PathWave Signal Generation (PWSG) for Pulse Building, Embedded Application

Key Features

- Create Keysight validated and performance optimized radar signals with up to 2.5 GHz of bandwidth from 1 to 54 GHz (up to 110 GHz with frequency extender)
- Produce simple CW pulses and pulses with shaping and complex phase and frequency-encoding
- Build pulses and pulse patterns to simulate a single radar emitter
- Support different PRI patterns, hop patterns and antenna scans for receiver test
- Import .pbp files generated by N7620B Signal Studio for Pulse Building for backwards compatibility
- Support SCPI programming for test automation
- Accelerate the signal creation process with a multi-touch graphic user interface

KEYSIGHT

Simplify Radar/EW Test Signal Creation

N7620APPC PathWave Signal Generation for Pulse Building embedded application is a flexible signal-creation tool that will reduce the time you spend on signal simulation for radar/EW and enhance the characterization and verification of your devices and systems. Through its multi-touch graphic user-interface you'll create custom test signals for component, transmitter, and receiver test.

The PathWave Signal Generation for Pulse Building embedded application enables you to:

- Create pulses based on user-defined parameters. Pulses can be custom designed and saved to the Pulse Library.
- Create patterns. Pulses, other patterns, and off-times can be combined into patterns and saved to the Pattern Library.
- Import/export signal Pattern Library in .csv files.
- Verify pulse signal generation before waveform playing.

Component and Transmitter Test

The PathWave Signal Generation for Pulse Building embedded application allows you to create corrected signals for component and transmitter test. Its multi-touch interface lets you design pulses with modulation, sequence them in pulse repetition intervals, and apply antenna scans and windowing functions. The applications include:

- Parametric test of components, such as amplifiers, mixers, diplexers, circulators and filters
- Tests of transmitter leakage into receiver
- System tests of analog performance in baseband/IF/RF stages
- Bench testing of novel radar waveforms

Receiver Test

The PathWave Signal Generation for Pulse Building embedded application enables you to create corrected signals for receiver test including:

- Performance verification and functional test of receivers during RF/IF/baseband integration and system verification
- Testing of threat identification for radar warning receivers and jammers
- Bench testing of novel radar waveforms

Apply Your Signals in Real-World Testing

Once you set up your signals using the PathWave Signal Generation for Pulse Building embedded application, you can generate and play the waveforms on the M9484C VXG vector signal generator with required licenses.

Instrument	Required License
M9484C VXG vector signal generator [1]	N7620APPC

1. M9484C VXG has installed the firmware A.18.00 or above version.

Component and Transmitter Test

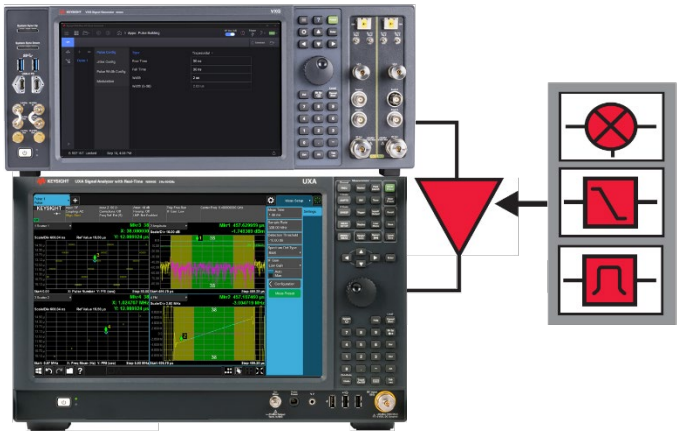

Figure 1. Typical test configuration using PathWave Signal Generation for Pulse Building with M9484C VXG signal generator and N9040B UXA signal analyzer

The PathWave Signal Generation for Pulse Building embedded application can create and customize radar waveforms to characterize the power and modulation performance of your components and transmitters. As radar modulation bandwidths, frequency diversity, and frequency hopping increase, the application works with M9484C VXG to keep you ahead of radar signal demands. Also, easy manipulation of a variety of signal parameters, including pulse width, rise time, fall time, pulse repetition interval (PRI), signal bandwidth, and modulation type, simplifies transmitter component test.

