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Agilent
ESG Family of RF Signal Generators

Data Sheet



	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 Web site at **http://www.agilent.com/find/esg**

Agilent Technologies

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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. 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 communications system testing now and in the future.

ESG family of RF signal generators

The family consists of four series:

ESG-A series: analog instruments
E4400B, E4420B, E4421B, E4422B

ESG-AP series: analog instruments with high spectral purity
E4423B, E4424B, E4425B, E4426B

ESG-D series: digital and analog instruments
E4430B, E4431B, E4432B, E4433B

ESG-DP series: digital and analog instruments with high spectral purity
E4434B, E4435B, E4436B, E4437B

Please refer to the related literature in the section ESG family application and product information for additional information.

Key standard features for entire family
- 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

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

Options available only with the digital series
- Built-in dual arbitrary waveform generator
- Multichannel, multicarrier CDMA personality
- Multichannel, multicarrier W-CDMA 1.0 personality
- Multichannel cdma2000 personality
- Real-time 3GPP W-CDMA personality
- Real-time cdma2000 personality
- Real-time EDGE personality
- Internal bit-error-rate analyzer
- Versatile timeslot, data and burst generation
- Adjustable symbol rates, filter factors and burst shape
- Digital modulation formats for DECT, GSM, NADC, PDC, PHS, and TETRA

Options available only with the analog series
- High-performance pulse modulation

Specifications for analog and digital models

Frequency

Range

ESG-A series	
E4400B	250 kHz to 1 GHz
E4420B	250 kHz to 2 GHz
E4421B	250 kHz to 3 GHz
E4422B	250 kHz to 4 GHz
ESG-AP series	
E4423B	250 kHz to 1 GHz
E4424B	250 kHz to 2 GHz
E4425B	250 kHz to 3 GHz
E4426B	250 kHz to 4 GHz
ESG-D series	
E4430B	250 kHz to 1 GHz
E4431B	250 kHz to 2 GHz
E4432B	250 kHz to 3 GHz
E4433B	250 kHz to 4 GHz
ESG-DP series	
E4434B	250 kHz to 1 GHz
E4435B	250 kHz to 2 GHz
E4436B	250 kHz to 3 GHz
E4437B	250 kHz to 4 GHz

Underrange 100 kHz

Resolution 0.01 Hz

Accuracy **Same as timebase**

Switching speed (typical)[1]	**ESG-A and ESG-D series**	**ESG-AP and ESG-DP series**
Modulation on		
Analog	<50 ms	<65 ms
Digital	<90 ms	<100 ms
Modulation off	<40 ms	<55 ms

Phase offset Phase is adjustable via GPIB or front panel in nominal 0.1° increments

Frequency bands

Band	**Frequency range**	**N #**
1	250 kHz to ≤249.999 MHz	1
2	>249.999 to ≤500 MHz	0.5
3	>500 MHz to ≤1 GHz	1
4	>1 to ≤2 GHz	2
5	>2 to ≤4 GHz	4

Sweep modes

Operating modes Frequency step, amplitude step and arbitrary list

Dwell time 1 ms to 60 s

Number of points 2 to 401

Internal reference oscillator

Stability	**ESG-A and ESG-D series standard**	**ESG-AP and ESG-DP series standard ESG-A and ESG-D series Option 1E5**
Aging rate	<±1 ppm/yr	<±0.1 ppm/yr or <±0.0005 ppm/day after 45 days
Temp. (0 to 55° C)	<±1 ppm, typical	<±0.05 ppm, typical
Line voltage	<±0.1 ppm, typical (+5%, –10%)	<±0.002 ppm, typical (+5%, –10%)

Timebase reference output

Frequency	10 MHz
Amplitude	>0.35 V_{rms} into 50 Ω load

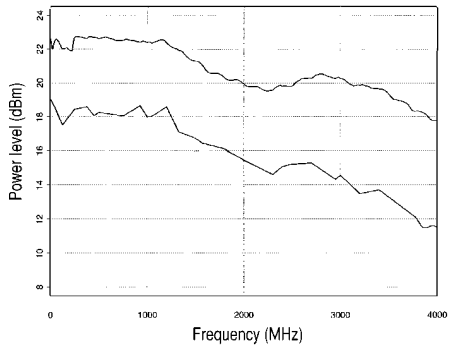
External reference input

Frequency	1, 2, 5, 10 MHz ± typical 10 ppm (typical 1 ppm, ESG-AP and ESG-DP series, ESG-A and ESG-D series Option 1E5)
Amplitude	>0.15 V_{rms}
Input impedance	50 Ω

Output

Power[2]	**Standard**	**Option UNB**
250 kHz to 1 GHz	+13 to –136 dBm	+17 to –136 dBm
>1 to 3 GHz	+10 to –136 dBm	+16 to –136 dBm
>3 to 4 GHz	+7 to –136 dBm	+13 to –136 dBm

Typical maximum available power



1. To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
2. With high performance pulse modulation (Option 1E6) installed, all maximum power specifications drop by 4 dB.

Specifications describe the instrument's warranted performance and apply after a 45 minute warm-up. All specifications are valid over the signal generator's entire operating/environmental range while in phase noise mode 2, unless otherwise noted. Supplemental characteristics, denoted typical or nominal, provide additional (nonwarranted) information useful in applying the instrument.

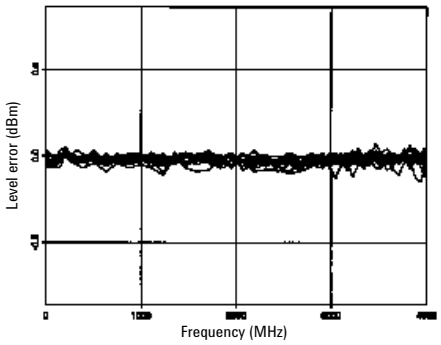
Resolution 0.02 dB

Attenuator hold level range

	Standard	Option UNB
250 kHz to 1 GHz	23 dB	27 dB
>1 to 3 GHz	20 dB	26 dB
>3 to 4 GHz	17 dB	23 dB

Level accuracy (dB)[1]

	Output power		
	+7 to –120 dBm		
Freq range	(+10 to –120 dBm, Option UNB)	–120 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.5	±0.5	±1.5
2 to 3 GHz	±0.9	±0.9	±2.5
3 to 4 GHz	±0.9	±0.9 (±1.5, Option UNB)	±2.5



Typical level accuracy

Amplitude switching speed

Without power search	<30 ms, typical
When using power search	<300 ms, typical

Reverse power protection[2]

250 kHz to 2 GHz	50 watts
>2000 to 4 GHz	25 watts
Max DC voltage	50 V

SWR (typical)

	Standard	Option UNB
250 kHz to 1 GHz	<1.5:1	<1.3:1
1 to 2 GHz	<1.4:1	<1.3:1
2 to 3 GHz	<1.3:1	<1.4:1
3 to 4 GHz	<1.5:1	<1.5:1

Output impedance 50 Ω

Spectral purity

SSB phase noise[3] (at 20 kHz offset)

	ESG-A and ESG-D Series	ESG-AP and ESG-DP Series
at 500 MHz	(<–120 dBc/Hz)	<–134 dBc/Hz, (<–138 dBc/Hz)
at 1 GHz	(<–116 dBc/Hz)	<–130 dBc/Hz, (<–134 dBc/Hz)
at 2 GHz	(<–110 dBc/Hz)	<–123 dBc/Hz, (<–127 dBc/Hz)
at 3 GHz	(<–104 dBc/Hz)	<–120 dBc/Hz, (<–124 dBc/Hz)
at 4 GHz	(<–104 dBc/Hz)	<–118 dBc/Hz, (<–122 dBc/Hz)

Residual FM[4] (CW mode, 0.3 to 3 kHz BW, CCITT, rms)

ESG-AP and ESG-DP series

<N x 1 Hz (<N x 0.5 Hz, typical)

ESG-A and ESG-D series

Phase noise mode 1	<N x 2 Hz
Phase noise mode 2	<N x 4 Hz

Harmonics

(≤+4 dBm (≤+7.5 dBm, Option UNB) output level) <–30 dBc (typical below 1 GHz)

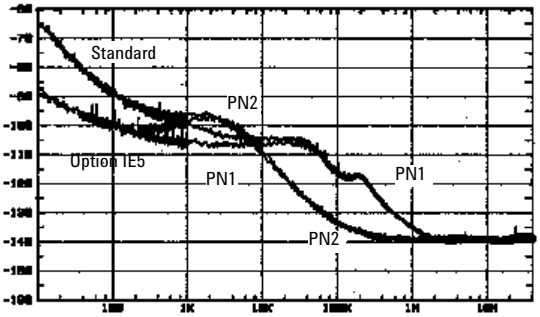
Nonharmonics

(<+7 dBm (<+10 dBm, Option UNB) output level)[5]

	ESG-A and ESG-D series[6]		ESG-AP and ESG-DP series[7]	
	>3 kHz offset	>10 kHz offset[3]	>3 kHz offset	>10 kHz offset[3]
250 kHz to 250 MHz	<–65 dBc	(<–75 dBc)	<–65 dBc	(<–75 dBc)
250 MHz to 500 MHz	<–65 dBc	(<–75 dBc)	<–80 dBc	<–80 dBc
500 MHz to 1 GHz	(<–65 dBc)	(<–75 dBc)	<–80 dBc	<–80 dBc
1 to 2 GHz	(<–59 dBc)	(<–69 dBc)	<–74 dBc	<–74 dBc
>2 GHz	(<–53 dBc)	(<–63 dBc)	<–68 dBc	<–68 dBc

Subharmonics

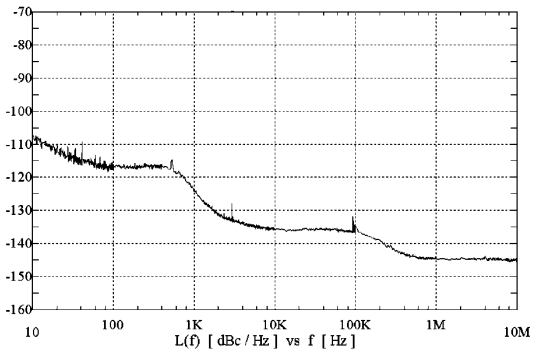
	ESG-A and ESG-D series	ESG-AP and ESG-DP series
≤1 GHz	None	None
>1 GHz	(<–40 dBc)	None



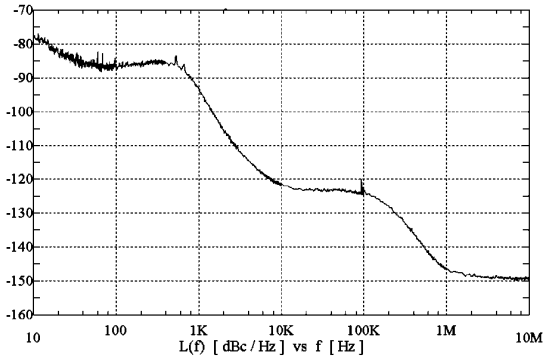
Characteristic ESG-A and ESG-D series SSB phase noise at 1 GHz (phase noise modes 1 and 2)

1. For 23 °C ±5 °C. Accuracy degrades by 0.02 dB/°C over the full temperature range and by 0.3 dB above +7 dBm (degraded by 0.5 dB above +10 dBm with Option UNB). Level accuracy specification maintained only with return to calibration.
2. The reverse power protection circuitry triggers at nominally 1 watt.
3. Parentheses denote typical performance.
4. Refer to frequency bands on page 4 to compute specifications.
5. Performance is typical for spurs at frequencies above the maximum operating frequency of the instrument. Performance typically is –60 dBc between 225 and 249.999 MHz.
6. Specifications apply for FM deviations <100 kHz and are not valid for FM.
   For non-constant amplitude digital formats, unspecified spur levels occur up to the second harmonic of the baseband rates.
7. Specifications apply for CW mode only.

