Discontinuance Notice

On 1 March 2007, the ESG-A/D Series will be discontinued. Agilent will continue to support these products until 1 March 2012. The recommended replacement is the Agilent MXG signal generator.

The Agilent MXG offers frequency ranges up to 6 GHz, the industry’s best ACPR, fast switching, and a simplified design for easy self-maintenance - all in two rack units (2RU).

For more information visit www.agilent.com/find/mxg.
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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

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

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

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
• 1-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**

<table>
<thead>
<tr>
<th>Range</th>
<th>E4400B</th>
<th>E4420B</th>
<th>E4421B</th>
<th>E4422B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESG-A series</td>
<td>250 kHz to 1 GHz</td>
<td>250 kHz to 2 GHz</td>
<td>250 kHz to 3 GHz</td>
<td>250 kHz to 4 GHz</td>
</tr>
<tr>
<td>E4430B</td>
<td>250 kHz to 1 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4431B</td>
<td>250 kHz to 2 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4432B</td>
<td>250 kHz to 3 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4433B</td>
<td>250 kHz to 4 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Underrange**

| ESG-D series | 100 kHz |

**Resolution**

| E4400B | 0.01 Hz |

**Accuracy**

| Same as timebase |

**Switching speed (typical)**

<table>
<thead>
<tr>
<th>ESG-A and ESG-D series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog</td>
</tr>
<tr>
<td>Digital</td>
</tr>
<tr>
<td>Modulation off</td>
</tr>
</tbody>
</table>

**Phase offset**

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

**Frequency bands**

<table>
<thead>
<tr>
<th>Band</th>
<th>Frequency range</th>
<th>N #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250 kHz to ≤ 249.999 MHz</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>&gt; 249.999 to ≤ 500 MHz</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 500 MHz to ≤ 1 GHz</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>&gt; 1 to ≤ 2 GHz</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 2 to ≤ 4 GHz</td>
<td>4</td>
</tr>
</tbody>
</table>

**Sweep modes**

<table>
<thead>
<tr>
<th>Operating modes</th>
<th>Frequency step, amplitude step and arbitrary list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwell time</td>
<td>1 ms to 60 s</td>
</tr>
<tr>
<td>Number of points</td>
<td>2 to 401</td>
</tr>
</tbody>
</table>

**Internal reference oscillator**

<table>
<thead>
<tr>
<th>Stability</th>
<th>ESG-A and ESG-D series standard</th>
<th>ESG-A and ESG-D series Option 1E5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging rate</td>
<td>&lt; ±1 ppm/yr</td>
<td>&lt; ±0.1 ppm/yr or &lt; ±0.0005 ppm/day after 45 days</td>
</tr>
<tr>
<td>Temp. (0 to 55° C)</td>
<td>&lt; ±1 ppm, typical</td>
<td>&lt; ±0.05 ppm, typical</td>
</tr>
<tr>
<td>Line voltage</td>
<td>&lt; ±0.1 ppm, typical (+5%, –10%)</td>
<td>&lt; ±0.002 ppm, typical (+5%, –10%)</td>
</tr>
</tbody>
</table>

| Timebase reference output | 10 MHz | > 0.35 Vrms into 50 Ω load |

<table>
<thead>
<tr>
<th>External reference input</th>
<th>1, 2, 5, 10 MHz ± typical 10 ppm ESG-A and ESG-D series Option 1E5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude</td>
<td>&gt; 0.15 Vrms</td>
</tr>
<tr>
<td>Input impedance</td>
<td>50 Ω</td>
</tr>
</tbody>
</table>

**Output**

<table>
<thead>
<tr>
<th>Power2</th>
<th>Standard</th>
<th>Option UNB</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 1 GHz</td>
<td>+13 to –136 dBm</td>
<td>+17 to –136 dBm</td>
</tr>
<tr>
<td>&gt; 1 to 3 GHz</td>
<td>+10 to –136 dBm</td>
<td>+16 to –136 dBm</td>
</tr>
<tr>
<td>&gt; 3 to 4 GHz</td>
<td>+7 to –136 dBm</td>
<td>+13 to –136 dBm</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Standard</th>
<th>Option UNB</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 1 GHz</td>
<td>23 dB</td>
<td>27 dB</td>
</tr>
<tr>
<td>&gt; 1 to 3 GHz</td>
<td>20 dB</td>
<td>26 dB</td>
</tr>
<tr>
<td>&gt; 3 to 4 GHz</td>
<td>17 dB</td>
<td>23 dB</td>
</tr>
</tbody>
</table>

Level accuracy (dB)

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Level Accuracy (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 2 GHz</td>
<td>±0.5, ±0.5, ±1.5</td>
</tr>
<tr>
<td>2 to 3 GHz</td>
<td>±0.9, ±0.9, ±2.5</td>
</tr>
<tr>
<td>3 to 4 GHz</td>
<td>±0.9, ±1.5, ±2.5</td>
</tr>
</tbody>
</table>

Output power

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Output Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>+7 to −120 dBm</td>
<td>−127 dBm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Output Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 2 GHz</td>
<td>50 watts</td>
</tr>
<tr>
<td>&gt; 2000 to 4 GHz</td>
<td>25 watts</td>
</tr>
<tr>
<td>Max DC voltage</td>
<td>50 V</td>
</tr>
</tbody>
</table>

SWR (typical)

