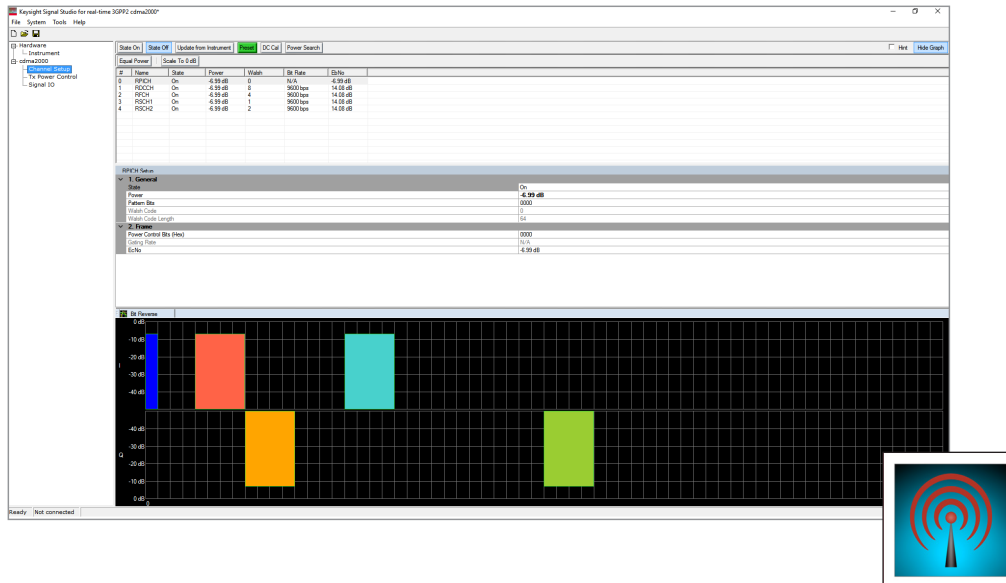# Keysight Technologies
Signal Studio for cdma2000®/1xEV-DO
N7601C

Technical Overview

- Create Keysight validated and performance optimized reference signals compliant with IS-95A, cdma2000 and 1xEV-DO Rev. A and Rev. 0
- Perform UE and BTS component testing
- Perform UE and BTS receiver conformance testing with predefined configurations in all of the supported radio formats and mixed format configurations
- Perform UE and BTS receiver testing with transport-channel coding
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

KEYSIGHT
TECHNOLOGIES

Simplify cdma2000 and 1xEV-DO Signal Creation

Keysight Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation. For cdma2000 and 1xEV-DO, Signal Studio's performance-optimized reference signals—validated by Keysight—enhance the characterization and verification of your devices. Through its application-specific user-interface you'll create standards-based and custom test signals for component, transmitter, and receiver test.

Component and transmitter test

Signal Studio's basic capabilities use waveform playback mode to create and customize waveform files needed to test components and transmitters. Its user-friendly interface lets you configure signal parameters, calculate the resulting waveforms and download files for playback. The applications for these partially coded, statistically correct signals include:

– Parametric test of components, such as amplifiers and filters
– Performance characterization and verification of RF sub-systems

Receiver test

Signal Studio's advanced capabilities enable you to create fully channel-coded signals for receiver bit-error-rate (BER), block-error-rate (BLER), packet-error-rate (PER), or frame error rate (FER) analysis. Applications include:

– Performance verification and functional test of receivers, during RF/baseband integration and system verification
– Coding verification of baseband subsystems, including FPGAs, ASICs, and DSPs

More advanced capabilities operate in real-time mode, which is used to define the parameters of nonrepeating and dynamically changing signals needed for receiver testing. A graphical interface provides a direct instrument connection for parameter transfer and closed-loop or interactive control during signal generation.

Apply your signals in real-world testing

Once you have setup your signals in Signal Studio, you can download them to a variety of Keysight instruments and software platforms. Signal Studio software complements these platforms by providing a cost-effective way to tailor them to your test needs in design, development and production test.

– Vector signal generators
  – X-Series: MXG and EXG
  – PSG
  – ESG
  – First-generation MXG
  – M9381A PXIe VSG
– E6640A EXM wireless test set
– M8190/95A arbitrary waveform generator
– M9420/21A PXIe VXT vector transceiver

Typical Measurements

Test components with basic capabilities:

– IMD/NPR
– ACLR
– CCDF
– EVM
– Modulation accuracy
– Code domain power
– Channel power
– Occupied bandwidth

Verify receivers with advanced capabilities:

– Sensitivity
– Maximum input level
– Selectivity
– Blocking
– Intermodulation
– Power control

Component and Transmitter Test

Figure 1. Typical component test configuration using Signal Studio's basic capabilities with a Keysight X-Series signal generator and an X-Series signal analyzer

The N7601C Signal Studio for cdma2000/1xEV-DO software's basic capabilities enable you to create waveforms with multiple and mixed carriers for component testing. With the purchase of the N7601C software's Basic CDMA license, the software generates waveforms in both the IS-95A and the cdma2000 radio formats. With the purchase of the N7601C software's Basic 1xEV-DO license, the software generates waveforms in both the 1xEV-DO Rev. 0 and 1xEV-DO Rev. A radio formats. Both Basic licenses allow the software to generate waveforms in all four radio formats.