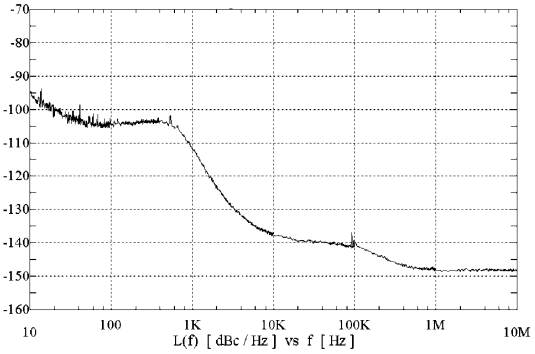
Characteristic SSB phase noise for ESG-AP and ESG-DP series



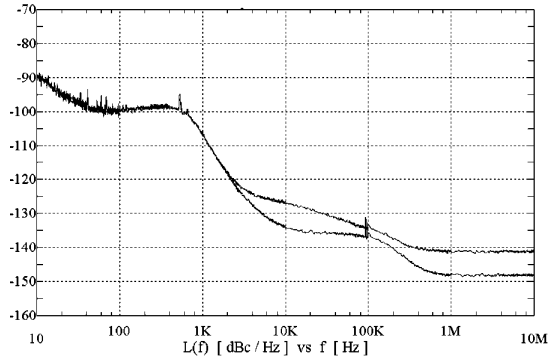
fc = 100 MHz (CW, standard instrument)



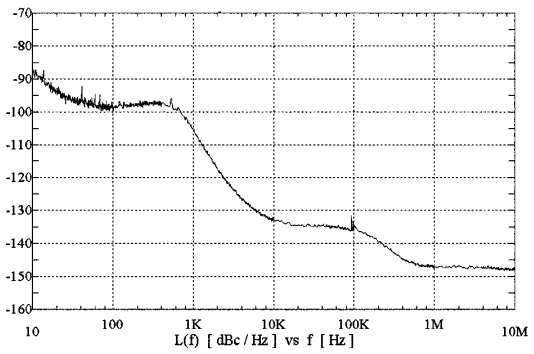
fc = 4 GHz (CW, standard instrument)



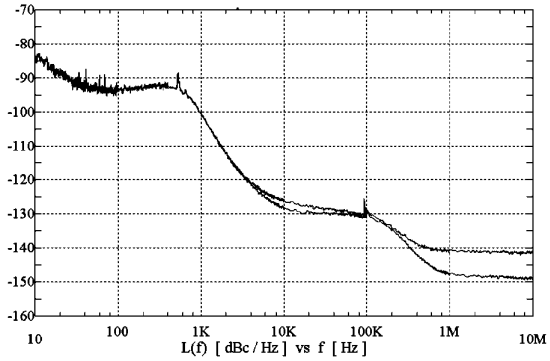
fc = 500 MHz (CW, standard instrument)



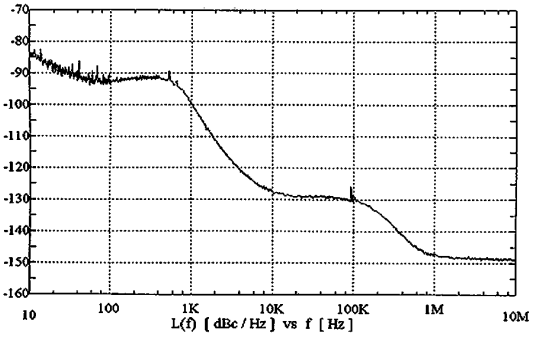
fc = 900 MHz (CW and I/Q modulation on)



fc = 1 GHz (CW, standard instrument)



fc = 1.8 GHz (CW and I/Q modulation on)



fc = 2 GHz (CW, standard instrument)

Jitter in µUI [1,2,3]

Carrier frequency	SONET/SDH data rates	rms jitter bandwidth	ESG-A, ESG-D (µUI RMS)	ESG-AP, ESG-DP (µUI RMS)
155 MHz	155 MB/s	100 Hz to 1.5 MHz	(239)	(43)
622 MHz	622 MB/s	1 kHz to 5 MHz	(149)	(34)
2.488 GHz	2488MB/s	5 kHz to 15 MHz	(375)	(73)

Jitter in seconds [1,2,3]

Carrier frequency	SONET/SDH data rates	rms jitter bandwidth	ESG-A, ESG-D	ESG-AP, ESG-DP
155 MHz	155 MB/s	100 Hz to 1.5 MHz	(1.54 ps)	(277 fs)
622 MHz	622 MB/s	1 kHz to 5 MHz	(240 fs)	(55 fs)
2.488 GHz	2488MB/s	5 kHz to 15 MHz	(151 fs)	(29 fs)

Frequency modulation

Maximum deviation

ESG-A and ESG-D series	ESG-AP and ESG-DP series
N x 10 MHz	N x 1 MHz

Resolution 0.1% of deviation or 1 Hz, whichever is greater

Modulation frequency response (deviation = 100 kHz)[4]

	Rates 1 dB bandwidth	3 dB bandwidth, typical
FM1	dc/20 Hz to 100 kHz	dc/5 Hz to 10 MHz
FM2	dc/20 Hz to 100 kHz	dc/5 Hz to 1 MHz

Deviation accuracy[5] <±(3.5% of FM deviation + 20 Hz) (1 kHz rate, deviation < N x 100 kHz)

Carrier frequency accuracy relative to CW in dcFM[5,6] ±0.1% of set deviation + (N x 1 Hz)

Distortion[5] <1%
(1 kHz rate, THD, dev.= N x 100 kHz)

External inputs Ext 1 or Ext 2

Sensitivity 1 V_{peak} for indicated deviation

Input impedance 50 Ω, nominal

Paths FM 1 and FM 2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2. The FM 2 path is limited to a maximum rate of 1 MHz. The FM 2 path must be set to a deviation less than FM 1.

Phase modulation

Maximum deviation[5]

	ESG-A and ESG-D series	ESG-AP and ESG-DP series
Normal BW	N x 90 radians	N x 10 radians
High BW	N x 9π radians	N x 1 radian

Resolution 0.1% of set deviation

Modulation frequency response[5]
ESG-A and ESG-D series

Mode	Maximum deviation	Rates (3 dB BW) ΦM1	ΦM2
Normal BW	N x 2π rad	dc to 100 kHz	dc to 100 kHz
High BW	N x 2π rad	dc to 1.5 MHz (typ)	dc to 0.9 MHz (typ)
	N x π/2 rad	dc to 4 MHz (typ)	dc to 1 MHz (typ)

ESG-AP and ESG-DP series

Mode	Maximum deviation	Rates (3 dB BW) ΦM1	ΦM2
Normal BW	N x 10 rad	dc to 100 kHz	dc to 100 kHz
High BW	N x 1 rad	dc to 1 MHz (typ)	dc to 1 MHz (typ)

Deviation accuracy <±(5% of deviation + 0.01 radians) (1 kHz rate, Normal BW mode)

Distortion[5] <1%
1 kHz rate, THD, dev <N x 90 rad (dev < N x 10 rad for ESG-AP and ESG-DP series), Normal BW mode

External inputs Ext 1 or Ext 2

Sensitivity 1 V_{peak} for indicated deviation

Input impedance 50 Ω, nominal

Paths ΦM 1 and ΦM 2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2. The ΦM 2 path is limited to a maximum rate of 1 MHz. The ΦM 2 path must be set to a deviation less than ΦM 1.

1. Parentheses denote typical performance.
2. Calculated from phase noise performance in CW mode only at +2.0 dBm for standard instruments, +5.0 dBm with Option UNB, and –1.0 dBm with Option H99.
3. For other frequencies, data rates, or bandwidths, please contact your sales representitive.
4. Since the internal modulation source operates over 0.1 Hz to 50 kHz, FM rates above 50 kHz must be supplied externally.
5. Refer to frequency bands on page 4 to compute specifications.
6. At the calibrated deviation and carrier frequency, within 5 °C of ambient temperature at time of calibration.

Amplitude modulation[1] (fc > 500 kHz)

Range (envelope peak ≤ maximum specified power)	0 to 100%
Resolution	0.1%
Rates (3 dB bandwidth)	dc/10 Hz to 10 kHz
Accuracy (1 kHz rate)	< ± (6% of setting + 1%)[1]
Distortion (1 kHz rate, THD)	
30% AM	<1.5%
90% AM	<4%, typical
External inputs	Ext 1 or Ext 2
Sensitivity	1 V_{peak} for indicated depth
Input impedance	50 Ω, nominal

Paths AM 1 and AM 2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2.

Wideband AM (ESG-DP and ESG-D series only)

Rate (1 dB bandwidth, typical)	
ALC On	400 Hz to 10 MHz
ALC Off	dc to 10 MHz
External input	I input
Sensitivity	0.5 V = 100%
Input impedance	50 Ω, nominal

Pulse modulation

On/off ratio	
≤3 GHz	>80 dB
>3 GHz	>60 dB
Rise/fall times	150 ns, typical
Minimum width	
ALC On	2 µs, typical
ALC Off	0.4 µs, typical
Pulse repetition frequency	
ALC On	10 Hz to 250 kHz, typical
ALC Off	dc to 1.0 MHz, typical
Level accuracy	<±0.5 dB, typical ≤3 GHz <±0.8 dB, typical ≤4 GHz (relative to CW)[2]
External input	Ext 2
Input voltage	
RF on	>+0.5 V, nominal
RF off	<+0.5 V, nominal
Input impedance	50 Ω, nominal
Internal pulse generator	
Square wave rate	0.1 Hz to 50 kHz
Pulse	
Period	16 µs to 30 sec
Width	8 µs to 30 sec
Resolution	4 µs

High-performance pulse modulation (Option 1E6, ESG-AP and ESG-A series) [3]

On/off ratio	
≤2 GHz	>80 dB
>2 GHz	>70 dB
Rise/fall times	<10 ns
Delay	<60 ns, typical
External input	Pulse in
Input voltage	+5 V (with RF on, TTL compatible)
Input impedance	

1. AM is typical above 2 GHz or if wideband AM or I/Q modulation is simultaneously enabled.
2. With ALC off, specifications apply after the execution of power search. With ALC on, specifications apply for pulse repetition rates ≤10 kHz and pulse widths ≥5µs.
3. With high performance pulse modulation (Option 1E6) installed, all maximum power specifications drop by 4 dB.

Internal modulation source

(Provides FM, ΦM, and AM modulation signals and LF out)

Waveforms	sine, square, ramp, triangle, pulse, noise

Rate range

Sine	0.1 Hz to 50 kHz
Square, ramp, triangle	0.1 Hz to 10 kHz

Resolution	0.1 Hz
Pulse only	4 µs

Frequency accuracy	0.005%, typical

Swept sine mode (frequency, phase continuous)

Operating modes	Triggered or continuous sweeps
Frequency range	0.1 Hz to 50 kHz
Sweep time	1 ms to 65 sec
Resolution	1 ms

Dual sinewave mode

Frequency range	0.1 Hz to 50 kHz
Amplitude ratio	0 to 100%
Amplitude ratio resolution	0.1%

LF out (internal modulation source)

Amplitude	0 to 3 V_{peak} into 50 Ω
Output impedance	<1 Ω

External modulation inputs

Modulation types

Ext 1	FM, ΦM, AM, and burst envelope
Ext 2	FM, ΦM, AM, and pulse

High/Low Indicator (100 Hz to 10 MHz BW, AC coupled inputs only) Activated when input level error exceeds 3% (nominal)

Simultaneous modulation

All modulation types may be simultaneously enabled, except: FM with FM; AM with burst envelope; Wideband AM with I/Q. AM, FM, and FM can sum simultaneous inputs from any two sources (INT, EXT 1, and EXT 2.) Any given source (INT, EXT 1, or EXT 2) may only be routed to one activated modulation type.