- Create radar modes at a variety of duty cycles, power levels, and frequencies to test power amplifier linearity, gain, and amplitude flatness
- Add modulation onto pulse to measure chip width, chirp linearity and time side lobe levels
- Use a variety of markers to measure average power, peak power, band power, duty cycle jamming-to-signal ratio, and adjacent channel power on an X-series signal analyzer

Receiver Test

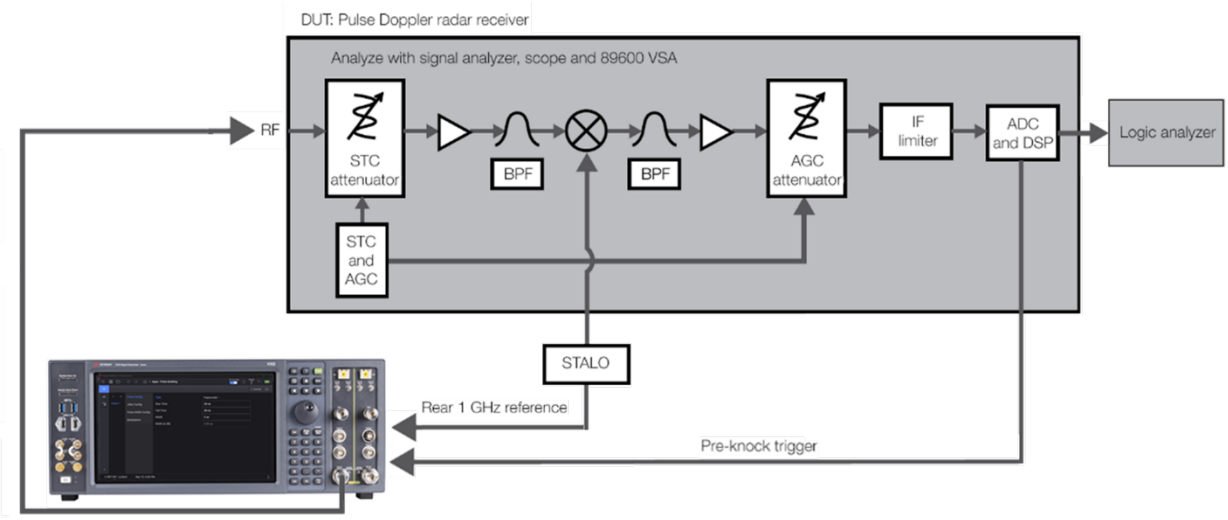

Figure 2. Test your pulse Doppler radar receiver using PathWave Signal Generation for Pulse Building embedded application with M9484C VXG signal generator. The phase reference can come from the STALO or COHO depending on the receiver architecture

The PathWave Signal Generation for Pulse Building embedded application makes coherent testing of radar receivers easy. Use a variety of signal generators and arbitrary waveform generators to customize your solution for your testing needs. Achieve up to 2.5 GHz of modulation bandwidth with phase coherence up to 54 GHz.

Using PathWave Signal Generation for Pulse Building embedded application can test electronic warfare receivers and jammers, emulate any radar threat and future-proof your electronic warfare and electronic countermeasure testing up to 54 GHz.

Radar Receiver Testing

- Create pulse width patterns with jitter to test response to impairments
- Create pulse repetition interval patterns to test range gating and range/Doppler ambiguity resolution
- Add frequency and phase offsets to test moving target indicator modes and Doppler processing
- Create custom pulses with clutter to test clutter rejection performance
- Import custom waveforms created in MATLAB or SystemVUE to simulate radar cross section, clutter, and electronic countermeasures

