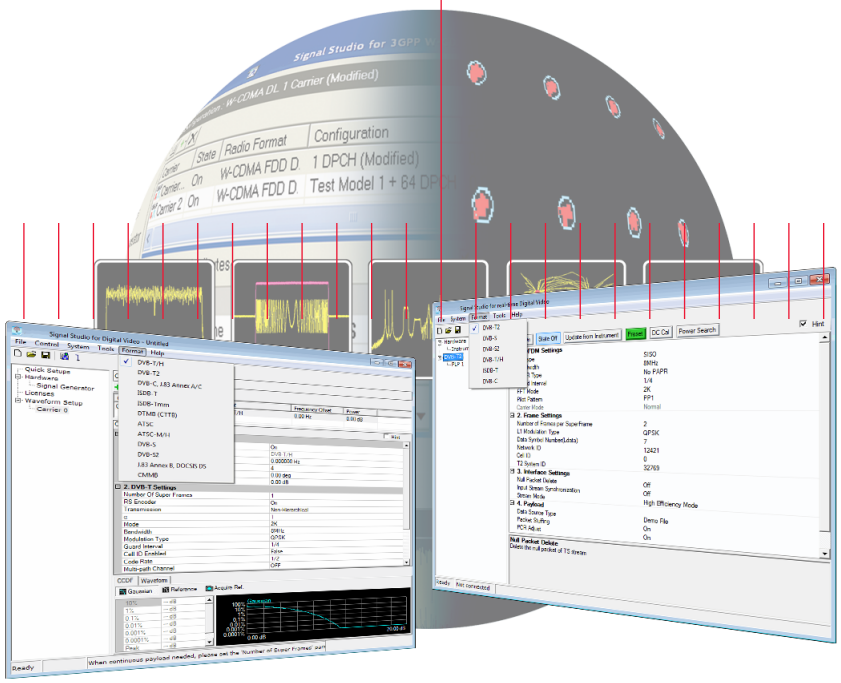
Keysight Technologies
Signal Studio for Digital Video
N7623B

Technical Overview



KEYSIGHT TECHNOLOGIES

Typical Measurements

Typical digital video component measurement

- IMD / NPR
- ACLR
- CCDF
- EVM / MER
- Modulation accuracy
- Channel power
- Occupied bandwidth
- Spectrum emissions

Typical digital video receiver measurements

- Sensitivity
- Maximum input level
- Immunity to adjacent channel signal
- Immunity to co-channel signal
- Impulse interference test
- C/N performance in Gaussian and fading channels
- Performance in SFN network (pre-echo, post-echo and 0-dB echo)
- Blocking

Features

- Create real-time digital video signals compliant to DVB-T/H, DVB-T2, DVB-C/S/S2 and ISDB-T/TB/TSB
- Create Keysight Technologies, Inc. validated and performance optimized reference waveforms compliant to DVB-T/H, DVB-T2, DVB-C/S/S2, ISDB-T/TB/TSB/Tmm, ATSC, ATSC-M/H, DTMB (CTTB), CMMB, J.83 Annex A/B/C, and DOCSIS DS standards
- Perform BER tests with PN sequence, all 1s, all 0s, or user-defined data patterns or subjective evaluation with MPEG2-TS or ColorBar demo file
- Real-time fading, SFN simulation, MISO simulation, AWGN, and interferers for conformance testing with N5106A PXB
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

Simplify Digital Video 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 digital video standards including DVB-T/H, DVB-T2, DVB-C/S/S2, ISDB-T/TB/TSB/Tmm, ATSC, ATSC-M/H, DTMB(CTTB), CMMB, J.83 Annex A/B/C, and DOCSIS DS, 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 advanced 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 -coded, statistically correct signals include

- Parametric test of components, such as amplifiers, filters, gap-filler and repeater
- 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), frame error rate (FER), packet-error-rate (PER), or subjective failure point (SFP) analysis.

