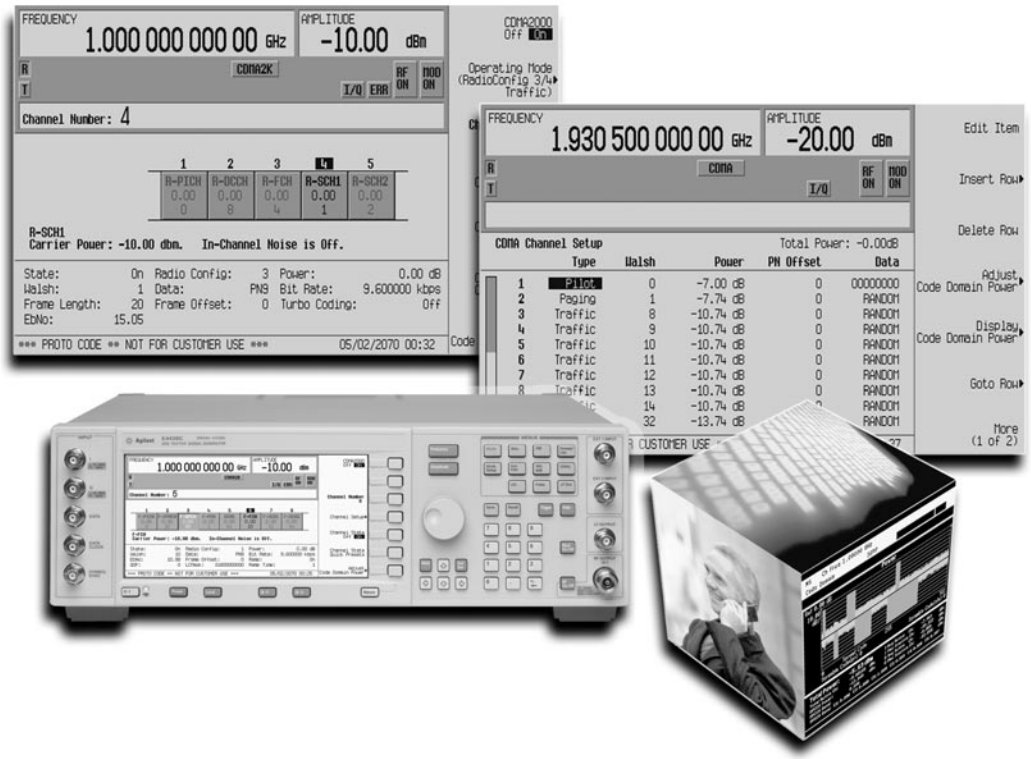
Agilent cdma2000 and IS-95A Personalities for the E4438C ESG Vector Signal Generator

Option 401
Product Overview



The cdma2000 and IS-95A personalities for the Agilent E4438C ESG Vector Signal Generator provide a broad collection of CDMA test signals in a single firmware option. Arbitrary waveform playback and real-time signal generation personalities for cmda2000 and IS-95A are combined to:

- Provide a viable test solution for the existing 2G and evolving 3G mobile radio networks.
- Offer flexible CDMA signal generation for both development and manufacturing.
- Simplify the ordering process.

New enhancements

cdma2000 real-time signal generation

- More fully coded channels in a single ESG
- Presets for common channel configurations
- Set C/N and E_b/N_o

cdma2000 and IS-95A arbitrary waveform playback

- Faster waveform build times
- Increased storage capacity
- Increased carrier spacing

Agilent Technologies

Introduction

The cdma2000 and IS-95A firmware option for the ESG combines three flexible signal generation personalities to provide a powerful development and manufacturing test suite for 2G and 3G mobile radios, base stations, and their components.

- IS-95A arbitrary waveform playback mode
- cdma2000 arbitrary waveform playback mode
- cdma2000 real-time signal generation mode

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

The arbitrary waveform playback mode and real-time signal generation personalities 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 arbitrary waveform playback mode and real-time signal generation mode are highlighted in table 1.

Introduction

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cdma2000 and IS-95A personalities [Option 401]

Feature	IS-95A arbitrary waveform playback	cdma2000 arbitrary waveform playback	cdma2000 real-time signal generation
Primary application	Component testing	Component testing	Receiver testing and ASIC baseband verification
Signal coding level	*Partially coded* Supports physical layer coding, i.e. spreading and scrambling only	*Partially coded* Supports physical layer coding, i.e. spreading and scrambling only	*Fully coded* Supports CRC, convolutional/ turbo coding, interleaving, power control and complex scrambling
Waveform length	26.67 ms	26.67 ms	Infinite
Number of carriers	Up to 12	Up to 12	1
Number of channels per carrier	Up to 256	Up to 256	Up to 8 forward link Up to 5 reverse link
Set E_b/N_o and C/N	No	No	Yes

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

arbitrary waveform playback mode

Using the cdma2000 and IS-95A arbitrary waveform playback personalities, configure multi-carrier forward and reverse link CDMA test signals with the proper stress level to exercise components – such as 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 arbitrary waveform playback mode, the ESG baseband generator operates like a traditional arbitrary waveform generator. After the signal parameters have been configured, a sampled version of the baseband I/Q signal is stored in waveform RAM. These samples are then played back through a reconstruction filter and fed to the I/Q modulator.