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Standard</th>
<th>Option UNB</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 1 GHz</td>
<td>&lt; 1.5:1</td>
<td>&lt; 1.3:1</td>
</tr>
<tr>
<td>1 to 2 GHz</td>
<td>&lt; 1.4:1</td>
<td>&lt; 1.3:1</td>
</tr>
<tr>
<td>2 to 3 GHz</td>
<td>&lt; 1.3:1</td>
<td>&lt; 1.4:1</td>
</tr>
<tr>
<td>3 to 4 GHz</td>
<td>&lt; 1.5:1</td>
<td>&lt; 1.5:1</td>
</tr>
</tbody>
</table>

Output impedance

50 Ω

Spectral purity

SSB phase noise

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>ESG-A and ESG-D Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 MHz</td>
<td>(&lt; −120 dBc/Hz)</td>
</tr>
<tr>
<td>1 GHz</td>
<td>(&lt; −116 dBc/Hz)</td>
</tr>
<tr>
<td>2 GHz</td>
<td>(&lt; −104 dBc/Hz)</td>
</tr>
<tr>
<td>3 GHz</td>
<td>(&lt; −104 dBc/Hz)</td>
</tr>
<tr>
<td>4 GHz</td>
<td>(&lt; −104 dBc/Hz)</td>
</tr>
</tbody>
</table>

Residual FM

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 2 GHz</td>
<td>&lt; N x 2 Hz</td>
</tr>
<tr>
<td>&gt; 3 GHz</td>
<td>&lt; N x 4 Hz</td>
</tr>
</tbody>
</table>

Harmonics

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 250 MHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>250 MHz to 500 MHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>500 MHz to 1 GHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>1 to 2 GHz</td>
<td>&lt; −59 dBc</td>
</tr>
<tr>
<td>&gt; 2 GHz</td>
<td>&lt; −53 dBc</td>
</tr>
</tbody>
</table>

Nonharmonics

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 kHz to 250 MHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>250 MHz to 500 MHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>500 MHz to 1 GHz</td>
<td>&lt; −65 dBc</td>
</tr>
<tr>
<td>1 to 2 GHz</td>
<td>&lt; −59 dBc</td>
</tr>
<tr>
<td>&gt; 2 GHz</td>
<td>&lt; −53 dBc</td>
</tr>
</tbody>
</table>

Subharmonics

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GHz</td>
<td>None</td>
</tr>
<tr>
<td>&gt; 1 GHz</td>
<td>(&lt; −40 dBc)</td>
</tr>
</tbody>
</table>

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.
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. Specifications apply for FM deviations < 100 kHz and are not valid for FM.
6. For non-constant amplitude digital formats, unspecified spur levels occur up to the second harmonic of the baseband rates.
Phase modulation

<table>
<thead>
<tr>
<th>Maximum deviation</th>
<th>ESG-A and ESG-D series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal BW</td>
<td>N x 90 radians</td>
</tr>
<tr>
<td>High BW</td>
<td>N x 8π radians</td>
</tr>
</tbody>
</table>

Resolution
0.1% of set deviation

Modulation frequency response

<table>
<thead>
<tr>
<th>Mode</th>
<th>Maximum deviation</th>
<th>Rates (3 dB BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal BW</td>
<td>dc to 100 kHz</td>
<td>dc to 100 kHz</td>
</tr>
<tr>
<td>High BW</td>
<td>N x 360 rad</td>
<td>dc to 1.5 MHz (typ)</td>
</tr>
<tr>
<td></td>
<td>N x 90 rad</td>
<td>dc to 0.9 MHz (typ)</td>
</tr>
</tbody>
</table>

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

Distortion
< 1%

External inputs
Ext 1 or Ext 2

Sensitivity
1 Vpeak 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.

Frequency modulation

 Maximum deviation
ESG-A and ESG-D series
N x 10 MHz

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

Modulation frequency response (deviation = 100 kHz)

<table>
<thead>
<tr>
<th>Rates</th>
<th>1 dB bandwidth</th>
<th>3 dB bandwidth, typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM1</td>
<td>dc/20 Hz to 100 kHz</td>
<td>dc/5 Hz to 10 MHz</td>
</tr>
<tr>
<td>FM2</td>
<td>dc/20 Hz to 100 kHz</td>
<td>dc/5 Hz to 1 MHz</td>
</tr>
</tbody>
</table>

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

 Carrier frequency accuracy relative to CW in dcFM
< ±0.1% of set deviation + (N x 1 Hz)

 Distortion
< 1%

 External inputs
Ext 1 or Ext 2

 Sensitivity
1 Vpeak 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.

Jitter in µUI

<table>
<thead>
<tr>
<th>Carrier frequency</th>
<th>SONET/SDH data rates</th>
<th>rms jitter bandwidth</th>
<th>ESG-A, ESG-D μUI RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>155 MHz</td>
<td>155 MB/s</td>
<td>100 Hz to 1.5 MHz</td>
<td>(239)</td>
</tr>
<tr>
<td>622 MHz</td>
<td>622 MB/s</td>
<td>1 kHz to 5 MHz</td>
<td>(149)</td>
</tr>
<tr>
<td>2.488 GHz</td>
<td>2488 MB/s</td>
<td>5 kHz to 15 MHz</td>
<td>(375)</td>
</tr>
</tbody>
</table>