Applications include:
Performance verification and conformance test of receivers, during RF/baseband integration and system verification

- Coding verification of baseband subsystems, including FPGAs, ASICs, and DSPs
- Receiver chipset design and verification, performance test (IC design house or certification lab)
- Receiver module integration and verification (terminal vendors)
- Receiver manufacturing for phones (smart phones) or set top boxes

In addition to waveform playback mode, DVB-T/H, DVB-T2, DVB-C/S/S2 and ISDB-T advanced capabilities can operate in real-time mode, which is used to define the parameters of nonrepeating and dynamically changing signals needed for receiver testing. Its 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 set up your signals in Signal Studio, you can download them to a variety of Keysight instruments. 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
  - PXIe M9381A
- EXT wireless communication test set
- PXB baseband generator and channel emulator
- M9252A DigRF host adaptor
- SystemVue simulation software

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.

Signal Studio's advanced capabilities enable you to create and customize waveforms compliant with digital video standards, including DVB-T/H/T2/C/S/S2, ISDB-T/TB/TSB/Tmm, ATSC, ATSC-M/H, DTMB (CTTB), CMMB, J.83 Annex A/B/C and DOCSIS DS, to characterize the power and modulation performance of your components and transmitters. Easy manipulation of a variety of signal parameters, including transmission bandwidth, cyclic prefix, and modulation type, simplifies signal creation.

- Create spectrally-correct signals for ACLR, channel power, spectral mask, and spurious testing
- Set parameters such as channel power and data channel modulation type (BPSK, QPSK, 16QAM, 64QAM) for modulation verification and analysis, such as MER, EVM tests
- Configure multi-carrier waveforms, each with different modulation settings, frequency offsets, power, baseband filter, and more
- Create multi-path signals for SFN (Single Frequency Network) tests with an X-Series Signal Analyzer to measure the CIR (Channel Impulse Response)
- View CCDF, spectrum and time domain graphs to gain insight into the effects of power ramps, modulation formats, power changes, clipping, and other effects on device performance

Receiver Test

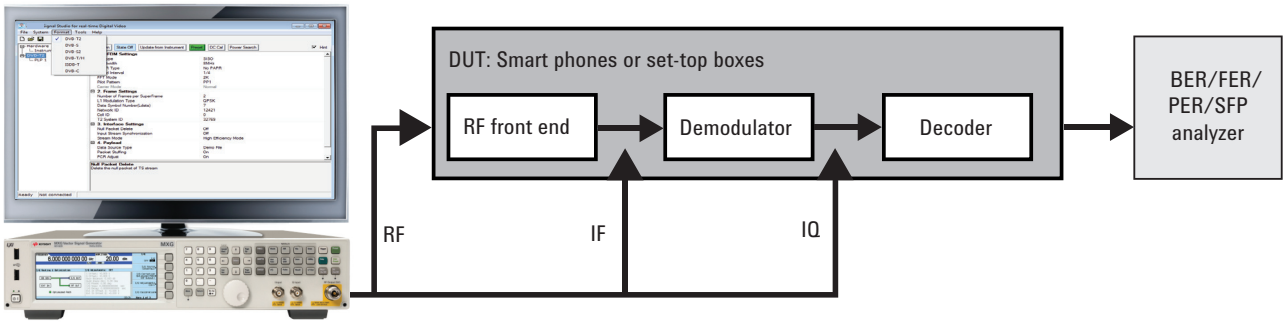


Figure 2. Generate fully channel-coded signals to evaluate the BER, FER, PER, or SFP of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities.

Signal Studio's advanced capabilities address applications in digital video receiver test, including the verification of baseband designs, the integration of the baseband and RF modules, and the manufacturing of phones (smart phones) and set-top boxes. Using the waveform playback mode enables transport-channel coding to validate digital video receiver characteristics and performance. The real-time mode enables you to define the parameters of non-repeating signals and generate signals with MPEG2-TS file streaming for hours.