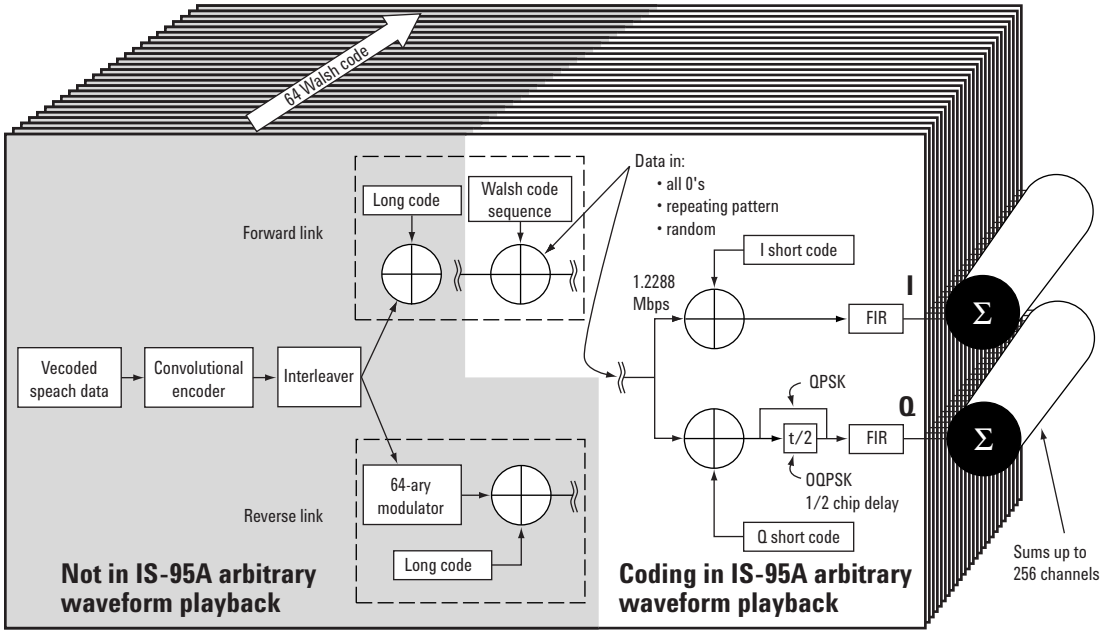
Because these signals are primarily intended for component test, full channel coding is not implemented. Instead, partially coded signals that are statistically equivalent to fully coded signals are generated in arbitrary waveform playback mode. This means the signal will stress amplifiers and other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

IS-95A arbitrary waveform playback

Block diagram

Generate single or multi-carrier partially coded IS-95A signals using the arbitrary waveform playback personality.

IS-95A arbitrary waveform playback provides the highlighted section of the physical layer for forward traffic channels. It also includes a single reverse channel beginning with short code spreading.



Physical layer of IS-95A CDMA standard block diagram.

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IS-95A arbitrary waveform playback key features

Single or multi-carrier CDMA

Stress active components by generating multi-carrier CDMA configurations. Place up to 12 carriers within a 30 MHz bandwidth, each with a custom channel configuration.

256 configurable channels per carrier

Simulate multiple base stations or mobiles transmitting on the same carrier frequency. Choose from the following channel types:

- Forward link: Pilot, paging, synchronization, traffic
- Reverse link: Traffic

Tailor the test signal to specific requirements, like the Complementary Cumulative Distribution Function [CCDF], by explicitly defining the characteristics of each channel on each carrier.

Table-based channel configuration

Customize the channel setup to realistically stress components under test. Use the table based editor to define channel parameters, including Walsh code, power, PN offset, and data. Channel power level can be set individually, adjusted to meet the IS-97 standard, or set to equal power.

Pre-configured channel setups

Quickly setup common channel configurations to perform CDMA measurements. The pre-configured channel setups can be used as is or modified to meet your specific test requirement. Choose from five preset channel configurations:

Pilot channel Use the pilot to perform mobile turn-on or waveform quality tests.
9 channel forward This channel configuration is according to the IS-97 specifications.
32 channel forward Simulates a realistically loaded base station for typical base station testing.
64 channel forward Simulates a maximum capacity transmission for an IS-95 CDMA base station.
Reverse traffic channel Use this selection to characterize the performance of CDMA mobile components.

Custom and pre-defined filters

Choose or create a unique filter. Choose from IS-95 standard-based filters or a variety of other common filter types including Nyquist, root Nyquist and Gaussian filters. Define a custom FIR filter to meet specific [non-standard] test requirements.

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.

Code domain power and CCDF curve display

Visually check channel configuration and peak-to-average ratio of the configured signal. View the relative channel powers in the code domain or the power statistics of the IS-95A waveform as compared to Additive White Gaussian Noise [AWGN] before producing the RF signal.

