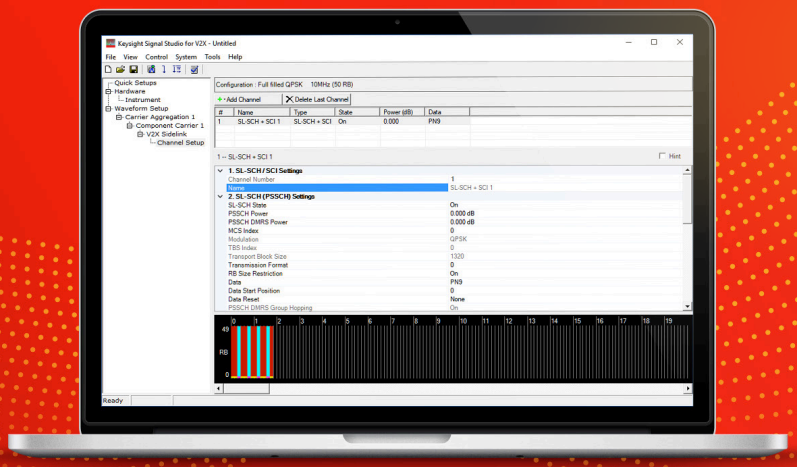


TECHNICAL OVERVIEW

Signal Studio Pro for V2X 2019

N7626C

- Create Keysight validated and performance optimized reference signals in compliance with 3GPP based cellular V2X signals (PC5 Sidelink)
- Create cellular V2X signals with fully coded PSSS, SSSS, PSBCH, PSCCH and PSSCH signals and channels
- Provide fixed reference channel (FRC) wizard for cellular V2X signals
- Support multi-UE scheduling
- Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

Simplify Cellular V2X Signal Creation

Keysight Technologies, Inc. Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation. 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.

Typical Measurements

Component and Transmitter Test		Receiver Test	
ACLR	CCDF	Sensitivity	Blocking
EVM	Channel Power	Selectivity	Intermodulation
Occupied Bandwidth			

KEYSIGHT TECHNOLOGIES

Component and Transmitter Test

Signal Studio's 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.

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

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

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. 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
  - MXG/EXG/CXG [3] X-Series
  - MXG/EXG with frequency extension (option FRQ) [3]
  - PSG [2]
  - M9381A PXIe VSG
  - M9383B/M9384B Microwave Signal Generator
  - First generation MXG N5182A [4]
  - ESG-C E4438C [4]
- M9420A/M9421A PXIe VXT
- E6640A EXM Communication Test Set
- M8190A Wideband AWGN [1]

1. This instrument only supports waveform playback only
2. PSG E8267D needs use manual power search with ALC turned off to get accurate power.
3. This hardware support is added in Signal Studio 2019 update 1.0 release (version 1.5.6.0).
4. Signal Studio 2019 update 1.0 or above release doesn't support this hardware. Signal Studio Pro 2020 release or above N7626C with N7626APPC PC license can support this hardware.

Component and Transmitter Test

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

Signal Studio generates RF performance optimized V2X waveform which enables you 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 V2X signals for channel power, spectral mask, and spurious testing
- Set parameters such as signal bandwidth and channel modulation type (QPSK, 16QAM and 64 QAM) for modulation verification and analysis, such as EVM tests
- View CCDF, spectrum, time domain, and power envelope graphs to investigate the effects of power ramps, modulation formats, power changes, clipping, and other effects on device performance
- Adjust baseband filter to achieve a balance among ACPR, EVM, and narrow resource block spectrum performance

