**E4432A Digital RF Signal Generator, 250 kHz to 3000 MHz (Discontinued - Support Information Only)**

**Data Sheet**

**Frequency Specifications**

**Frequency Range**: Agilent ESG-D3000A: 250 kHz to 3000 MHz

**Resolution**: 0.01 Hz

**Switching Speed**
- Modulation On: <45 ms, typical
- Modulation Off: <35 ms, typical

**Accuracy**: Same as timebase. Analog only RF Signal Generators are also available. See ESG Series Analog RF Signal Generators. Sweep Modes

**Operating modes**
- Step: frequency & power, and arbitrary list
- Dwell Time: 2 ms to 60 sec
- Number of Points: 2 to 401 Internal Reference Oscillator

**Stability Standard (typical)**
- High Stability (Opt 1E5)

**Aging Rate**: 
- Standard (typical) 
- <±2 ppm/yr or <±0.0005 ppm/day after 45 days
- High Stability (Opt 1E5) 
- <±0.1 ppm/yr or <±0.0005 ppm/day after 45 days

**Temperature**
- <±1 ppm <±0.05 ppm, typical (0° to 55° C)

**Line Voltage**
- <±0.1 ppm <±0.002 ppm, typical (+5%, -10%) (+5%, -10%)

**Timebase Reference Output**
- Frequency: 10 MHz Amplitude: >0.35 Vrms into 50 ohm load

**External Reference Input**
- Frequency: 1, 2, 5, 10 MHz ± typ. 10 ppm Option 1E5: 1 ppm, typical Amplitude: >0.15 Vrms

**Range**
- 250 kHz to 1000 MHz: +13 to -136 dBm >1000 MHz to 3000 MHz: +10 to -136 dBm >3000 MHz to 4000 MHz: +13 to -136 dBm

**Resolution**
- 0.02 dB

**Level Accuracy**
- (at 23 ±5°C) +7 to -127 dBm 250 kHz to 2 GHz: ±0.5 dB ±1.5 dB
- 2 GHz to 4 GHz: ±0.9 dB ±2.5 dB

**Attenuator Hold Level Range**: >17 dB

**Switching Speed**
- <25 ms typical
- With Power Search Mode: <210 ms typical

**Reverse Power Protection**: 250 kHz to 2000 MHz: 50 Watts 2000 MHz to 4000 MHz: 25 Watts Max DC Voltage: 50 V

**SWR (typical)**
- 250 kHz to 2000 MHz: <1.4:1 >2000 to 4000 MHz: <1.9:1

**Output Impedance**: 50 ohms. Accuracy degrades by 0.02 dB/°C over full temperature range and by 0.3 dB above +7 dBm. Level Accuracy with Digital Modulation (With ALC on; relative to CW; with PRBS-modulated data; if using I/Q inputs, = [square root of (I^2 + Q^2)]=0.5 Vrms nominal)

**pi/4 DQPSK or QPSK Formats**: ±0.15 dB (with raised cosine or root-raised cosine filter and alpha >=0.35; with 10 kHz symbol rate <1 MHz; at RF Freq. >25 MHz; power <max. specified -3 dBm)

**Constant Amplitude Formats** (FSK, GSMK, etc.): no degradation in power level accuracy

**Level Accuracy with ALC Off**: ±0.5 dB, typical (after power search is executed; relative to CW level accuracy with ALC on; with burst off if external I/Q is enabled; [square root of (I^2 + Q^2)]= 0.5 Vrms)

**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
Spectral Purity

SSB Phase Noise (typical, at 20 kHz offset) at 500 MHz: <-120 dBc/Hz at 1000 MHz: <-116 dBc/Hz at 2000 MHz: <-110 dBc/Hz at 3000 MHz: <-104 dBc/Hz at 4000 MHz: <-104 dBc/Hz

Residual FM (CW mode, 0.3-3 kHz BW, CCITT, rms): Phase Noise Mode 1: <N x 2 Hz Phase Noise Mode 2: <N x 4 Hz

Harmonics <=+4 dBm output level: <-30 dB

Nonharmonics (>3 kHz offset, <+7 dBm output level) 250 kHz to 1000 MHz: <-65 dBc >1000 MHz to 2000 MHz: <-59 dBc >2000 MHz: <-53 dBc