IS-95A arbitrary waveform playback features

IS-95A arbitrary waveform playback features

Multi-carrier	
Number of carriers	3 [pre-defined], 4 [pre-defined], custom [up to 12]
Frequency offset [per carrier]	Up to ± 15 MHz
Offset resolution	< 100 Hz
Carrier power [per carrier]	-40 dB to +0 db
Channels [per carrier]	Up to 256
Chip [symbol] rate	10 cps to 10 Mcps [4x oversampling] 1.2288 Mcps [default]
Modulation	
Forward	QPSK with Walsh and short code spreading
Reverse	Offset QPSK with short code spreading of random data
Pre-defined channel configurations[1]	
Forward[2]	Pilot channel 9 channel - pilot paging, sync, 6 traffic 32 channel - pilot, paging, sync, 29 traffic 64 channel - pilot, 7 paging, sync, 55 traffic
Reverse[3]	Traffic channel
User-defined channel parameters [table editor]	
Number of channels	1 to 256 [using different PN offsets]
Walsh codes	0 to 63
Channel power	-40 dB to 0 dB
PN offset	0 to 511
Data	00 to FF [Hex] or random
Walsh code power selection	IS-97 compliant, equal channel power, scaled to 0 dB, user-defined
IS-95 filter selection[4]	IS-95 IS-95 with equalizer IS-95 modified IS-95 modified with equalizer
Other FIR filters	
Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0 to 1
Custom FIR	16 bit resolution, automatically scaled
Oversampling ratio	
Range	2 to 8
Resolution	1
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.]

1. Power levels per IS-97-A.
2. Forward channel includes IS-95 modified filter with equalizer.
3. Reverse channel includes IS-95 modified filter.
4. All are IS-95 compliant. "Modified" filters reduce spurious emissions for adjacent channel power measurements.

IS-95A arbitrary waveform playback specifications

IS-95A arbitrary waveform playback specifications[1, 2, 3]

Spurious emissions

[dBc, IS-95 modified filter with equalizer and amplitude = ≤ -5 dBm standard, ≤ -3 dBm for Option 506, ≤ 0 dBm for Option UNB][1]

	0.885 to 1.25 MHz		*1.25 to 1.98 MHz*		*1.98 to 5 MHz*	
Channels/frequencies	Standard	Option 506	Standard	Option 506	Standard	Option 506
Reverse						
30 – 200 MHz	(–74)	(–74)	(–77)	(–77)	(–80)	(–80)
700 – 1000 MHz	–73 (–77)	–73 (–77)	(–81)	(–81)	(–85)	(–85)
>1000 – 2000 MHz	–76 (–79)	–75 (–79)	(–83)	(–83)	(–85)	(–85)
9/64 channels						
30 – 200 MHz	(–70)	(–70)	(–73)	(–73)	(–79)	(–79)
700 – 1000 MHz	–73 (–76)	–73 (–76)	(–79)	(–79)	(–82)	(–82)
>1000 – 2000 MHz	–72 (–76)	–71 (–76)	(–79)	(–79)	(–82)	(–82)

Rho[1] [≤ 4 dBm standard and Option 506, or ≤ 7 dBm Option UNB, IS-95 filter, ≤ 2 GHz]

$\rho \geq 0.9992$ (.9998)

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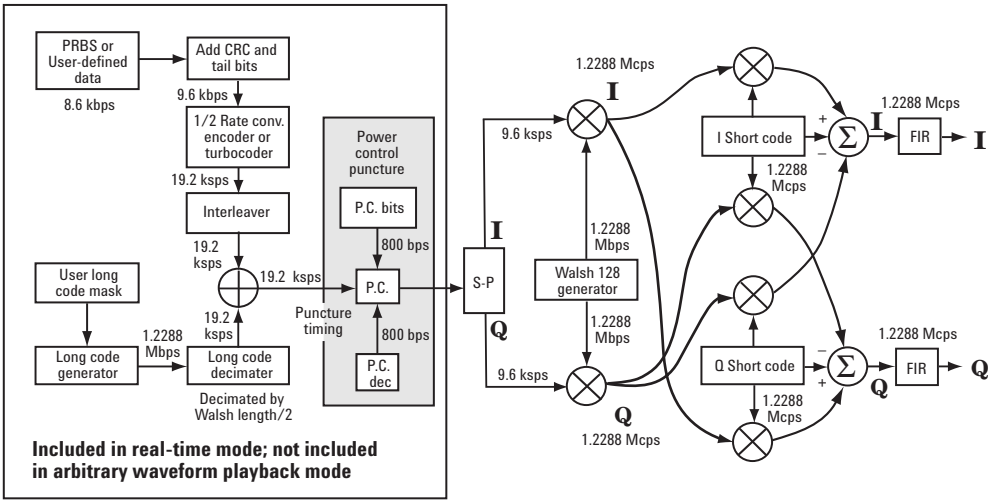
1. Parentheses denote typical performance.
2. Valid for 23° ±5°C.
3. See ESG data sheet for platform specifications

cdma2000 arbitrary waveform playback

Block diagram

Generate single or multi-carrier forward and reverse link standard based signals using the cdma2000 arbitrary waveform playback personality.