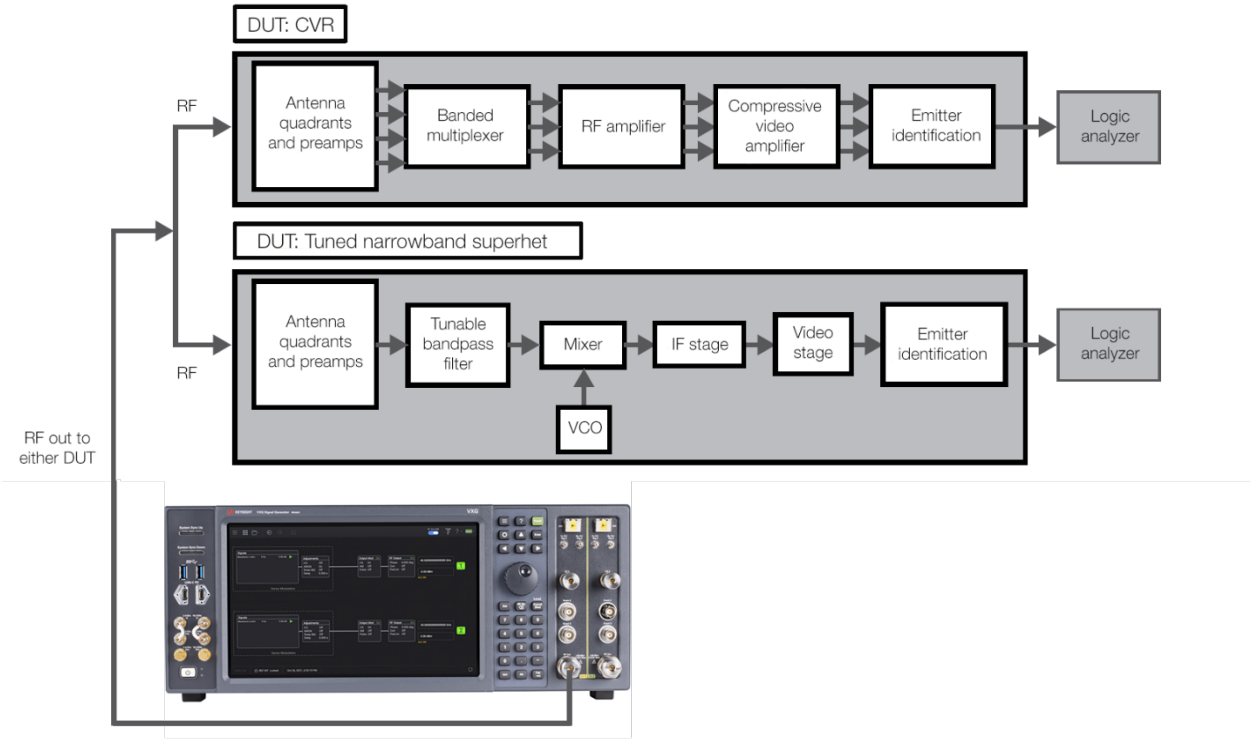

Figure 3. Generate high-fidelity wideband radar signals to test your EW receivers with PathWave Signal Generation for Pulse Building embedded application on M9484C VXG with 2 different receiver architectures (CVR or tuned narrowband superhet)

Radar Warning Receiver (RWR)/Jammer Receiver Testing

- Define a pulse width, rise and fall time, rise time shape, and modulation-on-pulse
- Add a pulse to a pattern and specify pulse repetition interval patterns or wobbulation
- Organize nested patterns into coherent processing intervals, looks, and dwells
- Create an antenna scan for more threat emitter realism
- Import data from an emitter intelligence database for rapid EW reprogramming
- Use a logic analyzer to verify pulse descriptor words, pulse de-interleaving, emitter identification, input scheduling, and interface management

