PathWave Signal Generation

Accelerate your test and design workflows

KEYSIGHT

PATHWAVE

Simplify Signal Creation

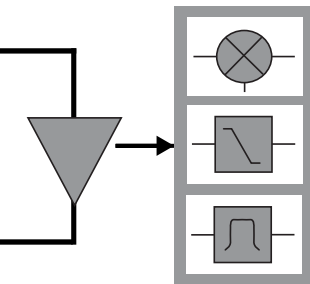## Reduce the time you spend on signal simulation

Signal Studio comes with performance-optimized signals validated by Keysight. You can easily modify these signals to meet your needs. Or you may quickly create custom reference signals for testing devices. Its fast and simple user interface features tree-style navigation and graphical, parameterized signal configuration.
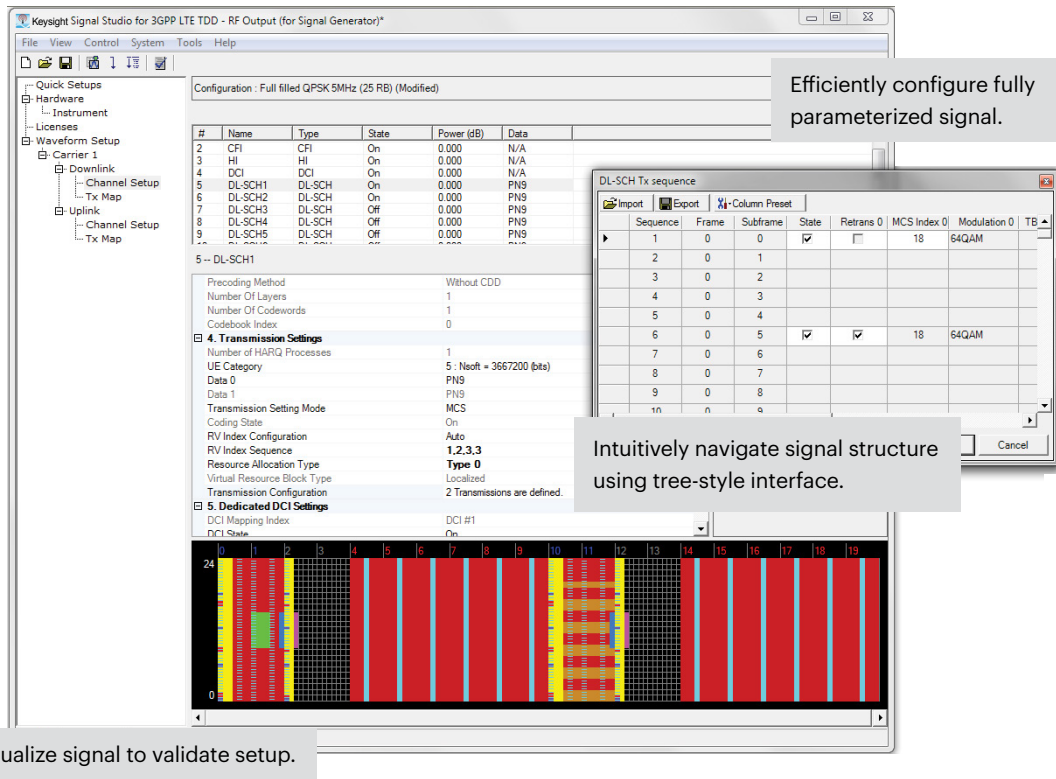
What is Signal Studio?

Signal Studio is signal creation software that runs on a PC. It enables the creation of application specific test signals at baseband, RF and microwave frequencies.

Enhance component testing with virtually distortion-free stimulus signals.

Evaluate receiver tolerance by creating calibrated additive signal impairments.

Efficiently configure fully parameterized signal.

Intuitively navigate signal structure using tree-style interface.

Visualize signal to validate setup.

Typical measurements

Test components and transmitters:

- CCDF
- EVM
- channel power
- occupied bandwidth
- spectrum

Test receivers:

- component test along receiver chain
- receiver sensitivity
- BER

Next-Generation Signal Creation

PathWave Signal Generation Desktop or Embedded

PathWave Signal Generation has two types of applications: Desktop and Embedded. PathWave Signal Generation Desktop runs on a PC like Signal Studio and can create and download generated waveforms into various signal generators. PathWave Signal Generation Embedded is a fully integrated application in Keysight VXG signal generator's firmware. PathWave Signal Generation Embedded uses the same measurement technology as PathWave Signal Generation Desktop and includes a graphical user interface (GUI) optimized for touch-based operations.

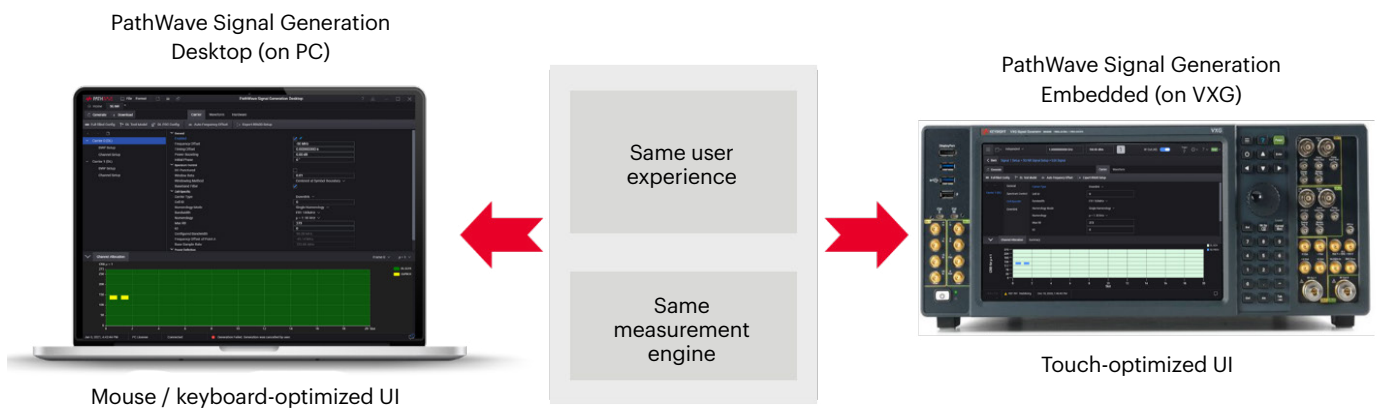## PathWave Signal Generation is an integrated application

- Supports multiple radio formats in a single application.
- Provides the same user experience and measurement engines across Desktop and Embedded versions.
- Generates encrypted waveforms (*.wfm) for downloading or playback.
- Includes a hardware driver that performs waveform download and setup for play back.
- Provides a high-DPI display with scaling support.

PathWave Signal Generation uses the same licensing scheme as Signal Studio

- N76xxAPPC as PathWave Signal Generation Desktop PC application license. installed on PC or PathWave Signal Generation Embedded license installed on VXG.
- N76xxEMBC as waveform playback license installed in the signal generator.
- Existing Signal Studio users can use the same license for equivalent features in PathWave Signal Generation Desktop.

What is PathWave Signal Generation?

Keysight PathWave Signal Generation is Keysight's next-generation signal-generation software. It unifies various signal-generation applications together with Waveform Utility and toolkit. It provides a consistent and optimized user experience from R&D through manufacturing to enable smoother collaboration.

PathWave Signal Generation
Desktop (on PC)

PathWave Signal Generation
Embedded (on VXG)

Same user experience

Same measurement engine

Mouse / keyboard-optimized UI

Touch-optimized UI

Easily Create Signals for Your Bench or Production Line

Whether you need test stimuli in R&D or manufacturing, Signal Studio simplifies creation of the signals you need for characterization, verification, and pass / fail testing of components, devices, receivers, and more.

Simplify signal creation on the bench

Create your own signal-creation workstation in R&D by connecting Signal Studio to a Keysight instrument through the LAN or GPIB port of a PC. A built-in configuration tool makes it fast and simple, and the Signal Studio user interface includes a window that enables direct control of a connected instrument.

For advanced automation and control, the available application programming interface (API) exposes the signal creation and generation parameters of the software. This capability also enables creation of a custom user interface for signal creation.

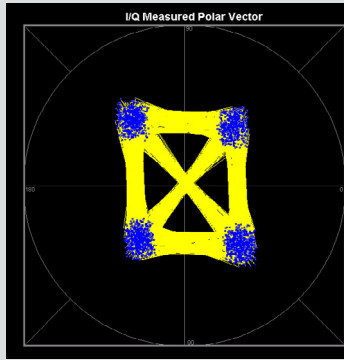## Accelerate testing on the production line

To save time during automated testing, waveforms created in Signal Studio can be downloaded to an instrument and stored in memory. Recall and playback can be initiated programmatically with SCPI commands or through the front panel.