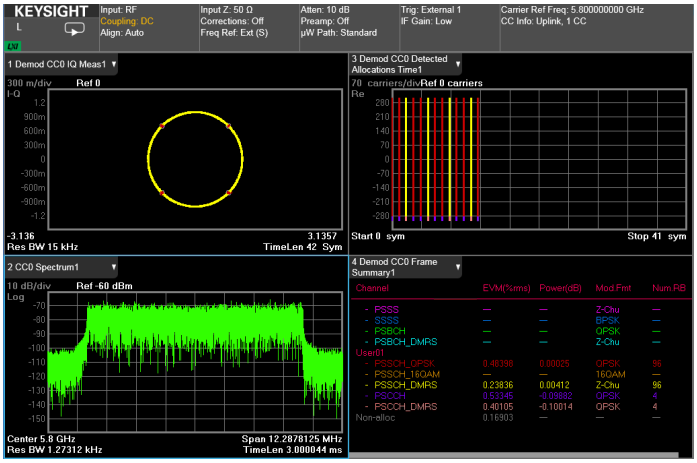


Figure 2: V2X signal measurement with N9080EM4E LTE V2X measurement application

Receiver Test

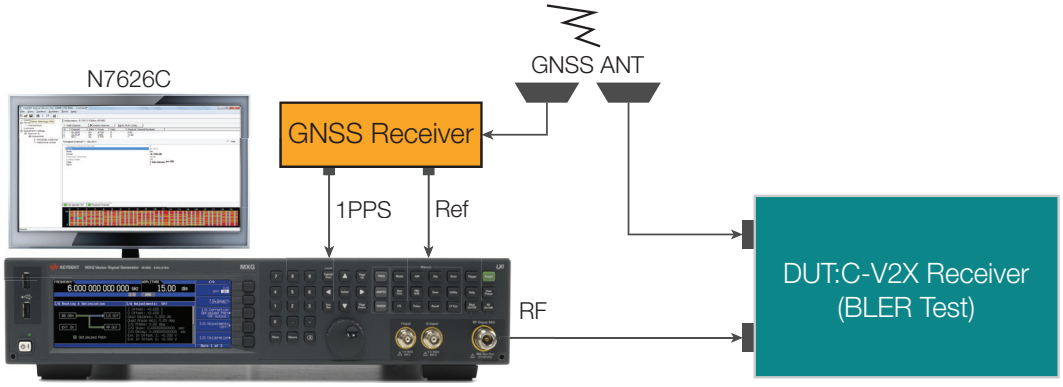


Figure 3: Generate fully channel-coded signals to evaluate the throughput of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities.

Signal Studio Pro for V2X can be used to generate cellular based V2X signals for early testing of receiver system and component hardware. Pair with X-Series measurement application on Keysight signal analyzers and oscilloscopes to evaluate receiver performance at various stages of the receiver chain (RF, IF, and IQ).

Testing of Receiver Hardware

- Create 3GPP standard Release 14 and 15 defined cellular V2X signals for V2X (V2V, V2I, V2P or V2N) direct communication using PC5 interface
- Quickly configure and generate Fixed Reference Channels (FRC)
- Create V2X signals with fully coded PSSCH and PSCCH for BLER and BER tests
- Support multi-UE scheduling
- Support retransmission
- Support SCI auto generation