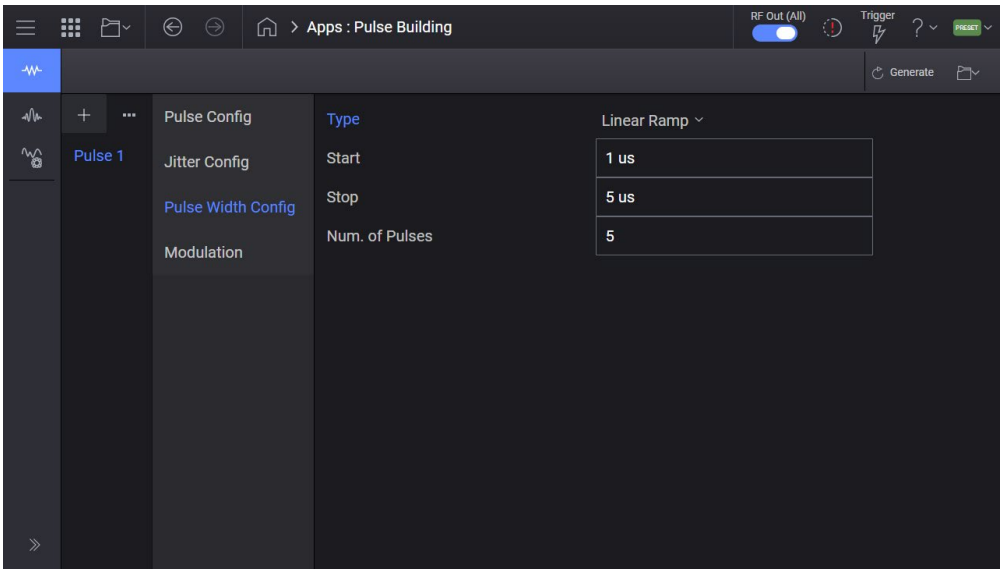

Figure 4. Create a custom pulse library

Figure 5. PRI pattern – staggered

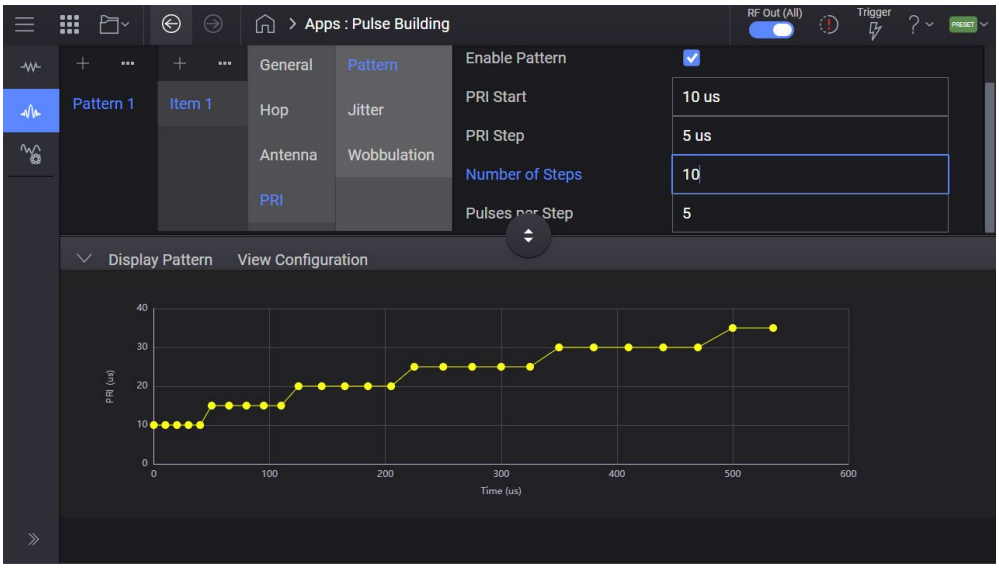

Figure 6. PRI pattern – stepped

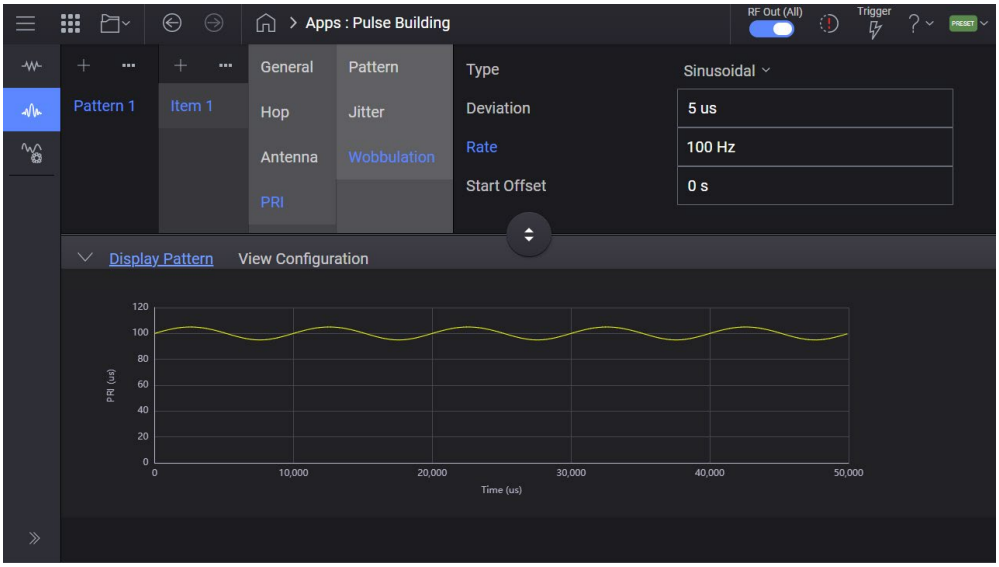

Figure 7. Sinusoidal PRI wobbulation

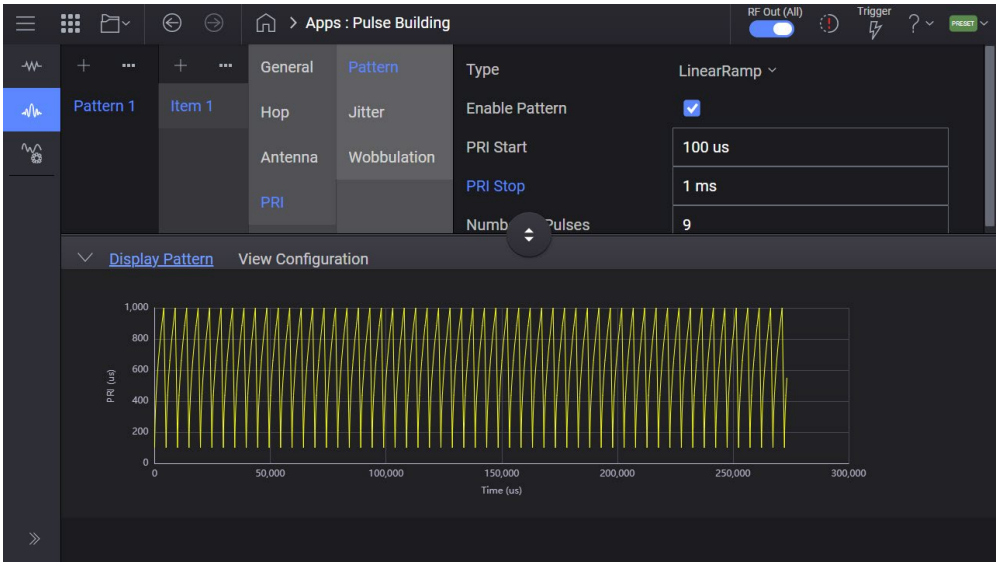

Figure 8. PRI pattern – linear ramp

Feature Summary

Features	Description
Pulse Parameters	
Pulse type	Trapezoidal, raised-cosine, custom profile, custom IQ
Rise time	
Fall time	
Edge shape	
Jitter	Gaussian, uniform, or U-shaped jitter specified by jitter deviation
Pulse width pattern	Linear ramp, stepped, or staggered specified by timing parameters and number of pulses
Modulation-on-Pulse Parameters	
AM step	Selectable amplitude offset and step size
FM step	Selectable frequency offset and step size
Barker	Seven different Barker codes (2, 3, 4, 5, 7, 11, 13)
BPSK	Alternating one-zero (0° and 180°) bit pattern with user-defined step size
Custom BPSK	User-defined bit pattern (0° and 180°)
FM chirp	User-defined FM chirp deviation and offset up to ± 1 GHz [1]
Custom (nonlinear) FM chirp	Polynomial coefficient representation of the instantaneous frequency versus time
QPSK	User-defined step size with symbols at 45°, 135°, 225°, 315°