When you need to use custom signals with multiple test systems, flexible right-to-use licenses can meet your specific needs, schedules and budget requirements. For example, waveform licensing is ideal for cost-effective deployment of Signal Studio test signals in a manufacturing environment. Each of these licenses is fixed to a single instrument but is available in packs of 5 or 50 waveform licenses that can be used for different signal formats. Please see the licensing section for more information about other licensing options.
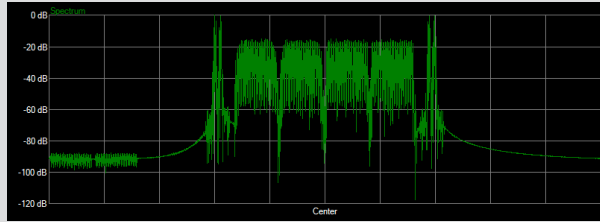
Key features and attributes

Signal generation	• Custom, standards-based, and presets for common test signals • Arbitrary IQ waveform and real-time IQ generation
Additive impairments	• I/Q impairments • AWGN • Real-time fading
Graphs	• I(t), Q(t), I(t) + Q(t), P(t) • Spectrum, CCDF, CDP • Frame structure • Power envelope

Easy-to-use graphical display for signal visualization and verification

IQ polar vector display with added IQ impairments
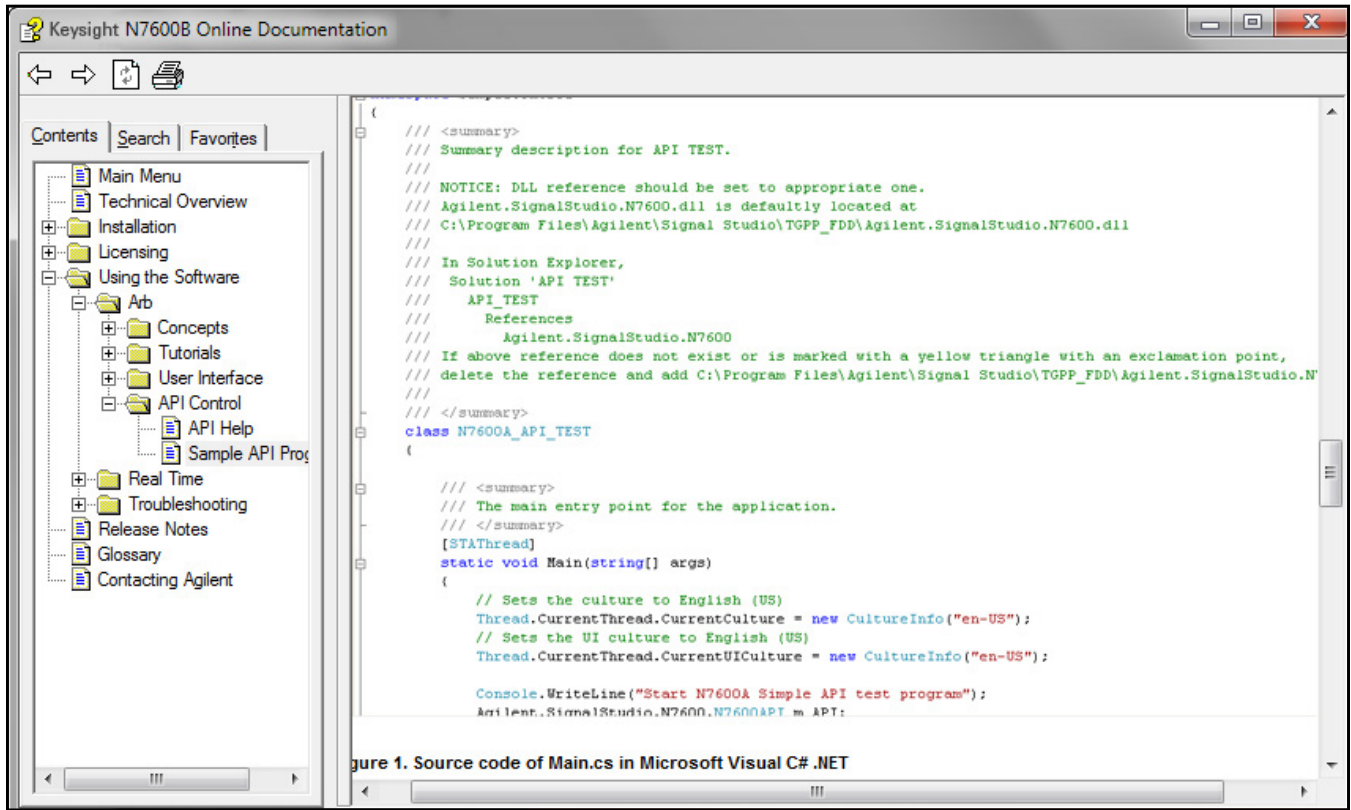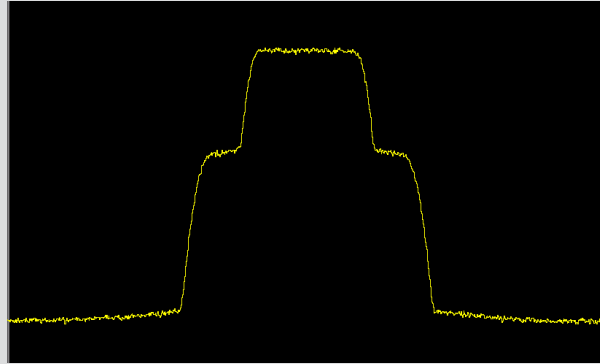
Calibrated AWGN to simulate a noisy environment

Automate test with .NET API or SCPI (for real-time applications)

Apply Your Signals in Real-World Testing

When you have fully defined your signals, you can download them to various Keysight instruments. This offers flexibility in generating signals at various carrier frequencies with different bandwidths for multiple applications. Signal Studio complements these instruments by providing a cost-effective way to tailor them to your design, development, and production test needs. And with our record of support for new standards, Signal Studio will help you stay at the forefront as wireless systems evolve.

PXIe vector signal generators and vector transceiver

Keysight M9381A PXIe vector signal generator: Accelerate throughput with new levels of speed in your modular test system with bandwidths up to 160 MHz.

Keysight M9383B PXIe microwave signal generator: Realize 5G signal confidence in your design validation test solution, with available upgrades of frequency and bandwidth to 44 GHz and 2 GHz, respectively.

Keysight M9421A PXIe VXT vector transceiver: Features exceptional EVM performance for dense modulation schemes required by 802.11ax design verification and manufacturing test up to 8 x 8 MIMO.

Keysight M9410A / M9411A / M9415A PXIe VXT vector transceiver: Build-in 1.2 GHz signal generation and analysis bandwidth and frequency extension to cover millimeter-wave (mmWave) (FR2) with M1740A mmWave transceiver.
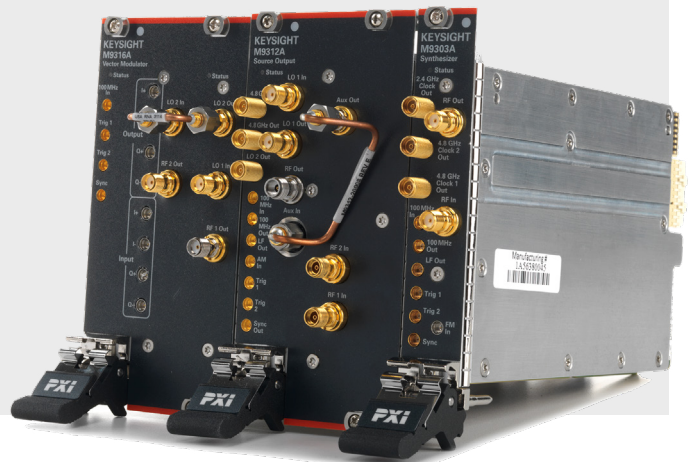
AXIe arbitrary waveform generator (AWG)

M8190A or M8195A AWG is a source of greater fidelity, delivering high resolution and wide bandwidth simultaneously. This unique combination lets you create signal scenarios that push your designs to the limit and bring new insights to your analysis.

Benchtop vector signal generators

Keysight E8267D PSG: Create reference signals for aerospace, defense, radar, and broadband wireless applications up to 44 GHz.

Keysight N5182B and Next Generation N5186A MXG X-Series: Design and verify receivers for cellular base stations, wireless connectivity, digital video, and more.

Keysight N5172B EXG X-Series: Maintain tight tolerances in component and module manufacturing.

Keysight N5166B CXG X-Series: Perform basic parametric with this low-cost signal generator for general-purpose, IoT, and educational applications.

Wireless test set

Keysight E6640A / E6680A / E6681A EXM wireless test sets are scalable to meet your production needs and in sync with the latest cellular and WLAN chipsets. The EXM delivers the speed, accuracy, and port density you need to ramp up rapidly and optimize full-volume manufacturing.

VXG microwave vector signal generator

The **Keysight M9484C VXG** is the industry's first dual-channel microwave vector signal generator capable of up to 110 GHz signals and 2.5 GHz signal bandwidth. **Keysight M9384B VXG** microwave signal generators are dual-channel 1 MHz to 44 GHz VSG with up to 2 GHz bandwidth.

Configure a Suite That Meets Your Needs

Signal Studio software is scalable to meet a wide range of component and receiver testing requirements. It starts with a choice of two operating modes: waveform playback mode and real-time mode. Waveform playback mode supports two levels of functionality: basic and advanced. Real-time mode provides advanced capabilities such as closed-loop control during signal generation.

A typical component test configuration using Signal Studio with an X-Series signal generator and analyzer

Enhance component and receiver testing with waveform playback

Signal Studio's basic waveform playback capabilities enable you to create and customize waveform files to test components and transmitters. Its user-friendly interface lets you manipulate various signal parameters, calculate the resulting waveforms, and download files for playback with a Keysight instrument.