The block diagram details the level of channel coding provided by the cdma2000 arbitrary waveform playback personality.



cdma2000 arbitrary waveform playback key features

Single or multi-carrier cdma2000

Configure single or multi-carrier forward or reverse link cdma2000 test signals. Generate up to 12 individually configured SR1, SR3, or combination of SR1 and SR3 carriers within a 30 MHz bandwidth. Adjust frequency spacing and power offset of each carrier to meet test requirements.

256 configurable channels per carrier

Simulate multiple base stations or mobiles transmitting on the same carrier frequency. Choose from the following channel types:

- Forward link: Pilot, paging, synchronization, fundamental, and supplemental
- Reverse link: Pilot, dedicated control, synchronization, fundamental, and supplemental

Tailor the test signal to specific requirements, like the Complementary Cumulative Distribution Function [CCDF], by explicitly defining the characteristics of each channel on each carrier.

Table-based channel configuration

Customize the channel setup to realistically stress components under test. The table editor allows you to modify the:

- cdma2000 forward link by choosing the radio configuration, Walsh code, relative channel power, PN offset, data rate, and data pattern for each channel
- cdma2000 reverse link by choosing the radio configuration, relative channel power, data rate, and data pattern for each channel

Pre-configured channel setups

Quickly setup common channel configurations to perform CDMA measurements. The pre-configured channel setups can be used as is or modified to meet your specific test requirement. Choose from five preset channel configurations:

Forward pilot channel Use the pilot to perform mobile turn-on or waveform quality tests.
Forward 9 channel This channel configuration is according to the IS-97 specifications.
Reverse pilot channel Use this selection to characterize the performance of mobile components.
Reverse 5 channel This is a standard based Reverse link test signal.
Reverse 8 channel Stress components with eight traffic channels.

Custom and pre-defined filters

Choose or create a unique filter. Choose from IS-95 standard-based filters or a variety of other common filter types including Nyquist, root Nyquist and Gaussian filters. Define a custom FIR filter to meet specific [non-standard] test requirements.

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.

Code domain power and CCDF curve display

Visually check channel configuration and peak-to-average ratio of the configured signal. View the relative channel powers in the code domain or the power statistics of the cdma2000 waveform as compared to Additive White Gaussian Noise [AWGN] before producing the RF signal.

cdma2000 arbitrary waveform playback features

cdma2000 arbitrary waveform playback features

Multi-carrier	
Number of carriers	Up to 12 [user defined, individually configured]
Frequency offset [per carrier]	Up to ± 15 MHz
Offset resolution	< 100 Hz
Power offset	-40 dB to 0 dB
Channels [per carrier]	Up to 256
Spread rate	1x [SR1], 3x [SR3]

Forward and reverse link

Walsh code power selection	user-defined
IS-95 filter selection[1]	IS-95 IS-95 with equalizer IS-95 modified IS-95 modified with equalizer
Other FIR filters	
Nyquist, root Nyquist	α = 0 to 1
Gaussian	B_bT = 0 to 1
Custom FIR	16 bit resolution, automatically scaled
Rectangular	
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.]

1. All are IS-95 compliant. "Modified" filters reduce spurious emissions for adjacent channel power measurements.

cdma2000 arbitrary waveform playback features

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Forward link

Spread type	Direct spread [DS], multi-carrier
User-defined channel configurations	
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 selected radio configuration]
Walsh codes	Pilot: Walsh 0 [fixed] Sync: Walsh 32 [fixed] Other channels have codes selected from specific ranges depending on the chosen radio configuration
Channel power	-40 dB to 0 dB
PN offset	0 to 511
Data pattern	00 - FF [Hex] or random
Pre-defined channel configurations	
Pilot channel DS/SR1	Pilot at Walsh 0
Pilot channel DS/SR3	Pilot at Walsh 0
Pilot channel multi-carrier/SR1	Pilot at Walsh 0
9 channel DS/SR1	Radio configuration 3 Pilot at 9.6 kbps, paging at 9.6 kbps, sync at 1.2 kbps, two fundamental traffic channels at 9.6 kbps, and four supplemental traffic channels at 19.2 kbps
9 channel DS/SR3 or multi-carrier/SR3	Radio configuration 6 Pilot at 9.6 kbps, sync at 1.2 kbps, three fundamental traffic channels at 9.6 kbps, and four supplemental traffic channels at 38.4 kbps

Reverse link

Spreading type	Direct spread only
User-defined channel configurations	
Channel types [partially coded]	Pilot, dedicated control channel, fundamental traffic channel, and supplemental traffic channel
Radio configuration	1 to 6
Data rate	1.2 kbps to 1036.8 kbps [depends on selected radio configuration]
Channel power	0 to -40 dB
Data pattern	00 - FF [Hex] or random
Pre-defined channel configurations	
Pilot channel SR1or SR3	Pilot at Walsh 0
5 channel SR1 or SR3	Pilot, dedicated control RC3 traffic at 9.6 kbps, supplemental-1 traffic at 307.2 kbps, and supplemental-2 traffic at 76.8 kbps
8 channel SR1	RC1 traffic at 9.6 kbps and 7 supplemental-1 traffic channels at 9.6 kbps

cdma2000 arbitrary waveform playback specifications

cdma2000 arbitrary waveform playback specifications[1, 5]