Jitter in seconds

<table>
<thead>
<tr>
<th>Carrier frequency</th>
<th>SONET/SDH data rates</th>
<th>rms jitter bandwidth</th>
<th>ESG-A, ESG-D seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>155 MHz</td>
<td>155 MB/s</td>
<td>100 Hz to 1.5 MHz</td>
<td>(1.54 ps)</td>
</tr>
<tr>
<td>622 MHz</td>
<td>622 MB/s</td>
<td>1 kHz to 5 MHz</td>
<td>(240 fs)</td>
</tr>
<tr>
<td>2.488 GHz</td>
<td>2488 MB/s</td>
<td>5 kHz to 15 MHz</td>
<td>(151 fs)</td>
</tr>
</tbody>
</table>

Carrier SONET/SDH rms jitter

<table>
<thead>
<tr>
<th>Frequency data rates</th>
<th>Bandwidth (µUI RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>155 MHz 155 MB/s</td>
<td>100 Hz to 1.5 MHz</td>
</tr>
<tr>
<td>622 MHz 622 MB/s</td>
<td>1 kHz to 5 MHz</td>
</tr>
<tr>
<td>2.488 GHz 2488 MB/s</td>
<td>5 kHz to 15 MHz</td>
</tr>
</tbody>
</table>

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.

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.
3. For other frequencies, data rates, or bandwidths, please contact your sales representative.
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)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>0 to 100% (envelope peak ≤ maximum specified power)</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>0.1%</td>
</tr>
<tr>
<td><strong>Rates</strong> (3 dB bandwidth)</td>
<td>dc/10 Hz to 10 kHz</td>
</tr>
<tr>
<td><strong>Accuracy</strong> (1 kHz rate)</td>
<td>&lt; ± (6% of setting + 1%)(^1)</td>
</tr>
<tr>
<td><strong>Distortion</strong> (1 kHz rate, THD)</td>
<td></td>
</tr>
<tr>
<td>30% AM</td>
<td>&lt; 2.0%</td>
</tr>
<tr>
<td>90% AM</td>
<td>&lt; 4%, typical</td>
</tr>
<tr>
<td><strong>External inputs</strong></td>
<td>Ext 1 or Ext 2</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>1 (V_{\text{peak}}) for indicated depth</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td>50\ (\Omega), nominal</td>
</tr>
</tbody>
</table>

**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-D series only)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate</strong> (1 dB bandwidth, typical)</td>
<td></td>
</tr>
<tr>
<td>ALC On</td>
<td>400 Hz to 10 MHz</td>
</tr>
<tr>
<td>ALC Off</td>
<td>dc to 10 MHz</td>
</tr>
<tr>
<td><strong>External input</strong></td>
<td>1 input</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>0.5 (V = 100%)</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td>50\ (\Omega), nominal</td>
</tr>
</tbody>
</table>

### Pulse modulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On/off ratio</strong></td>
<td>(\leq 3 \text{ GHz}) &gt; 80 dB</td>
</tr>
<tr>
<td>(&gt; 3 \text{ GHz})</td>
<td>&gt; 60 dB</td>
</tr>
<tr>
<td><strong>Rise/fall times</strong></td>
<td>150 ns, typical</td>
</tr>
<tr>
<td><strong>Minimum width</strong></td>
<td>ALC On 2 (\mu) s, typical</td>
</tr>
<tr>
<td>ALC Off</td>
<td>0.4 (\mu) s, typical</td>
</tr>
<tr>
<td><strong>Pulse repetition frequency</strong></td>
<td></td>
</tr>
<tr>
<td>ALC On</td>
<td>10 Hz to 250 kHz, typical</td>
</tr>
<tr>
<td>ALC Off</td>
<td>dc to 1.0 MHz, typical</td>
</tr>
<tr>
<td><strong>Level accuracy</strong></td>
<td>&lt; ±0.5 dB, typical (\leq 3 \text{ GHz})</td>
</tr>
<tr>
<td></td>
<td>&lt; ±0.8 dB, typical (\leq 4 \text{ GHz}) (relative to CW)(^2)</td>
</tr>
<tr>
<td><strong>External input</strong></td>
<td>Ext 2</td>
</tr>
<tr>
<td><strong>Input voltage</strong></td>
<td>RF on (&gt; +0.5 \text{ V}), nominal</td>
</tr>
<tr>
<td>RF off</td>
<td>(&lt; +0.5 \text{ V}), nominal</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td>50 (\Omega), nominal</td>
</tr>
</tbody>
</table>

### Internal pulse generator

- **Square wave rate**
  - 0.1 Hz to 50 kHz
- **Pulse**
  - **Period** 16 \(\mu\) s to 30 sec
  - **Width** 8 \(\mu\) s to 30 sec
  - **Resolution** 4 \(\mu\) s

### High-performance pulse modulation (Option 1E6, ESG-A series) \(^3\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On/off ratio</strong></td>
<td>(\leq 2 \text{ GHz}) &gt; 80 dB</td>
</tr>
<tr>
<td>(&gt; 2 \text{ GHz})</td>
<td>&gt; 70 dB</td>
</tr>
<tr>
<td><strong>Rise/fall times</strong></td>
<td>&lt; 10 (\text{ ns})</td>
</tr>
<tr>
<td><strong>Delay</strong></td>
<td>&lt; 60 (\text{ ns}), typical</td>
</tr>
<tr>
<td><strong>External input</strong></td>
<td>Pulse in</td>
</tr>
<tr>
<td><strong>Input voltage</strong></td>
<td>+5 (V) (with RF on, TTL compatible)</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