- Create spectrally correct signals for channel power, spectral mask, and spurious testing.
- 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 peak-to-average ratio with the crest factor reduction technology.
- Save Keysight PathWave Vector Signal Analysis (89600 VSA) or X-Series measurement application setup files using selected Signal Studio software products for further analysis. See the appropriate technical overview for product-specific information.
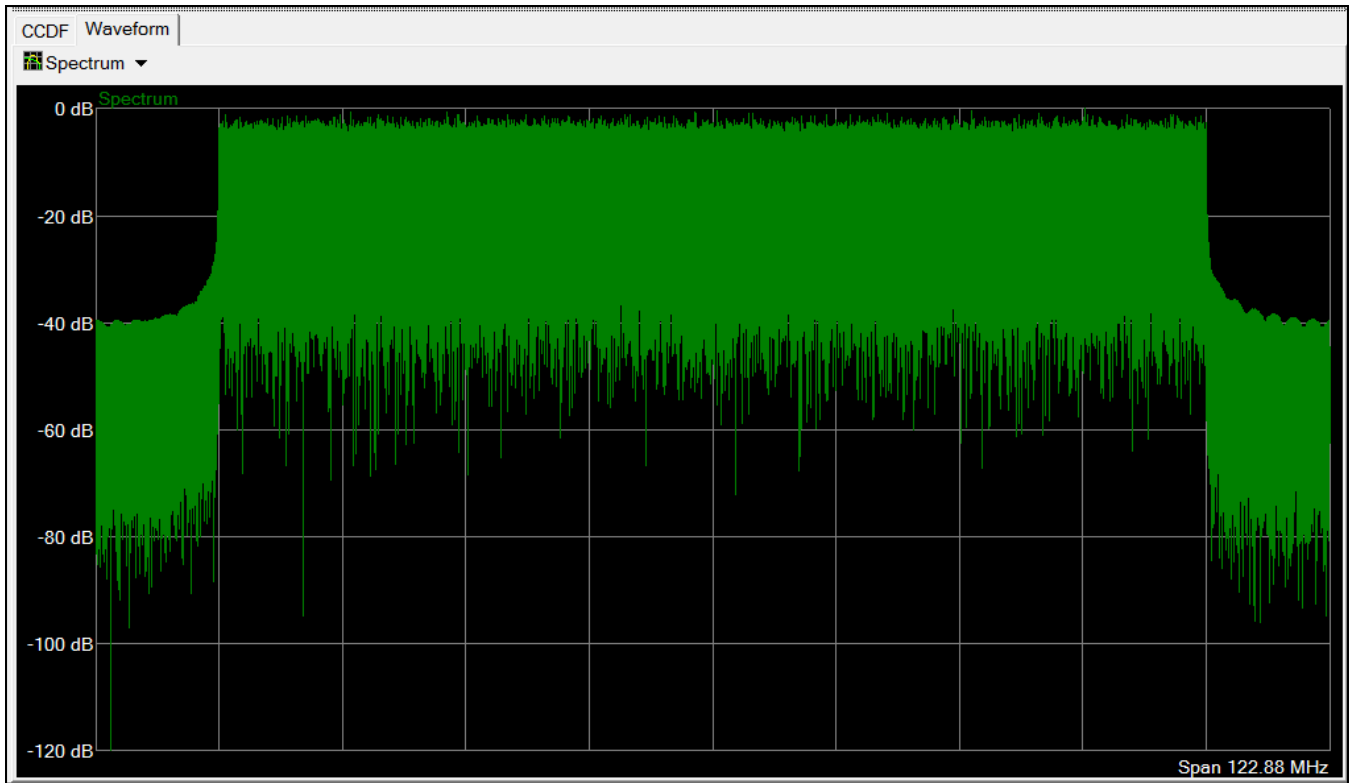
Integrated spectrum view of Signal Studio
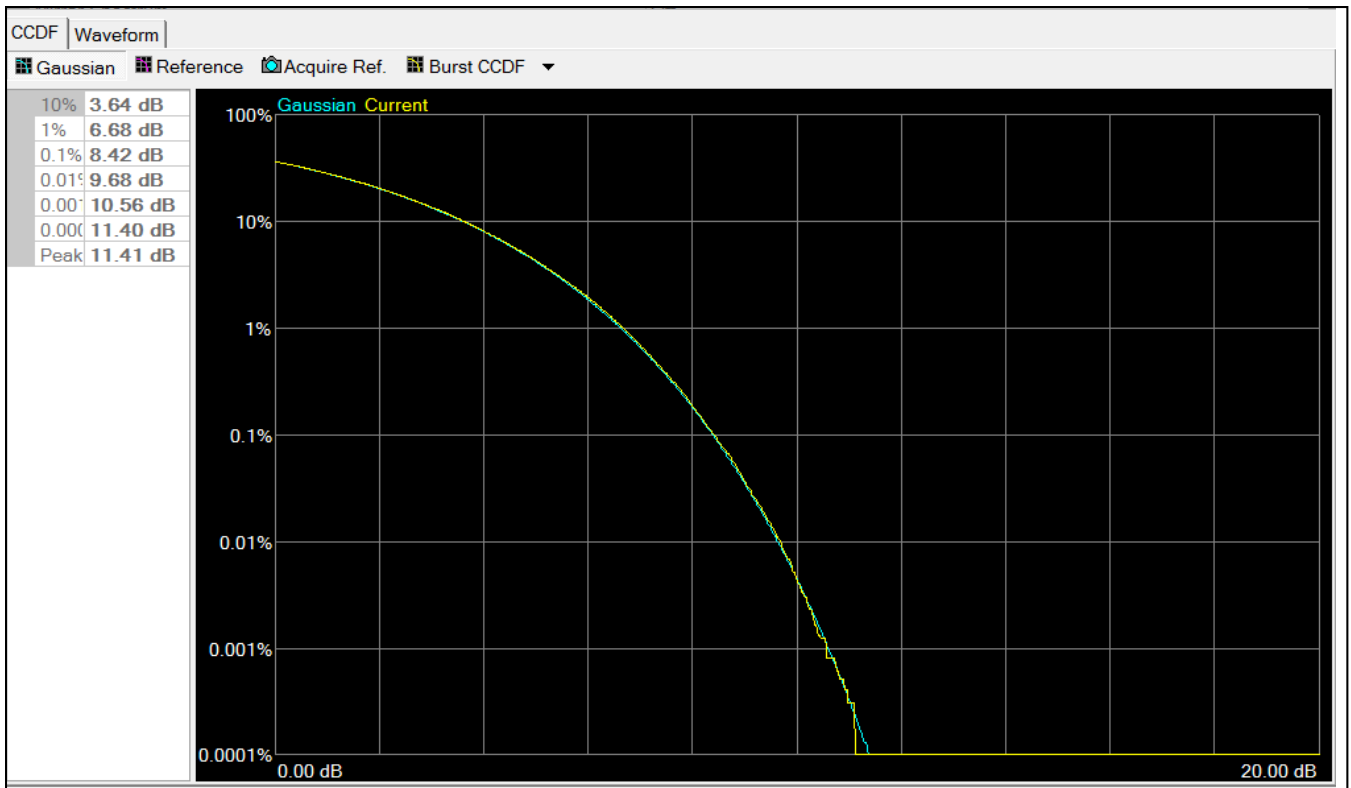
Integrated CCDF view of Signal Studio

Receiver Test with Advanced and Real-Time Capabilities

Signal Studio can generate standards-compliant or custom signals for early testing of receiver system and component hardware with channel coding and multi-antenna port. Evaluate receiver performance at various stages of the receiver chain (RF, IF, and IQ) on signal analyzers and oscilloscopes together with PathWave 89600 VSA software or X Series measurement applications.

Use selected Signal Studio software to support the following:

- Standards-compliant signals for receiver testing with channel coding.
- Enabling or disabling channel coding, scrambling, and interleaving.
- Uplink and downlink configurations.
- Multi-antenna port transmitters, including spatial multiplexing and transmit diversity.
- Multiuser channel generation.
- Single carrier and multiple carriers.
- Customized data: PN9, PN15, custom bit pattern, or user-defined file with coded bits for bit error ratio (BER) testing.
- Addition of real-time additive white Gaussian noise (AWGN) to signal generators to set the carrier-to-noise ratio, carrier bandwidth, and noise bandwidth.
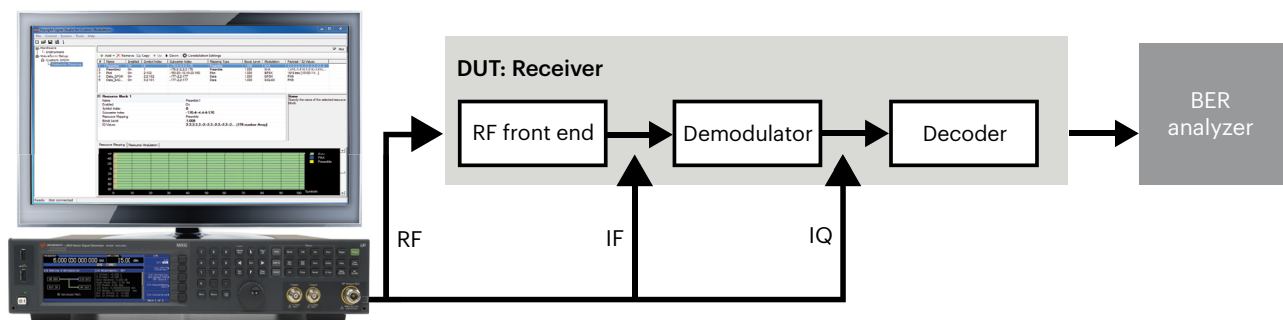

Note: Payload data should be coded bits

Generate receiver test signals for early testing of your receiver with Keysight X-Series signal generators and Signal Studio

Real-time capabilities available with selected Signal Studio software provide additional features to help you create signals for testing receiver designs in all stages of development. Advanced options enable you to create fully channel-coded signals for analysis of receiver BER, FER, BLER, and PER so you can verify baseband subsystem coding in ASICs, DSPs, and more. You can also check receiver performance and functionality during RF / baseband integration, system-level test, and beyond.

