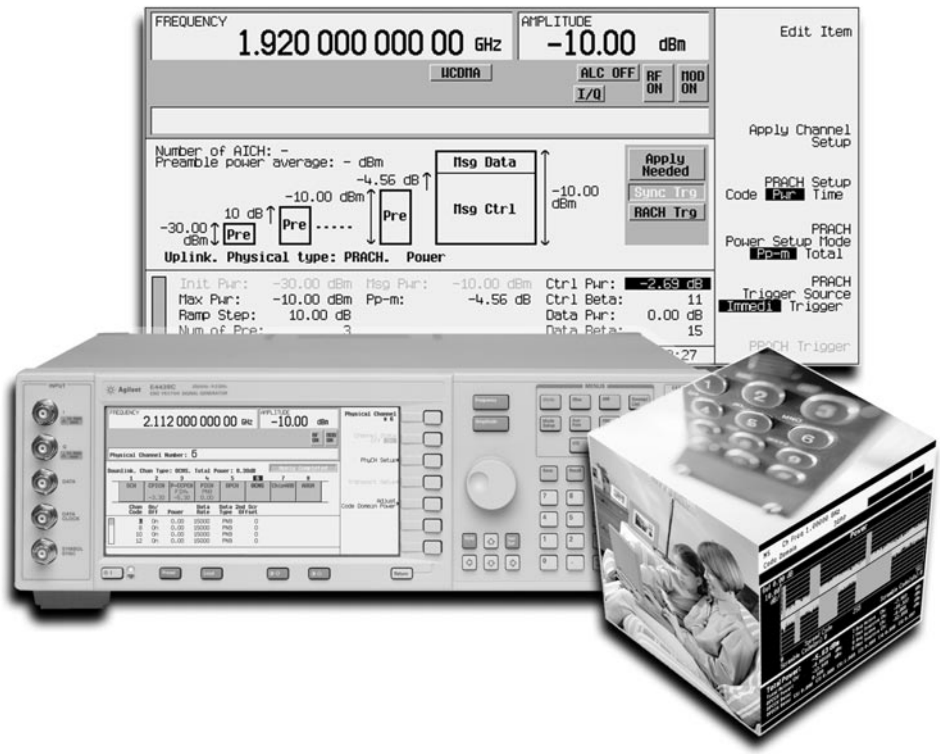
Agilent 3GPP W-CDMA Firmware Option for the E4438C ESG Vector Signal Generator

Option 400
Product Overview



The 3GPP W-CDMA firmware option for the Agilent E4438C ESG Vector Signal Generator provides a broad collection of W-CDMA test signals. Combining the 3GPP W-CDMA waveform playback and real-time personalities into a single firmware option provides a viable test solution for evolving 3G mobile radio networks – from the component to the system level. This simplifies the ordering process and provides a flexible test solution for both development and manufacturing engineers.

New enhancements

W-CDMA real-time signal generation

- Compressed mode support
- PRACH
- Set C/N, E_b/N_o, or E_cN_o
- Independent transport layer definitions for DPCH
- 16 OCNS channels
- Adjust channel powers in real-time
- Preconfigured 3GPP W-CDMA tests
- Closed loop power control

W-CDMA waveform playback

- Faster waveform build times
- Increased carrier spacing
- Increased storage capacity
- S-CCPCH
- Multi-carrier timing offsets

Introduction

The 3GPP W-CDMA firmware option for the E4438C ESG combines two flexible signal generation personalities to provide a powerful development and manufacturing test suite for evolving 3G mobile radios, base stations, and their components.

- 3GPP W-CDMA waveform playback
- 3GPP W-CDMA real-time signal generation

These personalities are designed to run on the powerful E4438C ESG baseband generator. They have been enhanced to take advantage of the baseband generator's 80 MHz I/Q bandwidth, 32 Msamples waveform playback RAM, and optional 6 GB hard drive. The baseband generator can operate in one of two modes, waveform playback or real-time signal generation.

The waveform playback and real-time signal generation modes are not equivalent. In fact, they are intended to serve completely different test needs. Combined, they provide a comprehensive set of standard-based test signals for both R&D and manufacturing. The key differences between the waveform playback and real-time signal generation capabilities are highlighted in table 1.

Introduction

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3GPP W-CDMA Firmware personality [Option 400]

Feature	W-CDMA arbitrary waveform playback	W-CDMA real-time signal generation
Access method supported	Frequency Division Duplex [FDD] W-CDMA	
Version of standard supported	June 2001 issue of the Rev 99 3GPP specifications	
Primary application	Component testing Example, testing ACPR and EVM where spectrally correct signals are needed	Receiver testing & ASIC and baseband verification Example testing BER and frames with full channel coding are needed
Coding level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Fully coded Supports transport & physical layer coding, i.e. CRC, convolutional/turbo coding, interleaving, rate matching, etc.
Waveform length	10 ms continuously repeated	Infinite
Filters	Standards based and custom	Standards based and custom
Baseband clipping	Yes	No
Differential outputs available	Yes	Yes
Number of DPCH channels	512	2
Number of OCNS	512	16
Data types	PN9 and random	PN9, PN15, User File, 4 bit pattern
Standards based setups	Test models 1 through 4	Reference measurement channels Conformance tests
Multi-Carrier	4 Carriers	1
Compressed Mode	No	Yes
Set C/N, E_c/N_o or E_b/N_o	No	Yes
Waveform build times	Seconds	Milliseconds
Downlink channels	C-PICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, DPCH, OCNS	C-PICH, P-SCH, S-SCH, P-CCPH, PICH, DPCH, OCNS
Uplink channels	DPCCH, DPDCH	DPCCH, DPDCH, PRACH

Table 1. Arbitrary waveform playback and real-time signal generation feature comparison.

3GPP W-CDMA arbitrary waveform playback mode

Configure multi-carrier Up and Down link 3GPP W-CDMA test signals with the proper stress level to exercise components – including combiners, filters, and amplifiers. Signals generated in arbitrary waveform playback mode can be used for base station and mobile tests ranging from the component level to the system level; however, they are primarily intended for the component test industry.