Designers and manufacturers of both access network (AN) and access terminal (AT) components will find the N7601C Signal Studio for cdma2000/1xEV-DO extremely useful. The N7601C software provides cdma2000, IS-95A, and 1xEV-DO waveforms for testing many cdma products, such as multicarrier power amplifiers (MCPAs) and dual-mode handset components.

Using the N7601C software's CCDF capability, you can verify the performance of your handset (MS or AT) power amplifiers for all of the radio formats.

Signal Studio for cdma2000/1xEV-DO allows you to test MCPAs with up to 25 carriers placed within a 160 MHz bandwidth. The forward link waveform includes an idle slot gain feature that can be used to vary the noise level relative to the pilot channel during idle slot transmissions. This allows the on/off power ratio to be set to meet the transmission envelope mask requirements of the system. Forward and reverse link physical channel parameters can be individually configured in each timeslot.

The waveforms provided by the N7601C Signal Studio for cdma2000/1xEV-DO software enable you to perform the following component tests:

 – Conducted spurious emission tests
 – Complementary-cumulative-probability distribution function (CCDF) tests
 – Waveform quality tests
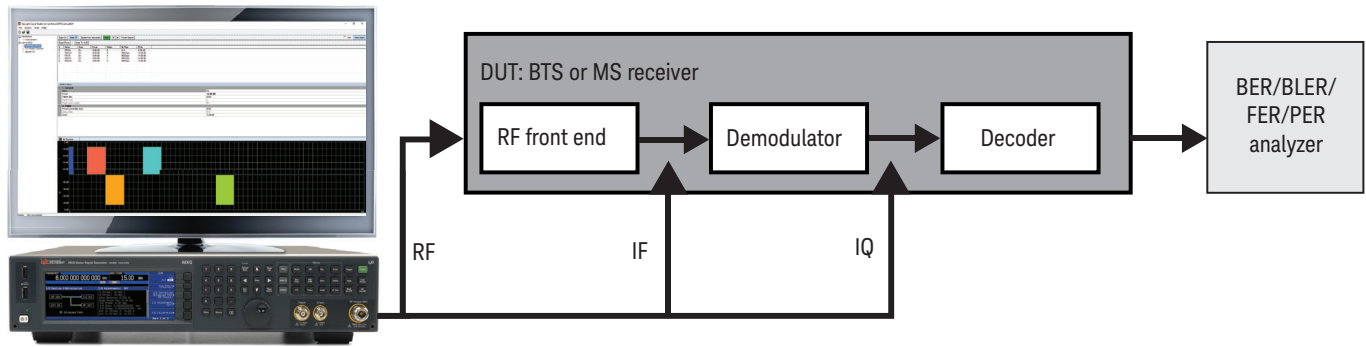 – Code domain power (CDP) tests

Receiver Test

Figure 2. Generate fully channel-coded signals to evaluate the BER, BLER, PER, or FER of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities

The N7601C Signal Studio for cdma2000/1xEV-DO software's advanced capabilities can be used for receiver testing in cdma2000, 1xEV-DO Rev. 0 and 1xEV-DO Rev. A applications. With the purchase of the advanced licenses, the software generates fully-coded cdma2000 or 1xEV-DO signals in the physical and transport layers which can be used for packet error rate (PER) verification. These fully-coded signals are available in both the forward link and reverse link directions from the advanced selections.

The Additive White Gaussian Noise (AWGN) signal generator feature (Option 403) can be used as part of the receiver test process. AWGN is not likely to be used in component testing applications.