Signal Studio's real-time capabilities include the following:

- GSM / EDGE signal creation
- WCDMA / HSPA+ signal creation
- LTE and LTE-Advanced FDD signal creation
- GNSS signal creation for GPS, Beidou, Galileo, and GLONASS
- digital video signal creation for DVB-T / H / T2 / C / S / S2 and ISDB-T
- broadcast audio signal creation for XM
- fading signal creation
- 5G NR PUSCH signal creation and phase compensation
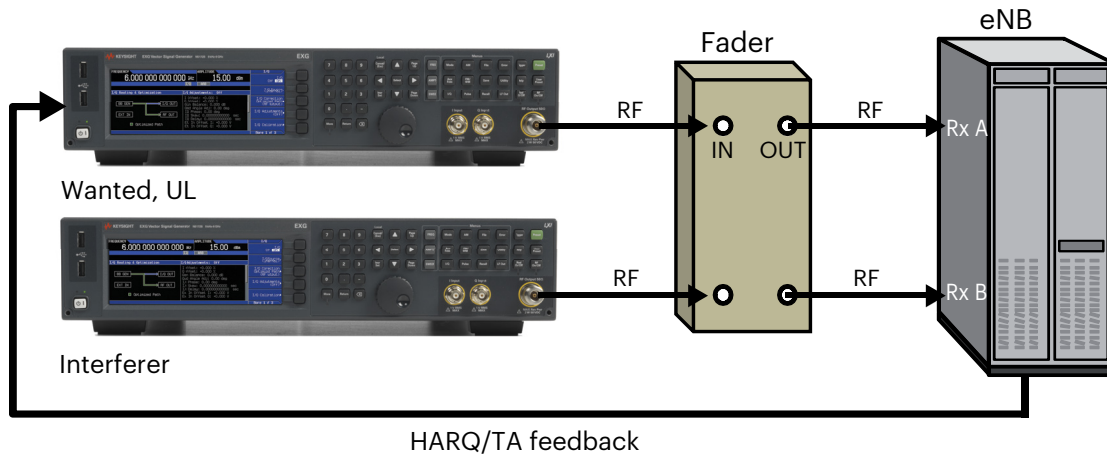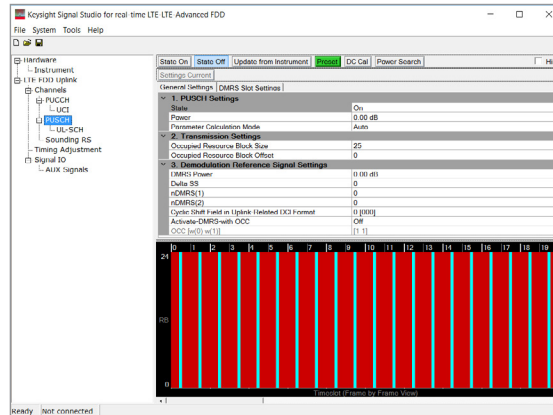
LTE receiver performance test with real-time signal generation

Signal Studio, PathWave Signal Generation Software, and Compatible Instruments

Below is a list of Signal Studio, PathWave Signal Generation Desktop, and Embedded software products and supported instruments. Click the hyperlinked product number in the left column for product-specific information.

Cellular communications

Current model[4]	Communications standard	Real-time capability[1]	N5166B CXG N5172B EXG N5182B MXG N5186A MXG (Benchtop)	E8267D PSG (Benchtop)	M9384B M9484C MW VXG (Benchtop)	M9381A PXIe VSG (PXI)	M9383A PXIe MW VSG (PXI)	M9410A/11A M9415A M9421A PXIe VXT (PXI)	M9336A PXIe AWG P9336A USB AWG (PXI)	M819xA AXIe AWG (AXIe)	E6640A E6680A E6681A EXM (Test set)
N7600C	W-CDMA / HSPA+	●	●[7]	●	●[2]	●	●[2]	●[3]	●[2]		●
N7601C	cdma2000® / 1xEV-DO	●	●[7]	●	●[2]	●	●[2]	●[2]	●[2]		●
N7602C	GSM / EDGE / Evo	●	●[7]	●	●[2]	●	●[2]	●[3]	●[2]		●
N7612C	TD-SCDMA / HSPA		●[7]	●	●[2]	●	●[2]	●[3]	●[2]		●
N7624C	LTE / LTE-A FDD	●	●	●[4]	●	●	●	●[3]	●[2]	●[2]	●
N7625C	LTE / LTE-A TDD	●	●	●[4]	●	●	●	●[3]	●[2]	●[2]	●
N7626C	V2X		●	●	●	●	●	●[3]	●[2]	●[2]	●[2]
N7630C	5GTF (pre-5G)		●[7]	●	●[2]	●	●	●[3]	●[2]	●	●[2]
N7631C	5G NR (New Radio)		●	●	●	●	●	●[3]	●[2]	●	●[2]

Wireless connectivity

Current model[4]	Communications standard	Real-time capability[1]	N5166B[2] CXG N5172B EXG N5182B MXG N5186A MXG (Benchtop)	E8267D M9484C PSG (Benchtop)	M9384B M9484C MW VXG (Benchtop)	M9381A PXIe VSG (PXI)	M9383A PXIe MW VSG (PXI)	M9410A/11A M9421A PXIe VXT (PXI)	M819xA AXIe AWG (AXIe)	E6640A E6680A EXM (Test set)
N7606C	*Bluetooth®* (BR, EDR, 4.0 / 4.2, BT5, BT5.1 (AoA and AoD) , BT5.3		●	●	●[2]	●		●[2]		●
N7607C	DFS radar profiles		●	●	●			●		●
N7610C	IoT (Internet of Things) (Wi-SUN, ZigBee®, Z-Wave, LoRa, and HRP UWB)		●	●	●[2]	●		●		●[2]
N7615C	Mobile WiMAX™		●		●[2]	●[2]		●[2]		
N7617C	WLAN 802.11 a / b / g / j / p / n / ac / ah / af / ax		●	●	●[2]	●	●	●	●[2]	●
N7637C	mmWave WLAN 802.11ad / ay								●	

Video, audio, and radio test

Current model[8]	Communications standard	Real-time capability[1]	Benchtop			PXI			AXIe	Test set
			N5172B EXG N5182B MXG N5186A MXG	E8267D PSG	M9384B MW VXG	M9381A PXIe VSG	M9383A PXIe MW VSG	M9421A PXIe VXT	M819xA AXIe AWG	E6640A EXM
N7611C	Broadcast radio	●	●		●[2]	●[2]				
N7623C	Digital video (w / DOCSIS3.1)	●	●	●	●[2]	●[2]			●	
N7640C	Land-mobile radio		●		●[2]	●[2]				

Detection, positioning, tracking, and navigation

Current model[8]	Description	Real-time capability[1]	Benchtop				PXI		AXIe	Test set
			N5172B EXG N5182B MXG N5186A MXG	E8267D PSG	N519xA UXG	M9384B MW VXG	M9381A PXIe VSG	M9421A PXIe VXT	M819xA AXIe AWG	E6640A EXM
N7609C	Global navigation satellite systems (GNSS)	●	●	●[2]		●[2]	●[2]	●[2]	●[2]	●[2]
N7620B	Pulse building		●	●	●	●			●	
N7660C	Multi-emitter scenario generation (MESG)				●					

1. Supports selected standards. Please refer to specific product technical overviews for more information.
2. Supports only file export-based waveform playback.
3. M9420A / 21A supports live connectivity, but M9410A / 11A and M9415A only supports the "file export" based waveform playback.
4. The amplitude accuracy is not guaranteed with ALN turning off which need manual power search.
5. For information regarding Signal Studio products and their supported hardware, please visit www.keysight.com/find/signalstudio_platforms.
6. Signal Studio 2019 update 1.0 or above does not support MXG-A N5182A and ESG-C E4438C. Signal Studio Pro software N76xxC with N76xxAPPC as PC license can support N5182A and E4438C.
7. CXG N5166B only supports "file export" based waveform playback with this Signal Studio software.
8. For information regarding legacy Signal Studio or PathWave Signal Generation products (N76xxB) and their supported hardware, please visit www.keysight.com/find/signalstudio_platforms.

General purpose

Current model[3]	Description	Real-time capability[1]	N5172B EXG N5182B MXG N5186A MXG	E8267D PSG	M9384B MW VXG	M9381A PXIe VSG	M9383A PXIe MW VSG	M9410A/11A M9415A M9421A PXIe VXT	M9336A PXIe AWG P9336A USB AWG	M819xA AXIe AWG	E6640A EXM
			Benchtop			PXI				AXIe	Test set
N7605C	Real-time fading	●	●								
N7608C	Custom modulation		●	●	●	●	●[2]	●[6]	●[2]	●	
N7614C	Power amplifier test	●	●	●[5]	●	●	●	●		●	
N7621B	Multitone distortion		●	●						●	
N7622C	IQ toolkit		●	●		●		●		●	●

PathWave Signal Generation — Embedded (on M9383B / M9384B or M9484C VXG)

Current model[3]	Description	Signal Generator	
		M9384B VXG microwave signal generator M9383B VXG-m microwave signal generator	M9484C vector signal generator
N7631APPC	5G NR	●[4]	●[4]
N7621APPC	Basic multitone	●[4]	●[4]
N7642APPC	IQ-based AM, FM, phase modulation	●[4]	●[4]
N7653APPC	Automatic channel response correction and S-parameter de-embedding	●[4]	●[4]
N7605AP0C	3GPP MIMO fading	●[4]	●[4]

PathWave Signal Generation — Desktop

Model	Description	Benchtop N5166B CXG N5172B EXG N5182B MXG N5186A MXG	Benchtop M8383B / M9384B VXG M9484C VXG	PXI M9410A / M9411A M9415A PXI VXT
N7631APPC	5G NR, PC application	●	●	●
N7631EMBC	5G NR, waveform playback	●	●	●
N7618APPC	Advanced Waveform Utility, PC application	●	●	●

1. Supports selected standards. Please refer to specific product technical overviews for more information.
2. Supports only file export-based waveform playback
3. For information regarding legacy Signal Studio or PathWave Signal Generation products (N76xxB) and their supported hardware, please visit www.keysight.com/find/signalstudio_platforms.
4. Those are embedded applications with touch-optimized GUI.
5. For power amplifier test, E8267D supports only DPD and CFR. It can also be used as upconverted with M8190A for wideband DPD solution.
6. M9420A / 21A supports live connectivity, but M9410A / 11A and M9415A only supports the "file export" based waveform playback.
7. Custom modulation on VXG is beta, which supports only custom modulation and no SCPI command control.