Specifications for digital models only

Level accuracy with digital modulation (ESG-DP and ESG-D series only)

With ALC On; relative to CW; with PRBS modulated data; if using I/Q inputs, $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$, nominal)[1]

π/4 DQPSK or QPSK formats

ESG-D series	ESG-DP series	
±0.20 dB	±0.20 dB	≤3 GHz
±0.30 dB	±0.30 dB	>3 GHz

(Relative to CW; with raised cosine or root-raised cosine filter and $\alpha \geq 0.35$; with 10 kHz ≤ symbol rate ≤1 MHz; at RF freq ≥25 MHz; power ≤ max specified –3 dB or –6 dB with Option UNB)

Constant amplitude formats (FSK, GMSK, etc)

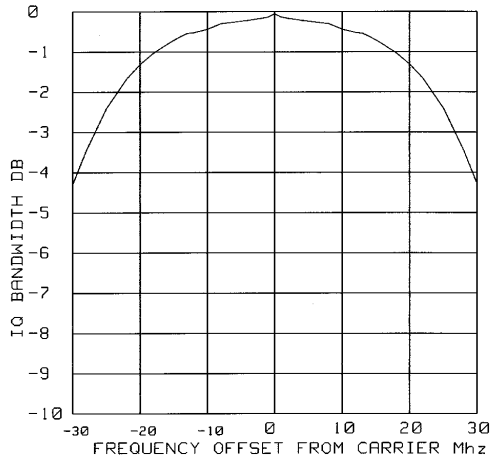
ESG-D series	ESG-DP series
No degradation	±0.10 dB

Level accuracy with ALC off[2] ±0.3 dB, typical
(After power search is executed; relative to CW level accuracy with ALC on; with burst off; if external I/Q is enabled $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$)

I/Q modulation (ESG-DP and ESG-D series only)

I/Q inputs

Input impedance 50 Ω
Full scale input[1] $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$



Typical I/Q frequency response

Adjustments/Impairments (nominal)

DC offset (I and Q independently adjustable) ±100%
I/Q gain ratio ±4 dB
I/Q quadrature ±10° (for fc ≤ 3.3 GHz)

External burst envelope (ESG-DP and ESG-D series only)

Input voltage

RF On 0 V
RF Off –1.0 V
Linear control range 0 to –1 V

On/off ratio

≤3 GHz >75 dB
>3 GHz >60 dB
V_{in} ≤–1.05 V

Rise/fall time <2 µs with rectangular input, typical

Minimum burst repetition frequency

ALC on 10 Hz, typical
ALC off dc

External input Ext 1

Input impedance 50 Ω, nominal

Coherent carrier out[3] *(ESG-DP and ESG-D series only)*

Range 250 MHz to maximum carrier frequency

Level 0 dBm ±5 dB, typical

Impedance 50 Ω

1. The optimum I/Q input level is $\sqrt{I^2+Q^2} = 0.5\ V_{rms}$, I/Q drive level affects EVM, origin offset, spectral regrowth, and noise floor. Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms}.
2. When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level. Power search is an internal calibration routine used to set output power when ALC is off. The routine disables all modulation inputs, adjusts output power while applying 0.5 V_{rms} to the I/Q modulathen enables modulation.
3. Coherent carrier is modulated by FM or ΦM when enabled.

I/Q baseband generator

(Option UN8, ESG-DP and ESG-D series only)

Modulation

PSK	BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
MSK	User-defined phase offset from 0 to 100°
QAM	4, 16, 32, 64, 256
FSK	Selectable: 2, 4, 8, 16 level symmetric
Custom:	Custom map of up to 16 deviation levels
Deviation:	Modulation index ≤1, ≤1.5 Msym/sec Modulation index ≤0.5, ≤2.0 Msym/sec
Resolution:	0.1 Hz
I/Q:	Custom map of 16 unique values for I and Q

Filter

Selectable	Nyquist, root Nyquist, Gaussian, rectangular α: 0 to 1, B_bT: 0.1 to 1
Custom FIR	256 coefficients, 16-bit resolution, 16 symbols long, automatically scaled

Symbol rate

For external data or internal PN sequences in pattern mode, symbol rate is adjustable from 200 symbols/sec to maximum listed in table.

Bits/symbol	Maximum symbol rate (Msym/sec)	Maximum data rate (Mbits/sec)
1	12.5	12.5
2	12.5	25
3	8.33	25
4	12.5	50
5	10	50
6	8.33	50
7	7.14	50
8	6.25	50

For all other data types and data structures the maximum bit rate is 5 Mbits/sec.

TDMA data structure

Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept a user file, PRBS (PN9 or PN15), or external data. Maximum bit rate is 5 Mbits/sec.

Reference frequency

Internal or external 1, 2, 5, 10 MHz reference
Data clock can be locked to an external 13 MHz (GSM) reference

Frame trigger delay control

Range	0 to 65,535 bits
Resolution	1 bit

Data types

Internally generated data	
Pseudo-random patterns	(meets ITU-T standard) Continuous PN9 (PRBS 2^9 –1) PN11 (PRBS 2^{11} –1), PN15[1] (PRBS 2^{15} –1), PN20 (PRBS 2^{20} –1), PN23 (PRBS 2^{23} –1).
Repeating sequence	Any 4-bit sequence
Downloadable data	
Maximum bit rate	5 Mbits/sec
Direct-pattern RAM (PRAM)	
Max size	1 Mbytes (standard) 8 Mbytes (Option UN9)
Use	Nonstandard framing
User file	
Max size	128 kbytes
Use	Continuous modulation or internally generated TDMA standard
Externally generated data	
Type	Serial data
Inputs	Data, bit/symbol clocks Accepts data rates ±5% of specified data rate

Internal burst shape control

Varies with standards and bit rates

Rise/fall time range	Up to 30 bits
Rise/fall delay range	0 to 63.5 bits

I/Q outputs

(Baseband I/Q outputs can be scaled from 0 to 1 $V_{peak\text{-}to\ peak}$ into 50 Ω)[2]

Standard	Default scaling	Maximum V (rms)
NADC, PHS, PDC	100	0.25
TETRA	65	0.25
GSM, DECT	N/A	0.35

EVM (NADC, PDC, PHS, TETRA)[3]	1% rms
Global phase error (GSM)[3]	0.75° rms
Deviation accuracy (DECT)[3]	1 kHz rms

I/Q outputs

(Baseband I/Q outputs can be scaled from 0 to 1 $V_{peak\text{-}to\ peak}$ into 50 Ω)[4]

Custom format[5]	Default scaling	Maximum V (rms)
FSK, MSK	NA	0.35
QPSK, BPSK	70	0.32
8PSK, 16PSK, D8PSK	70	0.20
π/4DQPSK	70	0.25
QAM	70	>0.10

1. PN15 is not continuous in bursted mode when TETRA is operated in a downlink mode.
2. Baseband I/Q ouputs cannot be scaled for GSM and DECT.
3. Specifications apply for the frequency range, symbol rates, root Nyquist filter, filter factors, and default scaling factor specified for each standard.
4. Baseband I/Q outputs cannot be scaled for FSK and MSK.
5. Filter factor (a or BbT) is set to 0.5.

I/Q baseband generator (continued)

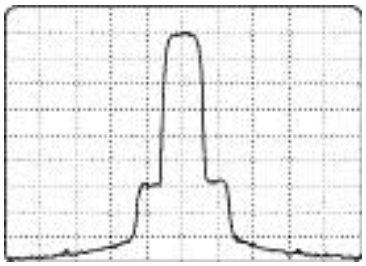
Digital communications standards

	NADC [5]		PDC		PHS		TETRA		DECT	GSM (DCS, PCS)	
Error vector magnitude[1] (% rms)	Continuous	Burst	Continuous	Burst	Continuous	Burst	Continuous	Burst	N/A	N/A	
Low EVM mode	0.7	1.4	0.9	1.3	0.9	1.0	0.8	1.7			
Low EVM mode (typical)	0.4	1.1	0.6	0.9	0.6	0.8	0.5	1.3			
Low ACP mode (typical)	1.0	1.4	0.8	1.0	0.9	0.9	0.9	1.5			
Global phase error [1] (rms/pk)	N/A		N/A		N/A		N/A		N/A	0.6°/2.2° 0.3°/1.3° (typ)	
Deviation accuracy[1] (kHz)	N/A		N/A		N/A		N/A		3 (2, typ)	N/A	
Channel spacing (kHz)	30		25		300		25		1,728	200	
Adjacent channel power [1] (ACP)	Continuous	Burst	Continuous	Burst	Continuous	Burst	Continuous	Burst[2]	N/A	Continuous	Burst
(Low ACP Mode, dBc, typical)											
at adjacent channel[3]	–35	–34	–	–	–	–	–66[4]	–63		–37	–37
at 1st alternate channel[3]	–79	–77	–70	–70	–78	–78	–80	–78		–70	–70
at 2nd alternate channel[3]	–82	–80	–	–	–80	–79	–81	–80		–81	–79
at 3rd alternate channel[3]	–83	–82	–81	–79	–	–	–81	–80		–81	–80
Supported burst types	Custom, up/down TCH		Custom, up/down TCH, up Vox		Custom, TCH, sync		Custom, up control 1 & 2 up normal, down normal, down sync		Custom, dummy B 1 & 2, traffic B, low capacity	Custom, normal, FCorr, sync, dummy, access	
Scramble capabilities					Yes		Yes				

1. Specifications apply for the symbol rates, root raised cosine filter, filter factors (a or BbT) and default scaling factor specified for each standard, and at power levels ≤+7 dBm (≤+10 dBm, Option UNB).
2. ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root raised cosine filter applied at power levels ≤+4 dBm (≤+8 dBm, Option UNB).
3. The "channel spacing" determines the offset size of the adjacent and alternate channels: Adjacent channel offset = 1 x channel spacing, 1st alternate channel= 2 x channel spacing, 2nd alternate channel = 3 x channel spacing, etc.
4. TETRA ACP performance is typically <-69 dBc with Option H99 in continuous modulation mode.
5. Supports IS-54 and IS-136 traffic channels only.

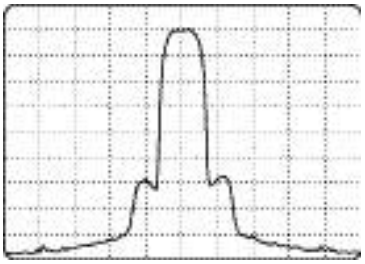
I/Q baseband generator (continued)

Digital communications standards



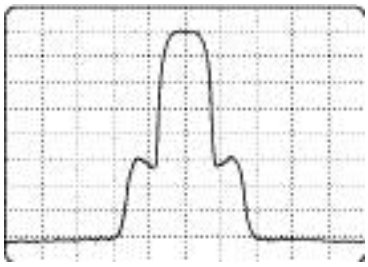
NADC spectrum

Fc = 849 MHz
Span = 0.3 MHz
Scale = 10 dB/div
Level = +4 dBm



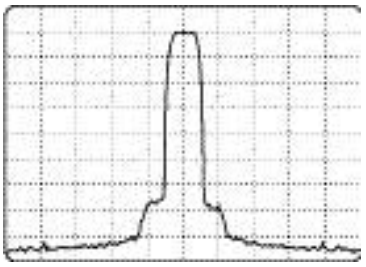
PDC spectrum

Fc = 810 MHz
Span = 0.25 MHz
Scale = 10 dB/div
Level = +4 dBm



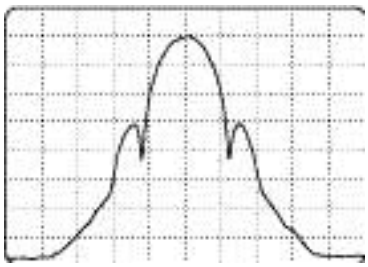
PHS spectrum

Fc = 1907 MHz
Span = 2 MHz
Scale = 10 dB/div
Level = +4 dBm



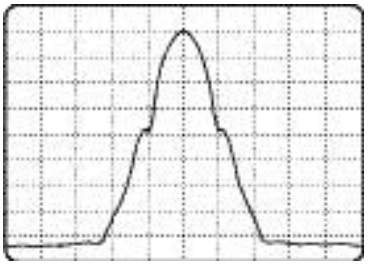
TETRA spectrum

Fc = 400 MHz
Span = 0.25 MHz
Scale = 10 dB/div
Level = +4 dBm



DECT spectrum

Fc = 1800 MHz
Span = 7 MHz
Scale = 10 dB/div
Level = +4 dBm



GSM spectrum

Fc = 920 MHz
Span = 2 MHz
Scale = 10 dB/div
Level = +4 dBm

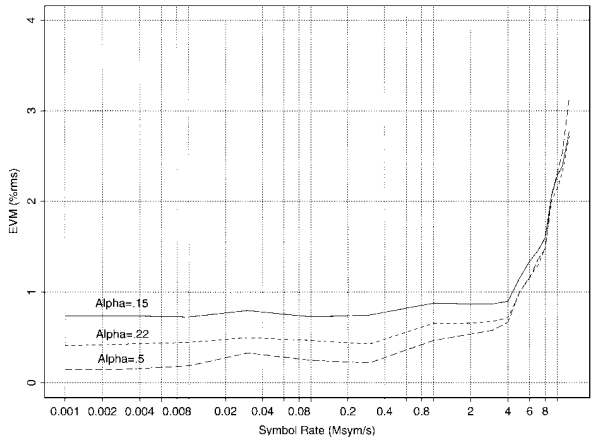
I/Q baseband generator (continued)