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 \(\leq 10 \text{ kHz}\) and pulse widths \(\geq 5 \mu\) s.
3. With high performance pulse modulation (Option 1E6) installed, all maximum power specifications drop by 4 dB.
### Internal modulation source

(Provides FM, $\Phi M$, and AM modulation signals and LF out)

<table>
<thead>
<tr>
<th>Waveforms</th>
<th>sine, square, ramp, triangle, pulse, noise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate range</strong></td>
<td></td>
</tr>
<tr>
<td>Sine</td>
<td>0.1 Hz to 50 kHz</td>
</tr>
<tr>
<td>Square, ramp, triangle</td>
<td>0.1 Hz to 10 kHz</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td></td>
</tr>
<tr>
<td>Pulse only</td>
<td>0.1 Hz</td>
</tr>
<tr>
<td></td>
<td>4 µs</td>
</tr>
<tr>
<td><strong>Frequency accuracy</strong></td>
<td>0.005%, typical</td>
</tr>
<tr>
<td><strong>Swept sine mode</strong></td>
<td>(frequency, phase continuous)</td>
</tr>
<tr>
<td>Operating modes</td>
<td>Triggered or continuous sweeps</td>
</tr>
<tr>
<td>Frequency range</td>
<td>0.1 Hz to 50 kHz</td>
</tr>
<tr>
<td>Sweep time</td>
<td>1 ms to 65 sec</td>
</tr>
<tr>
<td>Resolution</td>
<td>1 ms</td>
</tr>
<tr>
<td><strong>Dual sinewave mode</strong></td>
<td>Frequency range 0.1 Hz to 50 kHz</td>
</tr>
<tr>
<td>Amplitude ratio</td>
<td>0 to 100%</td>
</tr>
<tr>
<td>Amplitude ratio resolution</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

### LF out (internal modulation source)

<table>
<thead>
<tr>
<th>Amplitude</th>
<th>0 to 3 V$_{\text{peak}}$ into 50 $\Omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output impedance</td>
<td>&lt; 1 $\Omega$</td>
</tr>
</tbody>
</table>

### External modulation inputs

<table>
<thead>
<tr>
<th>Modulation types</th>
<th>FM, $\Phi M$, AM, and burst envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext 1</td>
<td>FM, $\Phi M$, AM, and pulse</td>
</tr>
<tr>
<td>Ext 2</td>
<td></td>
</tr>
</tbody>
</table>

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-D series only)
With ALC On; relative to CW; with PRBS modulated data; if using I/Q inputs, $\sqrt{I^2 + Q^2} = 0.5 \text{ V}_{\text{rms}},$ nominal $^1$

$\pi/4$ DQPSK or QPSK formats
ESG-D series
$\pm0.20 \text{ dB}$
$\pm0.30 \text{ dB}$

($\leq 3 \text{ GHz}$)
($> 3 \text{ GHz}$)

(ESG-D series)

$\pm0.20 \text{ dB}$

$\pm0.30 \text{ dB}$

$\pm0.30 \text{ dB}$

Level accuracy with ALC off $^2$
$\pm0.3 \text{ dB}$, typical

(ESG-D series)

I/Q modulation (ESG-D series only)

I/Q inputs
Input impedance $50 \Omega$

Full scale input $^1$

$\sqrt{I^2 + Q^2} = 0.5 \text{ V}_{\text{rms}}$

Adjustments/Impairments (nominal)

DC offset (I and Q independently adjustable) $\pm100\%$

I/Q gain ratio $\pm4 \text{ dB}$

I/Q quadrature $\pm10^\circ$ (for fc $\leq 3.3 \text{ GHz}$)

External burst envelope (ESG-D series only)

Input voltage

<table>
<thead>
<tr>
<th>On</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF On</td>
<td>0 V</td>
</tr>
<tr>
<td>RF Off</td>
<td>–1.0 V</td>
</tr>
</tbody>
</table>

Linear control range

0 to –1 V

On/off ratio

<table>
<thead>
<tr>
<th>≤ 3 GHz</th>
<th>&gt; 3 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 75 dB</td>
<td>&gt; 60 dB</td>
</tr>
</tbody>
</table>

Vin

≤ –1.05 V

Rise/fall time

< 2 µs with rectangular input, typical

Minimum burst repetition frequency

<table>
<thead>
<tr>
<th>ALC on</th>
<th>ALC off</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz, typical</td>
<td>dc</td>
</tr>
</tbody>
</table>

External input

Ext 1

Input impedance

50 $\Omega$, nominal

Coherent carrier out (ESG-D series only)

Range

250 MHz to maximum carrier frequency

Level

0 dBm $\pm5$ dB, typical

Impedance

50 $\Omega$

Typical I/Q frequency response

---

1. The optimum I/Q input level is $\sqrt{I^2 + Q^2} = 0.5 \text{ V}_{\text{rms}}$. 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 $\text{V}_{\text{rms}}$.

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 $\text{V}_{\text{rms}}$ to the I/Q modulator then enables modulation.

3. Coherent carrier is modulated by FM or ΦM when enabled.
I/Q baseband generator
(Optional UN8, ESG-D series only)

Modulation
- **PSK**: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, 8PSK
- **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
  - Resolution: 0.1 Hz
- **I/Q**: Custom map of 16 unique values for I and Q

Filter
- Selectable: Nyquist, root Nyquist, Gaussian, rectangular
- 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.