Spurious emissions

[dBc, IS-95 modified filter with equalizer and amplitude = ≤ -5 dBm standard, ≤ -3 dBm for Option 506, ≤ 0 dBm for Option UNB]

Channels/ frequencies	*Offsets from center of carrier* 2.135 to 2.50 MHz	2.50 to 3.23 MHz	3.23 to 10 MHz
Forward 9 channel, SR3/multi-carrier[1, 3]			
30 – 200 MHz	(–70)	(–69)	(–72)
700 – 1000 MHz	(–75)	(–74)	(–77)
>1000 – 2000 MHz	(–75)	(–74)	(–77)

Channels/ frequencies	*Offsets from center of carrier* 2.655 to 3.75 MHz	3.75 to 5.94 MHz	5.94 to 10 MHz
Forward 9 channel, SR3/DS[1, 4]			
30 – 200 MHz	(–76)	(–78)	(–78)
700 – 1000 MHz	(–80)	(–83)	(–85)
>1000 – 2000 MHz	(–80)	(–83)	(–85)
Reverse 5 channel, SR3/DS[1, 3]			
30 – 200 MHz	(–78)	(–78)	(–78)
700 – 1000 MHz	(–82)	(–83)	(–85)
>1000 – 2000 MHz	(–82)	(–83)	(–85)

Error Vector Magnitude [EVM]

[≤ 4 dBm standard and Option 506, ≤ 7 dBm for Option UNB]

EVM (825 MHz to 2100 MHz, SR3 pilot, IS-95 filter, which is optimized for EVM) <2.1%, <1.5% (typical)

1. Parentheses denote typical performance
2. Valid for 23°C.
3. Measurements performed with 30 kHz bandwidth relative to power in one carrier.
4. Measurements performed with 30 kHz bandwidth relative to total power.
5. See ESG data sheet for platform specifications

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Real-time signal generation mode

In real-time signal generation mode, the ESG baseband generator produces test signals continuously, rather than playing a stored waveform repeatedly. Once configured, the cdma2000 real-time personality continuously generates a stream of fully coded forward or reverse link frames on a single carrier.

Considerable effort has been put into simplifying the cdma2000 real-time signal generation user interface. Standard reverse link operating modes have been added to ease the test setup process. Using the powerful baseband generator, fully coded forward and reverse link channel configurations can be achieved in a single ESG.

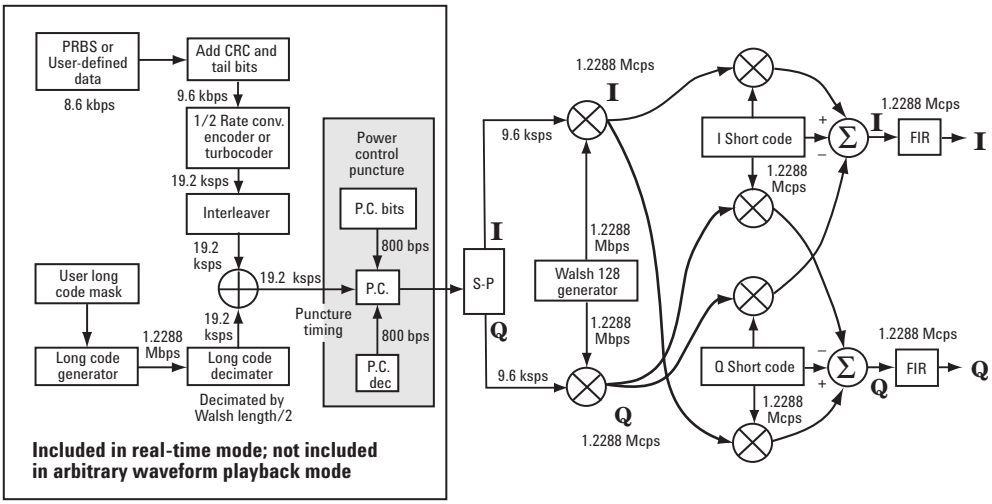
These test signals are primarily intended for mobile and base station receiver tests in the research and development environment. The high level of channel coding enables thorough evaluation of receiver demodulation capabilities at various design stages. Standard based measurements, including sensitivity, dynamic range, adjacent channel selectivity, traffic channel demodulation, FER/CRC verification 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.

cdma2000 real-time signal generation

Block diagram

Generate fully coded SR1 Forward or Reverse link signals using the cdma2000 real-time signal generation personality.

The block diagrams detail the coding path for a cdma2000 forward link SR1 RC4 traffic channel.



cdma2000 real-time signal generation key features

Table based setup

Quickly configure base station and mobile parameters. Set the following parameters for the relevant link type in a convenient table editor: Filter type, even second delay, chip rate, long code state, long code mask, PN Offset, and phase polarity.

Easily modify channel setup parameters.