Custom digitally modulated signals

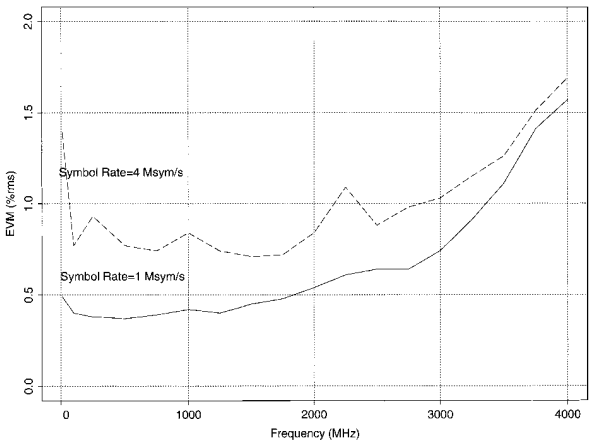
Modulation	QPSK	π/4DQPSK	16QAM	2FSK	GMSK
Filter		**Root Nyquist**		**Gaussian**	
Filter factor (α or B_bT)	0.25	0.25	0.25	0.5	0.5
Modulation index	N/A	N/A	N/A	0.5	N/A
Symbol rate (Msym/s)	4	4	4	1	1
	Error vector magnitude[1,2]			**Shift error**[1,2]	**Global phase error**[1,2]
		(% rms)	(% rms)		(degrees rms)
fc = 1 GHz	(0.9)	(0.9)	(0.8)	(0.7)	(0.2)
fc = 2 GHz	(1.0)	(1.0)	(1.0)	(0.7)	(0.2)
fc = 3 GHz	(1.5)	(1.5)	(1.4)	(0.8)	(0.4)
fc = 4 GHz	(2.8)	(2.6)	(3.5)	(1.0)	(0.5)

Typcal performance (power levels ≤ + 4 dBm [≤ + 8 dBm, Option UNB])

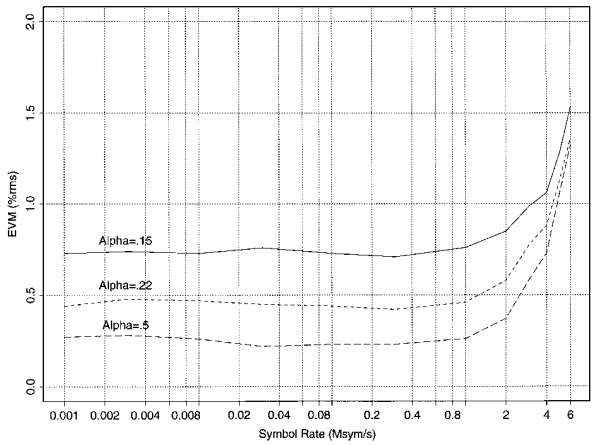
PSK formats



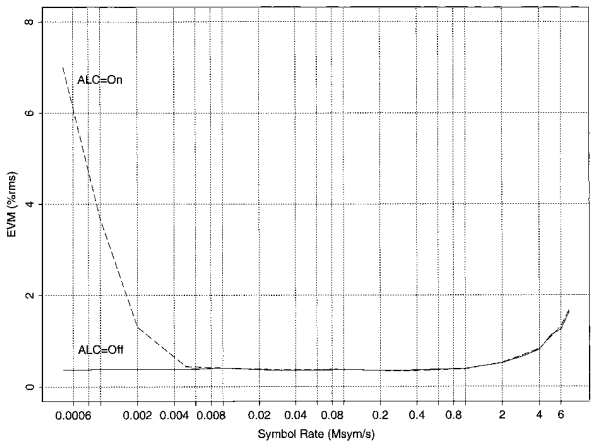
Baseband EVM performance versus symbol rate (root Nyquist filter, modulation = QPSK)



RF EVM performance versus frequency (root Nyquist filter, a = 0.25, ALC = off, modulation = π/4DQPSK)



RF EVM performance versus symbol rate (fc = 1 GHz, root Nyquist filter, ALC = off, modulation = QPSK)

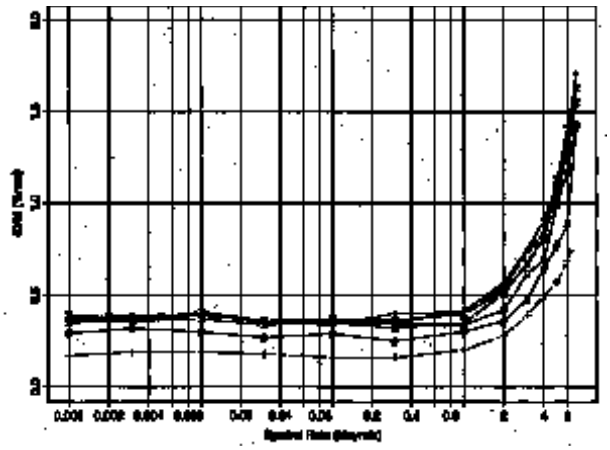


Effects of automatic level control (ALC) on EVM performance (fc = 1 GHz, root Nyquist filter, a = 0.25, modulation = QPSK)

1. Specifications apply at power levels ≤ +4 dBm, Option (UNB) with default scale factor of I/Q outputs.
2. Parentheses denote typical performance.

I/Q baseband generator (continued)

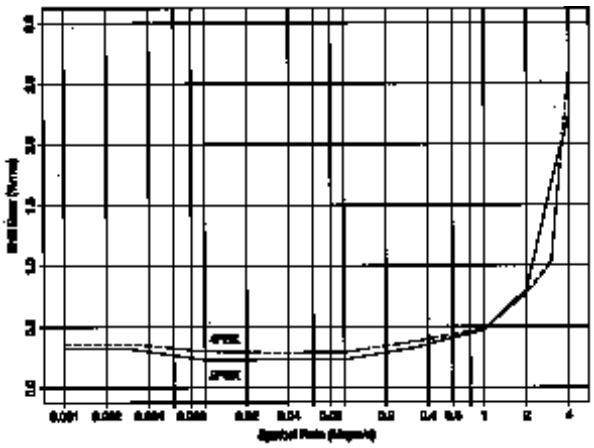
Non-constant amplitude formats



RF EVM performance versus symbol rate (fc = 1 GHz, root Nyquist filter, a = 0.25)

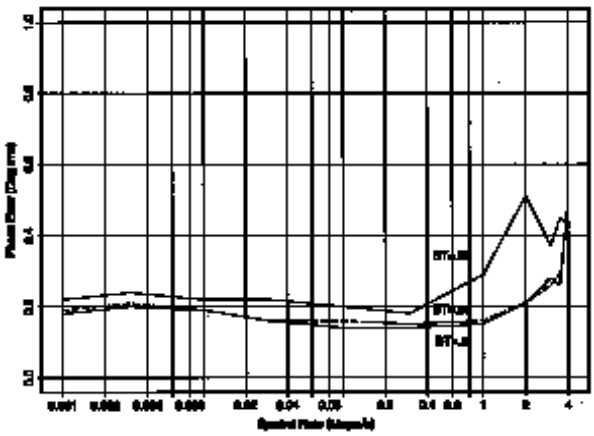
\+ ——— BPSK
X – – – OQPSK
• — — π/4DQPSK
o ——– 8PSK
-------- 16QAM
+ -- -- -- 256QAM
x --- --- QPSK

FSK formats

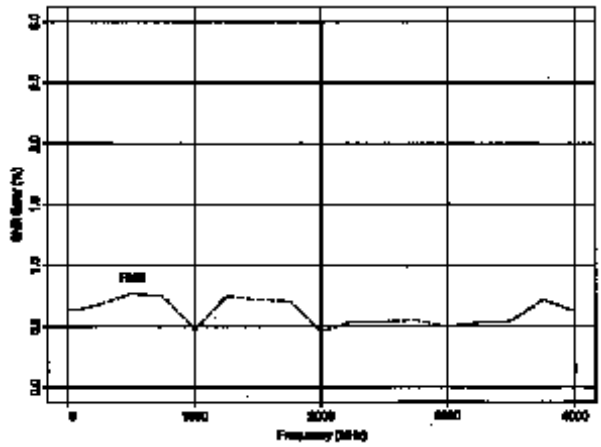


Shift error versus symbol rate (fc = 1 GHz, Gaussian filter, BbT = 0.5, modulation index = 0.5)

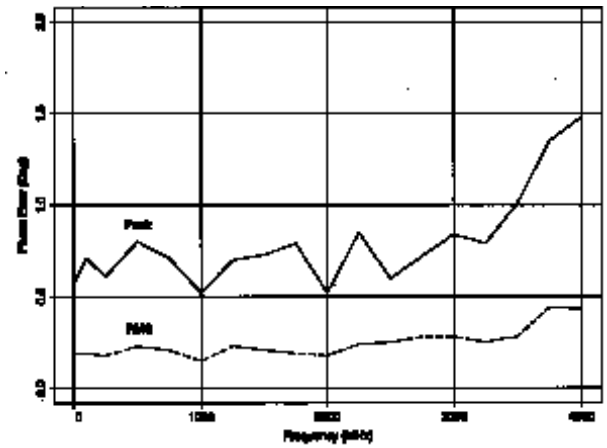
MSK formats



Phase error versus symbol rate (fc = 1 GHz, Gaussian filter)



Shift error versus frequency (Gaussian filter, BbT = 0.5, modulation index = 0.5, symbol rate = 1Msys/s)



Phase error versus frequency (Gaussian filter, BbT = 0.5, symbol rate = 1Msys/s)

Dual arbitrary waveform generator

(Option UND, ESG-DP and ESG-D series only)

Number of channels 2

Resolution 14 bits (1/16384)

Waveform memory

Length (playback)	1 Megasample/channel
Length (storage)	1 Megasample/channel in non-volatile RAM

Waveform segments

Segment length	16 samples to 1 Megasample
Number of segments	1 to 128 (even number of samples)

Waveform sequences

Sequencing	Continuously repeating
Number of sequences	1 to 128
Segments/sequence	1 to 65,535
Segment repetitions	1 to 4,095

Clock

Sample rate	1 Hz to 40 MHz
Resolution	1 Hz
Accuracy	Same as timebase

Output reconstruction filters

Type	Elliptic
Frequency cutoff (nominal, 3 dB)	250 kHz, 2.5 MHz, 8 MHz, and through (user-supplied external filter)

Baseband spectral purity

(typical, full scale sinewave, >20 x oversampling)

Harmonic distortion	
≤100 kHz	<–80 dBc
100 kHz to 2 MHz	<–65 dBc
Non-harmonic spurious (spur frequencies ≤10 MHz)	<–80 dBc
Phase noise (baseband output of 1 MHz sinewave at 20 kHz offset)	<–120 dBc/Hz
IM performance (two sinewaves at 950 kHz and 1050 kHz at baseband, full scale)	<–69 dB

Triggers

Types	Continuous, single, gated, segment advance
Source	Trigger key, bus, external
External polarity	Negative, positive
External delay time	2 µs to 3.6 ksec

Markers

(Markers are defined in a segment during the waveform generation process, or from the ESG front panel. A marker can also be tied to the RF blanking feature of the ESG.)