Cellular Communications

Signal Studio provides a comprehensive suite of standards-compliant solutions that address 2G to 5G and other emerging standards. As cellular technology advances, Signal Studio will help you sync up with the latest technology, streamline validation, and ensure interoperability. Here are a few examples of Signal Studio for cellular communications:

LTE / LTE-Advanced FDD / TDD

- Create Keysight-validated and performance-optimized reference signals in compliance with 3GPP LTE, LTE-Advanced, and LTE-Advanced Pro (with NB-IoT / eMTC) specifications.
- Support LTE co-existence signals with 5G NR for dynamic spectrum sharing (DSS).
- Use predefined setups for E-UTRA test models (E-TM) and fixed reference channels (FRC).
- Perform-closed loop HARQ and timing adjustment testing with real-time signal generation.
- Perform arb-based multi-UE simulation for eNB capacity testing.
- Perform multi-carrier, multiformat tests with multi-standard radio signal generation.
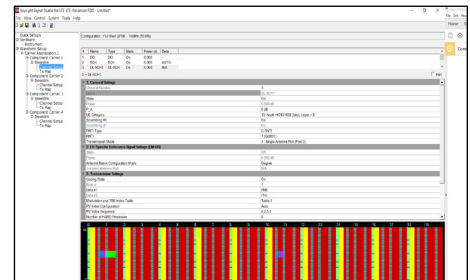
V2X (cellular V2X)

- Supports 3GPP Release 14 defined C-V2X sidelink carrier (using PC5 interface) with transmission mode 4.
- Supports fully coded PSSS, SSSS, PSBCH, PSCCH, and PSSCH signals and channels.
- Supports multi-UE scheduling.
- Provides FRC wizard.
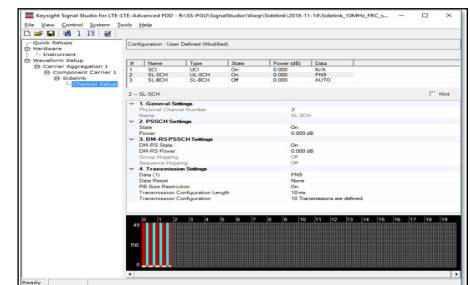
To learn more about other Signal Studio products for cellular communications, click below:

- W-CDMA / HSPA+
- cdma2000 / 1xEV-DO
- GSM / EDGE / Evo
- TD-SCDMA / HSPA
- pre-5G
- NB-IoT / eMTC

5G NR (Signal Studio, PathWave Signal Generation Desktop or Embedded)

- Enables 3GPP 5G NR-compliant signal creation for BTS and UE testing with LDPC, polar channel coding, and multi-antenna port.
- Support downlink channels for PDSCH and PDCCH and uplink channels for PUSCH, PUCCH, and PRACH.
- Supports multiuser channel generation with PUSCH and PDSCH.
- Supports downlink and uplink configuration with flexible sub-frame allocations
- Supports 5G NR signals with LTE co-existence for DSS.
- Enables flexible signal configuration with both single-carrier and multi-carrier support.
- Supports test model presets, FRC presets, and full-filled configurations.
- Supports real-time PUSCH HARQ and phase compensation.
- Exports PathWave 89600 VSA setup file for demodulation.
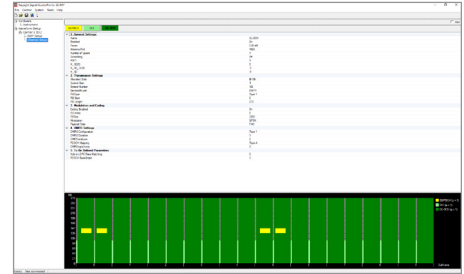
Want to learn more?

Click on the buttons below to download a technical overview for the following Signal Studio products:

LTE / LTE-A

5G NR

V2X
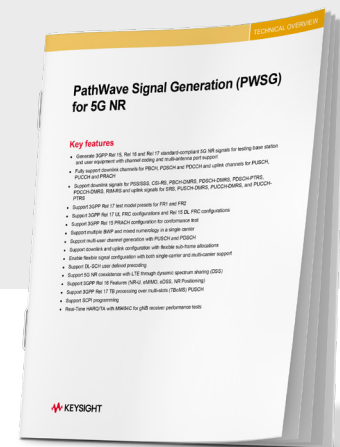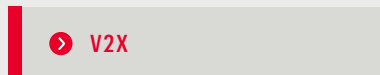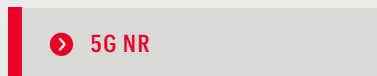
Wireless Connectivity

Wireless connectivity formats, such as WLAN, *Bluetooth®*, ZigBee, and Z-Wave, continue to evolve to address the growing need for faster data services and larger coverage. Whether you are working on long- or short-range wireless connectivity, Keysight strives to help you stay ahead of the pack with signal-creation solutions early in the life cycle of new standards and technologies. Here are a few examples of our wireless connectivity solutions:

WLAN 802.11a / b / g / j / p / n / ac / af / ah / ax / be

- Enables creation of Keysight-validated and performance-optimized reference signals compliant with the IEEE 802.11a / b / g / j / p / n / ac / ah / ax / be standards.
- Enables use of partially coded signals for testing components such as power amplifiers. Use full channel coding, flexible configuration of MAC headers, spatial stream mapping, and application of channel models for testing receivers.
- Supports bandwidth from 20 MHz to 160 MHz, and 320 MHz (802.11be).
- Supports modulation up to 1 024 QAM and 4 096 QAM (802.11be)
- Supports MIMO testing with up to 16 streams / antennas.
- Enables creation of FCC, ETSI, Japan MIC, Korean, or Chinese radar test signals using N7607C Signal Studio for DFS radar profiles.
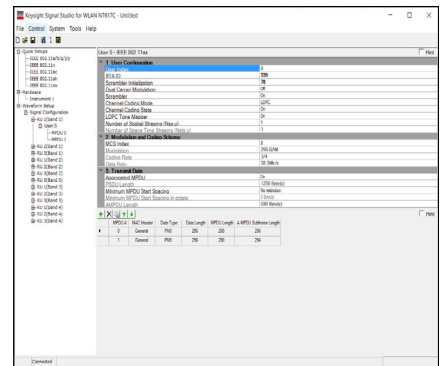
Bluetooth®

- Enables creation of Keysight-validated and performance-optimized reference signals compliant with *Bluetooth®* BR, EDR, LE 4.0, LE 4.2, *Bluetooth®* 5, and *Bluetooth®* 5.1 / 5.2 / 5.3 (AoA / AoD).
- Supports Qualcomm *Bluetooth®* High Speed Link format with mode as QHS-P2 / P3 / P4 / P5 / P6.
- Uses fully-coded *Bluetooth®* packets and modulated data streams for basic and enhanced data rates.
- Supports data length extension to 255 bytes for *Bluetooth®* LE 4.2.
- Supports 2 Ms/s symbol rate for higher data rate and channel coding for long range *Bluetooth®* 5.
- Uses dirty transmitter test setup for receiver sensitivity tests with DHx, 2-DHx, 2-EVx, 3-DHx, and 3-EVx packet types.
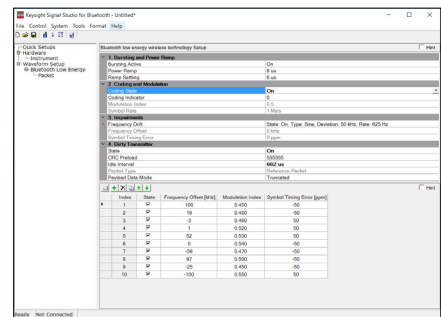
IoT (Internet of Things)

- Create signals for IEEE 802.15.4g SUN FSK and SUN OFDM and IEEE 802.15.4 O-QPSK / BPSK ZigBee specifications.

- Create signals for ITU-T G.9959 FSK / GFSK Z-Wave specification.

- Create signals for LoRa CSS specification.

- Create signals for IEEE 802.15.4 / 4z HRP UWB.

- Receive support for fully coded signal creation for receiver tests.

- Achieve signals with full-channel coding, flexible configuration of MAC headers, and data types for receiver testing.
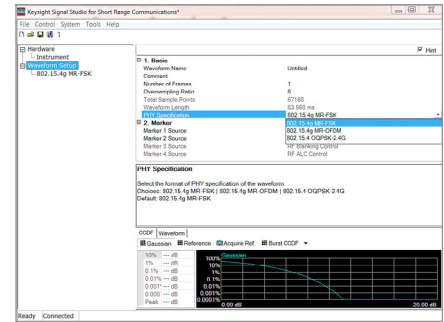
To learn more about other Signal Studio products for wireless connectivity click below:

- DFS radar profiles
- Mobile WiMAX™
- mmWave WLAN 802.11ad/ay

Want to learn more?