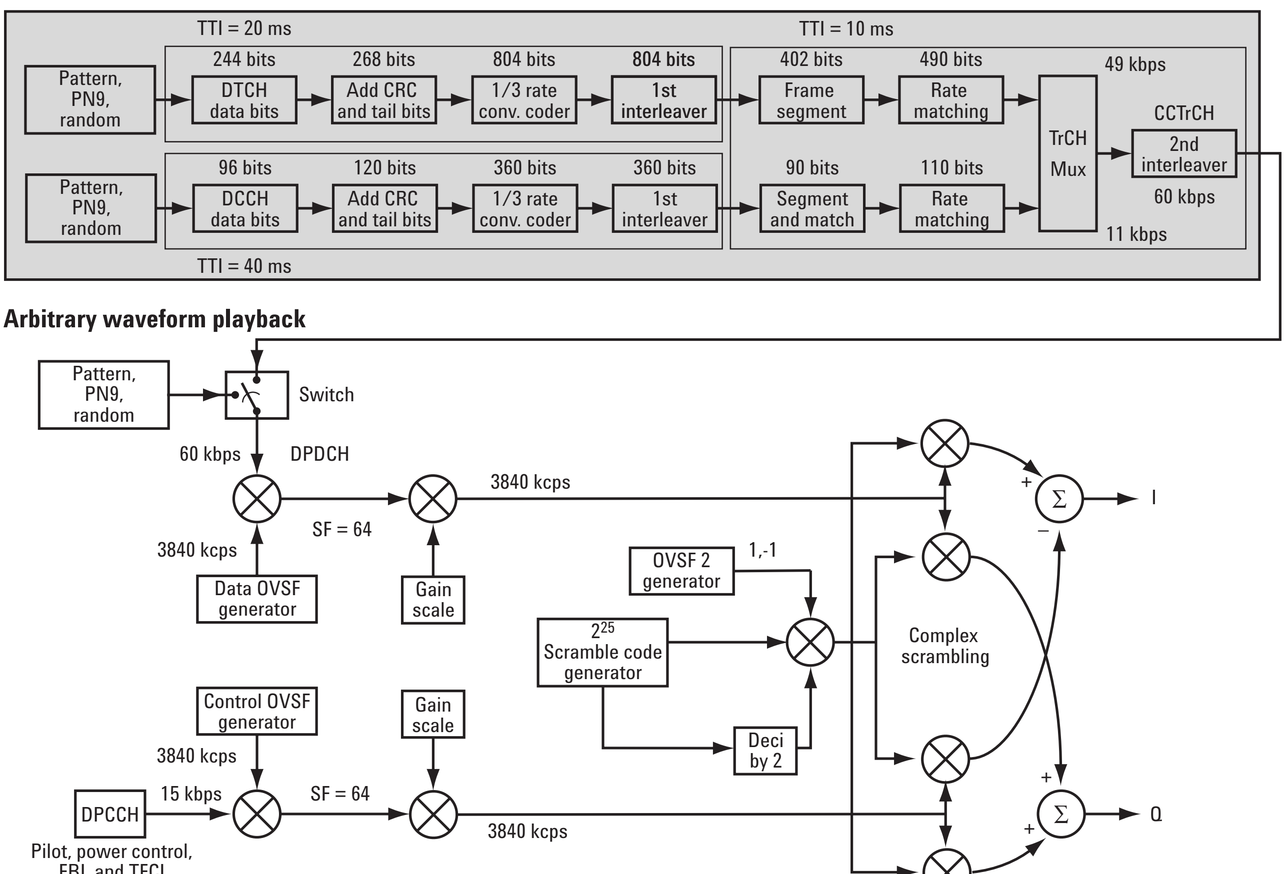
In the arbitrary waveform playback mode, the E4438C ESG baseband generator operates like a traditional arbitrary waveform generator. After the signal parameters have been configured, a sampled version of the baseband signal is stored in waveform RAM. These samples are then played back through a reconstruction filter and fed to the I/Q modulator.

Because these signals are primarily intended for component test, full channel coding is not implemented. Instead, partially coded signals that are statistically equivalent to fully coded signals are generated in waveform playback mode. This means the signal will stress amplifiers and other components exactly as a fully coded signal would.

Block diagram

The following uplink 3GPP W-CDMA block diagram illustrates the difference between the waveform playback and real-time signal generation modes.

Real-time fully coded transport layer (two of six available transport channels shown)



Uplink 3GPP W-CDMA block diagram outlining the difference the between arbitrary waveform playback and real-time W-CDMA personalities. The real-time personality encompasses the entire block diagram. The arbitrary waveform playback personality provides only the lower, unshaded portion of the block diagram. Both are included in Option 400.

3GPP W-CDMA arbitrary waveform playback key features

Multi-carrier capability
Stress active components by generating up to four W-CDMA carriers. Each carrier can be defined to have a unique channel configuration, frequency offset, and power offset. Also, the relative timing between each carrier and the scramble code of each carrier can be set to automatically increment to generate uncorrelated signals; important for creating realistic crest factors. This ensures the device under test sees actual operating conditions.

Table editor features
The table editor allows you to:
- Easily modify channel configurations
- Modify the W-CDMA down link by choosing: data rate, data pattern, Orthogonal Variable Spreading Factor [OVSF] code, power, τDPCH offset, TFCI bits, TFCI power, TPC bits, TPC power, pilot bits, pilot power, scramble code, scramble type, and scramble offset
- Modify the W-CDMA up link by choosing: data rate, data pattern, OVSF code, power, TFCI bits, TPC bits, and FBI bits

Pre-configured channel setups
Quickly generate 3GPP standard signals. Test models 1 through 4 are predefined for testing transmitter components.
- Test model 1 – ACLR, spurious emissions and intermodulation
- Test model 2 – Output power dynamics
- Test model 3 – Peak code domain power
- Test model 4 – EVM measurements

Also, commonly used configurations are predefined, such as the common pilot and sync channels or common pilot, sync and dedicated physical data channels.

Powerful filtering options
Choose or create unique filters. Choose from the standard W-CDMA filter, or root Nyquist, Nyquist, Gaussian filters, or rectangular filters. Define your own 256 tap FIR filter to meet specific [non-standard] test requirements. Time domain windows can be applied to the filter characteristic to improve ACLR performance.

Flexible baseband clipping
Reduce signal stress on power amplifiers. Clip the peak-to-average power of signals before or after baseband FIR filtering. Clipping the signal before filtering smooths any discontinuities in the resulting signal that can generate distortion. Optionally, the signal can be clipped after FIR filtering to simulate base stations that operate in this mode. Clipping may be applied individually to I and Q or to the composite I/Q vector.

