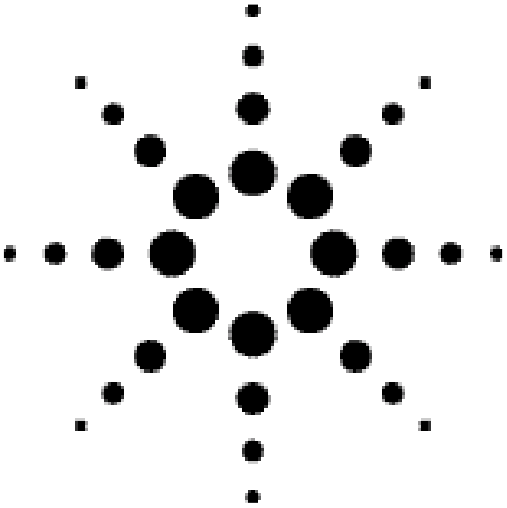

E4431A Digital RF Signal Generator, 250 kHz to 2000 MHz (Discontinued - Support Information Only)

Data Sheet

Frequency Specifications
Frequency Range[1] Agilent ESG-D2000A: 250 kHz to 2000 MHz
Resolution: 0.01 Hz
Switching Speed Modulation On: <45 ms, typical Modulation Off: <35 ms, typical
Accuracy: Same as timebase [1]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 <±2 ppm/yr <±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 V_{rms} into 50 ohm load
External Reference Input Frequency: 1, 2, 5, 10 MHz ± typ. 10 ppm Option 1E5: 1 ppm, typical Amplitude: >0.15 V_{rms} Input Impedance: 50 ohm Output
Range 250 kHz to 1000 MHz: +13 to -136 dBm >1000 MHz to 3000 MHz: +10 to -136 dBm >3000 MHz to 4000 MHz: +7 to -136 dBm
Resolution 0.02 dB
Level Accuracy[2] **(at 23 ±5°C) +7 to -127 dBm <-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 [2]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 V_{rms} nominal)[3]
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[4]**:** ±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 V_{rms}) [3]Typical, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms}. [4]When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.
Frequency Bands
Band Frequency Range N# 1 250 kHz to <=249.999 MHz 1 2 >249.999 to <=500 MHz 0.5 3 >500 MHz to <=1 GHz 1 4 >1 to <=2 GHz 2 5 >2 to 4 GHz 4

Agilent Technologies

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: <-104dBc/Hz at 4000 MHz: <-104 dBc/Hz
Residual FM (CWmode, 0.3-3 kHz BW,CCITT, rms): Phase Noise Mode l: <N x 2 Hz Phase Noise Mode 2: <N x 4 Hz
Harmonics <=+4 dBm output level: <-30 dBc
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 <=1000 MHz: None >1000 MHz: <-40 dBc IQ Modulation
I&Q Inputs: Input Impedance: 50 ohms Full Scale Input:[square root of(I^2+ Q^2)]=0.5 V_{rms} 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[5]: (relative to full scale, at <=+7 dBm) Frequency GHz: <0.6 0.6 to 2 2 to 3.7 <=4 Static EVM[6] (rms): <0.75% <0.5% 0.75% <1% Magnitude Error[6] (rms): <0.5% <0.35% <0.5% <0.75% Phase Error[6] (rms): <0.35° <0.25° <0.35° <0.5° Origin Offset dBc: <-46 <-46 <-40 <-40 [5]Valid for 10 days after executing internal calibration routine, provided temperature is maintained within ±5° C of calibration temperature. [6]Measured 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 2pi 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: I 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)[7]: ±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 [7]Typical, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms}. Burst Envelope
On/Off Ratio V_{IN}: <=-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, square, 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 [7] (PRBS 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) [7]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)[8]
[see table 1]

Channel Spacing: 30 kHz
Adjacent Channel Power[8] (ACP)
(Low ACP Mode, dBc, typical)
[see table 2]
Supported Burst Types: Custom, Up/Down TCH

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

[9]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.

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)[10]
[see table 3]
Channel Spacing:25kHz

Adjacent Channel Power[10] (ACP)
(Low ACP Mode, dBc, typical)
[see table 4]
Supported Burst Types: Custom, Up/Down TCH, Up Vox

[10]Specifications apply for the frequency range, data rates and filter factors (alpha) specified at power levels >=+7 dBm.
[11]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)[12]
[see table 5]
Channel Spacing: 300 kHz
Adjacent Channel Power[12] (ACP)
(Low ACP Mode, dBc, typical)
[see table 6]
Supported Burst Types: Custom, TCH, Sync
Scramble Capabilities: yes

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

[13]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.

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)[14]
[see table 7]
Channel Spacing: 25 kHz
Adjacent Channel Power[14] (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

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

[15]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.

[16]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] 6 (1.5, typical)
Channel Spacing: 1.728 MHz
Supported Burst Types: Custom, Dummy B 1 & 2, Traffic B,

Low Capacity

[17]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): .02 to 0.7
Global Phase Error:[18] (rms/pk) 1°/4°
0.5°/1.75° (typical)
Channel Spacing: 200 kHz
Adjacent Channel Power[18] **(ACP)**
(Low ACP Mode, dBc, typical)
[see table 9]
Supported Burst Types: Custom, Normal, FCorr, Sync, Dummy, Access

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

[19]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[20]
Range: 250 MHz to maximum carrier frequency
Level: 0 dBm ±5 dB, typical
Impedance: 50 ohms

[20]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

TABLE 1

	Continuous	Burst
Low EVM Mode	1.25	1.75
Low EVM Mode (typical)	0.8	1.25
Low ACP Mode (typical)	1.5	1.75

TABLE 2

	Continuous	Burst
At Adjacent Channel[9]	-35	-34
At 1st Alternate Channel[9]	-75	-73
At 2nd Alternate Channel[9]	-78	-77
At 3rd Alternate Channel[9]	-78	-78

TABLE 3

	Continuous	Burst
Low EVM Mode	1.25	1.75
Low EVM Mode (typical)	0.8	1.25
Low ACP Mode (typical)	1.25	1.25

TABLE 4

	Continuous	Burst
at 1st Alternate Channel[11]	-71	-69
at 3rd Alternate Channel[11]	-78	-78

TABLE 5

	Continuous	Burst
Low EVM Mode	1.5	1.75
Low EVM Mode (typical)	0.9	0.9
Low ACP Mode (typical)	1.25	1.25

TABLE 6

	Continuous	Burst
At 1st Alternate Channel[13]	-76	-75
At 2nd Alternate Channel[13]	-78	-77

TABLE 7

	Continuous	Burst
Low EVM Mode	1.25	2.0
Low EVM Mode (typical)	0.8	1.25
Low ACP Mode (typical)	3.25	3.25

TABLE 8

	Continuous	Burst[16]
At Adjacent Channel[15]	-68	-65
At 1st Alternate Channel[15]	-77	-76
At 2nd Alternate Channel[15]	-79	-79
At 3rd Alternate Channel[15]	-79	-79

TABLE 9

	Continuous	Burst
At AdjacentChannel[19]	-38	-37
At 1st Alternate Channel[19]	-71	-69
At 2nd Alternate Channel[19]	-81	-79
At 3rd Alternate Channel[19]	-83	-81

Agilent Technologies