

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

Taiwan:
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(fax) (886 2) 2545 6723

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(fax) (65) 836 0252
Email: tm_asia@agilent.com

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