<table>
<thead>
<tr>
<th>Bits/symbol</th>
<th>Maximum symbol rate (Msym/sec)</th>
<th>Maximum data rate (Mbits/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>2</td>
<td>12.5</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>8.33</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>12.5</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>8.33</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>7.14</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>6.25</td>
<td>50</td>
</tr>
</tbody>
</table>

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

1. PN15 is not continuous in bursted mode when TETRA is operated in a downlink mode.
2. Baseband I/Q outputs 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*

<table>
<thead>
<tr>
<th></th>
<th>NADC 5</th>
<th>PDC</th>
<th>PHS</th>
<th>TETRA</th>
<th>DECT</th>
<th>GSM (DCS,PCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Error vector magnitude</strong> (%) rms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low EVM mode</td>
<td>0.7</td>
<td>1.4</td>
<td>0.9</td>
<td>1.3</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Low EVM mode (typical)</td>
<td>0.4</td>
<td>1.1</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Low ACP mode (typical)</td>
<td>1.0</td>
<td>1.4</td>
<td>0.8</td>
<td>1.0</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Global phase error</strong> (rms/pk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burst</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Burst</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.6°/2.2°</td>
<td>0.3°/1.3° (typ)</td>
<td></td>
</tr>
<tr>
<td>Burst</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3 (2, typ)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Burst</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Deviation accuracy</strong> (kHz)</td>
<td>30</td>
<td>25</td>
<td>300</td>
<td>25</td>
<td>1,728</td>
<td>200</td>
</tr>
<tr>
<td>Channel spacing (kHz)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burst</td>
<td>-64</td>
<td>-63</td>
<td>-78</td>
<td>-78</td>
<td>-80</td>
<td>-78</td>
</tr>
<tr>
<td>Burst</td>
<td>-81</td>
<td>-80</td>
<td>-81</td>
<td>-80</td>
<td>-81</td>
<td>-80</td>
</tr>
<tr>
<td>Burst</td>
<td>-81</td>
<td>-80</td>
<td>-81</td>
<td>-80</td>
<td>-81</td>
<td>-80</td>
</tr>
<tr>
<td><strong>Supported burst types</strong></td>
<td>Custom, up/down TCH</td>
<td>Custom, up/down TCH, up Vox</td>
<td>Custom, TCH, sync</td>
<td>Custom, up control 1 &amp; 2 up normal, down normal, down sync</td>
<td>Custom, dummy B 1 &amp; 2 traffic B, low capacity</td>
<td>Custom, normal, FCcorr, sync, dummy, access</td>
</tr>
<tr>
<td>Scramble capabilities</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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.
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

<table>
<thead>
<tr>
<th>Modulation</th>
<th>QPSK</th>
<th>π/4DQPSK</th>
<th>16QAM</th>
<th>2FSK</th>
<th>GMSK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>Root Nyquist</td>
<td>Gaussian</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter factor ((\alpha \text{ or } B_0 T))</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Modulation index</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>Symbol rate ([\text{Msym/s]})</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Error vector magnitude (^1,2)</td>
<td>((% \text{ rms}))</td>
<td>((% \text{ rms}))</td>
<td>((% \text{ rms}))</td>
<td>((\text{degrees rms}))</td>
<td></td>
</tr>
<tr>
<td>fc = 1 GHz</td>
<td>(0.9)</td>
<td>(0.8)</td>
<td>(0.8)</td>
<td>(0.7)</td>
<td>(0.2)</td>
</tr>
<tr>
<td>fc = 2 GHz</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(0.7)</td>
<td>(0.2)</td>
</tr>
<tr>
<td>fc = 3 GHz</td>
<td>(1.5)</td>
<td>(1.5)</td>
<td>(1.4)</td>
<td>(0.8)</td>
<td>(0.4)</td>
</tr>
<tr>
<td>fc = 4 GHz</td>
<td>(2.8)</td>
<td>(2.6)</td>
<td>(3.5)</td>
<td>(1.0)</td>
<td>(0.5)</td>
</tr>
</tbody>
</table>

Typical performance (power levels \(\leq +4 \text{ dBm} \ [\leq +8 \text{ dBm, Option UNB}]\))

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 \(\leq +4 \text{ dBm}\), Option (UNB) with default scale factor of I/Q outputs.
2. Parentheses denote typical performance.
I/Q baseband generator (continued)

Non-constant amplitude formats

FSK formats

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

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)

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

MSK formats

Shift error versus frequency
(Gaussian filter, BbT = 0.5, modulation index = 0.5, symbol rate = 1Msys/s)
Dual arbitrary waveform generator
(Option UND, 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:
  - \( \leq \) 100 kHz: \(< -80 \text{ dBc}\)
  - 100 kHz to 2 MHz: \(< -65 \text{ dBc}\)
- Non-harmonic spurious (spur frequencies \(\leq 100 \text{ MHz}\)):
  - \(< -80 \text{ dBc}\)
- Phase noise:
  - \(\leq 100 \text{ kHz}\): \(< -120 \text{ dBc}/\text{Hz}\)
  - (baseband output of 1 MHz sinewave at 20 kHz offset):
    - \(< -69 \text{ dB}\)
- IM performance (two sinewaves at 950 kHz and 1050 kHz at baseband, full scale):
  - \(< -69 \text{ dB}\)