Click on the buttons below to download a technical overview for the following Signal Studio products:

> WLAN

> IoT

> *Bluetooth®*
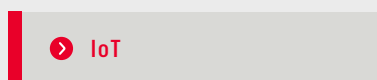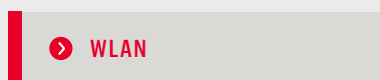
Video, Audio, and Radio Test

The push for better-quality mobile services is driving new technologies in broadcasting video, audio, and radio systems and handheld devices. Whether you are working on satellite, terrestrial, mobile or cable digital video, broadcasting audio, or radio test systems, count on Signal Studio to provide the tools to help you address the challenges of mobile device and set-to-box product design and manufacturing test. Here are some examples of our solutions:

Digital video

- Create standards-compliant single- or multi-carrier digital video waveforms for component or receiver test. Supported standards include DVB-T / H / T2 / C / S / S2 / S2X, ISDB-T / T_B / T_{SB} / Tmm, J.83 Annex A / B / C, and DOCSIS 3.1 upstream and downstream.
- Create real-time signal generation for DVB-T / H / T2 / C / S / S2 and ISDB-T.
- Select from multiple payload types: MPEG2-TS file or color bar for subjective evaluation or data pattern for BER test.
- Create fully coded signals with AWGN, IQ impairments, and multipaths for component or receiver test.
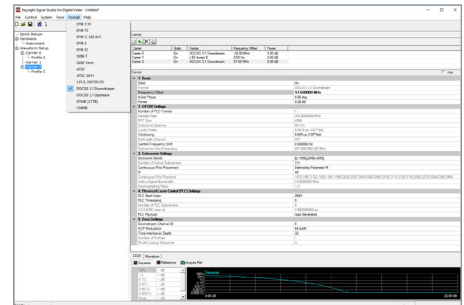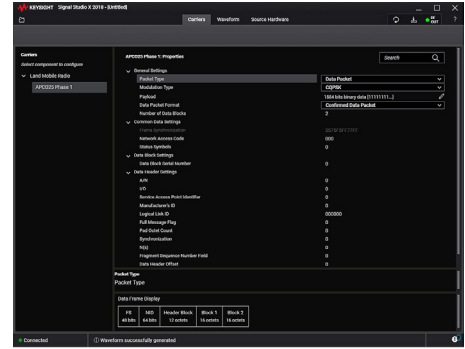

Broadcast radio

- Create standards-compliant waveforms for component or receiver test to FM stereo / RDS / RBDS, DAB / DAB+, T-DMB, and DMB-Audio.
- Use arb waveforms or real-time signals for XM.
- Select from multiple payload types: WAV, MP2 or AAC+ audio file, ETI or STI stream file, or data pattern.
- Use audio sample files and ETI demo stream files for subjective tests.
- Configure multi-carriers / multi-channels for up to 12 carriers independently.
- Add real-time fading, AWGN, and interferers for performance tests.
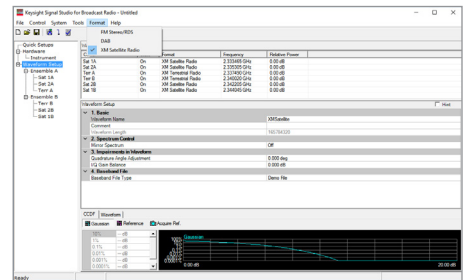
Radio test for land mobile radio

- Enables generation of standards-compliant LMR APCO25 Phase 1 signals for testing user equipment or fixed station with channel coding and predefined test pattern generation.

- Enables downloading and playback of LMR signal waveforms with Keysight-supported signal generators.

- Enables test setups with powerful and intuitive GUI built with HTML5 and JavaScript.

- Supports Red Hat Enterprise Linux and Microsoft Windows 7 and 10.

Want to learn more?

Click on the buttons below to download a technical overview for the following Signal Studio products:

- ❯ Digital video

- ❯ Land-mobile radio

- ❯ Broadcast radio

Detection, Positioning, Tracking, and Navigation

During receiver verification, advanced signal-creation tools provide highly realistic simulations of the operating environment facing detection, positioning, tracking, and navigation systems. What once required racks of test equipment can now be accomplished with cost-effective instruments and Signal Studio. Here are examples of detection, positioning, tracking, and navigation applications:

Global Navigation Satellite System (GNSS)

- Enables creation of real-time multi-satellite signals for the Global Positioning System (GPS), Russian Global Navigation Satellite System (GLONASS), European navigation system (Galileo), Chinese navigation satellite system (Beidou, also known as Compass), and SBAS / QZSS.
- Enables GPS support for single band as L1 C/A, L5I, and L5Q or dual band as L1 C/A plus L5I and L5Q.
- Supports static scenarios for stationary receivers or dynamic scenarios for moving receivers.
- Supports up to 24-hour simulation using saved scenario files or longer simulations using continuous scenario generation mode.
- Controls satellite visibility, power, multipath, and pseudo-range error in real time.
- Enables creation and editing of custom scenarios and supports receiver-antenna pattern modeling.
- Provides trajectory generator utility for moving receiver scenarios.
- Provides waveform files that simulate a single satellite for GPS, GLONASS, Galileo, Beidou (Compass), SBAS, and QZSS for manufacturing test in basic mode.

Pulse building

- Create waveforms that support custom formats and a variety of standard intra- pulse modulation formats: linear and non-linear FM chirp, FM step, AM step, BPSK, QPSK, Barker codes, Frank codes, and polyphase codes.
- Create, store, and recall complex pulse patterns that maximize instrument memory to play long scenarios.
- Set repetition interval, number of repetitions, and frequency, phase, and power offsets on a pulse-by-pulse basis.
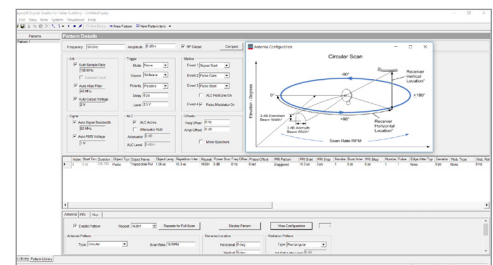
Multi-emitter scenario generation (MESG)

- Create validated, performance-optimized multi-emitter signal scenarios for electronic warfare test from 0 to 40 GHz.
- Define radar emitters in a GUI using parameters such as amplitude, frequency, pulse width, modulation-on-pulse, PRI, coherent processing interval, and mechanical and electronic antenna scan modulation.
- Define antenna dwells to simulate radars with electronically scanned arrays.
- Combine radar emitters into multi-emitter scenarios.
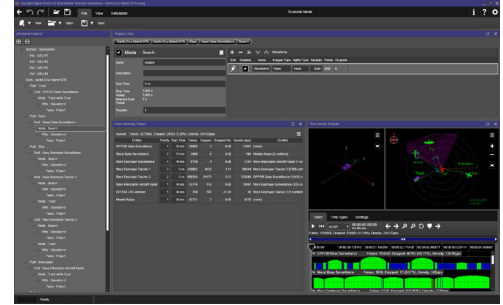
Want to learn more?

Click on the buttons below to download a technical overview for the following Signal Studio products:

> GNSS

> MESG

> Pulse building

General Purpose

Across a wide range of RF and microwave test applications, Signal Studio shortens development time by simplifying test setups and lowering the overall cost of test. Our innovative signal-creation and performance-optimization tools can accelerate the development and manufacturing of receivers and the components that comprise them. You can apply real-time fading to the signals, apply the CFR / ET / DPD power amplifier technologies to your signals, or create custom-defined modulation signals. Here are some examples:

Custom modulation

- Create 5G candidate waveforms, including FBMC, UFMC, GFDM, and F-OFDM, along with SCMA and NOMA multiple access.
- Create custom OFDM and IQ waveforms for analog modulation, automotive radar, wireless connectivity, land-mobile radio, digital video, broadcast audio, emerging wireless, 5G, and aerospace / defense custom / proprietary applications.
- Customize OFDM and IQ quick setups for applications such as LTE, WLAN 802.11a, 802.15.4, 802.15.4g, ITU G.9959, DVB-T / H, ISDB-T, DVB-S2X, DOCSIS 3.1, APCO25, TETRA, NXDN, dPMR, DECT, DMR, ARIB, DAB, and CDR DMR.
- Receive support for single-carrier or multi-carrier signal generation.
- Save to PathWave 89600 VSA setup file or X-series measurement application setup file for modulation analysis and MIMO setups.
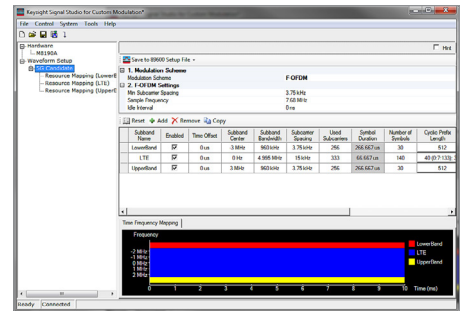
Power amplifier test

- Perform power amplifier (PA) test flow with crest factor reduction (CFR), envelope tracking (ET), and digital pre-distortion (DPD); Support wideband DPD, dual-band ET / DPD, and customer-provided IP DPD.
- Waveform block can import user-defined IQ waveforms, Signal Studio waveforms, and preloaded free waveforms.
- PA measurement result displays include CCDF, AM-AM, AM-PM, ACPR, Raw EVM, Demod EVM, Dynamic EVM, EVM vs. Power, PAE vs. Time, and PAE vs. PA output power.
- Align the envelope signal (you can export it as IQ waveform) and RF signal automatically or adjust them manually.
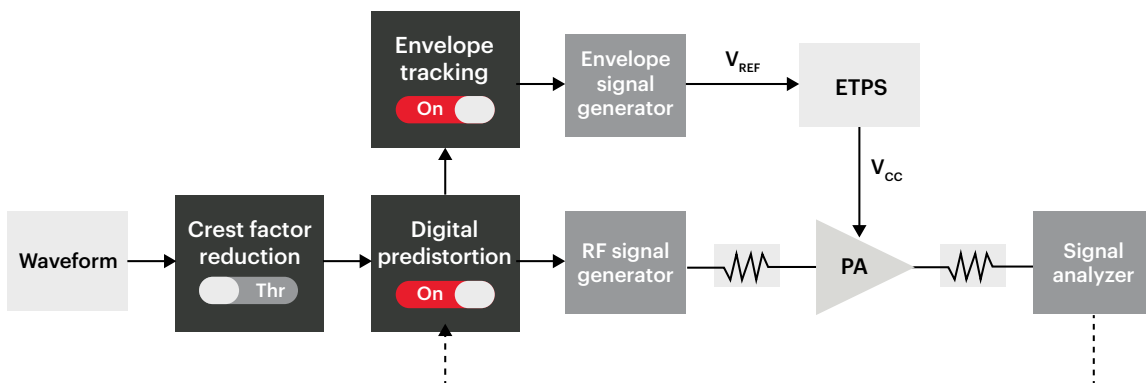
IQ waveform download toolkit

- Includes free software to download your custom IQ waveforms.