- Create real-time digital video signals for receiver design, verification and performance test
- Perform auto-stuffing and PCR adjustment with the real-time mode
- Perform BER tests with a PN9/PN15/PN23 sequence, all 1s, all 0s, or user-defined data patterns, or subjective evaluation with a user-defined MPEG2-TS file or ColorBar demo file
- Create multi-path signals for SFN (Single Frequency Network) tests with an X-Series signal analyzer to measure the CIR (Channel Impulse Response)
- Create signals with real-time fading, AWGN and interference tests using N5106A PXB

Features Summary

Digital video	Receiver/component testing	
	Advanced waveform playback mode	Advanced real-time mode
DVB-T/H[1, 2, 3]	**N7623B-QFP**	**N7623B-EFP**
2k, 4k, 8k modes	■	■
5, 6, 7, 8 MHz bandwidth	■	■
Modulation: QPSK, 16QAM, 64QAM	■	■
Baseband filter: On/Off	■	■
DVB-H enabled: On/Off	■	■
Real-time adjustments to signal parameters		■
DVB-T2[1, 2, 3]	**N7623B-ZFP**	**N7623B-HFP**
Real-time adjustments to signal parameters		■
Version 1.2.1	■	■
Single PLP	■	■
Multi-PLP		■
SISO	■	■
MISO		■[4]
1.7, 5, 6, 7, 8, 10 MHz bandwidth	■	■
FEC LDPC + BCH 1 /2, 3/5, 2/3, 3 /4, 4/5, 5/6	■	■
QPSK, 16QAM, 64QAM, 256QAM	■	■
FFT Size: 1K, 2K, 4K, 8K, 16K, 32K	■	■
Guard Interval: 1 /4, 19/256, 1 /8, 19/128, 1/16, 1/32, 1/128	■	■
DVB-C(J.83 Annex A/C)1, 2, 3	**N7623B-QFP**	**N7623B-FFP**
Real-time adjustments to signal parameters		■
16QAM, 32QAM, 64QAM, 128QAM, 256QAM,1024QAM	■	■
Variable symbol rate	■	■
Baseband shaping and modulation	■	■
Known Bit Error Rate (requires Option PFP)	■	
DVB-S[1, 2, 3]	**N7623B-VFP**	**N7623B-GFP**
Real-time adjustments to signal parameters		■
Modulation: QPSK	■	■
Transport multiplex adaptation and randomization for energy dispersal	■	■
Outer coder RS(204,188)	■	■
Inner coder convolutional coding	■	■
Variable symbol rate	■	■
Baseband shaping and modulation	■	■
DVB-S2[1, 2, 3]	**N7623B-WFP**	**N7623B-GFP**
Real-time adjustments to signal parameters		■
Powerful FEC system based on LDPC (Low-Density Parity Check) codes concatenated with BCH codes	■	■
4 constellations (QPSK, 8PSK, 16APSK, 32APSK)	■	■
A set of three spectrum shapes with roll-off factors 0,35, 0,25, and 0,20	■	■

1. *Supported payload includes data pattern (all 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet), color bar sample, and MPEG-TS file.*
2. *Real-time mode supports PN23 and PCR adjustment.*
3. *Waveform playback mode supports static multi-path simulation for SFN testing for up to 20 paths. Real-time mode supports static multi-path simulation for up to 4 paths.*
4. *DVB-T2 MISO is supported with N5106A PXB.*