Marker polarity	Negative, positive

Bluetooth (UND)

Packet type	DH1
Select	
Bluetooth device address (BD_ADDR)	12 Hex digits
Active member address (AM_ADDR)	0 to 7
Payload data	8-bit repeating pattern Truncated PN9 Continuous PN9
Impairments	
Frequency offset	–100 kHz to +100 kHz
Resolution	1 kHz
Frequency drift/packet	
Linear or Sinusoidal	–100 kHz to +100 kHz
Resolution	1 kHz
Modulation index	0.250 to 0.400
Resolution	.001
Symbol timing error	–50 ppm to 50 ppm
Resolution	1 ppm
AWGN with adjustable C/N	–10 dB to –40 dB
Resolution	1 dB
Burst	1 to 10 #symbol/ramp
Resolution	1 symbol/ramp
Clock/gate delay	0 to 24999.9 symbols
Resolution	0.1 symbols

Other formats (UND)

NADC, PDC, PHS, GSM, DECT, TETRA, APCO25, CDPD, PWT, EDGE and custom

Multicarrier

Number of carriers	Up to 64 (limited by a max bandwidth of 15 MHz)
Frequency offset (per carrier)	–7.5 MHz to +7.5 MHz
Power offset (per carrier)	0 dB to –40 dB

Modulation

PSK	BPSK, QPSK, OQPSK, π/4 DQPSK, 8PSK, 16PSK, D8PSK
QAM	4, 16, 32, 64, 256
FSK	Selectable: 2, 4, 8, 16
Level symmetric	
MSK	
Data	Random ONLY (For external data, bursting and framing refer to real-time I/Q baseband generator, Option UN8)

Multitone

Number of tones	2 to 64, with selectable on/off state per tone
Frequency spacing	100 Hz to 5 MHz
Bandwidth	Up to 16 MHz, typical
Phase (per tone)	0 to 360 degrees

Additive white Gaussian noise

Bandwidth	50 kHz to 15 MHz
Waveform lengths	16, 32, 64, 128, 256, 512, 1024 ksamples
Noise seeds	Fixed, random

Multichannel, multicarrier CDMA personality

(Option UN5, ESG-DP and ESG-D series only)

Chip (symbol) rate 1.2288 MHz (default)
Adjustable from 1 Hz to
10 MHz with 4x oversampling

Modulation

QPSK (forward)	with Walsh and short code spreading
Offset QPSK (reverse)	with short code spreading of random data

Pre-defined channel configurations
(power levels per IS-97-A)

Pilot channel	Includes IS-95 modified filter, with equalizer
9 channel	Includes pilot, paging, sync, 6 traffic and IS-95 modified filter, with equalizer
32 channel	Includes pilot, paging, sync, 29 traffic and IS-95 modified filter, with equalizer
64 channel	Includes pilot, 7 paging, sync, 55 traffic and IS-95 modified filter, with equalizer
Reverse channel	Includes IS-95 filter

Rho 0.9996
(≤ 4 dBm, IS-95 filter, ≤ 2 GHz, typical)

Pilot time offset ≤ 2 µs, typical

User-defined CDMA
Channel table editor

Number of channels	1 to 256
Walsh codes	0 to 63
Channel power	0 to –40 dB
PN Offset	0 to 511
Data	00-FF(HEX) or random

Walsh code power selection
IS-97 compliant
Equal channel power
Scaled to 0 dB
User-defined

IS-95 filter selection
IS-95
IS-95 with equalizer
IS-95 modified
IS-95 modified with equalizer
All are IS-95 compliant. "Modified" filters reduce spurious emissions for adjacent channel power measurements.

Other FIR filters

Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0.1 to 1
Custom FIR	Up to 256 coefficients 16-bit resolution Automatically scaled

Oversample ratio

Range	2 to 8
Resolution	1

Multicarrier

Number of carriers	3 or 4 (predefined), up to 12 (user-defined)
Carrier channels	Pilot, 9 channel, 32 channel, 64 channel, reverse, custom
Frequency offset (per carrier)	±7.5 MHz
Offset resolution	<100 Hz
Carrier power (per carrier)	0 dB to –40 dB

Clipping

Clip location	Pre or post FIR filter
Clipping type	|I+jQ|, |I| and |Q|
Clipping range	10% to 100% (clip the modulation level to a percentage of full scale. A level of 100% equates to no clipping)

Multichannel CDMA spurious emissions[1]
(dBc, with high crest factor on)

Channels/offsets	0.885 to 1.25 MHz Standard	0.885 to 1.25 MHz Option UNB	0.885 to 1.25 MHz Option H99 (Rev B)	1.25 to 1.98 MHz Standard	1.25 to 1.98 MHz Option UNB	1.25 to 1.98 MHz Option H99 (Rev B)	1.98 to 5 MHz[2] Standard	1.98 to 5 MHz[2] Option UNB	1.98 to 5 MHz[2] Option H99 (Rev B)
Reverse (at ≤ 0 dBm)									
30 – 200 MHz	–66 (–72)	–70 (–75)	(–75)	(–76)	(–78)	(–77)	(–79)	(–79)	(–79)
700 – 1000 MHz	–68 (–73)	–72 (–76)	–77 (–79)	(–76)	(–79)	(–81)	(–79)	(–79)	(–80)
1000 – 2000 MHz	–63 (–66)	–70 (–74)	–76 (–79)	(–70)	(–78)	(–81)	(–79)	(–79)	(–80)
9/64 channels (at ≤–2 dBm)									
30 – 200 MHz	–65 (–68)	–68 (–71)	(–68)	(–73)	(–76)	(–72)	(–78)	(–78)	(–80)
700 – 1000 MHz	–64 (–70)	–69 (–73)	–69 (–75)	(–75)	(–77)	(–78)	(–79)	(–79)	(–80)
1000 – 2000 MHz	–60 (–63)	–67 (–71)	–69 (–73)	(–68)	(–75)	(–77)	(–78)	(–78)	(–80)

1. Parentheses denote typical performance.
2. Specifications apply with high crest factor off.

Bit Error Rate (BER) analyzer

(Option UN7, ESG-DP and ESG-D series only)

Clock rate 100 Hz to 10 MHz

Supported data patterns PN9 and PN15

Resolution 10 digits (6 digits for BER (exp))

Minimum synchronization length

2 Mbps mode	9 bits (PN9), 15 bits (PN15)
10 Mbps mode	43 bits (PN9), 48 bits (PN15)

Bit sequence length 100 bits to 4.294 Gbits after synchronization

Features

	2 Mbps mode	10 Mbps mode
Real-time display		
Bit count	X	X
Error-bit-count	X	
Bit error rate	X	
Pass/fail indication	X	X
Valid data and clock detection	X	X
Automatic re-synchronization	X	
Special pattern ignore	X	

GSM/EDGE base station Bit Error Rate Test (BERT)

(ESG-D series only)
(Option 300 requires Option UN8 revision C or better.
Option UNA is highly recommended. The following are required:

GSM BTS test only

E4406A VSA-series transmitter tester with Options BAH (EDGE measurement personality) and 300 Rev. A (321.4 MHz output).

GSM/EDGE BTS test

E4406A VSA-series transmitter tester with Option 202 (GSM and EDGE measurement personality) and Option 300 Rev. B (321.4 MHz output). ESG firmware Option 202, EDGE personality, is also required. To upgrade from Option 300 Rev. A to Option 300 Rev. B requires new hardware.

See configuration guide for a bundled ordering convenience.

Test technique RF loopback

Supported systems

GSM 400
GSM 850
GSM 900 (P-GSM)
DCS 1800
PCS 1900
E-GSM (extended)

Minimum power level	–136 dBm (ESG minimum)
Maximum power level	+13 dBm (ESG maximum)
Power level accuracy	±0.5 dB (23° ± 50 °C)
Relative power level	0 to ±130 dB relative to timeslot under test. (Limited only by output power range of the ESG. Based on Option UNA specification.)
Timeslot under test	
timeslots tested	0 to 7 A single timeslot is tested at one time. (No frequency hopping.)
Encryption	None
Measurement triggers	Immediate, trigger key, bus, external
Measurement indication	Pass/fail
BCH sync	BCH signal from the BTS is used to determine TCH frame and multiframe location.
Threshold	Termination of measurement when error count exceeds user specified threshold.

GSM output data

Channel content	Full-rate speech (FS)
Data	PN9, PN15 coded as per ETSI GSM, 05.03 version 3.6.1 (Oct 94).
Frame structure	26-frame TCH multiframe structure as per ETSI GSM, 05.01 version 6.1.1 (1998-07).
Adjacent timeslots	
Data	PN9, PN15 coded as per ETSI, GSM, 05.03 version 3.6.1 (Oct 94).
Frame structure	26-frame TCH multiframe structure as per ETSI GSM, 5.01 version 6.1.1 (1998-07).

1. Perch power level is 3 dB below DPCH power.
2. DPCCH power level is 6 dB below DPDCH power.

Measurements

Results	Class Ib bit-error ratio (RBER for TCH/FS) Class II bit-error ratio (RBER for TCH/FS) Frame erasure ratio (FER) Downlink error frame count Class Ib bit-error count Class II bit-error count Erased frame count Total frame count
Maximum RBER	100%
Maximum FER	100%
Measurement modes	
Static reference	
Sensitivity test (BER%)	RBER at user-specified power level measured. (This is the complete conformance test as defined in pri-ETS 300 609-1 (GSM 11.21) version 4.12.0 (Dec 98), section 7.3.4.
BER sensitivity search	Automatically finds the input level (sensitivity) that causes a user specified RBER (normally 2%) for class II bits.
Maximum frame count	6,000,000 speech frames

EDGE/EGPRS output data

Channel content	Continuous PN9 or PN15 Sequence for raw BER Continuous PN9 or PN15 Sequence on header and data payload.
Data	Fully coded MCS-5 and MCS-9; channel coding provided on PN9 or PN15 for data payload. Coding is done on frames 0 – 11, 13-24, 26-37, 39-50 on a 52 PDCH multiframe. The selected signal pattern is inserted continuously across the full payload.
Frame structure	52-frame multiframe structure for EDGE/EGPRS channel as per ETSI GSM 05.01 release 99. Frames 12, 25, 38 and 51 are empty (no burst).
Adjacent timeslots	
Data	Continuous uncoded PN9, PN15 or coded MCS-5 or MCS-9 with PN9 or PN15 sequence data payload. Note: Maximum of 4 timeslots can be turned on with EDGE/EGPRS multiframe coded data.
Frame structure	EDGE/EGPRS PDCH multiframe. Repeating EDGE frame.

Measurements

Results	Payload bit error count/rate for raw BER. Total burst count for raw BER. Erased data block count/rate for coded channel (MCS-5 or MCS-9). Total data block count for coded channel (MCS-5 or MCS-9). Data block count which contains residual bit errors and bit error count.
Measurement modes	
static reference	
sensitivity test (BER%)	BER at user-specified power level measured; based on bit errors in total unencoded data.
Sensitivity search	BER/BLER

Baseband BER (Bit Error Rate) tester

(Included with Option 300; cannot be ordered separately.)

Clock rate 100 Hz to 10 MHz

Supported data patterns PN9 and PN15

Resolution 10 digits (6 digits for BER (exp))

Minimum synchronization length

2 Mbps mode	9 bits (PN9), 15 bits (PN15)
10 Mbps mode	43 bits (PN9), 48 bits (PN15)

Bit sequence length 100 bits to 4.294 Gbits after synchronization

Features

	2 Mbps mode	10 Mbps mode
Real-time display		
Bit count	X	X
Error-bit-count	X	
Bit error rate	X	
Pass/fail indication	X	X
Valid data and clock detection	X	X
Automatic re-synchronization	X	
Special pattern ignore	X	

Multichannel Multicarrier 3GPP W-CDMA personality

(Option 100, ESG-DP and ESG-D series only)

Supports R99 March 2001 3GPP W-CDMA standard. Provides partially coded data for component test applications.

Chip rates

3.84 Mchips/sec ± 10%

Frame duration

10 ms

Filters

W-CDMA	α = 0.22
Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0 to 1
IS-95	
IS-2000	
Custom FIR	Up to 256 coefficients, 16-bit resolution
Rectangle	
APCO 25 c4FM	
Reconstruction filters	250 kHz, 2.5 MHz 8.0 MHz, and through

I/Q mapping

Normal, invert

Clipping

Clip location	Pre-or post-FIR filter
Clipping type	|I+jQ|, |I| and |Q|
Clipping range	10% to 100% (Clip the modulation level to a percentage of full scale. A level of 100% equates to no clipping.)