Subharmonics <=1 kHz: None >1000 MHz: <-40 dBc IQ Modulation

I&Q Inputs: Input Impedance: 50 ohms Full Scale Input: sqrt(I^2 + Q^2) = 0.5 Vrms External Input RF Bandwidth (1 dB): 20 MHz, typical Adjustments/Impairments (nominal) DC Offset (I + Q independently adjustable): ±100% I/Q Gain Ratio: ±4 dB

DC Vector Accuracy: (relative to full scale, at <=+7 dBm) Frequency GHz: <0.6 0.6 to 2 2 to 3.7 <4 Static EVM (rms): <0.75% <0.5% 0.75% <1% Magnitude Error (rms): <0.5% <0.35% <0.5% <0.75% Phase Error (rms): <0.35° <0.25° <0.35° <0.5° Origin Offset dBc: <-46 <46 <46 <40 <40 5Valid for 10 days after executing internal calibration routine, provided temperature is maintained within ±5° C of calibration temperature. 6Measured at full scale with origin offset removed.

Frequency Modulation

Maximum Deviation: N x 10 MHz

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

Deviation Accuracy (1 kHz rate, dev. <=N x 100 kHz): <=(3.5% of FM deviation + 20 Hz)

Modulation Frequency Response (deviation = 100 kHz)

Path 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

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

Phase Modulation

Maximum Deviation: N x 90 radians

Resolution: 0.1% of set deviation

Deviation Accuracy (1 kHz rate): <=(5% of deviation + 0.01 radians)

Modulation Frequency Response

PM Mode Maximum Rates (3 dB BW) Deviation PM1 PM2 Normal BW N x 90 rad dc to 100 kHz dc to 100 kHz

High BW N x 2 pi rad dc to 1.5 MHz (typ) dc to 1 MHz (typ) N x pi/2 rad dc to 4 MHz (typ) dc to 0.9 MHz (typ)

Distortion (1 kHz rate, THD, dev <=N x 90 rad): <1% Amplitude Modulation fc>500 kHz

Range (envelope peak <=max specified power): 0 to 100%

Resolution: 0.1%

Rates (3 dB Bandwidth): dc/10 Hz to 10 kHz

Distortion (1 kHz rate, THD) 30% AM: <1.5% 90% AM: <4%

Accuracy (1 kHz rate): <=(5% of setting + 1%) Wide Band AM

Rate (1 dB Bandwidth, typical) ALC On: 400 Hz to 10 MHz ALC Off: DC to 10 MHz

Input: 1 Input

Impedance: 50 ohms

Sensitivity: 0.5 V=100% 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 (relative to CW) ²: ±0.5 dB, typical

External Input: Ext 2

Input Voltage RF On: >=+0.5 V, nominal RF Off: <+0.5 V, nominal

Input Impedance: 50 ohms, nominal

Internal Pulse Generator Squarewave Rate: 0.1 Hz to 50 kHz Pulse Period: 16 µs to 30 sec Pulse Width: 8 µs to 30 sec Pulse Resolution: 4 µs ³Typical, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 Vrms Burst Envelope

On/Off Ratio Vμ: <=1.05 V <=3 GHz: >75 dB >3 GHz: >65 dB

Rise/Fall Time: <=2 µs, typical

Minimum Burst Repetition Frequency ALC On: 10 Hz, typical ALC Off: DC

External Input: Ext 1

Input Impedance: 50 ohms
**Input Voltage** RF Off: -1.0 V RF On: 0 V Linear Control Range: 0 to -1.0 V Internal Modulation Source Provides FM, PM, and AM Modulation Signals and LF Out

**Waveforms:** sine, ramp, triangle, pulse, noise

**Rate Range** Sine: 0.1 Hz to 50 kHz Square, Ramp, Triangle Optional I/Q Baseband Generator (Option UN3 or UN4)

**Supported Standards:** DECT, GSM, NADC, PDC, PHS, and TETRA

**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 with the appropriate clock.

**Internal Data:** Pseudorandom Patterns (meets ITU-T standard): Continuous PN9 (PRBS $2^9-1$) or PN15 ($2^{15}-1$) Repeating Sequence: any 4-bit sequence