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3GPP W-CDMA arbitrary waveform playback key features

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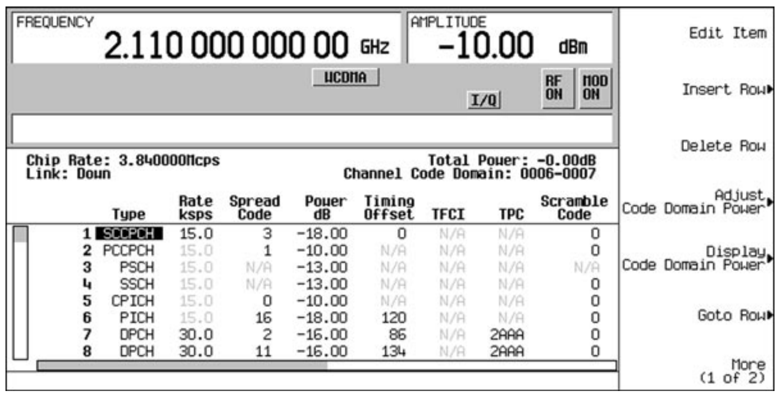
Code domain power and CCDF curve display
Visually check the channel configuration and the peak-to average ratio of the configured signal. View the relative channel power or the power statistics of the waveform as compared to Additive Gaussian White Noise [AWGN].

6 GB hard drive for signal storage
Store a vast array of test scenarios. Store all of your multi-format waveforms for W-CDMA, cdma2000, GSM, EDGE and more.

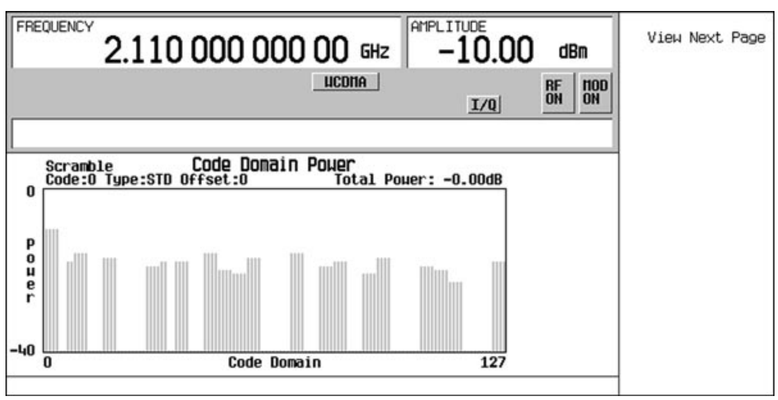
Hardware resampling technology
Eliminate reconstruction filter problems. The personality automatically resamples the signal in hardware resulting in:

- No need to quadruple your samples resulting in more effective memory usage
- Sampling images are automatically filtered out

Variable chip rates
Vary the 3.84 Mcps chip rate ±10% when integrating system components in R&D or simulate clock drift between systems.



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



Verify the distribution of power in the code domain before producing the signal

3GPP W-CDMA arbitrary waveform playback features

Downlink and uplink

Coding level	Supports physical layer coding
Chip rate variation	3.456 Mcps – 4.224 Mcps
Frame duration	10 ms
Filters	
W-CDMA	α = 0.22
Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0 to 1
Rectangle	
Custom FIR	Up to 256 coefficients, 16 bit resolution
I/Q mapping	Normal, invert
Clipping	
Clip location	Pre- or post-FIR filter [Multi-carrier signals use post FIR clipping only]
Clipping type	|I+jQ|, |I| and |Q|
Clipping range	10% to 100% [Clip the modulation level to a percentage of full scale. A level of 100% equates to no clipping.]

Downlink

Modulation	QPSK
Total number of channels	Up to 512 with any combination of supported channel types
Pre-defined channel configurations	Test model 1 with 16, 32, or 64 DPCH Test model 2 Test model 3 with 16 or 32 DPCH Test model 4 1 DPCH 3 DPCH PCCPCH + SCH PCCPCH + SCH + 1 DPCH PCCPCH + SCH + 3 DPCH
Primary Synchronization Channel [PSCH]	
Power	-40 dB to 0 dB
Secondary Synchronization Channel [SSCH]	
Power	-40 dB to 0 dB
Scramble type	Standard, left alternate, and right alternate
Primary Common Control Physical Channel [P-CCPCH]	
Power	-40 dB to 0 dB
Spreading code	0 to 255
Data pattern	PN9, random, fixed 8-bit pattern
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15

3GPP W-CDMA arbitrary waveform playback features

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Secondary Common Control Physical Channel [S-CCPCH]	
Power	-40 dB to 0 dB
Spreading code	15, 30, 60, 120, 240, 480, 960 ksps
Symbol rate	0 to 255
τDPCH offset	0 to 149 [in increments of 256 chips]
TFCI	0 to 1023, or disable TFCI bits in DPCCH
Number of pilot bits	0 or 8
Data pattern	PN9, random, fixed 8-bit pattern
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15
Common Pilot Channel [CPICH]	
Power	-40 dB to 0 dB
Spreading code	0 to 255
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15
Dedicated Physical Channel [DPCH]	
Power	-40 dB to 0 dB
Spreading code	0 to 511
Symbol rate	7.5, 15, 30, 60, 120, 240, 480,960 KSPS
τDPCH offset	0 to 149 [increments of 256 chips]
TFCI	0 to 1023, or disable TFCI bits in DPCCH
TFCI power	-20 to 20 dB relative to channel
TPC	0 to 7FFF hex
TPC power	-20 to 20 dB relative to channel
Number of pilot bits	4 or 8
Pilot power	-20 dB to 20 dB
Data pattern	PN9, random, fixed 8-bit pattern
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15
Page Indication Channel [PICH]	
Power	-40 dB to 0 dB
Spreading code	0 to 255
τDPCH offset	0 to 149 [increments of 256 chips]
Data pattern	18 bit paging pattern, PN9, random, fixed 8-bit pattern
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15
Orthogonal Channel Noise Simulator [OCNS]	
Power	-40 dB to 0 dB
Spreading code	0 to 511
Symbol rate	7.5, 15, 30, 60, 120, 240, 480, 960 ksps
Data pattern	PN9, random, fixed 8-bit pattern
Scramble code	0 to 511
Scramble type	Standard, left alternate, and right alternate
Scramble offset	0 to 15

3GPP W-CDMA arbitrary waveform playback features

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Downlink multi-carrier	
Number of carriers	Up to 4 [user defined, individually configurable]
Frequency offset [per carrier]	Up to ± 37.5 MHz
Offset resolution	< 1 Hz
Carrier Power [per carrier]	0 dB to -40 dB
Auto increment scramble code	The scramble code of each additional carrier will be incremented by 1
Auto increment timing offset	The relative timing for each additional carrier will be incremented by 1/5 of a timeslot [512 chips]
Inputs and outputs	
Inputs	10 MHz local oscillator reference Baseband generator clock reference [250 kHz to 100 MHz] Waveform start trigger
Outputs	Frame marker