**Triggers**
- Types: Continuous, single, gated, segment advance
- Source: Trigger key, bus, external
- External polarity: Negative, positive
- External delay time: 2 \(\mu\)s 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:
  - Resolution: 1 kHz
- Frequency drift/packet:
  - Linear or Sinusoidal: Resolution 1 kHz
  - Resolution: 0.250 to 0.400
- Modulation index:
  - Resolution: .001
- Symbol timing error:
  - Resolution: \(-50 \text{ ppm to 50 ppm}\)
- AWGN with adjustable C/N:
  - Resolution: 1 \(\text{dB}\)
  - Burst: 1 to 10 #symbol/ramp
  - Resolution: 1 symbol/ramp
  - Clock/gate delay: 0 to 2499.9 symbols
  - Resolution: 0.1 symbols

**Other formats (UND)**
- NADC, PDC, PHS, GSM, DECT, TETRA, APCC025, CDPD, PWT, EDGE and custom

**Multicarrier**
- Number of carriers: Up to 64 (limited by a max bandwidth of 15 MHz)
- Frequency offset (per carrier): \(-7.5 \text{ MHz to +7.5 MHz}\)
- Power offset (per carrier): 0 \(\text{dB to} -40 \text{ dB}\)

**Modulation**
- PSK: BPSK, QPSK, OQPSK, \(\pi/4\)DQPSK, 6PSK, 16PSK, 8\(\pi\)DPSK
- 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-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
- Gaussian $\alpha = 0$ 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 (carrier power): < 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**
(dBC, with high crest factor on)

<table>
<thead>
<tr>
<th>Channels/offsets</th>
<th>0.885 to 1.25 MHz</th>
<th>1.25 to 1.98 MHz</th>
<th>1.98 to 5 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Option UNB</td>
<td>Option H99 (Rev B)</td>
</tr>
<tr>
<td>Reverse (at ≤ 0 dBm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 – 699 MHz</td>
<td>–66 (–72)</td>
<td>–70 (–75)</td>
<td>–71 (–75)</td>
</tr>
<tr>
<td>700 – 1000 MHz</td>
<td>–68 (–73)</td>
<td>–72 (–76)</td>
<td>–78 (–79)</td>
</tr>
<tr>
<td>1000 – 2000 MHz</td>
<td>–63 (–66)</td>
<td>–70 (–74)</td>
<td>–78 (–79)</td>
</tr>
<tr>
<td>9/64 channels (at ≤ –2 dBm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 – 699 MHz</td>
<td>–65 (–68)</td>
<td>–68 (–71)</td>
<td>–70 (–73)</td>
</tr>
<tr>
<td>700 – 1000 MHz</td>
<td>–64 (–70)</td>
<td>–69 (–73)</td>
<td>–73 (–75)</td>
</tr>
<tr>
<td>1000 – 2000 MHz</td>
<td>–60 (–63)</td>
<td>–67 (–71)</td>
<td>–72 (–73)</td>
</tr>
</tbody>
</table>

1. Parentheses denote typical performance.
2. Specifications apply with high crest factor off.
Bit Error Rate (BER) analyzer
(Option UN7, 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

<table>
<thead>
<tr>
<th>Feature</th>
<th>2 Mbps mode</th>
<th>10 Mbps mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time display</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bit count</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Error-bit-count</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bit error rate</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pass/fail indication</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Valid data and clock detection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Automatic re-synchronization</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Special pattern ignore</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

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. Peak power level is 3 dB below DPCH power.
2. DPCCH power level is 6 dB below DPDCCH power.
Measurements

Results

Class Ia 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 Ia bit-error count
Class II bit-error count
Erased frame count
Total frame count

Maximum RBER
100%

Maximum FER
100%

Measurement modes

Static reference
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

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
BER at user-specified power level measured; based on bit errors in total unencoded data.

Sensitivity test (BER%)
BER 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.

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

Real-time display
2 Mbps mode X 10 Mbps mode X
Bit count X
Error-bit-count X
Bit error rate X
Pass/fail indication X 10 Mbps mode X
Valid data and clock detection X 10 Mbps mode X
Automatic re-synchronization X
Special pattern ignore X
Multichannel Multicarrier 3GPP W-CDMA personality
(Option 100, ESG-D series only)


**Chip rates** 3.84 Mchips/sec ± 10%

**Frame duration** 10 ms

**Filters**
- W-CDMA
  - $\alpha = 0.22$
- Nyquist, root Nyquist
  - $\alpha = 0$ to 1
- Gaussian
  - $B_0T = 0$ 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 $|Q|$
  - 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 DPCCH
  - 3 DPCCH
  - PCCPCH + SCH
  - PCCPCH + SCH + 1 DPCCH
  - PCCPCH + SCH + 3 DPCCH
- Test Model 1 with 16, 32, or 64 DPCCH
- Test Model 2
- Test Model 3 with 16 or 32 DPCCH
- Test Model 4

**User-defined channel parameters**
- Symbol rates 7.5, 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 1FFFFFFF, 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**

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

**Adjacent channel power**

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

**Alternate channel power**

1.8 GHz < $f_c$ < 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

**Channel Types**

| (downlink) | PICH, DCNS, PCCPCH, SCCPCH, PSCH, SSCH, CPICH, DPCH |
| (uplink)   | DPCCH, DPDCCH |

**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 kbps, spread code 0
  - DPCCH + 1 DPDCH 960 kbps, spread code 1
  - DPCCH + 2 DPDCH 960 kbps, spread code 1
  - DPCCH + 3 DPDCH 960 kbps, spread code 2
  - DPCCH + 4 DPDCH 960 kbps, spread code 2
  - DPCCH + 5 DPDCH 960 kbps, spread code 3