- Supports the following file formats: MATLAB MAT File, ASCII / CSV / DAT, Keysight 16-bit and 14-bit, Tek Arb floating format, and Tek Arb pattern format.

- Supports large waveform size (128 MSa), control frequency, amplitude, ALC, and more.

- Supports IQ impairments and adjustments
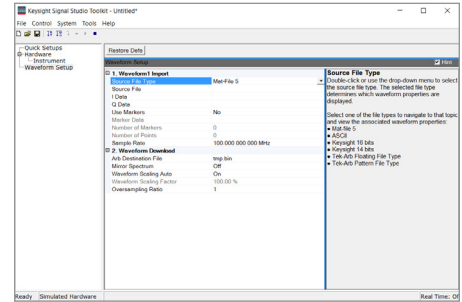
Want to learn more?

Click on the buttons below to download a technical overview for the following Signal Studio products:

❯ Custom modulation

❯ IQ waveform

❯ Power amplifier

Signal Studio Pro or PathWave Signal Generation Desktop PC License and Waveform Playback Licenses

PathWave Signal Generation Desktop or Signal Studio Pro software (N7608C, N7624C, N7625C, N7626C, N7630C, N7631C, and N7637C) offers 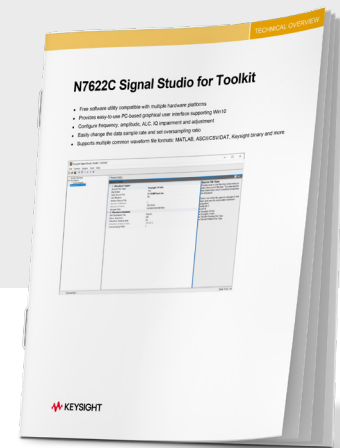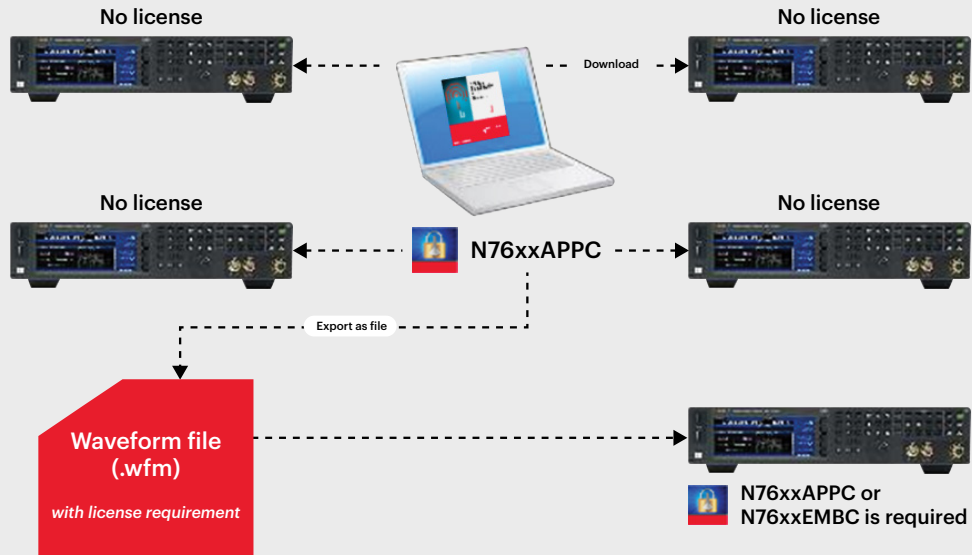two types of licenses: a PC license (N76xxAPPC) and a waveform playback license (N76xxEMBC). For licensing information for a specific Signal Studio product, please refer to the product's technical overview.

- N76xxAPPC is a PC-based license that enables N76xxC software or PathWave Signal Generation Desktop application operating in full capabilities mode to generate and make a live connection to download signal waveforms into the signal generators, VSG, VXG, VXT, or AWGs. N76xxAPPC is typically recommended for R&D teams.

- N76xxEMBC is an embedded license that runs on a signal generator, VSG, VXG, VXT, or AWGs. It lets you generate, make a live connection to download, and play back signal waveforms offline. N76xxEMBC is recommended for design verification, manufacturing teams, or pre-generated waveforms.

N76xxC software	With N76xxAPPC license	With N76xxEMBC license
Operation mode	PC license mode[1] or instrument mode[2]	Instrument mode[2]
Live connection	Yes[1, 2]	Yes
Programming API	Yes	Yes
Export VSA .setx or X-Series measurement application required setup files (if available)	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. PC license mode: When an N76xxAPPC license is installed in a standalone PC, the N76xxC software is working in PC license mode. No license is required inside the instrument if the generated waveform is downloaded but the downloaded waveform can't be saved or renamed.

2. Instrument license mode: The instrument requires a valid license (N76xxAPPC or N76xxEMBC) to play back waveforms. Users can save waveforms in a signal generator for offline playback.

3. A waveform exported as a waveform file (*.wfm) requires a waveform playback license in the instrument (N76xxAPPC, N76xxEMBC, or 5- / 50-pack).

4. Offline playback requires an embedded waveform playback license (N76xxAPPC, N76xxEMBC, or 5- / 50-pack license) on the signal generator, VSG, VXG, VXT, or AWG.

PC license mode

No license

No license

Download

No license

No license

N76xxAPPC

Export as file

Waveform file (.wfm)

with license requirement

N76xxAPPC or
N76xxEMBC is required

Instrument license mode

Download

N76xxAPPC or
N76xxEMBC is required

Download

N76xxAPPC or
N76xxEMBC is required

Export as file

Waveform file (.wfm)

with license requirement

N76xxAPPC or
N76xxEMBC is required
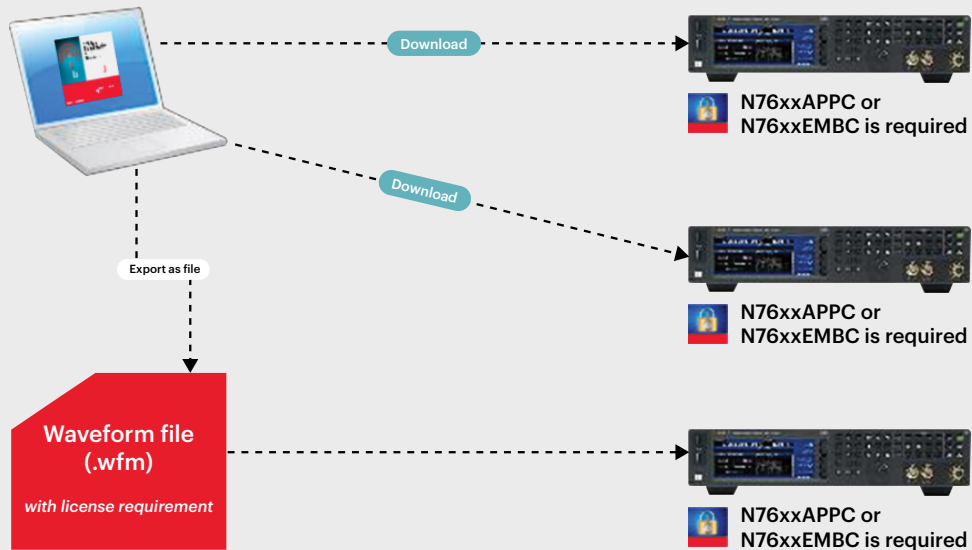
PathWave Signal Generation Embedded

PathWave Signal Generation is an embedded signal-generation application inside newly launched Keysight M9383B VXG-m, M9384B VXG, and M9484C VXG microwave signal generators. M9383B and M9384B VXG are dual-channel 1 MHz to 44 GHz VXG with up to 2 GHz signal bandwidth. M9484C is the first dual-channel microwave vector signal generator capable of up to 110 GHz signals and 2.5 GHz signal bandwidth.

M9384B and M9484C VXG microwave signal generators are integrated boxes with touch-front panels, and M9383B is the PXIe modular without a front panel. There are several embedded PathWave Signal Generation software applications developed with a touch-optimized GUI (see table, right). Furthermore, M9383B / M9384B VXG, M9484C VXG, and M9484C VXG support other Signal Studio-generated waveforms for offline playback enabled by licenses such as N76xxEMBC.