Uplink

Modulation	OCQPSK [HPSK]
Pre-defined channel configurations	1 DPCCH 15 ksps, spread code 0 DPCCH + 1 DPDCH 960 ksps, spread code 1 DPCCH + 2 DPDCH 960 ksps, spread code 1 DPCCH + 3 DPDCH 960 ksps, spread code 2 DPCCH + 4 DPDCH 960 ksps, spread code 2 DPCCH + 5 DPDCH 960 ksps, spread code 3
Number of channels	1 DPCCH and up to 6 DPDCH
Adjustable channel parameters	
Scramble code	0 to FFFFFF hex, common for all channels
Dedicated Physical Control Channel [DPCCH]	
Power	-60 dB to 0 dB
Spreading code	0 to 255
TFCI	0 to 1023, or disable TFCI bits
TPC	0 to 7FFF hex
Number of FBI bits	0, 1, or 2
Dedicated Physical Data Channel [DPDCH]	
Power	-60 dB to 0 dB
Spreading code	0 to 255
Symbol rate	15, 30, 60, 120, 240, 480,960 ksps
Data pattern	Random and fixed 8-bit pattern
Second DPDCH orientation	I or Q
Inputs and outputs	
Inputs	10 MHz local oscillator reference Baseband generator clock reference [250 kHz to 100 MHz] Waveform start trigger
Outputs	Frame marker

3GPP W-CDMA arbitrary waveform playback specifications

3GPP W-CDMA arbitrary waveform playback specifications

Error vector magnitude[1]

[1.8 GHz < f_c < 2.2 GHz, default W-CDMA filters, 2.1 MHz baseband filter, 3.84 Mcps chip rate, ≤ 4 dBm, ≤ 7 dBm with Option UNB]

1 DPCH	≤ 2.3%, (< 1.3%)

Level accuracy [relative to CW at 800, 900, 1800, 1900, 2200 MHz][1]

[≤ 2.5 dBm standard, 7.5 dBm for Option UNB, and 4.5 dBm for Option 506]

±0.7 dB (±0.35 dB)

Adjacent channel power[1]

[1.8 GHz < f_c < 2.2 GHz, default W-CDMA filters, 3.84 Mcps chip rate, ≤ 0 dBm Option UNB, ≤ –3dBm Option 506, ≤ –5 dBm standard in Optimize ADJ mode]

1 DPCH	–65 dBc (–67 dBc)
Test Model 1 + 64 DPCH	–63 dBc (–65 dBc)

Alternate channel power[1]

[1.8 GHz < f_c < 2.2 GHz, default W-CDMA filters, 3.84 Mcps chip rate, ≤ 2.5 dBm standard, ≤ 4.5 dBm Option 506, ≤ 7.5 dBm Option UNB, in Optimize ALT mode]

1 DPCH	–70 dBc (–73 dBc)
Test Model 1 + 64 DPCH	–68 dBc (–70 dBc)

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

Real-time signal generation mode

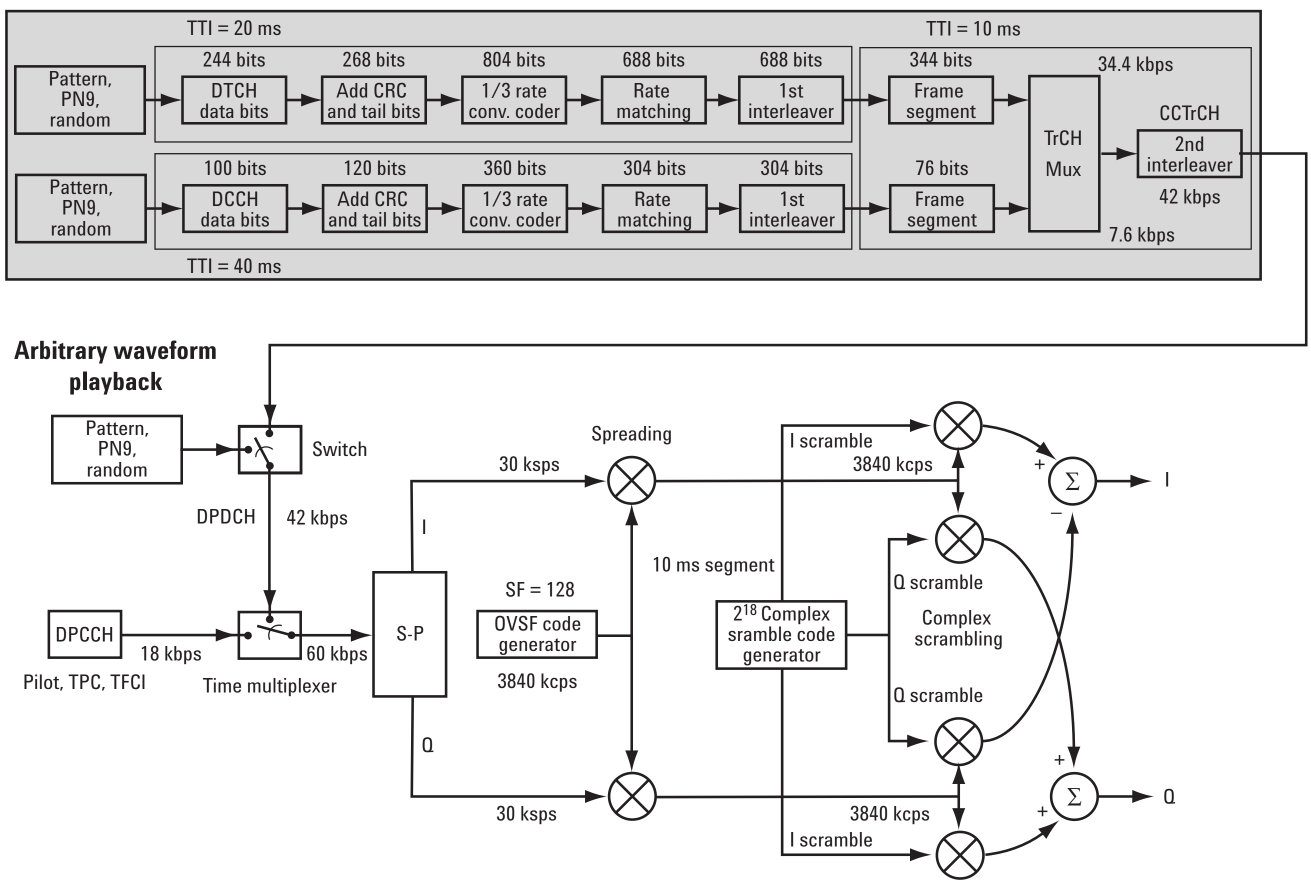
In real-time signal generation mode, the E4438C ESG baseband generator produces test signals continuously, rather than playing a stored waveform repeatedly. Once configured, the 3GPP W-CDMA personality generates a stream of fully coded downlink or uplink 3GPP W-CDMA frames.