Digital video	Receiver/component testing	
	Advanced waveform playback mode	Advanced real-time mode
ISDB-T[1, 2, 3]	N7623B-RFP	N7623B-JFP
Real-time adjustments to signal parameters		■
Japan and Brazil standards support	■	■
Outer coder (RS coder), Inner coding	■	■
Energy dispersal conducted at each hierarchical layer	■	■
Mapping: DQPSK, QPSK, 16QAM, 64QAM	■	■
1 segment, 3 segments, or 13 segments signal generation	■	■
Phase compensation of segment for consecutive transmission	■	■
Payload supports		
Data pattern: All 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet	■	■
Color bar sample	■	■
MPEG-TS file (seamless loop-back)	■	■
TS file wizard with three layers (A, B, and C) assignment	■	■
ISDB-Tmm[1]	N7623B-MFP	
Support up to 33 segments with bandwidth of 14.5 MHz	■	
Two super segment types: Type A, Type B	■	
Flexible assignment of 33 segments to type A or type B super segments	■	
Modulation: DQPSK, QPSK, 16QAM, 64QAM	■	
Outer coder (RS coder), Inner coding	■	
Built-in AC builder	■	
Phase compensation for connected transmission	■	
For type A super segment:		
13 segments	■	
Up to 3 hierarchical layers (A, B, and C)	■	
Assign programs in TS to each layer	■	
For type B super segment:		
Up to 14 conjugated single segments	■	
Configure each segment independently	■	
ATSC[1]	N7623B-UFP	
Data organization (Sync Mux)	■	
Modulation: 8VSB, 16VSB	■	
Pilot addition	■	
ATSC-M/H	N7623B-NFP	
Modulation type: 8VSB	■	
Parade configuration including:		
NoG (number of groups)	■	
RS frame mode: Single	■	
SCCC Mode: Separate/Paired	■	
RS code rate: (235, 187), (223, 187), (211, 187)	■	
SCCC code rate for Region A, B, C, D: 1 /2, 1 /4	■	
Payload supports		
Data pattern: All 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet	■	
Color bar sample	■	
Multiplexed TS	■	
Main Service: MPEG-TS	■	
M/H Service: IP stream or video & audio file	■	

1. *Supported payload includes data pattern (all 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet), color bar sample, and MPEG-TS file.*
2. *Real-time mode supports PN23 and PCR adjustment.*
3. *Waveform playback mode supports static multi-path simulation for SFN testing for up to 20 paths. Real-time mode supports static multi-path simulation for up to 4 paths.*

Digital video	Receiver/component testing	
	Advanced waveform playback mode	Advanced real-time mode
DTMB (CTTB)[1]	**N7623B-SFP**	
BCH and LDPC coding for 3 data rates	■	
Modulation: 4QAM-NR, 4QAM, 16QAM, 32QAM, 64QAM	■	
Single carrier and multi-carrier modulation (C=1 and C=3780)	■	
Framing: Frame header mode 1, 2, 3	■	
Filter: SRRC with settable roll-off factor (default value is 0.05)	■	
J.83 Annex B (DOCSIS DS)[1]	**N7623B-XFP**	
Input signal: Modified MPEG-2 transport stream	■	
Variable symbol rate	■	
Constellation 64-QAM, 256-QAM	■	
CMMB	**N7623B-YFP**	
Physical layer bandwidth: 8 MHz	■	
Provides transmission rate configurable transmission channels	■	
Physical logical channel (PLCH) includes	■	
CLCH (Control logic channel): carrying control information	■	
SLCH (Service logic channel): carrying broadcasting service	■	
Provide CMMB TS library	■	
Payload supports		
– Data pattern: All 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet	■	
– Multiplexed MFS file	■	
– MFS file by each SLCH	■	
– CMMB TS library	■	
BER Tools	**N7623B-PFP [2]**	
Known bit error rate: Range upper limit is 1E-4, lower limit is dependent on the frame length	■	

1. Supported payload includes data pattern (all 1s, all 0s, PN9, PN15, user defined pattern, NULL TS packet), color bar sample, and MPEG-TS file.