PathWave Signal Generation	Description	Key features
N7621APPC	Basic multitone	Provides basic multitone functionality.
N7631APPC	5G NR	Provides the 5G NR signal creation like N7631C, which supports dual channels: one for wanted signal and one for interference or configured as MIMO. It can import*.setx setup file from N7631C or export the PathWave 89600 VSA*.setx file for easy demodulation.
N7642APPC	Based AM, FM, phase modulation	Provides basic analog modulation function for AM / FM / PM with waveform, rate, AM depth and FM / PM deviation settings.
N7653APPC	Automatic channel response correction and S-parameter de-embedding	Provides correction that you can add from supported file formats (.s2p, .csv, uflat) or by direct measurement using one of the supported power sensors (power meter, spectrum analyzer, network analyzer).
N7608APPC	Custom modulation (beta)	Provides custom modulation settings.
N7605AP0C	3GPP MIMO fading (only with M9484C)	Provides fading profiles for 3GPP 5G NR FR1, FR2, and LTE.
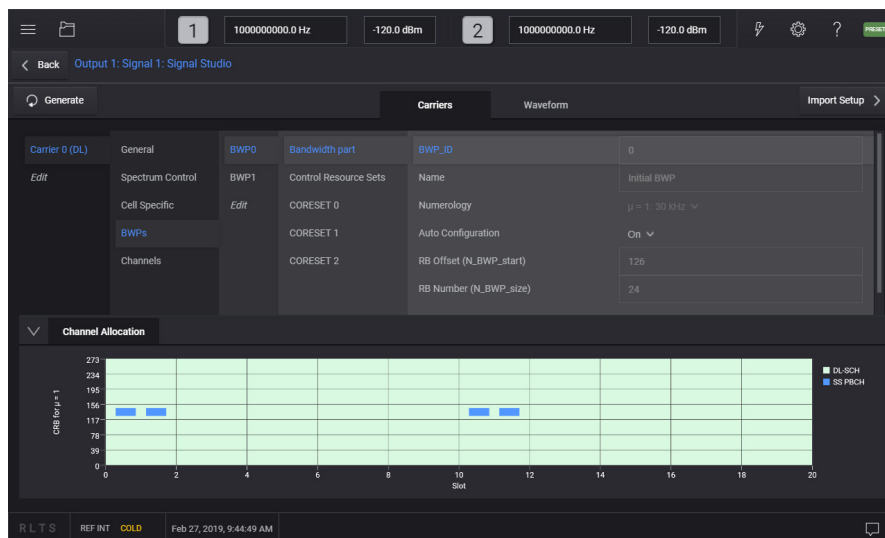
M9484C VXG with touch front-panel

M9384B VXG with touch front-panel

M9383B PXIe VXG without front-panel

Flexible Licensing Terms

Each of the following license types is available as a perpetual or subscription license, as shown in the table below. The pricing for subscription licenses includes a valid support contract. Perpetual license holders need a separate support contract to access Keysight technical support and software updates.

License type	Description	Pricing formula
Node-locked	Allows you to use the license on one specified instrument / computer.	
Transportable	Allows you to use the license on one instrument or computer at a time. You may transfer this license to another instrument or computer using Keysight's online tool.	130% of node-locked
USB portable	Allows you to move the license from one instrument / computer to another by end-user only with a certified USB dongle, which you can purchase separately.	130% of node-locked
Floating	Allows you to access the license on networked instruments / computers from a server, one at a time. For concurrent access, you may purchase multiple licenses.	140% of node-locked (floating single site) / 200% of node-locked (floating single region) / 250% of node-locked (floating worldwide)
Perpetual	Software license for use in perpetuity.	
Subscription	Software license is limited to a defined period, such as 12 months.	38% of perpetual for a 12-month license
Support contract for perpetual licenses	Allows license holder access to Keysight technical support and all software upgrades.	15% of perpetual for 12 months of support
Waveform pack	License and play back individual waveforms created using the Keysight Signal Studio software. Available in 5- and 50-waveform packs.	

Signal Studio and PathWave Signal Generation Ordering Information

PC-based licenses or PathWave Signal Generation Embedded licenses (N76xxAPPC)

Software license	Description	Support subscription
R-Y5B-001-A[2] R-Y4B-001-z[1]	Node-locked perpetual Node-locked 12-month	R-Y6B-001-y[2] Included
R-Y5B-004-D[2] R-Y4B-004-z[1]	Transportable perpetual Transportable 12-month	R-Y6B-004-y[2] Included
R-Y5B-002-B[2] R-Y4B-002-z[1]	Floating perpetual (single site) Floating 12-month (single site)	R-Y6B-002-y[2] Included
R-Y5B-005-E[2] R-Y4B-005-z[1]	USB portable perpetual USB portable 12-month	R-Y6B-005-y[2] Included
R-Y5B-006-F[2] R-Y4B-006-z[1]	Floating perpetual (single region) Floating 12-month (single region)	R-Y6B-006-y[2] Included
R-Y5B-010-J[2] R-Y4B-010-z[1]	Floating perpetual (worldwide) Floating 12-month (worldwide)	R-Y6B-010-y[2] R-Y6B-010-y[2]

Waveform playback licenses (N76xxEMBC)

Software license	Description	Support subscription
R-Y5B-001-A[2] R-Y4B-001-z[1]	Node-locked perpetual Node-locked 12-month	R-Y6B-001-y[2] Included
R-Y5B-004-D[2] R-Y4B-004-z[1]	Transportable perpetual Transportable 12-month	R-Y6B-004-y[2] Included

1. z means different subscription license durations: F for 6 months, L for 12 months, X for 24 months, and Y for 36 months. All subscription licenses include support for the duration of the subscription.

2. y means different support subscription durations: L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60 months. You must purchase a support subscription for all perpetual licenses with 12 months as default. Software licenses with a valid support subscription include all software upgrades and KeysightCare. You can extend support subscriptions for perpetual licenses with monthly support extensions.

PathWave Signal Generation Subscription Bundles

If you have a short-term need for multiple applications in the same category, Keysight offers subscription bundles with several PathWave Signal Generation licenses. You may choose from the licensing types and the duration you need to use the software. Refer to the following table as the PathWave Signal Generation subscription bundles are predefined, and each application bundle includes the specified licenses.

A more flexible PathWave Signal Generation subscription bundle enables you to choose any three or five PathWave Signal Generation licenses from the waveform playback or PC application list in the following table. The supported PathWave Signal Generation licenses are subject to change according to new application launches or discontinuance of some applications.

Description	Model number	PathWave signal generation licenses included
5G and 4G Waveform Playback Bundle	N7689EM1C	• N7624EMBC: LTE / LTE-A / LTE-A Pro FDD • N7625EMBC: LTE / LTE-A TDD • N7631EMBC: 5G NR
Wireless Connectivity Waveform Playback Bundle	N7689EM2C	• N7606EMBC: *Bluetooth®* • N7607EMBC: DFS radar profiles • N7610EMBC: IoT • N7617EMBC: WLAN 802.11
2G and 3G Waveform Playback Bundle	N7689EM4C	• N7600EMBC: W-CDMA / HSPA+ • N7601EMBC: cdma2000 / 1xEV-DO • N7610EMBC: GSM / EDGE / Evo • N7612EMBC: TD-SCDMA / HSPA
5 G and 4G PC Application Bundle	N7689AP1C	• N7624APPC: LTE / LTE-A / LTE-A Pro FDD • N7625APPC: LTE / LTE-A TDD • N7631APPC: 5G NR
O-RAN Studio Bundle	N7689ORNC	• N7624ORNC: LTE / LTE-A / LTE-A Pro FDD • N7625ORNC: LTE / LTE-A TDD • N7631ORNC: 5G NR
Pick Any 3 or 5 Waveform Playback Bundle	N7689EAXC	Pick any 3 or 5 from Keysight PathWave Signal Generation N76xxEMBC waveform playback licenses • N7600EMBC, N7601EMBC, N7602EMBC, N7605EMBC • N7606EMBC, N7607EMBC, N7608EMBC, N7609EMBC • N7610EMBC, N7611EMBC, N7612EMBC, N7614EMBC • N7615EMBC, N7617EMBC, N7623EMBC, N7624EMBC • N7625EMBC, N7626EMBC, N7630EMBC, N7631EMBC • N7637EMBC, N7640EMBC
Pick Any 3 or 5 PC Application Bundle	N7689PAXC	Pick any 3 or 5 from Keysight PathWave Signal Generation N76xxAPPC PC application licenses • N7608APPC, N7621APPC, N7624APPC, N7625APPC • N7626APPC, N7630APPC, N7631APPC, N7637APPC • N7640APPC, N7642APPC, N7653APPC

Description	Model number	PathWave signal generation licenses included
Pick Any 3 or 5 Signal Studio Waveform Playback and X-apps Bundle	N7689EAYC	Pick any 3 or 5 Signal Studio waveform playback and X-apps licenses from the list of N7689EAXC and N9089BAXE
Pick Any 3 or 5 Signal Studio PC Application and X-apps Bundle	N7689PAYC	Pick any 3 or 5 Signal Studio PC applications and X-apps licenses from the list of N7689PAXC and N9089BAXE
Pick Any 3 or 5 Signal Studio Waveform Playback and PathWave 89600 VSA Bundle	N7689EAZC	Pick any 3 or 5 Signal Studio waveform playback and 89600 VSA licenses from the list of N7689EAXC and 89601BAXC
Pick Any 3 or 5 Signal Studio PC Applications and PathWave 89600 VSA Bundle	N7689PAZC	Pick any 3 or 5 Signal Studio PC applications and 89600 VSA licenses from the list of N7689PAXC and 89601BAXC

Note:

1. Those subscription bundles support only the node-locked license type.
2. The subscription duration can be 12 months or 36 months.

Try before you buy!

Free 30-day trials of Signal Studio or PathWave Signal Generation 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 the following page:
www.keysight.com/find/SignalStudio_platforms

PC requirements

You need a PC to run Signal Studio or PathWave Signal Generation.

Model numbers and options

To learn more about Signal Studio or PathWave Signal Generation licensing, model numbers, and options, please visit the PathWave Signal Generation page.

Signal Studio or PathWave Signal Generation software

To download the latest or previous Signal Studio or PathWave Signal Generation software, please visit the following pages:

- www.keysight.com/find/signalstudio_software
- www.keysight.com/find/PWSG_software

KEYSIGHT