These fully coded test signals are primarily intended for mobile and base station receiver tests in the R&D environment. The high level of channel coding enables thorough evaluation of receiver demodulation capabilities at various design stages. Standards based measurements, including sensitivity, dynamic range, adjacent channel selectivity, blocking characteristics, and BER tests can be performed using these test signals. In addition, the baseband generator single-ended and differential I/Q outputs facilitate baseband verification and component tests.

Block diagram

The following 3GPP W-CDMA downlink block diagram illustrates the difference between the arbitrary waveform and real-time signal generation modes.

Real-time fully coded transport layer (two of six transport channels shown)



Downlink 3GPP W-CDMA block diagram outlining the difference between the arbitrary waveform playback and real-time W-CDMA personalities. The real-time personality encompasses the entire block diagram. The arbitrary waveform playback personality provides only the lower, unshaded portion of the block diagram. Both capabilities are included with Option 400.

3GPP W-CDMA real-time signal generation key features

Full transport channel coding

Enables BER/FER testing and baseband ASIC verification. Transport layer coding along with physical layer coding generates signals ready for BER and FER testing. Full control over transport layer coding, such as block size, coding type, TTI, data, rate matching attribute, CRC size, and transport channel position enable ASIC and RF chipset demodulation capabilities to be verified. Each DPCH/DPDCH [uplink/downlink] channel supports up to six transport channels.

Table editor

Create realistic test signals. Generate up to 16 OCNS channels along with the DPCH and common channels to create real world crest factors.

Table editor

Easily modify channel configurations. The table editor quickly enables the user to create new custom waveforms with slot structures defined by the 3GPP standard or modify predefined configurations. Add/delete channels, change OVSF codes, scramble codes, data rates, TPC patterns, τDPCH offset, TFCI, FBI, pilot bits, power levels and more.

Infinite frame generation

Create signals for BER and FER testing. The real-time generation capability of the personality generates continuous channel coded W-CDMA frames. The infinite continuous W-CDMA frames eliminate the need to worry about truncated data sequences.

Set E_b/N_o , E_c/N_o, and C/N

Emulate in-channel noise. The optional AWGN personality adds noise to the W-CDMA signal in a bandwidth twice the chip rate. The noise level is set by adjusting the Energy per chip to Noise power density ratio [Ec/No] [downlink only] or Energy per Bit to Noise power density ratio [Eb/No] [uplink only] or the Carrier to Noise density ratio [C/N]. This enables sensitivity testing of receivers to be made along with 3GPP functional tests.

The total RF output power remains constant as the noise ratio is changed. This ensures the receiver remains at the same gain level, important for reducing the number of factors contributing to the overall BER/FER.

Closed loop power control

Control the RF power of the mobile in real-time. The ESG accepts an external signal that controls the TPC bits being transmitted on a slot-by-slot basis. This enables:
- Calibrating mobile RF transmit power without using an external connector
- Power level of the mobile to be quickly changed for BER or conformance testing

Real-time OCNS power balancing

Continuously modify the DPCH power level without rebuilding the waveform. The DPCH power level can be modified in real-time while the power level of the OCNS channels adjust to keep the sum of all the channels at 0 dB. This is great for debugging designs and performing BER tests. Note, any of the channel powers can be modified in real-time without rebuilding the waveform, but the DPCH is the only channel that supports automatically balancing the power with the OCNS.

Compressed mode

Test mobile receivers ability to find available base stations. Both the uplink and downlink support compressed mode per the 3GPP standard.

The downlink supports physical layer coding using the reduction in spread factor by 2 method for early testing of mobile handsets. The uplink supports compressed mode using the SF/2 method and physical layer coding using the higher layer scheduling method.

Adjustable parameters include:

- Frame structures A and B optimized for transmission gap length and power control
- Scramble code offset
- Ratio of normal frames to compressed frames
- Transmission gap length
- Timing offset
- Slot format
- Power level relative to normal frames
- Starting slot of the of the transmission gap

3GPP W-CDMA real-time signal generation key features

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Multiple transport layer definitions

Save time by performing multiple receiver tests with one setup. Each downlink DPCH channel supports unique transport layer coding configurations. These multiple transport layer definitions enable testing of different reference measurement channels concurrently by demodulating and decoding a different OVSF code in the receiver. This eliminates reconfiguring the signal generator and then having the mobile resynchronize back to the ESG.

Predefined Reference Measurement Channel [RMC]

Quickly generate 3GPP standard signals. The uplink and downlink 3GPP W-CDMA reference measurement channels can be setup with the touch of a button.

Predefined 3GPP W-CDMA conformance tests[1]

Quickly generate signals for conformance testing. The following downlink conformance tests can be configured with the touch of a button per the 3G TS 25.101 and 3G TS 34.121 specifications:

- Reference sensitivity level
- Maximum input level
- Adjacent channel selectivity
- Blocking characteristics
- Spurious response
- Intermodulation characteristics
- Performance tests [with external fader]

Incrementing system frame number

Demodulate and decode transport channels with different Transmission Time Intervals [TTI]. The P-CCPCH channel contains the incrementing system frame number [SFN], which is necessary to decode the base station signal. The SFN enables the mobile to determine frame boundaries for a particular transmission time interval [TTI]. The SFN repeats every 4096 frames as defined by the standard.

Powerful filtering options

Choose or create unique filters. Choose from the standard W-CDMA filter, or root Nyquist, Nyquist, Gaussian filters, or rectangular filters. Define your own 256 tap FIR filter to meet specific [non-standard] test requirements. Time domain windows can be applied to the filter characteristic to improve ACLR performance.

Variable chip rates

Integrate and research. Vary the nominal 3.84 Mcps chip rate from 1 kcps to 4.25 Mcps when integrating system components in R&D or to simulate clock drift between systems.

BER testing

Perform BER tests in the ESG. The ESG can perform BER testing on PN9, PN11, PN15, PN20, and PN23 with clock rates up to 60 MHz using Option UN7. [Requires a decoded return signal.]

Flexible synchronization

Easily interface to mobile handsets and base stations.

- External baseband reference clock – 250 kHz to 100 MHz
- External 10 MHz frequency reference
- Synchronize to base stations using System Frame Number [SFN] reset or frame trigger from the base station

PRACH

Test base station ability to respond the physical random access channel. The fully coded message payload enables BER/BLER testing to be performed. Operating modes:

- send the preamble only
- send variable number of preambles and then the message payload
- send the preamble until the AICH trigger is received from the base station and then sending the message payload data

The PRACH supports incrementing power of the preamble, selectable signature, control over power levels, and configurable timing relationships.