**User-defined channel parameters**
- Symbol rates 15, 30, 60, 120, 240, 480, or 960 kbps
- Number of DPDCH channels 6
- Spreading code 0 to 511, symbol rate
- Scrambling code 1 to 1FFFFFFF, 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

**Electronic attenuator**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Mechanical attenuator (Option UNB)</th>
<th>Low ACP (Option H99 Rev B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DPCCH</td>
<td>(–58 dBc)</td>
<td>(–58 dBc)</td>
</tr>
<tr>
<td>Test Model 1</td>
<td>(–50 dBc)</td>
<td>(–55 dBc)</td>
</tr>
<tr>
<td>+ 64 DPCCH</td>
<td>(–58 dBc)</td>
<td>(–64 (–66 dBc)</td>
</tr>
</tbody>
</table>

**Mechanical attenuator**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Mechanical attenuator (Option UNB)</th>
<th>Low ACP (Option H99 Rev B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DPCCH</td>
<td>(–50 dBc)</td>
<td>(–55 dBc)</td>
</tr>
<tr>
<td>Test Model 1</td>
<td>(–58 dBc)</td>
<td>(–60 (–63 dBc)</td>
</tr>
</tbody>
</table>

**Low ACP**

<table>
<thead>
<tr>
<th>(Option H99)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 DPCCH</td>
</tr>
<tr>
<td>Test model 1 + 64 DPCCH</td>
</tr>
</tbody>
</table>

1. Parentheses denote typical performance.
2. Valid for 23 ± 5 °C.
Multichannel cdma2000 personality
(Option 101, 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
- Gaussian
- Custom FIR
  - \( \alpha = 0 \) to 1
  - \( B_0 T = 0.1 \) to 1
  - Up to 256 coefficients
  - 16-bit resolution
  - Automatically scaled
- Rectangle

**I/O mapping**
- Normal, invert

**Clipping**
- Clip location
  - Pre-or post-FIR filter
- Clipping type
  - \(|I+Q|\), \(|I|\) 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)
  - \(-7.5 \text{ MHz to } +7.5 \text{ MHz}\)
- Power offset
  - \(0 \text{ dB to } -40 \text{ dB}\)

**Forward link**
- Spreading type
  - Direct spread (DS), multicarrier
- Pre-defined channel configurations (partially coded)
  - Pilot channel, DS/SR1
  - Pilot channel, DS/SR3
  - Pilot channel, Multicarrier/SR3
  - 9 channel, DS/SR1

**Reverse link**
- Spreading type
  - Direct spread only
- Pre-defined channel configurations (partially coded)
  - Pilot channel, SR1
  - 5 channel, (SR1 or SR3)
  - Pilot at Walsh 0
  - Includes pilot, dedicated control channel, traffic RC3 at 9.6 bps, and two supplemental RC3 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 kbps 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 \(-40 \text{ dB}\)
  - PN offsets
  - 0 to 511
  - 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

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

<table>
<thead>
<tr>
<th>Channels/offsets</th>
<th>Offsets from center of carrier</th>
<th>Offsets from center of carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.135 to 2.50 MHz</td>
<td>2.50 to 3.23 MHz</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Option H99</td>
</tr>
<tr>
<td>Forward 9 channel, SR3/multicarrier³</td>
<td>(–68) (–68) (–66) (–68) (–69) (–70)</td>
<td>700 – 1000 MHz (–69) (–73) (–68) (–72) (–70) (–75)</td>
</tr>
<tr>
<td>Offset from center of carrier</td>
<td>2.655 to 3.75 MHz</td>
<td>3.75 to 5.94 MHz</td>
</tr>
<tr>
<td>Standard</td>
<td>Option H99</td>
<td>Standard</td>
</tr>
<tr>
<td>Forward 9 channel, SR3/DS⁴</td>
<td>30 – 200 MHz (–75) (–74) (–76) (–75) (–77) (–78)</td>
<td>700 – 1000 MHz (–76) (–79) (–78) (–82) (–78) (–82)</td>
</tr>
<tr>
<td>Reverse 5 channel, SR3/DS³</td>
<td>30 – 200 MHz (–77) (–77) (–77) (–75) (–76) (–79)</td>
<td>700 – 1000 MHz (–77) (–80) (–78) (–82) (–78) (–82)</td>
</tr>
</tbody>
</table>

1. Parentheses denote typical performance.
2. Excluding 10 MHz reference clock spur (\( \leq -67 \) 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-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 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: \( B_a T = 0 \) 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.)

<table>
<thead>
<tr>
<th>Channel Type</th>
<th>Power</th>
<th>Symbol rate</th>
<th>OVSF</th>
<th>Scramble code group</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSCH</strong></td>
<td>–40 to 0 dB</td>
<td>7.5, 15, 30, 60, 120, 240, 480, 960 Kbps</td>
<td>0 to 511 (dependent on channel symbol rate)</td>
<td>0 to 63 (coupled to primary scramble code)</td>
<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
<tr>
<td><strong>SSCH</strong></td>
<td>–40 to 0 dB</td>
<td>7.5, 15, 30, 60, 120, 240, 480, 960 Kbps</td>
<td>0 to 511 (dependent on channel symbol rate)</td>
<td>0 to 63 (coupled to primary scramble code)</td>
<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
<tr>
<td><strong>P-CCPCH</strong></td>
<td>–40 to 0 dB</td>
<td>7.5, 15, 30, 60, 120, 240, 480, 960 Kbps</td>
<td>0 to 511 (dependent on channel symbol rate)</td>
<td>0 to 255</td>
<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
<tr>
<td><strong>CPICH</strong></td>
<td>–40 to 0 dB</td>
<td>7.5, 15, 30, 60, 120, 240, 480, 960 Kbps</td>
<td>0 to 511 (dependent on channel symbol rate)</td>
<td>0 to 255</td>
<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
</tbody>
</table>