Downlink

Modulation QPSK

Pre-defined channel configurations (partially coded)

- 1 DPCH
- 3 DPCH
  - PCCPCH + SCH
  - PCCPCH + SCH + 1 DPCH
  - PCCPCH + SCH + 3 DPCH
- Test Model 1 with 16, 32, or 64 DPCH
- Test Model 2
- Test Model 3 with 16 or 32 DPCH
- Test Model 4

User-defined channel parameters

Symbol rates	7.5, 15, 30, 60, 120, 240, 480, or 960 ksps
Number of channels	Up to 512
Spreading code	0 to 511
Channel power	0 to –40 dB, 0.01 dB resolution
tDPCH offset	0 to 149
Scrambling code	0 to 511
Scramble types	Standard, left alternate, right alternate
Data pattern	Random, 00 to FF (HEX), PN9
TPC power	–20 to 20 dB relative to channel power
TPC value	0–5555
TFCI field	On /Off
TFCI value	0–1023
TFCI power	–20 to 20 dB relative to channel power
Pilot power	–20 to 20 dB relative to channel power
Pilot bits	4 or 8

Channel Types

(downlink)	PICH, OCNS, PCCPCH, SCCPCH, PSCH, SSCH, CPICH, DPCH
(uplink)	DPCCH, DPDCH

Multicarrier

Number of carriers	Up to 4 (user defined, individually configurable)
Frequency offset (per carrier)	Up to ±7.5 MHz
Offset resolution	<1 Hz
Carrier power (per carrier)	0 dB to –40 dB

Uplink

Modulation OCQPSK (HPSK)

Pre-defined channel configurations (partially coded)

1 DPCCH	15 ksps, spread code 0
DPCCH + 1 DPDCH	960 ksps, spread code 1
DPCCH + 2 DPDCH	960 ksps, spread code 1
DPCCH + 3 DPDCH	960 ksps, spread code 2
DPCCH + 4 DPDCH	960 ksps, spread code 2
DPCCH + 5 DPDCH	960 ksps, spread code 3

User-defined channel parameters

Symbol rates	15, 30, 60, 120, 240, 480, or 960 ksps
Number of DPDCH channels	6
Spreading code	0 to 511, symbol rate
Scrambling code	1 to 1FFFFFFFFF, common for all channels
Second DPDCH orientation	I or Q
Channel power	0 to –60 dB
Data pattern	Random, 00 to FF (HEX), PN9
FBI bits	0–2

Error vector magnitude[1]

1.8 GHz<f_c<2.2 GHz, default W-CDMA filters, 3.84 Mcps chip rate, ≤4 dBm, (≤7 dBm with Option UNB)

1 DPCH (2.3%)

Adjacent channel power[1,2]

1.8 GHz<f_c<2.2 GHz, default W-CDMA filters, 3.84 Mcps chip rate, ≤–2 dBm, (≤0 dBm with Option H99), 5 MHz offset

	Electronic attenuator (standard)	**Mechanical attenuator (Option UNB)**	**Low ACP (Option H99 Rev B)**
1 DPCH	(–58 dBc)	(–58 dBc)	–64 (–66 dBc)
Test Model 1 + 64 DPCH	(–50 dBc)	(–55 dBc)	–60 (–63 dBc)

Alternate channel power[1,2]

1.8 GHz<fc<2.2 GHz, default W-CDMA filters, 3.84 Mcps chip rate, ≤-2 dBm (0 dBm with Option H99 and baseband filter ON), 10 MHz offset

	Low ACP (Option H99)
1 DPCH	-70 (-72 dBc)
Test model 1 + 64 DPCH	-66 (-68 dBc)

1. Parentheses denote typical performance.
2. Valid for 23 ± 5 °C.

Multichannel cdma2000 personality

(Option 101, ESG-DP and ESG-D series only)

This personality conforms to cdma2000 specification revision 8. Provides partially coded data for component test applications.

Spreading rate 1x (SR1), 3x (SR3)

IS-95 filter selection
IS-95
IS-95 with equalizer
IS-95 modified
IS-95 modified with equalizer
All are IS-95 compliant. "Modified" filters reduce spurious emissions for adjacent channel power measurements.

Other FIR filters

Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0.1 to 1
Custom FIR	Up to 256 coefficients 16-bit resolution automatically scaled
Rectangle	

I/Q mapping Normal, invert

Clipping

Clip location	Pre-or post-FIR filter
Clipping type	|I+jQ|, |I| and |Q|
Clipping range	10% to 100% (clip the modulation level to a percentage of full scale. A level of 100% equates to no clipping.)
Multicarrier	Up to 12 (user defined, individually configured)
Frequency offset (per carrier)	–7.5 MHz to +7.5 MHz
Power offset	0 dB to –40 dB

Forward link

Spreading type	Direct spread (DS), multicarrier
Pre-defined channel configurations (partially coded)	
Pilot channel, DS/SR1	Pilot at Walsh 0
Pilot channel, DS/SR3	Pilot at Walsh 0
Pilot channel, Multicarrier/SR3	Pilot at Walsh 0
9 channel, DS/SR1	Radio configuration 3 Pilot at 9.6 kbps, paging at 9.6 kbps, sync at 1.2 kbps, two fundamental channels at 9.6 kbps, and four supplemental channels at 153.6 kbps
9 channel, DS or Multicarrier/SR3	Radio configuration 6 Pilot at 9.6 kbps, sync at 1.2 kbps, three fundamental channels at 9.6 kbps, and four supplemental channels at 153.6 kbps
User-defined cdma2000	
Channel types (partially coded)	Pilot, paging (SR1 only), sync, fundamental, and supplemental
Radio configuration	SR1: 1 to 5 SR3: 6 to 9
Data rate	1.2 kpbs to 1036.8 kbps, depends on the selected radio configuration
Walsh code	Pilot and sync have fixed codes, Walsh 0 and 32. Other channels have codes selected from specific ranges depending on the radio configuration chosen
Channel power	0 to –40 dB
PN offsets	0 to 511
Data pattern	00-FF(HEX) or random

Reverse link

Spreading type	Direct spread only
Pre-defined channel configurations (partially coded)	
Pilot channel, SR1	Pilot at Walsh 0
5 channel, (SR1 or SR3)	Includes pilot, dedicated control channel, traffic RC3 at 9.6 bps, and two supplemental RC3 at 153.6 kbps
User-defined cdma2000	
Channel type (partially coded)	Pilot, dedicated control channel, fundamental, and supplemental
Radio configuration[4]	1 to 6
Data rate	1.2 kbps to 1036.8 kbps, depends on the selected radio configuration
Channel power	0 to –40 dB
Data pattern	00-FF(HEX) or random

EVM <2.1%
(825 to 2100 MHz, SR3 pilot, IS-95 filter, which is optimized for EVM, typical)

Multichannel cdma2000 spurious emissions[1]

(dBc, with high crest factor on IS95 modified with equalizer filter and amplitude = ≤0 dBm)

	Offsets from center of carrier					
	2.135 to 2.50 MHz		2.50 to 3.23 MHz		3.23 to 10 MHz[2]	
Channels/offsets	**Standard**	**Option H99 revision B**	**Standard**	**Option H99 revision B**	**Standard**	**Option H99 revision B**
Forward 9 channel, SR3/multicarrier[3]						
30 – 200 MHz	(–68)	(–68)	(–66)	(–68)	(–69)	(–70)
700 – 1000 MHz	(–69)	(–73)	(–68)	(–72)	(–70)	(–75)
1000 – 2000 MHz	(–61)	(–73)	(–61)	(–73)	(–64)	(–75)

	Offsets from center of carrier					
	2.655 to 3.75 MHz		3.75 to 5.94 MHz		5.94 to 10 MHz[2]	
Channels/offsets	**Standard**	**Option H99**	**Standard**	**Option H99**	**Standard**	**Option H99**
Forward 9 channel, SR3/DS[4]						
30 – 200 MHz	(–75)	(–74)	(–76)	(–75)	(–77)	(–78)
700 – 1000 MHz	(–76)	(–79)	(–78)	(–82)	(–78)	(–82)
1000 – 2000 MHz	(–68)	(–79)	(–72)	(–82)	(–78)	(–82)
Reverse 5 channel, SR3/DS[3]						
30 – 200 MHz	(–77)	(–77)	(–77)	(–75)	(–76)	(–79)
700 – 1000 MHz	(–77)	(–80)	(–78)	(–82)	(–78)	(–82)
1000 – 2000 MHz	(–71)	(–81)	(–72)	(–82)	(–78)	(–82)

1. Parentheses denote typical performance.
2. Excluding 10 MHz reference clock spur (≤-67 dBc, typical).
3. Measurements performed with 30 kHz bandwidth relative to power in one carrier.
4. Measurements performed with 30 kHz bandwidth relative to total power.

Real-time 3GPP[1] W-CDMA personality

(Option 200, ESG-DP and ESG-D series only)

Description

Option 200 W-CDMA personality adds a flexible solution for W-CDMA mobile and base station test to Agilent ESG-D and ESG-DP (high spectral purity) series RF signal generators. Signals are fully coded in both forward and reverse links to provide complete testing of receivers.

Channel types generated

Primary Synchronization (PSCH), Secondary Synchronization (SSCH), Primary Common Control (P-CCPCH), Common Pilot (CPICH), Dedicated Physical (DPCH), Page Indication (PICH), Orthogonal Channel Noise Source (OCNS), Dedicated Physical Control Channel (DPCCH), Dedicated Physical Data Channel (DPDCH)

BTS setup

FIR filter

Root Nyquist, Nyquist	a = 0 to 1
Gaussian	B_bT = 0 to 1
User defined FIR	Up to 256 coefficients, 16-bit resolution

Chip rate

1 kcps to 4.25 Mcps

Primary scramble code

0 to 511

Downlink channel configurations

(Up to 4 channels can be configured simultaneously. With a two ESG setup, an additional four channels may be configured.)

PSCH

Power	-40 to 0 dB

SSCH

Power	-40 to 0 dB
Scramble code group	0 to 63 (coupled to primary scramble code)

P-CCPCH

Power	-40 to 0 dB
OVSF	0 to 255
Transport channel	BCH coding
Data field	PN9, PN15, 4-bit repeating pattern, user file

CPICH

Power	-40 to 0 dB

DPCH

Reference measurement channels	12.2, 64, 144, 384 kbps
Transport layer (DCH) control	(Up to 6 DCH's for each DPCH) block size, Transport Time Interval (TTI), rate matching, CRC size, transport channel number
Data	PN9, FIX4, user file
Coding	none, convolutional 1/2, convolutional 1/3, turbo

Physical layer control

Power	-40 to 0 dB
Symbol rate	7.5, 15, 30, 60, 120, 240, 480, 960 Ksps
OVSF	0 to 511 (dependent on channel symbol rate)
Slot format	0 to 16 (dependent on channel symbol rate)
TFCI pattern	10-bit user defined input pattern (converted to 30-bit code word with Reed-Mueller coding)
TPC pattern	Ramp up/down N number of times (N = 1 to 80), all up, all down
τDPCH offset	0 to 149
Secondary scramble code offset	0 to 15
Data	PN9, PN15, 4-bit repeating pattern, user file, transport channel

PICH

Power	-40 to 0 dB
OVSF	0 to 511
Data	PN9, PN15, user file, 4-bit repeating pattern

OCNS

Power	-40 to 0 dB
Symbol rate	7.5, 15, 30, 60, 120, 240, 480, 960 Ksps
OVSF	0 to 511 (Dependent on channel symbol rate)
Data	PN9, PN15
Secondary scramble code offset	0 to 15

1. Supports R99 December 2000 3GPP W-CDMA standard.

User equipment (UE) setup

FIR filter

Root Nyquist, Nyquist	a=0 to 1
Gaussian	BbT= 0 to 1

Chip rate

1 kcps to 4.25 Mcps

Primary scrambling code

0 to 16777215

Secondary scrambling offset

0 to 15

Uplink synchronization signal setup

Timing offset range:	Timing offset 512 to 2560 chips Slot delay 0 to 119 slots
Synchronization signal	System Frame Number (SFN) reset or frame clock
Frame clock interval	10 ms, 20 ms, 40 ms, 80 ms
Frame clock polarity	Positive, negative
SFN RST polarity	Positive, negative
Sync trigger mode	Single, continuous
	BBG data clock (chip clock) setup internal, external
External clock rate	x 1 (3.84 MHz), x 2 (7.68 MHz) x 4 (15.36 MHz)
External clock polarity	Positive, negative

Uplink channel configurations

Pre-set channel type

Reference measurement channel: 12.2 kbps, 64 kbps, 144 kbps, 384 kbps
UDI 64 k
AMR 12.2 k

User defined channels

One DPCCH, one DPDCH, up to 6 transport channels

DPCCH (Dedicated Physical Control Channel)

Power	-40 to 0 dB
Beta	0 to 15 (coupled to power)
Channel code	0 to 255
TFCI pattern	PN9, PN15, 0 to 03FF hex, user file
TFCI state	(Depends on slot format)
Symbol rate	15 ksps (Non adjustable)
FBI pattern	PN9, PN15, 0 to 3FFFFFFF hex, user file
FBI state	(Depends on slot format)
Slot format	0 to 5
Interleaver	On (non adjustable)
TPC pattern	PN9, PN15, 4-bit repeating pattern, user file, up/down, down/up, all up, all down
TPC pattern steps	1 to 80

DPDCH (Dedicated Physical Data Channel)

Power	Off, -40 to 0 dB
Beta	0 to 15 (coupled to power)
Channel code	0 to 255 (maximum value depends on symbol rate/slot format)
Data	PN9, PN15, 4-bit repeating pattern, user file, transport channel
Symbol rate	15, 30, 60, 120, 240, 480, 960 ksps depending on slot format
Slot format	0 to 6

Transport channel setup

Block size	0 to 5000
Number of blocks	0 to 4095
Coding	1/2 convolutional, 1/3 convolutional, turbo, none
TTI	10 ms, 20 ms, 40 ms, and 80 mSec
Data	PN9, 4-bit repeating pattern, user file
Rate matching attributes	1 to 256
CRC size	0, 8, 12, 16, 24
Error insertion	BLER or BER, or none
BLER (Block Error Rate)	0 to 1 (resolution 0.001)
BER (Bit Error Rate)	0 to 1 (resolution 0.0001)
Bits frame	Automatically calculated

Input

Synchronization signal (SFN RST or frame clock): Pattern trigger in
BBG data clock (chip clock): data clock in

Output

Chip clock out (3.84 MHz): Data clock out
Frame timing out: system sync out
DPDCH (I) symbol data: event1 out
DPDCH (I) symbol clock: event2 out
DPCCH (Q) symbol data: data out

Real-time cdma2000 personality

(Option 201, ESG-DP and ESG-D series only)

Description

Option 201, cdma2000 personality, adds a flexible solution for cdma2000 mobile and base station test to Agilent Technologies ESG-D and ESG-DP (high spectral purity) series RF signal generators. 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 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 base station and mobile simulation modes, through support of radio configuration 1 and 2.