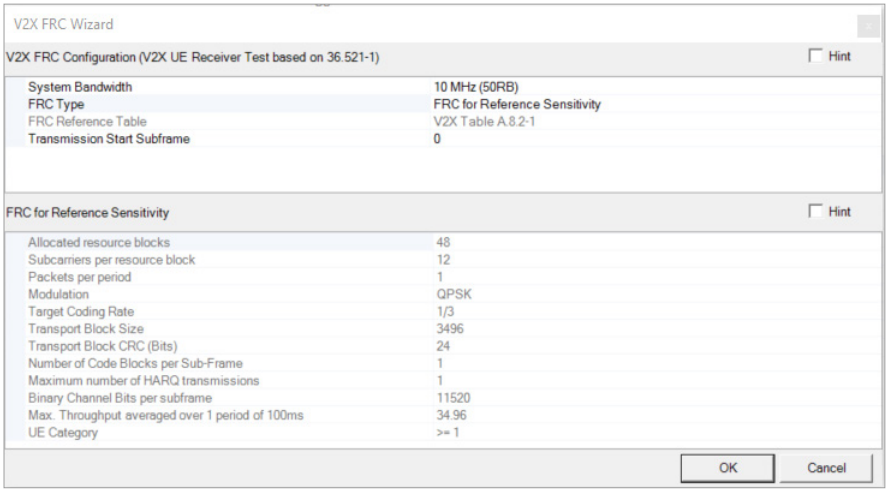


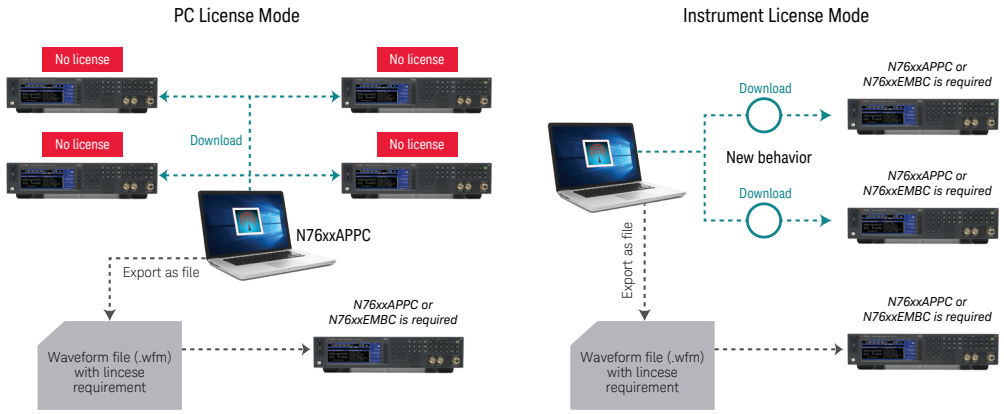
Figure 4: V2X FRC Wizard with Table A8.2-1 as example

Signal Studio Pro for V2X Licensing: Choosing PC License or Waveform Playback License

Signal Studio Pro for V2X offers two types of license: a PC-based license N7626APPC and a waveform playback license N7626EMBC. And they can make the N7626C software working either in a PC license mode or instrument license mode as the description below.

- N7626APPC is PC based license which enables N7626C software operating in PC license mode to generate and make a live connection to download signal waveforms into multiple signal generators, VSGs, VXTs or VXGs without license requirement. N7626APPC is typically recommended for R&D teams. If the N7626APPC license is installed on an instrument, then it can also work same as N7626EMBC license as instrument license mode.
- N7626EMBC is an embedded license installed on a signal generator, VSG, VXT or VXG, which enables you to generate, make a live connection to download and offline playback V2X waveforms. N7626EMBC is recommended for design and verification or manufacturing teams.
- PC license mode: when N7626APPC license is installed in a stand-alone PC, then the N7626C software is working as the PC license mode. No license is required inside the instrument if generated waveform is downloaded but the downloaded waveform can't be saved or renamed.
- Instrument license mode: each instrument needs a valid license (N7626APPC or N7626EMBC) to playback waveforms. Waveforms can be saved in signal generators for offline playback.

N7626C Software	With N7626APPC License	With N7626EMBC License
Operation mode	PC license mode [1] or instrument mode [2]	Instrument mode [2]
Live connection	Yes	Yes
Programming API	Yes	Yes
Export VSA setx or X-Series measurement application required setup files (If have)	Yes	Yes
Waveform export	Yes [3]	Yes [3]
Offline playback	No/Yes [4]	Yes [4]
License type	Node-locked, transportable, USB portable, floating (single site, single region, worldwide)	Node-locked, transportable



1. Downloaded waveforms can't be renamed or stored in non-volatile memory. New download is required to play different waveforms.
2. Waveforms can be saved and renamed in signal generators for offline playback.
3. When the waveform is exported as waveform file (*.wfm), then It requires waveform playback license in instrument (N7626APPC, N7626EMBC or 5/50 pack).
4. Offline waveform playback requires embedded waveform playback license (N7626APPC, N7626EMBC or 5/50 pack license) on X-Series signal generators, PXIe VSG, PXIe VXTs or VXG-m/VXG microwave signal generators.
5. N7626APPC is only supported with N7626C Signal Studio Pro for V2X 2020 release or above.

Features Summary

Signal Studio Pro for V2X allow you to create 3GPP standard-based V2X signals for sidelink testing.

Capabilities	N7626EMBC or N7626APPC[3]
Support Sidelink transmission mode 3 and 4	Y
Preconfigured FRC signals with transport channel coding (A8.2-1/2/3)	Y
Sidelink channels: PSCCH and PSSCH with adjacency ON/OFF	Y
PSSCH auto-detection based on decoded SCI[2]	
Sidelink signals and channels: PSSS, SSSS and PSBCH with State On/Off[2]	Y
Support bandwidth 1.4, 3,5, 10, 15, and 20 MHz	Y
Support QPSK/16QAM/64QAM with MCS index (0 to 28 for Tx Format 0 and 0 to 31 for Tx Format 1)	Y
Support retransmission	Y
Support multiple UE scheduling (Up to 300 vehicles)	Y
Support SCI auto generation	Y
RB overlapping check on/off	Y
Waveform length up to 1024 frames (10,240 ms)	Y
Support both single carrier and multi-carrier	Y
Graphical display for frame resource allocation	Y
Import/Library waveform files (5G NR or other form[1]	Y
Export waveform files (encrypted Signal Studio waveform file)	Y
Live Connection to Signal Generators, PXIe VXT/VSG, EXM and AXIe AWG	Y
Offline waveform file playback	Y
Static multipath[1]	Y
LTE interference signal[1]	Y