**DPCH**
Reference measurement channels
- Transport layer (DCH control)
  - Transport size: 12.2, 64, 144, 384 kbps
  - (Up to 6 DCH’s for each DPCH)
  - Block size, Transport Time Interval (TTI), rate matching, CRC size, transport channel number
  - Data 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 Kbps
- 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

**TPCH offset**
0 to 149

**Secondary scramble code offset**
0 to 15

**OCNS**
- Power: –40 to 0 dB
- Symbol rate: 7.5, 15, 30, 60, 120, 240, 480, 960 Kbps
- OVSF: 0 to 511 (dependent on channel symbol rate)

<table>
<thead>
<tr>
<th>Channel Type</th>
<th>Power</th>
<th>Symbol rate</th>
<th>OVSF</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSCH</strong></td>
<td>–40 to 0 dB</td>
<td>7.5, 15, 30, 60, 120, 240, 480, 960 Kbps</td>
<td>0 to 511 (dependent on channel symbol rate)</td>
<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
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<td><strong>SSCH</strong></td>
<td>–40 to 0 dB</td>
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<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
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<td>PN9, PN15, 4-bit repeating pattern, user file, transport channel</td>
</tr>
</tbody>
</table>

---

User equipment (UE) setup

FIR filter
Root Nyquist, Nyquist Gaussian \( a = 0 \) 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 \( x \times 1 \) (3.84 MHz), \( x \times 2 \) (7.68 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

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 kps 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
DPCC (Q) symbol data: data out
Real-time cdma2000 personality
(Option 201, ESG-D series only)

Description
Option 201, cdma2000 personality, adds a flexible solution for cdma2000 mobile and base station test to Agilent ESG-D 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
- PC ramp, Yi FFCH, Yq FFCH, FPCH W, Sync W, FPCH X, 25 ms clock
- Data out
- 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
- 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 0-3FFFFFFF
- 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 0-3FFFFFFF
- Power control N up/down, "N" may be set from 1 to 80
- Power puncture On/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, Zl, 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

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
          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 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, 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, 38.4, 76.8, 153.6, 307.2 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2, 230.4 kbps for RC4
          For frame length = 40
          1.35, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
          For frame length = 80
          1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
          For frame length = 160
          1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 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, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
          For frame length = 40
          1.35, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
          For frame length = 80
          1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
          For frame length = 160
          1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6 kbps for RC 3
          1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 kbps for RC4
Frame offset  (0 to frame length/1.25) –1

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1. Only one channel is available in RC1 and 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.
For frame length = 80
1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8 kbps
for RC 3
1.8, 3.6, 7.2, 14.4, 28.8, 57.6 kbps
for RC 4

Frame offset
(0 to frame length/1.25) –1

R-CCCH3 (Reverse Common Control Channel) and R-EACH3
(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 EDGE3 personality
(Option 202, 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.

EVM performance (typical)

<table>
<thead>
<tr>
<th>Output power</th>
<th>Output frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Option UNB</td>
</tr>
<tr>
<td>≤ 7 dBm</td>
<td>≤ 10 dBm</td>
</tr>
<tr>
<td>≤ 4 dBm</td>
<td>≤ 7 dBm</td>
</tr>
</tbody>
</table>

Alternate time slot power level control
(Option UNA, ESG-D series only)

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

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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 traffic channel for component tests.
**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’s 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 Vpeak 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 Vrms and 10 Vpeak.
  (BNC, front panel)

**External input 2**
- Drives either AM, FM, ΦM, or pulse. Nominal input impedance 50 ohms, damage levels are 5 Vrms and 10 Vpeak.
  (BNC, front panel)

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

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

**10 MHz input**
- 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-A series and** **Option 1E6 only**

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

**With 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 Vrms and 10 Vpeak.
  (BNC, front panel)

**“Q” input**
- Accepts a “Q” input for I/Q modulation. Nominal input impedance 50 ohms, damage levels are 1 Vrms and 10 Vpeak.
  (BNC, front panel)

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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 249.9990001 MHz to maximum frequency. For RF carriers below this range, output frequency = 1 GHz – frequency of RF output. Damage levels 20 Vdc and 13 dBm reverse RF power. (SMA, rear panel)

With 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, 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, 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 on bit resolution. Damage levels are > +8 and < –4 V. (BNC, 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, rear panel)

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

Triggers 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 Vpeak to peak. Nominal impedance 50 ohms, DC-coupled, damage levels are > +2 and < –2 V. (BNC, rear panel)

With ESG-D series and Option UND only

"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 Vpeak 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, rear panel)

With 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, 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-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, 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
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

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
<table>
<thead>
<tr>
<th>Model #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E4432B</td>
<td></td>
</tr>
<tr>
<td>E4432B-UND</td>
<td></td>
</tr>
<tr>
<td>E4432B-100</td>
<td></td>
</tr>
</tbody>
</table>

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
Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

Agilent Direct

www.agilent.com/find/quick
Quickly choose and use your test equipment solutions with confidence.

Agilent Open

www.agilent.com/find/open
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