The following channel types are supported:

- Forward link: Pilot, synchronization, quick paging, paging, fundamental, supplemental 1, supplemental 2, and OCNS.
- Reverse link: Pilot, dedicated control, common control, access, enhanced access, fundamental, and supplemental.

Select the channel type and define the relevant parameters, including: Walsh code, radio configuration, data type, bit rate, power level, E_b/N_o, frame length, and frame offset. Channel power level can be set individually, set to equal power, or scaled to 0 dB.

Full channel coding

Enables BER/FER testing and baseband ASIC verification. Both forward and reverse link signals are fully channel coded, including: long and short codes, cyclic redundancy checks, convolutional or turbo encoding, interleaving, power control, and complex scrambling.

Reverse link operating modes

Easily setup standard based cdma2000 signals for base station test.

Pre-configured Setups	*Channels*
RC1/RC2 traffic	Fundamental traffic, supplemental traffic 1
RC1/RC2 access	Access
RC3/RC4 traffic	Pilot, dedicated control, fundamental traffic, supplemental traffic 1, supplemental traffic 2
RC3/RC4 enhanced access	Pilot, enhanced access
RC3/RC4 common control	Pilot, common control

Custom and pre-defined filters

Choose or create a unique filter. Choose from IS-95 standard-based filters or a variety of other common filter types including Nyquist, root Nyquist and Gaussian filters. Define a custom FIR filter to meet specific [non-standard] test requirements.

Set E_b/N_o and C/N[1]

Intuitive user interface for defining the C/N ratio and E_b/N_o. Configure the channel setup and then navigate the noise menu when performing tests like receiver sensitivity. Modify C/N and E_b/N_o and see how this affects BER and FER results.

1. Requires the calibrated noise personality [Option 403].

cdma2000 real-time signal generation features

Forward link

BTS setup	
IS-95 filter	IS-95, IS-95 with equalizer, IS-95 MOD, IS-95 modified with equalizer
Other filters	User-defined FIR, Nyquist, root Nyquist, Gaussian, UN3/4 GSM Gaussian, APCO 25 C4FM, rectangular
Spread rate	SR1
Chip rate	1 kcps to 1.3 Mcps
PN offset	0 to 511
Even second delay[1]	0.5 to 128 chips
Long code state	0 to 3FF FFFF FFFF Hex
Phase polarity	Normal or invert
Baseband generator reference clock	Internal or external
Input/output	
Data out [AUX]	Power control bit [F-FCH]
Data clock out [AUX]	Chip clock [1.2288 MHz]
Symbol sync out [AUX]	Even second [internal]
Pattern trigger in [BNC]	System sync input
Alt power in [AUX]	Long code state latch strobe input
Event 1 out [BNC]	Even second [delayed to line up with RF]
Event 2 out [BNC]	System sync [one chip active low]
Event 3 out [AUX]	20 ms frame trigger [delayed to line up with RF]
Event 4 out [AUX]	80 ms frame trigger [delayed to line up with RF]
Single-ended Analog I/Q out [BNC]	Analog I and Q signals
Differential Analog I/Q out [BNC]	Differential I and Q signals
Forward channel types	
F-PICH	Pilot
F-SYNC	Synchronization
F-QPCH	Quick paging
F-PCH	Paging
F-FCH	Fundamental
F-SCH1	Supplemental 1
F-SCH2	Supplemental 2
OCNS	Orthogonally Coded Noise Simulator
Pilot channel [F-PICH]	
Power	-40 dB to 0 dB
Walsh	0 [non-adjustable]
E_b/N_o	Minimum: -30 dB + normalized channel power [dB] Maximum: +30 dB + normalized channel power [dB]

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cdma2000 real-time signal generation features

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Sync channel [F-SYNCH]	
Power	-40 dB to 0 dB
Walsh	0 to 63
System ID	0 to 32767
Network ID	0 to 65535
FSYNCH type	IS95, JSTB8, IS2000
System time	0 to F FFFF FFFF Hex
PRAT	0 to 3
LTM_Off	0 to 63
Message type	0 to 255
P_Rev	0 to 255
P_Rev_Min	0 to 255
Leap seconds	0 to 255
DAYLT	0 or 1
CDMA frequency	0 to 2047
Ext CDMA frequency	0 to 2047
Reserved	0 to 7
Bit rate	1.2 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
Quick paging channel [F-QPCH]	
Power	-40 dB to 0 dB
Configuration change	0 to 3
Paging indicator	-1 to 191 [2.4 kbps] -1 to 383 [4.8 kbps]
Bit rate	2.4 kbps or 4.8 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
Paging channel [F-PCH]	
Power	-40 dB to 0 dB
Walsh	0 to 63
Long code mask[1]	0 to 3FF FFFF FFFF Hex
Frame length	20 ms
Data	Default paging message or user file
Bit rate	4.8 to 9.6 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

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cdma2000 real-time signal generation features

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RC factor	
1	10 log [0.5 x 11/(11+9600/BitRate)]
2	10 log [0.5 x 23/(23+14400/BitRate)]
3	10 log [11/(11+9600/BitRate)]
4	10 log [11/(11+9600/BitRate)]
5	10 log [11/(11+14400/BitRate)]