1. The ESG can generate the desired signal only. Interferers must be provided seperately.

3GPP W-CDMA real-time signal generation features

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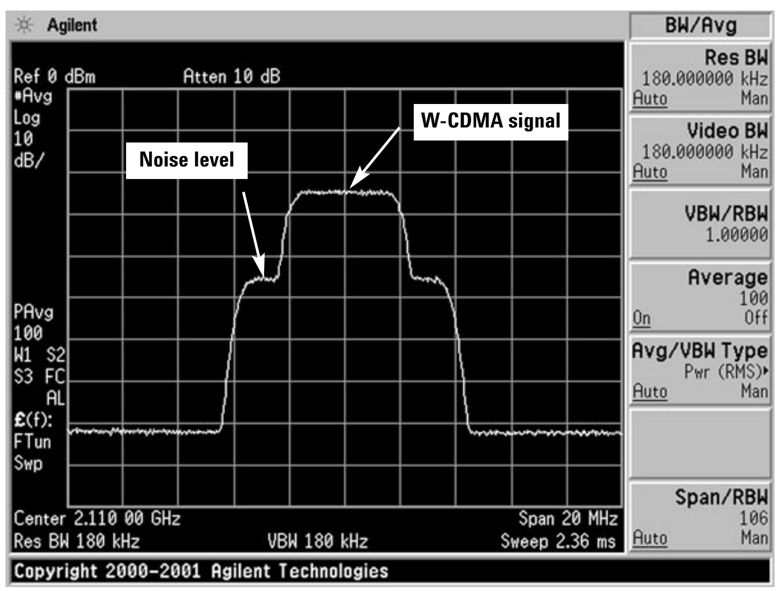
Downlink and uplink

Coding Level	Transport and physical layer coding
Chip rate variation	1 kcps – 4.25 Mcps
Frame duration	10 ms
Filters	
W-CDMA	α = 0.22
Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0 to 1
Rectangle	
Custom FIR	Up to 256 coefficients, 16 bit resolution

Downlink

Modulation	QPSK
Primary scramble code	0 to 511
Primary Synchronization Channel [PSCH]	
Power	-40 dB to 0 dB
Secondary Synchronization Channel [SSCH]	
Power	-40 dB to 0 dB
Scramble code group	0 to 63 [coupled to primary scramble code]
Primary Common Control Physical Channel [P-CCPCH]	
Power	-40 dB to 0 dB
OVSF	0 to 255
Transport channel	BCH coding
Data field	PN9, PN15, 4-bit repeating pattern, user file
Common Pilot Channel [CPICH]	
Power	-40 dB to 0 dB
OVSF	Fixed at 0



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

3GPP W-CDMA real-time signal generation features

Dedicated Physical Channel [DPCH]	
Number of channels	2
Pre-configured reference measurement channels	12.2, 64, 144, 384 kbps RMC AMR 12.2 kbps 64 kbps UDI ISDN
Predefined conformance tests	Reference sensitivity level, maximum input level, adjacent channel selectivity, blocking characteristics, spurious response, intermodulation characteristics, performance test
Transport layer	
DCH control	Up to 6 DCH's for each DPCH
Block set size	0 to 5000
Block size	0 or same as block set size
Number of blocks	1 to 8
Coding	1/2 conventional, 1/3 convolutional, turbo, or none
Transport Time Interval [TTI]	10, 20, 40, or 80 msec
Data	PN9, fixed 4-bit pattern, user file
Rate matching attribute	1 to 256
CRC size	0, 8, 12, 16, or 24 bits
Transport position	Fixed or flexible
Display parameters	bits/frame, puncturing percentage, bit rate
Physical layer control	
Power	-40 dB to 0 dB
Symbol rate	7.5, 15, 30, 60, 120, 240, 480,960 Ksps
OVSF	0 to 511 [dependent on channel symbol rate]
Slot format	0 to 16 [dependent on channel symbol rate]
TFCI pattern	10-bit user defined input pattern [converted to 30-bit code word with Reed-Mueller coding]
TPC pattern	Ramp up/down N number of times [N = 1 to 80], all up, all down, user file, and ext DPCH 1 only]
τDPCH offset	0 to 149 [increments of 256 chips]
Secondary scramble code offset	0 to 15
Data	PN9, PN15, user file, 4-bit repeating pattern, one of two independent transport layer definitions
Page Indication Channel [PICH]	
Power	-40 dB to 0 dB
Symbol rate	7.5, 15, 30, 60, 120, 240, 480,960 Ksps
OVSF	0 to 511 [dependent on channel symbol rate]
Data	PN9, PN15, user file, 4-bit repeating pattern
Number of PI bits	288
Number of paging indication bits	144
Orthogonal Channel Noise Simulator [OCNS]	
Number of channels	16
Power	-40 dB to 0 dB
Symbol rate	7.5, 15, 30, 60, 120, 240, 480, 960 Ksps
OVSF	0 to 155 [Dependent on channel symbol rate]
Data	PN9, PN15
Secondary scramble code offset	0 to 15
τOCNS offset	0 to 149 [increments of 256 chips]

3GPP W-CDMA real-time signal generation features

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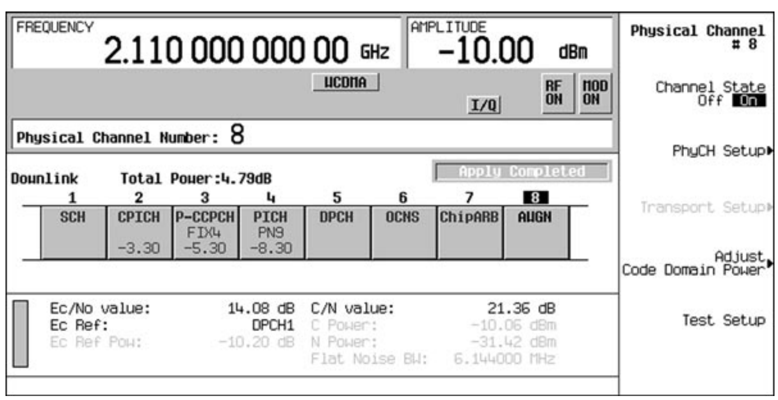
Compressed Dedicated Physical Channel [C-DPCH]	
Power	-40 dB to 0 dB
Slot format	0 to 15
OVSF	0 to 511 [dependent on channel symbol rate]
tDPCH offset	0 to 149 [in increments of 256 chips]
Secondary scramble code offset	0 to 15
Data	PN9, PN15
Secondary scramble code type	Normal, right, and left
Starting slot of transmission gap	0 to 7
Transmission gap length	0 to 7
Frame structure	Type A or type B
Playback ratio	1:1 to 4096