Custom QPSK	User-defined bit pattern with phase shift in any quadrant
Polyphase codes	Frank, P1, P2, P3, P4, custom phase pattern
Pattern Parameters	
Number of pulse repetitions	
Pulse repetition interval	
Repetition interval jitter	
PRI start/stop time	
PRI patterns	Bursted, linear ramp, staggered, stepped
PRI jitter	Gaussian, uniform, or U-shaped jitter specified by jitter deviation
PRI wobbulation	Sawtooth, sinusoidal, triangular
Amplitude (power) scaling	
Frequency offset	
Phase offset	
Additional off time	
Hop pattern	Linear ramp, staggered, stepped specified by timing parameters and number of pulses
Hop start/stop frequency	
Antenna Scan Parameters	
Windowing functions (radiation pattern)	Rectangular, cosine (1,2,3,4,5), Blackman, exact Blackman, Hamming, 3 term, 3 term minimum, user defined (programmable)
Antenna scan type	Circular, conical, custom, bidirectional raster, unidirectional raster, bidirectional sector, unidirectional sector
Backward Compatibility	
Import N7620B pulse building project (.pbp files)	.pbp files are generated by N7620B Signal Studio for Pulse Building including the signals settings

Supported Standards and Test Configurations

Use PathWave Signal Generation for Pulse Building embedded application for the following radar and EW tests.