Global controls across all channels

Channel power	0 to –40 dB
I/Q voltage scale	0 to –40 dB

Forward channel configurations

Channel types generated

Up to four channels simultaneously, of any of the following

- Pilot
- Paging
- Sync
- F-Fundamental
- F-Supplemental
- OCNS

BNC MUX outputs

Event 1	Delayed even second, 20 ms trig delay, 80 ms trig delay, offset 80 ms trig, 25 ms clock, page enable sync, offset 80 ms sync
Data out	PC ramp, Yi FFCH, Yq FFCH, FPCH W, Sync W, FPCH X, 25 ms clock
Data clock out	Chip clock, 19.2 clock, 38.4 clock, offset 80 ms trig, forward channel clock, forward channel I clock, forward channel
Q clock	
Symbol sync out	Even second, FPCH page, page sync, FFCH page, 20 ms trig delay, FFCH frame sync, PN sync

BTS setup

Filter	Root Nyquist, Nyquist, Gaussian, IS-95, IS-95 w/ EQ, IS-95 MOD, IS-95 MOD w/ EQ, rectangle, APCO 25 C4FM, user file
Spread rate	1
PN offset	0-511
Chip rate	50 cps-1.3 Mcps
Even second delay	0.5 to 128 chips
Long code state	0 to 3FFFFFFFFF

Pilot channel

Walsh	0 (non-adjustable)

Sync channel

Walsh	0 to 63
Data	Free editing of the following fields: SID, NID, F-synch type, Sys_Time, PRAT, LTM_Off, Msg_Type, P_REV, MIN_P_REV, LP_SEC, DAYLT, CDMA Freq, ext CDMA freq, and Reserved

Paging channel

Walsh	0 to 63
Data	Default paging message or userfile
Long code mask	0-3FFFFFFFFFh
Rate	4.8 or 9.6 kbps

Fundamental channel

Radio configuration	1 to 5
Walsh	0 to 63
Data rate	1.2 to 14.4 kbps, depending on radio configuration
Data	PN9, PN15, userfile, external serial data, or predefined bit patterns
Long code mask	0-3FFFFFFFFFh
Power control	N up/down, "N" may be set from 1 to 80
Power puncture	0n/off
Frame offset	0 (non-adjustable)
Frame length	20 ms (non-adjustable)

Supplemental channel

Same channel configuration as fundamental, except:

Radio configuration	3 to 5
Walsh	0-63, depending on RC and data rate
Data rate	19.2 to 307.2 kbps, depending on radio configuration
Turbo coding	May be selected for data rates from 28.8 to 153.6 kbps
Power control	Not provided
Power puncture	Not provided

OCNS channel

Walsh	0 to 63

Inputs

External data	Can be selected for one channel, either fundamental or supplemental

Outputs

Various timing signals such as chip clock and even second

Reverse channel configurations

IS-95 is supported using RC1 or RC2 which utilizes a single, selectable channel type:

Reverse Access Control Channel (R–ACH)
Reverse Fundamental Channel (R–FCH)
Reverse Supplemental Channel (R–SCH)

IS-2000 features are supported using RC3 or RC4. The channel types consist of the following:
Reverse Pilot Channel (R–PICH) (with or without gating)
Reverse Dedicated Control Channel (R–DCCH)
Reverse Common Control Channel (R–CCCH)
Reverse Enhanced Access Channel (R–EACH)
Reverse Fundamental Channel (R-FCH)
Reverse Supplemental Channel (R-SCH)

BNC MUX outputs

Event 1	Delayed even second, PN sync
Data out	Long code, pilot, coded RSCH, coded RDCCH, coded RFCH, coded RCCCH, coded REACH, Zi, Zq
Data clock out	Chip clock, 5 ms, 10 ms, 20 ms , 40 ms, 80 ms
Symbol sync out	Even second, long code sync

Mobile set-up

Radio configuration	1 to 4
Trigger advance	1 to 2457599
Trigger edge	Rising, falling
Long code state	0 to 3FFF FFFF FFFF FFFF hex
Long code mask	0 to 3FFF FFFF FFFF FFFF hex

Radio configurations 1[1] and 2[1]

Reverse Access Channel (RACH)

Data	PN9, PN15, fixed 4 bit pattern, user file
Data rate	4.8 kbps
Frame length	20
Frame offset	0 to 15

Reverse Fundamental Channel (R-FCH)

Data	PN9, PN15, fixed 4 bit pattern, user file
Data rate	1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps for RC1 1.8 kbps, 3.6 kbps, 7.2 kbps, 14.4 kbps for RC2
Frame length	20 mSec
Frame offset	0 to 15

Reverse Supplemental Channel 0 (R-SCH)

Turbo coding	On/off
Data	PN9, PN15, fixed 4 bit pattern, user file
Data rate	1.2 kbps, 2.4 kbps, 4.8 kbps, 9.6 kbps for RC1 1.8 kbps, 3.6 kbps, 7.2 kbps, 14.4 kbps for RC2
Frame length	20 mSec
Frame offset	0 to 15

1. Only one channel is available in RC1and RC2.
2. These data rates are available with turbo encoding.
3. If either REACH or RCCCH is on, then RPICH is the only other channel that can be on.

Radio configurations 3 and 4

Reverse Pilot Channel (R-PICH)

Walsh code	0 (non adjustable)
Gating rate	Quarter, half, full
PCB data	0 to FFFF hex

Reverse Dedicated Control Channel (R-DCCH)

Walsh code	0 to 15
Data	PN9, PN15, fixed 4 bit pattern, user file
Frame length	5 or 20 mSec
Data rate	For frame length = 5 9.6 kbps, for RC 3 or 4 For frame length = 20 9.6 kbps for RC 3 and 14.4 kbps for RC4
Frame offset	(0 to frame length/1.25) -1

Reverse Fundamental Channel (R-FCH)

Walsh code	0 to 15
Data	PN9, PN15, fixed 4 bit pattern, user file
Frame length	5 or 20 mSec
Data rate	For frame length = 5 9.6 kbps, for RC 3 or 4 For frame length = 20 1.5, 2.7, 4.8, and 9.6 kbps for RC 3 1.8, 3.6, 7.2, and 14.4 kbps for RC4
Frame offset	(0 to frame length/1.25) -1

Reverse Supplemental Channel 0 (R-SCH0)

Walsh code	0 to 7
Data	PN9, PN15, fixed 4 bit pattern, user file
Frame length	20, 40 or 80 mSec
Data rate	For frame length = 20 1.5, 2.7, 4.8, 9.6,19.2[2], 38.4[2],76.8[2],153.6[2], 307.2 kbps for RC 3 1.8, 3.6, 7.2, 14.4, 28.8[2], 57.62, 115.2[2], 230.4 kbps for RC4 For frame length = 40 1.35, 2.4, 4.8, 9.6,19.2[2], 38.4[2],76.8[2], 153.6[2] kbps for RC 3 1.8, 3.6, 7.2, 14.4[2], 28.8[2], 57.6[2], 115.2[2] kbps for RC4 For frame length = 80 1.2, 2.4, 4.8, 9.6,19.2[2], 38.4[2],76.8[2], kbps for RC 3 1.8, 3.6, 7.2[2], 14.4[2], 28.8[2], 57.6[2] kbps for RC4
Frame offset	(0 to frame length/1.25) -1

Reverse Supplemental Channel 1 (R-SCH1)

Walsh code	0 to 7
Data	PN9, PN15, Fixed 4 bit pattern, user file
Frame length	20, 40 or 80 mSec
Data rate	For frame length = 20 1.5, 2.7, 4.8, 9.6,19.2[2], 38.4[2],76.8[2] kbps for RC 3 1.8, 3.6, 7.2, 14.4, 28.8[2], 57.6[2], 115.2[2] kbps for RC4 For frame length = 40 1.35, 2.4, 4.8, 9.6,19.2[2], 38.4[2],76.8[2], 153.6[2] kbps for RC 3 1.8, 3.6, 7.2, 14.4[2], 28.8[2], 57.6[2], 115.2[2] kbps for RC4

	For frame length = 80 1.2, 2.4, 4.8, 9.6,19.2[2], 38.4[2],76.8[2],kbps for RC 3 1.8, 3.6, 7.22, 14.42, 28.82, 57.62 kbps for RC4
Frame offset	(0 to frame length/1.25) -1

R-CCCH[3] (Reverse Common Control Channel) and R-EACH[3] (Reverse-Enhanced Access Channel)

Walsh code	0 to 7
Data	PN9, PN15, fixed 4 bit pattern, user file
Frame length	5, 10 or 20 mSec
Data rate	For frame length = 5 38.4 kbps For frame length = 10 19.2, 38.4 kbps For frame length = 20 9.6, 19.2, 38.4 kbps

Real-time EDGE[3] personality

(Option 202, ESG-DP and ESG-D series only)

Description

Option 202 is a firmware personality built upon the internal real-time I/Q baseband generator (Option UN8). This option will simulate both uplink and downlink EDGE signals. Data can be generated internally or externally with continuous data, or bursted and framed signals. Use custom filtering and framing to keep pace with the evolving definition of EDGE.

Modulation	3π/8-rotating 8PSK (per EDGE specifications) user-selectable (see Modulation under Option UN8)
Filter	"Linearized" Gaussian (per EDGE specifications) user-selectable (see Filter under Option UN8)
Symbol rate	User-adjustable (see Symbol rate under Option UN8) 270.833 kHz (default)
Burst Shape	Defaults to EDGE standard power vs. time mask with user definable rise and fall time. Alternatively, upload externally defined burst shape waveforms.
Data structure	Time slots may be configured as normal or custom. The data field of a time slot can accept a user file, PRBS (PN9 or PN15), a fixed sequence or external data. All other fields in a timeslot are editable.

1. All specifications apply at 23 ± 5 °C.
2. With ALC OFF, specifications apply after the execution of power search. With ALC ON, specifications apply for pulse repetition rates ≤ 10 kHz and pulse widths ≥ 5 µs.
3. EDGE and IS-136HS traffic channels have the same physical layer. This EDGE signal can be used to simulate an IS-136HS trafffic channel for component tests.

EVM performance (typical)[1]

Output power		Output frequency	
Standard	**Option UNB**	**800 MHz**	**1900 MHz**
≤7 dBm	≤10 dBm	< 0.75%	< 1.75%
≤4 dBm	≤7 dBm	< 0.75%	< 1.00%

Alternate time slot power level control

(Option UNA, ESG-DP and ESG-D series only)

Amplitude is settled within 0.5 dB in 20 µsecs, +4 to –136 dBm at 23 ± 5 °C

Improved ACP performance for TETRA, CDMA and W-CDMA

(Option H99, ESG-D and ESG-DP series only)

ACP improvements for TETRA, CDMA and W-CDMA are listed in the appropriate heading under Options 100, 101, UN8, UN5, and H98 respectively. Specifications that are changes from the standard are listed below[1].