Additive White Gaussian Noise [AWGN]	
E_c/N_o	-5 dB to 20 dB
C/N	-30 dB to 30 dB
Ec Ref	P-CCPCH, DPCH 1, DPCH 2, CPICH, PICH

Input/output	
Inputs	TPC bits input, external chip clock System Frame Number [SFN] reset Frame clock Baseband generator frequency reference [250 to 100 MHz] 10 MHz local oscillator reference
Outputs	Longest TTI marker System frame number reset TPC bits out Chip clock Compressed frame trigger Time slot trigger 10 MHz local oscillator reference



Adjust AWGN as E_c/N_o, E_b/N_o or C/N in real-time

3GPP W-CDMA real-time signal generation features

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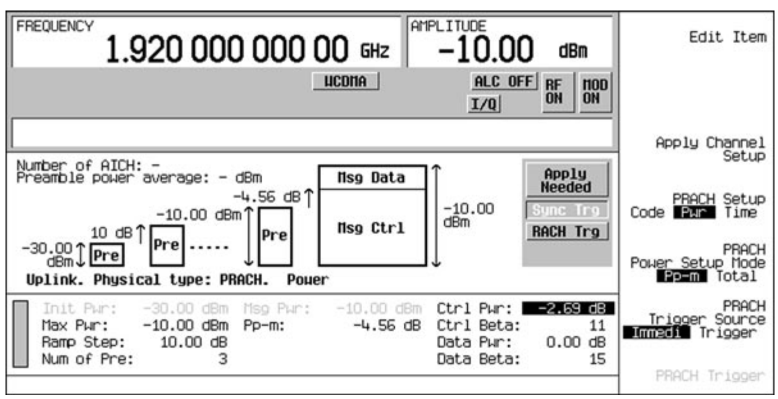
Uplink

Modulation	OCQPSK [HPSK]
Scrambling code	0 to 16,777,215
Synchronization setup	
Timing offset range	Timing offset -512 to 2560 chips; timeslot offset 0 to 119 slots
Synchronization signal	System Frame Number [SFN] reset or frame clock
Frame clock interval	10, 20, 40, 80, or 2560 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	x1 [3.84 MHz], x2 [7.68 MHz], x4 [15.36 MHz]
External clock polarity	Positive, negative
Dedicated Physical Control Channel [DPCCH]	
Power	-40 dB to 0 dB
Beta	0 to 15 [coupled to power]
Channel code	0 to 255
TFCI pattern	PN9, PN15, 0 to 03FF hex, user file
TFCI state	[Depends on slot format]
Symbol rate	15 ksps [Non adjustable]
FBI pattern	PN9, PN15, 0 to 3FFFFFFF
FBI state	[Depends on slot format]
Slot format	0 to 5
Interleaver	On [non adjustable]
TPC pattern	PN9, PN15, 4-bit repeating pattern, user file, up/down,
TPC pattern steps	down/up, all up, all down 1 to 80



Configure a fully transport layer coded PRACH signal for BER testing

3GPP W-CDMA real-time signal generation features

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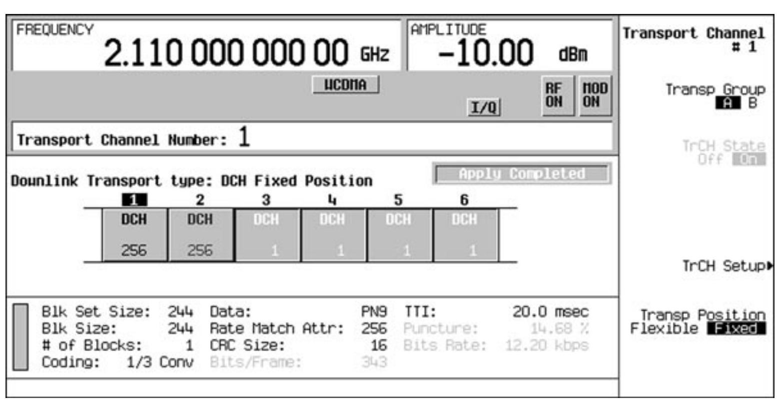
Dedicated Physical Data Channel [DPDCH]

Pre-configured reference measurement channels	12.2 kbps, 64 kbps, 144 kbps, 384 kbps RMC, AMR 12.2 kbps, 64 kbps UDI
Transport Layer	
DCH control Up to 6 DCH	
Block size	0 to 5000
Number of blocks	0 to 4095
Coding	1/2 convolutional, 1/3 convolutional, turbo, none
Transport Time Interval [TTI]	10, 20, 40, 80 ms
Data	PN9, 4-bit repeating pattern, user file
Rate matching attribute	1 to 256
CRC size	0, 8, 12, 16 or 24 bits
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]
Displayed parameters	bits/frame, puncturing percentage, bit rate,
Physical layer control	
Power	Off, -40 dB to 0 dB
Beta	0 to15 [coupled to power]
Channel code	0 to 255 [maximum value depends on symbol rate and slot format]
Data	PN9, PN15, 4-bit repeating pattern
Symbol rate	15, 30, 60, 120, 240, 480, 960 ksps [depends on slot format]
Slot format	0 to 6
Compressed mode	
CM method	SF/2 or higher layer scheduling
Power offset	0 dB to 6 dB, or auto
TGPS	Active or inactive
TGPRC	Infinity or 1 to 511
TGPL1	1 to 144
TGPL2	1 to 144, or omitted
TGSN	0 to 14
TGL1	3, 4, 5, 7, 10, 14
TGL2	3, 4, 5, 7, 10, 14, or omitted
TDG	15 to 269, or undefined
TGPSI	Fixed at 1
Predefined setups	Reference types from 3GPP TS 25.101: 1.1, 1.2, 2.1, and 2.2
Additive White Gaussian Noise [AWGN]	
E_b/N_o value	Range depends on parameters from E_b reference channel
C/N - 30 dB to 30 dB	
E_b reference	DPCCH, DPDCH, or transport DCH 1 to 6



Choose up to six independent transport channels for each DPCH

3GPP W-CDMA real-time signal generation features

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Physical Random Access Channel [PRACH]