Test	Supported Features
Component and Transmitter Test	
Average power	✓
Peak power	✓
Duty cycle	✓
AM/PM conversion	✓
Gain compression	✓
Linearity	✓
Frequency accuracy	✓
Phase accuracy	✓
Rise time	✓
Fall time	✓
Pulse shape	✓
Pulse width	✓
Overshoot	✓
Amplitude ripple	✓
Pulse repetition frequency	✓
Modulation bandwidth	✓
Modulation accuracy	✓
Pulse compression	✓
Time budgeting	✓
Power multiplexing	✓
Time multiplexing	✓
Frequency multiplexing	✓
Electronic countermeasures	✓
Receiver Test	
Range gating	✓
Velocity gating	✓
Pulse compression	✓
Phase detection	✓
Sensitivity time control	✓
Automatic gain control	✓
Electronic counter countermeasures	✓
PRI De-interleaving	✓
Input scheduling	✓
Look through	✓
Frequency set-on	✓
Threat identification	✓
Identification correlation	✓
Frequency	✓
Amplitude	✓
Time of arrival	✓
Pulse width	✓
Modulation-on-pulse	✓

Performance Characteristics

Characteristic Performance

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

The following performance characteristics are given for:

- Internal baseband generators

Parameters

- Rise/fall times tested with 0 ns rise/fall times programmed into pulse building and 30 ns pulse widths. Values are 0-100%.
- Pulse widths tested with 30 ns rise/fall times and pulse widths of 1 sample specified by the deviation resolution. Values are 100-100%.
- On/off ratio measured with pulse building corrections applied and user-optimized IQ modulator correction. Values measured with pulse modulator off and on with 1 us rise and fall times, 50 us pulse widths, and 100 us

Instrument	M9484C VXG (internal Arb) Option R25
Pulse Properties (Pulse Modulator OFF/ON)	
Frequencies	8.5 GHz, 20 GHz, 44 GHz, 54 GHz
Rise time	1 ns
Fall time	1 ns
Minimum pulse width	2 ns
On/off ratio	80 dB (nom.)
Modulation-on-Pulse	
Maximum chirp deviation	±1.25 GHz
Pattern Properties	
Minimum PRI	170 ns
Maximum pulse width with maximum sampling rate (limited by maximum number of samples)	330 ms [1]
Max unique pulses per pattern	27,000
Waveform Granularity	1 sample
Frequency offset range	±1.25 GHz
Phase offset range	±180°

1. Maximum IQ samples supported up to 1Gsamples.
2. M9484C VXG requires firmware version A.18 or above.

Ordering Information

Software Licensing and Configuration

PWSG embedded application 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 support 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.
- Subscription (Time-based): License is time limited to a defined period, such as 6, 12, 24 or 36 months

PathWave Signal Generation for Pulse Building embedded application license
N7620APPC[1] for Pulse Building

Software License Type	Software License	Keysightcare Subscription
Node-locked perpetual	SW1000-LIC-0x[2]	SW1000-SUP-0x[2]
Node-locked time-based	SW1000-SUB-0x[2]	Included
Transportable perpetual	SW1000-LIC-0x[2]	SW1000-SUP-0x[2]
Transportable time-based [1]	SW1000-SUB-0x[2]	Included

1. Support M9484C VXG vector signal generator with firmware version A.18 and later
2. 0x means the month period: for example, 01 means 1 month, 06 means 6 months, 36 means 36 months.

Try Before You Buy!

Download the PathWave Signal Generation and use it free for 30 days to make measurements with your analysis hardware: www.keysight.com/find/n7620appc,

Request your free trial license today: www.keysight.com/find/signalstudio_trial

Additional Information

Hardware Configurations

To learn more about compatible hardware and required configurations, please visit:

www.keysight.com/find/M9484C

Websites

Access the software webpage and request a trial license.

www.keysight.com/find/N7620APPC

Literatures

PathWave Signal Generation, Brochure, 5989-6448EN

Keysight M9484C, Vector Signal Generators, Technical Overview, 3122-1440EN

Keysight M9484C, Vector Signal Generators, Data Sheet, 3122-1445EN

N7620B Signal Studio for Pulse Building, Technical Overview, 5991-0779EN