Fundamental channel [F-FCH]

Power	-40 dB to 0 dB
Radio configuration	RC1, RC2, RC3, RC4, or RC5
Walsh	0 to 63 [RC1, RC2, RC3, RC5] 0 to 127 [RC4]
Long code mask	0 to 3FF FFFF FFFF Hex
Frame length	20 ms
Frame offset	0 to 15
Data	PN9, PN 15, 4-bit pattern, user file, or external serial data
Bit rate	RC1: 1.2, 2.4, 4.8, or 9.6 kbps RC2, RC5: 1.8, 3.6, 7.2, or 14.4 kbps RC3, RC4: 1.5, 2.7, 4.8, or 9.6 kbps
Power ramp	On/off
Power ramp time	1 to 8 frames [up/down]
QoF	0 to 3
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] + RC factor Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] + RC factor

Supplemental channel 1 [F-SCH1] and supplemental channel 2 [F-SCH2]

Power	-40 dB to 0 dB
Radio configuration	RC3, RC4, or RC5
Walsh	RC3: 0 to 31 [19.2 kbps] 0 to 15 [38.4 kbps] 0 to 7 [76.8 kbps] 0 to 3 [153.6 kbps] RC4: 0 to 63 [19.2 kbps] 0 to 31 [38.4 kbps] 0 to 15 [76.8 kbps] 0 to 7 [153.6 kbps] 0 to 3 [307.2 kbps] RC5: 0 to 31 [28.8 kbps] 0 to 15 [57.6 kbps] 0 to 7 [115.2 kbps] 0 to 3 [230.4 kbps]
Long code mask	0 to 3FF FFFF FFFF Hex
Frame length	20 ms
Frame offset	0 to 15
Data	PN9, PN 15, 4-bit pattern, user file, or external serial data
Bit rate	RC3: 19.2, 38.4, 76.8, 153.6 kbps RC4: 19.2, 38.4, 76.8, 153.6, or 307.2 kbps RC5: 28.8, 57.6, 115.2, or 230.4 kbps
Turbo coding	RC3: 19.2 to 76.8 kbps RC4: 19.2 to153.6 kbps RC5: 28.8 to 115.2 kbps
QoF	0 to 3
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Orthogonal Channel Noise Simulator [OCNS]

Power	-40 dB to 0 dB
Walsh	0 to 63
Data	Spread PN [uncoded]
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

cdma2000 real-time signal generation features

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Reverse link

Mobile set-up	
IS-95 filter	IS-95, IS-95 with equalizer, IS-95 MOD, IS-95 modified with equalizer
Other filters	User-defined FIR, Nyquist, root Nyquist, Gaussian, rectangular
Spread rate	SR1
Chip rate	1000 cps to 1.3 Mcps
Long code state	0 to 3FF FFFF FFFF Hex
Long code mask	0 to 3FF FFFF FFFF Hex
Even second delay	0.5 to 128 chips
Trigger advance	1 to 2457599
Trigger edge	Falling or rising
Phase polarity	Normal or inverted
Baseband generator data clock	Internal or external

Input/output	
Data out [AUX]	Long code
Data clock out [AUX]	Chip clock
Symbol sync out [AUX]	Even second [internal]
Pattern trigger in [BNC]	System sync input
Event 1 out [BNC]	Even second [delayed to line up with RF]
Event 2 out [BNC]	System synch [one chip active low]
Event 3 out [BNC]	PN synch [short code 26.67 ms]
Event 4 out [BNC]	20 ms marker
Single-ended analog I/Q out [BNC]	Analog I and Q signals
Differential analog I/Q out [BNC]	Differential analog I and Q signals

Reverse channel types	
R-PICH	Pilot
R-ACH	Access control
R-EACH	Enhanced access
R-DDCH	Dedicated control
R-CCCH	Common control
R-SCH1	Supplemental 1
R-SCH2	Supplemental 2

Reverse operating mode: RC1/RC2 traffic

Fundamental channel [R-FCH] and supplemental channel 0 [R-SCH]	
Power	-40 dB to 0 dB
Radio configuration	RC1 or RC2
Frame length	20 ms
Frame offset	0 to 15
Data	PN9, PN 15, fixed 4-bit pattern, user file
Bit rate	RC1: 1.2, 2.4, 4.8, or 9.6 kbps RC2: 1.8, 3.6, 7.2, or 14.4 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

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Reverse operating mode: RC1/RC2 access

Access channel [RACH]

Power	-40 dB to 0 dB
Radio configuration	RC1 or RC2
Frame length	20 ms
Frame offset	0 to 15
Data	PN9, PN 15, fixed 4-bit pattern, user file
Bit rate	4.8 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
	Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Reverse operating mode: RC3/RC4 traffic

Pilot channel [R-PICH]

Power	-40 dB to 0 dB
Walsh code	0
Power control bits	0 to FFFF Hex
E_b/N_o	Minimum: -30 dB + normalized channel power [dB]
	Maximum: +30 dB + normalized channel power [dB]