2. N7623B-PFP requires N7623B-QFP or N7623B-XFP.

Supported Standards

Format	Standard	Version/Date
DVB-C	ETSI EN 300 429	V1.2.1, April, 1998
DVB-T/H	ETSI EN 300 744	V1.5.1, November, 2004
DVB-T2	ETSI EN 302 755	V1.2.1, February, 2011
DVB-S	ETSI EN 300 421	V1.1.2, August, 1997
DVB-S2	ETSI EN 302 307	V1.1.2, June, 2006
ISDB-T	ARIB STD-B31	V1.5, July, 2003
ISDB-Tmm	ARIB STD-B46	V1.0, November, 2010
ATSC	ATSC A/53 (formerly Annex D)	January, 2007
ATSC-M/H	A/153 Part 2: 2009	October, 2009
J.83	ITU-T Recommendation J.83	April, 1997
DTMB (CTTB)	GB20600-2006	August, 2006
CMMB	GY/T 220.1-2006	October, 2006

Supported Test Configurations

Test Items	Receiver chipset design or conformance test	Receiver module integration and verification	Receiver manufacturing
Max signal input	■	■	□
Min signal input (Sensitivity)	■	■	■
C/N in Gaussian	■	■	□
C/N in multi-path fading without Doppler shift	■	■	
C/N in multi-path fading with Doppler shift	■	■	
Immunity to analog signal in other channel	■	□[1]	
Immunity to digital signal in other channel	■	□[1]	
Immunity to co-channel interference of analog TV	■	□[1]	
Guard interval utilization in SFN network	■	□	
Impulse interference test	■	□[1]	
Cellular signal blocking	■	□[1]	
Degradation criteria	BER or SFP	BER or SFP	SFP
Recommended solution	MXG/EXG/ESG +PXB +N7623B	MXG/EXG/ESG/ M9381A +N7623B	MXG/EXG/ ESG/EXT/M9381A +N7623B

1. More than one signal generator is needed to generate both the wanted signal and the interference signal.

Legend:
■ = Recommended test items
□ = Optional test item
SFP = Subjective failure point

Performance Characteristics

Definitions

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).

Characteristic performance:

Non-warranted value based on testing during development phase of this product.

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

Modulation error ratio (MER) (Note: values refer to averaged values over 10 tests)

Standard		Carrier	Characteristic value				Performance range[1]			
			N5162A N5182A MXG	E4438C ESG	E8267D PSG	M9381A (typ)	N5162A/ N5182A MXG	E4438C ESG	E8267D PSG	M9381A
DVB-T/H	2K mode	–30 dBm power at 474 MHz	45.3	47.8	46.9	52.85	45.3 to 48.8	47.8 to 49.9	46.0 to 50.7	52.71 to 53.26
	4K mode		45.7	48.1	47.3	52.96	45.5 to 47.7	47.9 to 50.5	46.4 to 52.0	52.80 to 53.43
	8K mode		44.5	47.6	47.1	53.03	44.5 to 48.2	47.3 to 49.9	46.4 to 52.0	52.99 to 53.53
DVB-T2		–30 dBm power at 474 MHz	N/A	N/A	N/A	52.76	N/A	N/A	N/A	52.68 to 53.07
DVB-C			45.4	45.7	43.3	48.17	45.4 to 49.9	45.7 to 47.3	43.2 to 45.8	47.11 to 48.68
DVB-S		–30 dBm power at 2 GHz	42.3	40.0	38.8	47.74	42.3 to 42.8	40.0 to 40.9	38.6 to 41.1	47.57 to 47.92
ISDB-T		–30 dBm power at 713.142857 MHz	44.7	47.7	46.2	53.31	44.7 to 47.9	47.5 to 48.6	46.2 to 48.9	52.98 to 54.30
ATSC		–30 dBm power at 635 MHz	40.8	40.9	40.3	40.26	40.8 to 41.7	40.9 to 41.4	40.3 to 41.2	40.22 to 40.87
ATSC-M/H			40.7	39.3	N/A	40.74	40.6 to 42.1	39.3 to 40.8	N/A	40.74 to 40.94
DVB-S2		–30 dBm power at 1 GHz, symbol rate is 10 MHz	42.6	41.4	39.0	50.06	42.6 to 47.9	41.4 to 47.0	39.0 to 40.6	49.98 to 50.58
J.83/B		–30 dBm power at 2 GHz	48.3	45.6	43.8	49.38	47.8 to 50.0	45.6 to 47.0	43.8 to 44.7	49.29 to 50.00
DTMB (CTTB)		–30 dBm power at 474 MHz, mode = 1 or 2, 16QAM or 64QAM	45.5	43.3	44.8	49.55	45.5 to 47.1	43.3 to 47.5	44.8 to 47.1	49.54 to 49.64
CMMB		–30 dBm power at 634 MHz, SLCH modulation type = 16QAM	42.4	42.4	N/A	53.63	42.4 to 43.3	42.4 to 43.3	N/A	53.57 to 53.83
ISDB-Tmm		–30 dBm power at 214.714286 MHz	N/A	N/A	N/A	48.05	N/A	N/A	N/A	48.00 to 48.42