Receiver testing

Baseband verification

– Packet error rate (PER) test for testing the performance of an access terminal (AT) and access network (AN) receiver. PER is the ratio, in percent, of the number of test packets not successfully received by the AT/AN receiver to the number of test packets sent to the AT/AN receiver.
– PER test by turbo-coded interleaved packet repetition
– HARQ (hybrid automatic repeat request) test in 1xEV-DO Rev. A
– Turbo coding check at early termination
– 1xEV-DO Rev.0/A AN/AT PER test and 1xEV-DO Rev. A RL throughput verification
– 1xEV-DO Rev. A baseband functional test

RF conformance test

– Receiver Sensitivity, ACS, Blocking

Features Summary

IS-95A cdma2000 1xEV-DO Rev. 0 1xEV-DO Rev. A	Component & transmitter testing	Receiver testing	
	Basic waveform playback mode	Advanced waveform playback mode	Advanced real-time mode (cdma2000)
Calibrated AWGN	●	●	●
CCDF, spectrum, and time domain graphics	●	●	
Code domain	●	●	●
PER verification		●	●
BER, FER Insertion			●
Short length waveform	●		
Channel setup			
Power (–40dB to 0 dB)	●		●
Walsh Code (0 to 63)	●		●
Data: Random, PN9, user	●		●
IS-95A forward			
Predefined Configurations (varies by radio format)	●		
Radio configuration	●		
Fully coded channels	●		
IS95A Reverse			
Predefined configurations (varies by radio format)	●		●
Radio configuration	●		●
Fully coded channels	●		●
cdma2000 forward			
Predefined configurations (varies by radio format)	●	●	
Radio configuration	●	●	
Fully coded channels	●	●	
cdma2000 reverse			
Predefined configurations (varies by radio format)	●		●
Radio configuration	●		●
Fully coded channels	●		●
1xEV-DO Rev. 0 forward			
Predefined configurations			
Traffic 16QAM (no coding)	●	●	
Traffic 8PSK (no coding)	●	●	
Traffic QPSK (no coding)	●	●	
Forward test mode		●	
Supported channels			
Pilot	●	●	
MAC	●	●	
Traffic	●	●	
1xEV-DO Rev. 0 reverse			
Predefined configurations			
Traffic BPSK (no coding)	●	●	
Traffic 153.6k (no coding)		●	
Supported channels			
Pilot	●	●	
Reverse rate indicator	●	●	
Data rate control	●	●	
ACK	●	●	
Data	●	●	
Data encoding		●	

Features Summary (continued)

IS-95A cdma2000 1xEV-DO Rev. 0 1xEV-DO Rev. A	Component & transmitter testing	Receiver testing	
	Basic waveform playback mode	Advanced waveform playback mode	Advanced real-time mode (cdma2000)
1xEV-DO Rev. A forward			
Predefined configurations			
Traffic 16QAM (no coding)	●	●	
Traffic (4096,1,64)		●	
Traffic (1024,1,64)		●	
Forward test mode		●	
Supported channels			
Pilot	●	●	
MAC	●	●	
Control	●	●	
Traffic	●	●	
Reverse activity	●	●	
DRCLock	●	●	
Reverse power control	●	●	
ARQ	●	●	
Packet data encoding		●	
1xEV-DO Rev. A reverse			
Predefined configurations			
Traffic Q2 (no coding)	●	●	
Traffic (4096,Q2)		●	
Traffic(8192,Q4Q2)		●	
Traffic(12288,E4E2)		●	
Supported channels			
Pilot	●	●	
Auxiliary pilot	●	●	
MAC	●	●	
Reverse rate indicator	●	●	
Data rate control	●	●	
Data source control	●	●	
ACK	●	●	
Data	●	●	
Packet data encoding		●	

Supported Standards and Test Configurations

3GPP functional freeze date	3GPP technical specification	Version	Notes
cdma2000	3GPP2 C.S0002-D	V2.0	Feb. 2004
EVDO Rev 0	3GPP2 C.S0024-0	V4.0	Oct. 2002
EVDO Rev A	3GPP2 C.S0024-A	V3.0	Sept. 2006

Performance Characteristics

Definitions

Specification (spec):

Represents warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. The specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

Typical (typ):

Represents characteristic performance, which 80% of the instruments manufactured will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 25 °C).

Measured (meas):

An attribute measured during the design phase for purposes of communicating expected performance, such as amplitude drift vs. time. This data is not warranted and is measured at room temperature (approximately 25 °C).

The following performance characteristics apply to the instruments indicated in the respective tables. For performance characteristics of other instruments, refer to the respective product data sheet.