1. This feature is added in the Signal Studio 2019 Update 1.0 release (version 1.0.2.0)
2. This feature is added in the Signal Studio Pro 2020 release (version 1.7.6.0).
3. N7626APPC is only supported with N7626C Signal Studio Pro for V2X 2020 release or above.

Supported Standards

Specification	Name	Version	Date
3GPP TS36.211	Physical channels and modulation	15.4.0	2018-12
3GPP TS36.212	Multiplexing and channel coding	15.4.0	2018-12
3GPP TS36.213	Physical layer procedures for control	15.4.0	2018-12
3GPP TS36.331	Radio Resource Control (RRC)	15.4.0	2018-12
3GPP TS36.521-1	Protocol specification User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing	15.4.0	2018-12
3GPP TS36.306	User Equipment (UE) radio access capabilities	15.3.0	2018-12

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. Floating supports single site, single region and worldwide three different types.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Time-based:** License is time limited to a defined period, such as 12-months.

Signal Studio Pro for V2X, PC license (N7626APPC)

Software License Type	Software License	Support Subscription
Node-locked perpetual	R-Y5B-001-A	R-Y6B-001-y[2]
Node-locked time-based	R-Y4B-001-z[1]	Included
Transportable perpetual	R-Y5B-004-D	R-Y6B-004-y[2]
Transportable time-based	R-Y4B-004-z[1]	Included
Floating perpetual (single site)	R-Y5B-002-B	R-Y6B-002-y[2]
Floating time-based (single site)	R-Y4B-002-z[1]	Included
Floating perpetual (single region)	R-Y5B-006-F	R-Y6B-006-y[2]
Floating time-based (single region)	R-Y4B-006-z[1]	Included
Floating perpetual (worldwide)	R-Y5B-010-J	R-Y6B-010-y[2]
Floating time-based (worldwide)	R-Y4B-010-z[1]	Included
USB portable perpetual	R-Y5B-005-E	R-Y6B-005-y[2]
USB portable time-based	R-Y4B-005- z[1]	Included

Signal Studio Pro for V2X, waveform playback license (N7626EMBC)

Software License Type	Software License	Support Subscription
Node-locked perpetual	R-Y5B-001-A	R-Y6B-001-y[2]
Node-locked time-based	R-Y4B-001- z[1]	Included
Transportable perpetual	R-Y5B-004-D	R-Y6B-004- y[2]
Transportable time-based	R-Y4B-004- z[1]	Included

One-month KeysightCare software support subscription extension[3]

Support Subscription	Description
R-Y6B-501	1-month of support subscription for node-locked perpetual licenses
R-Y6B-504	1-month of support subscription for transportable perpetual licenses
R-Y6B-502	1-month of support subscription for floating perpetual licenses (single site)
R-Y6B-506	1-month of support subscription for floating perpetual licenses (single region)
R-Y6B-510	1-month of support subscription for floating perpetual licenses (worldwide)
R-Y6B-505	1-month of support subscription for USB portable perpetual licenses

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

1. z means different time-based license duration. F for 6 months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. y means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly 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 and Options

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

Additional Information

Websites

www.keysight.com/find/SignalStudio

Comprehensive Online Documentation
www.keysight.com/find/signalstudio_support

Signal Studio Pro for V2X
www.keysight.com/find/n7626c

Signal Studio Pro for LTE, LTE-Advanced and LTE-A Pro FDD
www.keysight.com/find/n7624c

Signal Studio Pro for LTE and LTE-Advanced TDD
www.keysight.com/find/n7625c

Signal Studio Pro for 5G NR
www.keysight.com/find/n7631c

LTE V2X measurement application
www.keysight.com/find/n9080em4e

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

Literature

PathWave Signal Generation, Brochure, 5989-6448EN

www.keysight.com/find/n7626c

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

KEYSIGHT TECHNOLOGIES