Preamble signature	0 to 15
Message control	
TFCI 0 to 3FF, PN9, PN15, or user file	
Data PN9, PN15, 4-bit repeating pattern, user file, 3GPP	
Slot format	0 to 3
Channel code	0 to 255
Message data	
Data	PN9, PN15, 4-bit repeating pattern, user file, or transport channel coding
Slot format	0 to 3
Symbol rate	15, 30, 60, 120 ksps
Channel code	0 to 255
Transport channel coding	
Block size	0 to 5000
Number of blocks	0 to 4095
TTI	10 to 20 msec
Data	PN9, 4-bit repeating pattern, or user file
CRC size	0,8,12, 16, or 24
Error insertion	BLER, BER, or NONE
BLER [Block Error Rate]	0 to 1 [resolution 0.001]
BER [Bit Error Rate]	0 to 1 [resolution 0.001]
Displayed parameters	Coding type, rate matching attribute, bits/frame, puncturing percentage, bit rate
Additive White Gaussian Noise [AWGN]	
E_b/N_o value	Depends on parameters of E reference channel
E_c/N_o value	-30 dB to 30 dB
C/N value	-30 dB to 30 dB
E_b reference	Preamble, message control, message data, RACH TrCH
Power menu setup	
Ramp step	0 dB to 10 dB
Number of preambles	1 to 30 [when # steps x # preambles ≤ 30 dB Infinite when step size = 0 dB]
Message power	-136 dB to 20 dB
Power delta between preamble and message control	-20 dB to 10 dB
Control power	-40 dB to 0 dB
Control beta	0 to 15
Data power	-40 dB to 0 dB
Data beta	0 to 15
Time menu setup	
Number of PRACH cycles	1 to 2,147,483,647, or infinite
Number of preambles	1 to 30 [when # steps x # preambles ≤ 30 dB Infinite when step size = 0 dB]
Start sub channel number	0 to 11
Message part	On, off, or wait for AICH trigger
Time between preambles	1 to 60 access slots
Time between preamble and message payload	1 to 15 access slots
TTI	10 msec or 20 msec

3GPP W-CDMA real-time signal generation features

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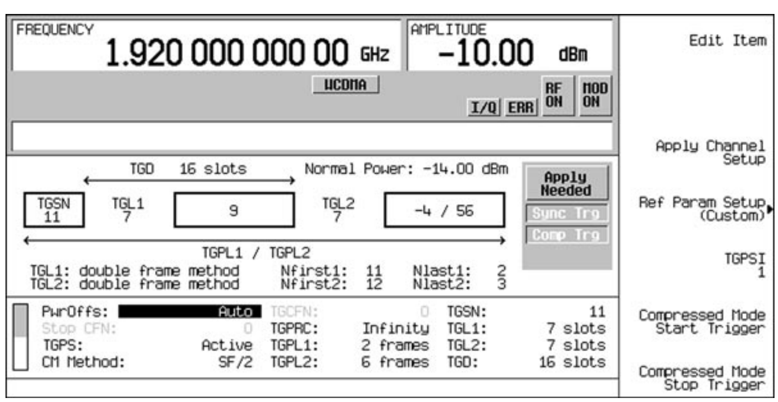
Inputs and outputs

Common to uplink and downlink		
	Inputs	Baseband generator clock reference [250 – 100 MHz] 10 MHz local oscillator reference
	Outputs	10 MHz local oscillator reference
Uplink Dedicated Physical Channel [DPCH]		
	Inputs	Frame sync trigger User file start trigger for TPC Compressed mode start trigger Compressed mode stop trigger
	Outputs	Chip clock DPDCH raw data DPDCH raw data clock DPCCH raw data DPCCH raw data clock 10 ms frame pulse Trigger sync reply Compressed frame TTI frame clock CFN #0 frame pulse Compressed frame indication
Uplink Physical Random Access Channel [PRACH]		
	Inputs	Frame sync trigger PRACH start trigger AICH trigger
	Outputs	Chip clock Message data raw data Message data raw data clock Message control raw data Message control raw data clock Message pulse Preamble raw data Preamble raw data clock PRACH processing PRACH pulse Preamble pulse Sub-channel timing 10 ms frame pulse Trigger sync reply 80 ms frame pulse



Configure compressed mode frames in uplink [compressed mode for downlink is also available]

Connectivity information

The E4438C ESG Vector Signal Generator offers a wide array of I/O capabilities to simplify measurement setups.

Perform firmware upgrades, download waveforms to the instrument, or remotely control the instrument with SCPI commands using either 10BaseT LAN or IEEE-488 GPIB. LAN control requires the use of the K version of Agilent I/O libraries, downloadable from the Agilent web site: **www.agilent.com**

Recommended configuration

E4438C ESG Vector Signal Generator

Frequency option	
503	250 kHz to 3 GHz frequency range
Hardware options	
1E5	High-stability time base
002	Internal baseband generator with 32 Msample memory
005	6 GB hard drive [Option 001or 002 required]
Firmware option	
400	3GPP W-CDMA personality
403	Calibrated noise personality

Other configurations are available. For details regarding the E4438C ESG option structure, refer to the *Configuration Guide* in the *Related Agilent literature* section.

Ordering information

The 3GPP W-CDMA firmware personality may be purchased as Option 400 with a new Agilent E4438C ESG Vector Signal Generator. If you need assistance, your Agilent field sales engineer can help configure your instrument properly. Contact information can be found at: **www.agilent.com/find/assist**

Upgrade kits

If you currently own an E4438C ESG with the optional baseband generator and are interested in obtaining an upgrade kit only [license key], order: E4438CK Option 400.

This kit is not compatible with earlier models of the ESG.

Firmware updates

Firmware updates can be downloaded from **www.agilent.com/find/esg**

Related Agilent literature

Brochures

Agilent E4438C ESG Vector Signal Generator
Publication number 5988-3935EN

Wireless 3G Solutions
Publication number 5968-5860

Data sheets

Agilent E4438C ESG Vector Signal Generator
Publication number 5988-4039EN

Configuration guides

E4438C ESG Vector Signal Generator
Publication number 5988-4085EN

Application Notes

Digital Modulation in Communication Systems-An Introduction
Publication number 5965-7160E

Testing and Troubleshooting Digital RF Communications Transmitter Designs - Application note 1313
Publication number 5968-3578E

Testing and Troubleshooting Digital RF Communications Receiver Designs
Publication number 5968-3579E

Designing and Testing W-CDMA User Equipment – Application Note 1356
Publication number 5980-1238E

Designing and Testing W-CDMA Base Stations – Application Note 1355
Publication number 5980-1239E

Characterizing Digitally Modulated Signals with CCDF Curves
Publication number 5968-6875E

Other products

Wireless Communications Products
Publication number 5968-6174E

CDMA Solutions
Publication number 5966-3058E

Agilent E4406A Vector Signal Analyzer
Publication number 5968-7618E

Agilent E4440E Performance Spectrum Analyzer
Publication number 5980-1284E

See **www.agilent.com** for more information

Agilent Technologies' Test and Measurement Support, Services, and Assistance

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

Our Promise

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

Your Advantage

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

Notice

Please contact Agilent Technologies
for the latest information
or check the ESG Web site at
www.agilent.com/find/esg

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

Online Assistance

www.agilent.com/find/assist

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