3GPP2 cdma2000 EVM performance

Frequency (MHz)	Channel configuration		Standard		Option 1EA	
800 to 900 or 1800 to 2200	FL Pilot	M9381A VSG (STD ≤ +8 dBm, Option 1EA ≤ +12 dBm)	Measured	Typical	Measured	Typical
			0.28% rms	0.31% rms	0.29% rms	0.41% rms
		N5172B EXG/N5182B MXG (STD ≤ +8 dBm, Option 1EA ≤ +12 dBm)	Specification	Typical	Specification	Typical
			1.30%	0.80%	1.30%	0.80%
380 to 490, 695 to 960, or 1425 to 2180	FL Pilot	M9420A PXIe VXT (RF output: STD +10 dBm, Option 1EA +15 dBm	< 1.1%, nominal		< 1.1%, nominal	

Conducted spurious emission (CSE) measured performance, – 9 channel forward link

N5172B EXG/N5182B MXG (dBc)	Frequency offsets				Frequency offsets			
	750 kHz	885 kHz	1.25 MHz	1.98 MHz	750 kHz	885 kHz	1.25 MHz	1.98 MHz
	Amplitude level: ≤ +2 dBm for STD				Amplitude level: ≤ +5 dBm with Option UNV and Option 1EA			
cdma2000 (Measured)	–82.0	–84.7	–87.9	–91.6	–82.9	–84.8	–88.4	–92.7
1xEV-DO Rev 0 (Measured)	–71.9	–77.1	–83.9	–88.5	–72.7	–77.4	–84.1	–89.1
1xEV-DO Rev A (Measured)	–73.6	–78.8	–85.3	–88.0	–74.2	–78.9	–85.2	–89.1
M9381A PXIe VSG (dBc)	Amplitude level: ≤ +4 dBm for both STD and Option 1EA				Amplitude level: +12 dBm for Option 1EA			
cdma2000 (Measured)	–71.0	–74.2	–80.2	–91.9	–63.0	–64.1	–69.1	–80.4
cdma2000 (Typ)	–69.0	–71.1	–76.2	–88.4	–60.3	–61.3	–66.2	–77.6
1xEV-DO Rev 0 (Typ)	–71.3	–74.9	–81.3	–89.3	–61.9	–63.4	–67.8	–82.6
1xEV-DO Rev A (Typ)	–71.3	–74.8	–81.2	–89.0	–61.5	–62.7	–67.7	–81.2

Ordering Information

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **Time-based:** License is time limited to a defined period, such as 12-months.

N7601C Signal Studio for cdma2000/1xEV-D0

Waveform playback licenses (N7601EMBC)

Software	Support Contract	Description
N7601EMBC-1FP	R-Y5B-001-A[2]	Node-locked perpetual license
N7601EMBC-1FL	R-Y4B-001-L[1]	Node-locked 12-month license
N7601EMBC-1TP	R-Y5B-004-D[2]	Transportable perpetual license
N7601EMBC-1TL	R-Y4B-004-L[1]	Transportable 12-month license

Software support subscription for perpetual licenses [3]

Support Contract	Description
R-Y6B-001-L	12-months of support for node-locked licenses
R-Y6B-004-L	12-months of support for transportable licenses
R-Y6B-501	1-month of support for node-locked licenses (extension after 1st year)
R-Y6B-504	1-month of support for transportable licenses (extension after 1st year)

1. All time-based software licenses include a 12-month support contract.
2. Support contracts must be purchased for all perpetual licenses in the first year. All software upgrades and KeysightCare support are provided for software licenses with valid support contracts.
3. After the first year, support contracts for all perpetual licenses may be extended with annual and monthly support extensions.

Hardware configurations

To learn more about compatible hardware and required configurations, please visit: **www.keysight.com/find/SignalStudio_platforms**

PC requirements

A PC is required to run Signal Studio. **www.keysight.com/find/SignalStudio_pc**

Model numbers & options

To learn more about Signal Studio licensing, model numbers and options, please visit: **www.keysight.com/find/signalstudio_model**

Websites

www.keysight.com/find/SignalStudio
www.keysight.com/find/N7601C

Comprehensive Online Documentation

www.keysight.com/find/signalstudio_support

Keysight's cdma2000 design and test solutions

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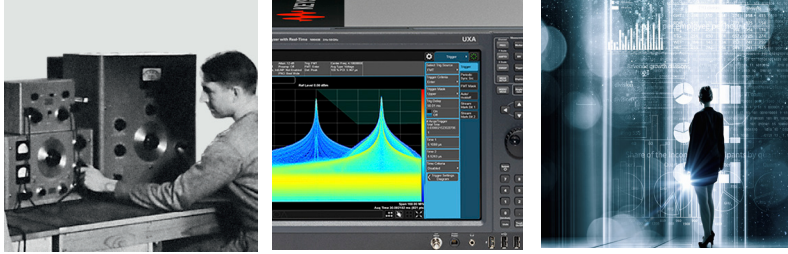
Literature

Signal Studio Software, Brochure, literature number **5989-6448EN**

Transition from 2G/3G to 3.9G/4G Base Station Receiver Conformance Test, Application Note, literature number **5991-0280EN**

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