Output power

250 kHz to 3 GHz	+ 10 dBm to –136 dBm
>3 GHz	+ 4 dBm to –136 dBm

Coherent carrier out

–4 dBm ± 5 dBm, typical

Level accuracy

Specifications degrade by 0.2 dB

Level accuracy with digital modulation

≤3 GHz specifications apply at ≤+7 dBm output power
>3 GHz specifications apply at ≤+4 dBm output power

DC vector accuracy

>3.7 GHz specifications apply down to >3 GHz
>3 GHz specifications apply at ≤4 dBm
Attenuator hold level range is same as Option UNB

Spectral purity nonharmonics

>3 GHz specifications apply at ≤+4 dBm output power

Amplitude modulation

500 kHz to 3 GHz specification is typical
>3 GHz not specified

Pulse modulation

On/off ratio

<250 MHz	>60 dB

Pulse modulation

Level accuracy < ± 0.7 dB (relative to CW)[2], typical

General characteristics

Power requirements	90 to 254 V; 50, 60, or 400 Hz; 200 W maximum
Operating temperature range	0 to 55 °C
Storage temperature range	–40 to 71 °C
Shock and vibration	Meets MIL-STD-28800E Type III, Class 3.

Leakage: Conducted and radiated interference meets MIL-STD-461C CE02 Part 2 and CISPR 11. Leakage is typically <1 µV (nominally 0.1 µV with a 2-turn loop) at ≤1000 MHz, measured with a resonant dipole antenna, one inch from any surface with output level <0 dBm (all inputs/outputs properly terminated).

Storage registers: Memory is shared by instrument states, user data files, sweep list files and waveform sequences. Depending on the number and size of these files, up to 800 storage registers and 10 register sequences are available.

Weight	<13.5 kg (28 lb.) net, <19.5 kg (42 lb.) shipping
Dimensions	133 mm H x 426 mm W x 432 mm D (5.25 in H x 16.8 in W x 17 in D)

Remote programming

Interface GPIB (IEEE-488.2-1987) with listen and talk. RS-232.

Control languages SCPI version 1992.0, also compatible with 8656B and 8657A/B/C/D/J[1] mnemonics.

Functions controlled All front panel functions except power switch and knob.

IEEE-488 functions SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2.

ISO compliant

The ESG series RF signal generators are manufactured in an ISO-9001 registered facility in concurrence with Agilent Technologies commitment to quality.

Accessories

Transit case	**Part number 9211-1296**
Remote interface	**83300A**

Inputs and outputs

All front panel connectors can be moved to rear with Option 1EM.

RF output
Nominal output impedance 50 ohms. (type-N female, front panel)

LF output
Outputs the internally-generated LF source.
Outputs 0 to 3 Vpeak into 50 ohms, or 0 to 5 V_{peak} into high impedance. (BNC, front panel)

External input 1
Drives either AM, FM, ΦM, or burst envelope. Nominal input impedance 50 ohms, damage levels are 5 V_{rms} and 10 V_{peak}. (BNC, front panel)

External input 2
Drives either AM, FM, ΦM, or pulse. Nominal input impedance 50 ohms, damage levels are 5 V_{rms} and 10 V_{peak}. (BNC, front panel)

Auxiliary interface
Used with 83300A remote keypad sequencer (9-pin RS-232 connector female, rear panel)

10 MHz input
Accepts a 10 MHz ±10 ppm (standard timebase) or ±1 ppm (high-stability timebase) reference signal for operation with an external timebase. Nominal input impedance 50 ohms. (BNC, rear panel)

10 MHz output
Outputs the 10 MHz internal reference level nominally +7 dBm ±2 dB. Nominal output impedance 50 ohms. (BNC, rear panel)

GPIB
Allows communication with compatible devices. (rear panel)

Sweep output
Generates output voltage, 0 to +10 V when signal generator is sweeping. Output impedance <1 ohm, can drive 2000 ohms. (BNC, rear panel)

Trigger output
Outputs a TTL signal: high at start of dwell, or when waiting for point trigger in manual sweep mode; low when dwell is over or point trigger is received, high or low 4 µs pulse at start of LF sweep. (BNC, rear panel)

Trigger input
Accepts TTL signal for triggering point-to-point in manual sweep mode, or to trigger start of LF sweep. Damage levels ≥+10 V or ≤–4 V. (BNC, rear panel)

With ESG-AP and ESG-A series and Option 1E6 only

Pulse input
Drives pulse modulation. Input impedance TTL. (BNC, front or rear panel)

With ESG-DP and ESG-D series only

"I" input
Accepts an "I" input either for I/Q modulation or for wideband AM. Nominal input impedance 50 ohms, damage levels are 1 V_{rms} and 10 V_{peak}. (BNC, front panel)

"Q" input
Accepts a "Q" input for I/Q modulation. Nominal input impedance 50 ohms, damage levels are 1 V_{rms} and 10 V_{peak}. (BNC, front panel)

1. ESG series does not implement 8657A/B "Standby" or "On" (R0 or R1, respectively) mnemonics.

General characteristics (continued)

Coherent carrier output
Outputs RF modulated with FM or ΦM, but not IQ or AM. Nominal power 0 dBm ±5 dB. Frequency range from 249.99900001 MHz to maximum frequency. For RF carriers below this range, output frequency = 1 GHz – frequency of RF output. Damage levels 20 V_{dc} and 13 dBm reverse RF power. (SMA, rear panel)

With ESG-DP and ESG-D series and Option UN8 only

Data input
Accepts serial data for digital modulation applications. Expects CMOS input. Leading edges must be synchronous with DATA CLOCK rising edges. The data must be valid on the DATA CLOCK falling edges. Damage levels are >+8 and <–4 V. (BNC, front panel)

Data clock input
Accepts CMOS clock signal (either bit or symbol), to synchronize inputting serial data. Damage levels are >+8 and <–4 V. (BNC, front panel)

Symbol sync input
Accepts CMOS synchronization signal. Symbol sync might occur once per symbol or be a single, one bit wide pulse to synchronize the first bit of the first symbol. Damage levels are >+8 and <–4 V. (BNC, front panel)

Baseband generator reference input
Accepts 0 to +20 dBm sinewave, or TTL squarewave, to use as reference clock for GSM applications. Only locks the internal data generator to the external reference; the RF frequency is still locked to the 10 MHz reference. Nominal impedance is 50 ohms at 13 MHz, AC-coupled. Damage levels are >+8 and <–8 V. (BNC, rear panel)

Burst gate input
Accepts CMOS signal for gating burst power when externally supplying data. Damage levels are >+8 and <–4 V. (BNC[1], rear panel)
Pattern trigger input accepts CMOS signal to trigger internal pattern or frame generator to start single pattern output. Damage levels are >+ 8 and <–4 V. (BNC[1], rear panel)

Event 1 output
Outputs pattern or frame synchronization pulse for triggering or gating external equipment. May be set to start at the beginning of a pattern, frame, or timeslot and is adjustable to within ± one timeslot with one bit resolution. Damage levels are >+ 8 and <–4 V. (BNC[1], rear panel)

Event 2 output
Outputs data enable signal for gating external equipment. Applicable when external data is clocked into internally generated timeslots. Data is enabled when signal is low. Damage levels >+8 and <–4 V. (BNC[1], rear panel)

Data output
Outputs data from the internal data generator or the externally supplied signal at data input. CMOS signal. (BNC[1], rear panel)
Data clock output relays a CMOS bit clock signal for synchronizing serial data. (BNC[1], rear panel)

Symbol sync output
Outputs CMOS symbol clock for symbol synchronization, one data clock period wide. (BNC[1], rear panel)

"I" and "Q" baseband outputs
Outputs in-phase and quadrature-phase component of I/Q modulation from the internal baseband generator. Full scale is 1 V_{peak} to peak. Nominal impedance 50 ohms, DC-coupled, damage levels are >+2 and <–2 V. (BNC, rear panel)

With ESG-DP and ESG-D series and Option UND only

Baseband generator reference input
Accepts a TTL or > –10 dBm sinewave. Rate is 250 kHz to 20 MHz. Pulse width is >10 ns.

Trigger types Continuous, single, gated, segment advance

"I" and "Q" baseband outputs
Outputs in-phase and quadrature-phase component of I/Q modulation from the internal baseband generator. Full scale is 1 V_{peak} to peak. Nominal impedance 50 ohms, DC-coupled, damage levels are >+2 and <–2 V. (BNC, rear panel)

Event 1 output
Even second output for multichannel CDMA. Damage levels are >+8 V and <–4 V. (BNC[1], rear panel)

With ESG-DP and ESG-D series and Option UN7 only

Data, clock and clock gate inputs
Accepts TTL or 75 Ω input. Polarity is selected. Clock duty cycle is 30% to 70%. Damage levels are >+8 V and <–4 V (BNC[1], rear panel)

Sync loss output
Outputs a TTL signal that is low when sync is lost. Valid only when measure end is high. Damage levels are >+8 V and <–4 V. (SMB, rear panel)

No data detection output
Outputs a TTL signal that is low when no data is detected. Valid only when measure end is high. (SMB, rear panel)
Error-bit-output (not supported at 10 Mbps rate)
Outputs 80 ns (typical) pulse when error bit is detected. (SMB, rear panel)

Test result output
Outputs a TTL signal that is high for fail and low for pass. Valid only on measure end falling edge. (SMB, rear panel)

Measure end output
Outputs a TTL signal that is high during measurement. Trigger events are ignored while high. (SMB, rear panel)

With ESG-DP and ESG-D series and Option UNA

Alternate power input
Accepts CMOS signal for synchronization of external data and alternate power signal timing. Damage levels are >+8 and <–4V. (BNC[1], rear panel)

With ESG-D and Option 300

321.4 MHz input
Accepts a 321.4 MHz IF signal. Nominal input impedance 50 ohms. (SMB, rear panel)

1. Option 1EM replaces this BNC connector with an SMB connector.

Ordering information

See *ESG Family RF Signal Generators Configuration Guide* (literature number 5965-4973E) for more information

E4400B 1 GHz ESG-A series RF signal generator
E4420B 2 GHz ESG-A series RF signal generator
E4421B 3 GHz ESG-A series RF signal generator
E4422B 4 GHz ESG-A series RF signal generator

E4423B 1 GHz ESG-AP series RF signal generator
E4425B 3 GHz ESG-AP series RF signal generator
E4424B 2 GHz ESG-AP series RF signal generator
E4426B 4 GHz ESG-AP series RF signal generator

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

Options

See *ESG Family RF Signal Generators Configuration Guide* (literature number 5965-4973E) for more information

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

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

Model #-OB1	Adds extra manual set
Model #-OBV	Adds service documentation, component level
Model #-OBW	Adds service documentation, assembly level
Model #-OBX	Adds service documentation, assembly and component level
Model #-1CM	Adds rack mount kit, part number 5063-9214
Model #-1CN	Adds front handle kit, part number 5063-9227
Model #-1CP	Adds rack mount kit with handles, part number 5063-9221
Model #-1E5	Adds high-stability timebase
Model #-1E6	High-performance pulse modulation
Model #-1EM	Moves all front panel connectors to rear panel
Model #-UN5	Adds multichannel IS-95 CDMA personality
Model #-UN7	Adds internal bit-error-rate analyzer
Model #-UN8	Adds real-time I/Q baseband generator with TDMA standards and 1 Mbit of RAM
Model #-UN9	Adds 7 Mbits of RAM to Option UN8
Model #-100	Adds multichannel W-CDMA personality
Model #-101	Adds multichannel cdma2000 personality
Model #-200	Adds real-time 3GPP W-CDMA personality
Model #-201	Adds real-time cdma2000 personality
Model #-202	EDGE personality for Real-Time BB generator
Model #-300	Base station BERT extension for Option UN7 (internal bit-error-rate analyzer)
Model #-404	Signal Studio for 1xEV-DO
Model #-406	Signal Studio for Bluetooth
Model #-UNA	Alternate timeslot power level control
Model #-UNB	Adds higher power with mechanical attenuator
Model #-UND	Adds internal dual arbitrary waveform generator
Model #-H99	Improves ACP performance for TETRA, CDMA, and W-CDMA

ESG family application and product information

Application notes, product notes, and product overviews

- *RF Source Basics,* a self-paced 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 Communications Systems*, Product Note, literature number 5091-8687E.
- *Controlling TDMA Timeslot Power Levels in the ESG-D Series Option UNA,* 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 UND,* 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 Mobile Stations,* 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.
- *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.

Product literature

- *ESG Family RF Signal Generators,* Brochure, literature number 5968-4313E.
- *ESG Family RF Signal Generators,* Technical Specifications, literature number 5965-3096E.
- *ESG Family RF Signal Generators,* Configuration Guide, literature number 5965-4973E.
- *Signal Generators: Vector, Analog, and CW Models,* Selection Guide, literature number 5965-3094E.

See the ESG family Web page for the latest information

Get the latest news, product and support information, application literature, firmware upgrades and more. Agilent's Internet address for the ESG family is: **http://www.agilent.com/find/esg**



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