Dedicated control channel [R-DCCH]

Power	-40 dB to 0 dB
Radio configuration	RC3 or RC4
Walsh code	8
Frame length	5 or 20 ms
Frame offset	
Frame length = 5 ms	0 to 3
Frame length = 20 ms	0 to 15
Data	PN9, PN 15, fixed 4-bit pattern, user file
Bit rate	
Frame length = 5 ms	RC3: 9.6 kbps
	RC4: 9.6 kbps
Frame length = 20ms	RC3: 9.6 kbps
	RC4: 14.4 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
	Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Fundamental channel [R-FCH]

Power	-40 dB to 0 dB
Radio configuration	RC3 or RC4
Walsh code	4
Data	PN9, PN 15, fixed 4-bit pattern, user file
Frame length	5 or 20 ms
Frame offset	
Frame length = 5 ms	0 to 3
Frame length = 20 ms	0 to 15
Data	PN9, PN 15, fixed 4-bit pattern, user file
Bit rate	
Frame length = 5 ms	RC3: 9.6 kbps
	RC4: 9.6 kbps
Frame length = 20 ms	RC3: 1.5, 2.7, 4.8, or 9.6 kbps
	RC4: 1.8, 3.6, 7.2, or 14.4 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
	Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

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Supplemental channel 1 [R-SCH1] and supplemental channel 2 [R-SCH2]

Power	-40 dB to 0 dB
Radio configuration	RC3 or RC4
Walsh code	R-SCH1: 1 or 2 R-SCH2: 2 or 6
Frame length	20, 40, or 80 ms
Frame offset	
Frame length = 20 ms	0 to 15
Frame length = 40 ms	0 to 31
Frame length = 80 ms	0 to 63
Data	PN9, PN 15, fixed 4-bit pattern, user file
Bit rate	
Frame length = 20	RC3: 1.5, 2.7, 4.8, 9.6, 19.2, 38.4, 76.8, 153.6, or 307.2 kbps RC4: 1.8, 3.6, 7.2, 14.4, 28.8, 57.6, 115.2 or 230.4 kbps
Frame length = 40	RC3: 1.35, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, or 153.6 kbps RC4: 1.8, 3.6, 7.2, 14.4, 28.8, 57.6, or 115.2 kbps
Frame length = 80	RC3: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, or 76.8 kbps RC4: 1.8, 3.6, 7.2, 14.4, 28.8, or 57.6 kbps
Turbo coding	
Frame length = 20	RC3: 19.2, 38.4, 76.8, or 153.6 kbps RC4: 28.8, 57.6, or 115.2 kbps
Frame length = 40	RC3: 19.2, 38.4, 76.8, or 153.6 kbps RC4: 14.4, 28.8, 57.6, or 115.2 kbps
Frame length = 80	RC3: 19.2, 38.4, or 76.8 kbps RC4: 7.2, 14.4, 28.8, or 57.6 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Reverse operating mode RC3 and RC4 enhanced access

Pilot channel [R-PICH]

Power	-40 dB to 0 dB
Walsh code	0
Gating rate	Quarter, half, full
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Enhanced access control [R-EACH]

Power	-40 dB to 0 dB
Radio configuration	RC3 or RC4
Walsh code	2
Data	PN9, PN 15, fixed 4-bit pattern, user file
Frame length	5, 10 or 20 ms
Frame offset	
Frame length = 5 ms	0 to 3
Frame length = 10 ms	0 to 7
Frame length = 20 ms	0 to 15
Bit rate	
Frame length = 5 ms	38.4 kbps
Frame length = 10 ms	19.2 or 38.4 kbps
Frame length = 20 ms	9.6, 19.2, or 38.4 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate] Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Reverse operating mode RC3 and RC4 common control

Pilot channel [R-PICH]

Power	-40 dB to 0 dB
Walsh code	0
Gating rate	Quarter, half, full
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
	Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

Common control channel [R-CCCH]

Power	-40 dB to 0 dB
Radio configuration	RC3 or RC4
Walsh code	2
Data PN9, PN 15, fixed 4-bit pattern, user file	
Frame length	5, 10 or 20 ms
Frame offset	
Frame length = 5 ms	0 to 3
Frame length = 10 ms	0 to 7
Frame length = 20 ms	0 to 15
Bit rate	
Frame length = 5 ms	38.4 kbps
Frame length = 10 ms	19.2 or 38.4 kbps
Frame length = 20 ms	9.6, 19.2, or 38.4 kbps
E_b/N_o	Minimum: -30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]
	Maximum: +30 dB + normalized channel power + 10 $\log_{10}$ [chip rate/bit rate]

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	
401	cdma2000 and IS-95A personalities
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 cdma2000 and IS-95A personalities may be ordered as Option 401 for the Agilent E4438C ESG Vector Signal Generator. If you need help, your Agilent field sales engineer can help you configure your ne w 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 401.

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

Agilent 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 cdma2000 Base Stations - Application Note 1357
Publication number 5980-1303E

Designing and Testing cdma2000 Mobile Stations - Application Note 1358
Publication number 5980-1237E

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

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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.

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Notice

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

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