**Downloadable Data (User Files):** Type: Serial Data Minimum Size: Must fill entire field for which it was selected Maximum Size: 1 Mbits (Opt UN3), 8 Mbits (Opt UN4)

**External Data:** Type: Serial Data Inputs: Data, Bit/Symbol Clocks Accepts data rates ±5% of specified data rate Reference Frequency Internal or External: 1, 2, 5, 10 MHz reference Data clock can be locked to the external 13 MHz reference (GSM)

**Frame Trigger Delay Control** Range: 0 to 65,000 bits Resolution: 1 bit

**Internal Burst Shape Control** Rise/Fall Time Range: up to 30 bits Rise/Fall Delay Range: 0 to 63.5 bits (varies with standard) PN15 is not continuous in bursted mode for TETRA applications. NADC (Option UN3 or UN4)

**Modulation Format:** pi/4 DQPSK

**Data Rate** (default): 48.6 kbits/sec Adjustment Range: 40 to 75.5 kbits/sec

**Filter:** Root-Raised Cosine or Raised Cosine Default Value: $\alpha = 0.35$ Range (alpha): 0.3, 0.35, 0.4, 0.5, 0.6

**Error Vector Magnitude** (% rms)
[see table 1]

**Channel Spacing:** 30 kHz

**Adjacent Channel Power** (ACP)
(Low ACP Mode, dBC, typical)
[see table 2]

**Supported Burst Types:** Custom, Up/Down TCH

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**Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+7 dBm.**

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**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, 3rd Alternate Channel = 4 x channel spacing.

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**PDC (Option UN3 or UN4)**

**Modulation Format:** pi/4 DQPSK

**Data Rate** (default): 42 kbits/sec Adjustment Range: 40 to 75.5 kbits/sec

**Filter:** Root-Raised Cosine or Raised Cosine Default Value: $\alpha = 0.5$
Range (alpha): 0.3, 0.35, 0.4, 0.5, 0.6

**Error Vector Magnitude** (% rms)
[see table 3]

**Channel Spacing:** 25 kHz

**Adjacent Channel Power** (ACP)
(Low ACP Mode, dBC, typical)
[see table 4]

**Supported Burst Types:** Custom, Up/Down TCH, Up Vox

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**Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+7 dBm.**
The "channel spacing" determines the offset size of the adjacent and alternate channels: 1st Alternate Channel = 2 x channel spacing, 3rd Alternate Channel = 4 x channel spacing.

**PHS (Option UN3 or UN4)**

**Modulation Format:** pi/4 DQPSK  
**Data Rate** (default): 384 kbits/sec  
Adjustment Range: 320 to 605 kbits/sec  
**Filter:** Root-Raised Cosine or Raised Cosine  
Default Value: alpha = 0.5  
Range (alpha): 0.3, 0.35, 0.4, 0.5, 0.6  
**Error Vector Magnitude** (% rms)  
[see table 5]  
**Channel Spacing:** 300 kHz  
**Adjacent Channel Power** (ACP)  
(Low ACP Mode, dBc, typical)  
[see table 6]  
**Supported Burst Types:** Custom, TCH, Sync  
**Scramble Capabilities:** yes  

Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+7 dBm.

**TETRA (Option UN3 or UN4)**

**Modulation Format:** pi/4 DQPSK  
**Data Rate** (default): 36 kbits/sec  
Adjustment Range: 31 to 37.8 kbits/sec  
**Filter:** Root-Raised Cosine or Raised Cosine  
Default Value: alpha = 0.35  
Range (alpha): 0.3, 0.35, 0.4, 0.5, 0.6  
**Error Vector Magnitude** (% rms)  
[see table 7]  
**Channel Spacing:** 25 kHz  
**Adjacent Channel Power** (ACP)  
(Low ACP Mode, dBc, typical)  
[see table 8]  
**Supported Burst Types:** Custom, Up Control 1 & 2, Up Normal, Down Normal, Down Sync  
**Scramble Capabilities:** Yes  

Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+4 dBm.

The "channel spacing" determines the offset size of the adjacent and alternate channels: 1st Alternate Channel = 2 x channel spacing, 2nd Alternate Channel = 3 x channel spacing.

ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root-raised cosine filter applied.
DECT (Option UN3 or UN4)
Modulation Format: GFSK
Data Rate (default): 1,152 kbits/sec
Adjustment Range: 922 to 1209.6 kbits/sec
Filter: Gaussian
Default Value: BT = 0.5
Range (BT in 0.5 steps): 0.2 to 0.7
Deviation Accuracy: 17° (1.5, typical)
Channel Spacing: 1.728 MHz
Supported Burst Types: Custom, Dummy B 1 & 2, Traffic B, Low Capacity

Specifications apply for the frequency range, data rates and filter factors (BT) specified at power levels >=+7 dBm.

GSM (DCS1800/PCS1900) (Option UN3 or UN4)
Modulation Format: GMSK
Data Rate (default): 270.83 kbits/sec
Adjustment Range: 163 to 300 kbits/sec
Filter: Gaussian
Default Value: Bbt = 0.3
Range (BT in 0.5 steps): 0.2 to 0.7
Global Phase Error: 18° (rms/pk) 1°/4°
0.5°/1.75° (typical)
Channel Spacing: 200 kHz
Adjacent Channel Power (ACP)
(Low ACP Mode, dBC, typical)
[see table 9]
Supported Burst Types: Custom, Normal, FCorr, Sync, Dummy, Access

Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+7 dBm.

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, 3rd Alternate Channel = 4 x channel spacing.

Coherent Carrier Out
Range: 250 MHz to maximum carrier frequency
Level: 0 dBm ±5 dB, typical
Impedance: 50 ohms

Coherent carrier is modulated by FM or phase modulation when enabled.

Internal Modulation Source
Provides FM, PM, 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
Frequency Accuracy: 0.005%
External Modulation Inputs

**Modulation Types**
Ext1: FM, PM, AM, and Burst Envelope
Ext2: FM, PM, AM, and Pulse

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<thead>
<tr>
<th>TABLE 1</th>
<th>Continuous</th>
<th>Burst</th>
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<tbody>
<tr>
<td>Low EVM Mode</td>
<td>1.25</td>
<td>1.75</td>
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<tr>
<td>Low EVM Mode (typical)</td>
<td>0.8</td>
<td>1.25</td>
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<tr>
<td>Low ACP Mode (typical)</td>
<td>1.5</td>
<td>1.75</td>
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<td>TABLE 2</td>
<td>Continuous Burst</td>
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<tr>
<td>At Adjacent Channel&lt;sup&gt;5&lt;/sup&gt;</td>
<td>-35</td>
<td>-34</td>
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<tr>
<td>At 1st Alternate Channel&lt;sup&gt;9&lt;/sup&gt;</td>
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<td>At 2nd Alternate Channel&lt;sup&gt;9&lt;/sup&gt;</td>
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<td>At 3rd Alternate Channel&lt;sup&gt;9&lt;/sup&gt;</td>
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<th>TABLE 3</th>
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<tbody>
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<td>Low EVM Mode</td>
<td>1.25</td>
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<tr>
<td>Low EVM Mode (typical)</td>
<td>0.8</td>
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<tr>
<td>Low ACP Mode (typical)</td>
<td>1.25</td>
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<th>TABLE 4</th>
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<tr>
<td>at 1st Alternate Channel&lt;sup&gt;11&lt;/sup&gt;</td>
<td>-71</td>
</tr>
<tr>
<td>at 3rd Alternate Channel&lt;sup&gt;11&lt;/sup&gt;</td>
<td>-78</td>
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<th>TABLE 5</th>
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<td>Low EVM Mode</td>
<td>1.5</td>
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<td>Low EVM Mode (typical)</td>
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<td>Low ACP Mode (typical)</td>
<td>1.25</td>
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<tr>
<td>At 1st Alternate Channel&lt;sup&gt;13&lt;/sup&gt;</td>
<td>-76</td>
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<tr>
<td>At 2nd Alternate Channel&lt;sup&gt;13&lt;/sup&gt;</td>
<td>-78</td>
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<th>TABLE 7</th>
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<td>Low EVM Mode</td>
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<td>Low EVM Mode (typical)</td>
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<tr>
<td>Low ACP Mode (typical)</td>
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