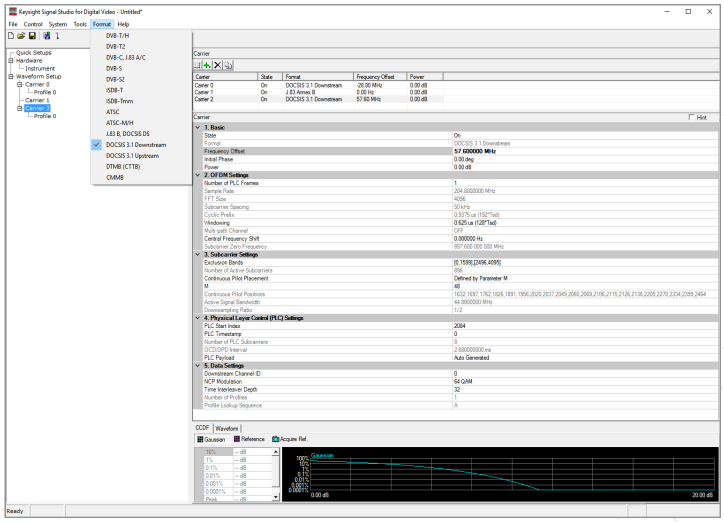
TECHNICAL OVERVIEW

Signal Studio for Digital Video N7623C

2020 update 1.0



- Create Keysight validated and performance optimized reference waveforms compliant with DVB-T/H, DVB-T2, DVB-C/S/S2/S2X, ISDB-T/T_B/T_{SB}/T_{MM}, ATSC, ATSC-M/H, DTMB (CTTB), CMMB, J.83 Annex A/B/C, and DOCSIS 1.x/2.0/3.0/3.1 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 Signal Studio for Real-time Fading (N7605C)
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

KEYSIGHT TECHNOLOGIES

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/S2X, ISDB-T/T_B/T_{SB}/T_{MM}, ATSC, ATSC-M/H, DTMB (CTTB), CMMB, J.83 Annex A/B/C, and DOCSIS 1.x/2.0/3.0/3.1, 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

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 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 wireless test set
- M819xA arbitrary waveform generator

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

1. N7623C 2020 update 1.0 or above doesn't support MXG-A N5182A and ESG E4438C.

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/S2X, ISDB-T/TB/TSB/Tmm, ATSC, ATSC-M/H, DTMB (CTTB), CMMB, J.83 Annex A/B/C and DOCSIS 1.x/2.0/3.0/3.1, 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, BER tests
- Configure multi-carrier waveforms, each with different modulation settings, frequency offsets, power, baseband filter, and more
- 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

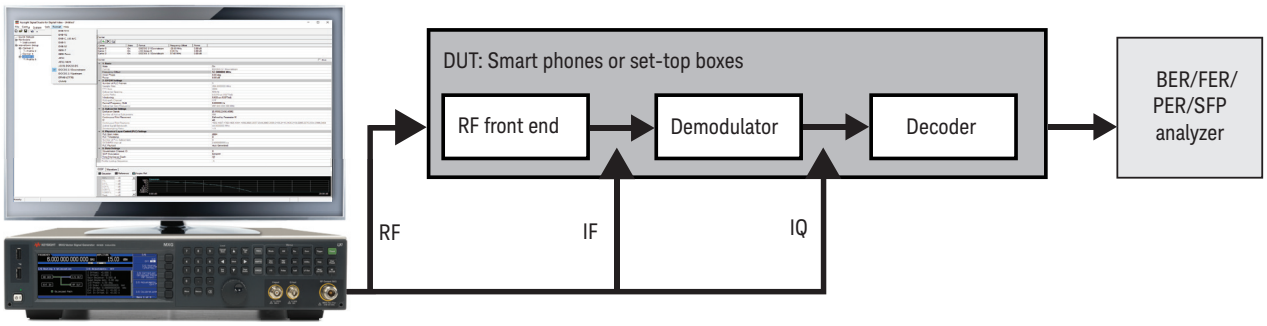


Figure 2. Generate fully channel-coded signals to evaluate the BER, FER, PER, or SFP of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities.

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
- Create signals with real-time fading, AWGN and interference tests using Signal Studio for Real-time Fading (N7605C)

Features Summary

Digital video	Receiver/component testing	
	Advanced waveform playback mode	Advanced real-time mode
DVB-T/H[1, 2, 3]		
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]		
Real-time adjustments to signal parameters		■
Version 1.2.1	■	■
Single PLP	■	■
Multi-PLP		■
SISO	■	■
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		
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]		
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]		
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	■	■
DVB-S2X[1, 3]		
Modulation: 8PSK, 8APSK to 256 APSK	■	
Coding Rate: 1/5 to 77/90 (33 types)	■	
Rolloff factors: 0.05-0.35	■	

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
ISDB-T[1, 2, 3]		
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]		
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]		
Data organization (Sync Mux)	■	
Modulation: 8VSB, 16VSB	■	
Pilot addition	■	
ATSC-M/H		
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]		
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]		
Input signal: Modified MPEG-2 transport stream	■	
Variable symbol rate	■	
Constellation 64-QAM, 256-QAM	■	
CMMB		
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		
Known bit error rate: Range upper limit is 1E-4, lower limit is dependent on the frame length	■	
DOCSIS 3.1		
Carrier type: DOCSIS 3.1 DS and US	■	
Modulation bandwidth: 24 – 192 MHz	■	
FEC coding	■	
Multi-carrier	■	
Payload supports:		
– Fixed pattern	■	
– PN sequence	■	
– User files	■	
Multi-profile for DS	■	
Mixed modulation	■	
PLC information for DS	■	
Exclusive bands	■	
Wizard for cable loading generation	■	

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.

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
DVB-S2X	ETSI 302 307-2	V1.1.1, March, 2014
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.83B	ITU-T Recommendation J.83	April, 1997
DTMB (CTTB)	GB20600-2006	August, 2006
CMMB	GY/T 220.1-2006	October, 2006
DOCSIS 3.1	CM-SP-MULPv3.1	Version I06, June, 2015

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 + interference signal +N7623C	MXG/EXG/ESG/ M9381A +N7623C	MXG/EXG/ ESG/EXT/M9381A +N7623C

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

Standard	Carrier	Characteristic value	Performance range[1]
		M8190A	M8190A
DOCSIS 3.1 DS	192 MHz BW at 500 kHz	52.41 dB	51.57 to 54.03 dB
	192 MHz BW at 1 GHz	51.13 dB	49.82 to 53.64 db

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

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.

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

N7623C Signal Studio for Digital Video

Waveform playback licenses (N7623EMBC)

Software	Support Contract	Description
N7623EMBC-1FP	R-Y5B-001-A[2]	Node-locked perpetual license
N7623EMBC-1FL	R-Y4B-001-L[1]	Node-locked 12-month license
N7623EMBC-1TP	R-Y5B-004-D[2]	Transportable perpetual license
N7623EMBC-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)

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**

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.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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