1. *Non-warranted range based on testing during product development. All instruments tested performed within this range.*

Ordering Information

Try Before You Buy!

Free 30-day trials of Signal Studio software provide unrestricted use of the features and functions, including signal generation, with your compatible platform. Redeem a trial license online at

www.keysight.com/find/SignalStudio_trial

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

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

– Fixed license: Allows you to create unlimited I/Q waveforms with a specific Signal Studio product and use them with a single, specific platform.

– Transportable/floating license: Allows you to create unlimited I/Q waveforms with a specific Signal Studio product and use them with a single platform (or PC in some cases) at a time. You may transfer the license from one product to another.

– Waveform license: Allows you to generate up to 545 user-configured I/Q waveforms with any Signal Studio product and use them with a single, specific platform.

The table below lists fixed, perpetual licenses only; additional license types may be available. For detailed licensing information and configuration assistance, please refer to the Licensing Options web page at www.keysight.com/find/SignalStudio_licensing

N7623B Signal Studio for digital video

Model-Option	Description
Connectivity	
N7623B-1FP	Connect to E4438C ESG signal generator
N7623B-2FP	Connect to E8267D PSG signal generator
N7623B-3FP	Connect to N5182/62 MXG, N5172 EXG signal generator
N7623B-6FP	Connect to N5106A PXB baseband generator and channel emulator
N7623B-7FP	Connect to Keysight simulation software
N7623B-8FP	Connect to E6607 EXT wireless communications test set
N7623B-9FP	Connect to M9381A and M9252A
Capability	
N7623B-EFP	Advanced DVB-T/H real-time
N7623B-FFP	Advanced DVB-C/J.83 Annex A/C real-time
N7623B-GFP	Advanced DVB-S/S2 real-time
N7623B-HFP	Advanced DVB-T2 real-time
N7623B-JFP	Advanced ISDB-T real-time
N7623B-MFP[1]	Advanced ISDB-Tmm capability, ISDB-T enhanced
N7623B-NFP	Advanced ATSC-M/H capability
N7623B-PFP[2]	Advanced BER tools capability
N7623B-QFP	Advanced DVB-T/H/C/J.83 Annex A/C capability
N7623B-RFP	Advanced ISDB-T capability
N7623B-SFP	Advanced DTMB (CTTB) capability
N7623B-UFP	Advanced ATSC capability
N7623B-VFP	Advanced DVB-S capability
N7623B-WFP	Advanced DVB-S2 capability
N7623B-XFP	Advanced J.83 Annex B capability
N7623B-YFP	Advanced CMMB capability
N7623B-ZFP	Advanced DVB-T2 capability
N7623B-MEU	Latest enhancements

1. *N7623B-MFP requires on N7623B-JFP.*
2. *N7623B-PFP requires on N7623B-QFP or N7623B-XFP*

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