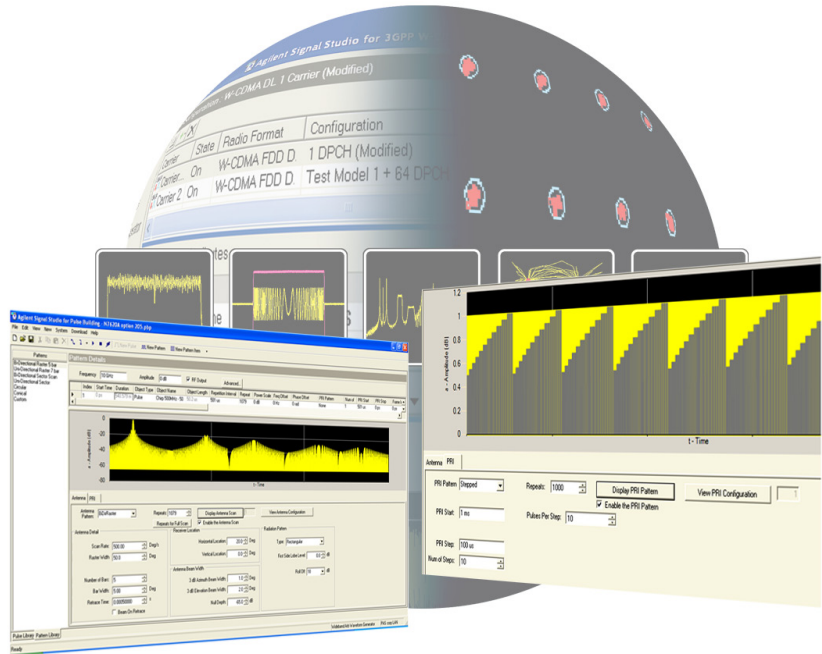# Agilent
N7620A Signal Studio for Pulse Building

Technical Overview

- Create a library of complex pulses and pulse patterns by selecting parameters in the software or by importing custom pulses

- Maximize your investments with long scenarios using advanced sequencing and nesting features

- Get the highest performance with baseband pre-distortion, automatic re-sampling and enhanced pattern control

- Select popular modulation schemes, antenna patterns and pulse timing parameters

- Configure signals in an easy-to-use, application-specific graphical interface

The N7620A Signal Studio for Pulse Building software has been updated to a newer version, N7620B. It now supports the M8190A arbitrary waveform generator and offers improved features such as greater pulse sequencing capability with the M8190A, 2 GHz modulation bandwidth up to 44 GHz RF with the PSG and M8190A, and Windows 7 compatibility.

For more information, visit **www.agilent.com/find/N7620B**

Agilent Technologies

Create Sophisticated Single Emitter Test Patterns

Signal Studio for pulse building is software for creating sophisticated single emitter test patterns for radar receiver design and verification. Custom pulse shaping, modulation, antenna patterns, and user-defined pulse patterns are easily achieved with the straightforward graphical user interface or with your own test executive using the COM-based application programming interface (API).

Configure pulses by setting high-level pulse parameters like rise time, pulse width, fall time, and modulation type. Or import custom, proprietary, and recorded pulse signals to the software using pulse profile definitions or custom I/Q waveform data. Modulation can also be applied to imported pulses.

The software operates with the Agilent E8267D PSG or E4438C ESG vector signal generators and their internal AWGs. Extend your pulse capability by adding the N6030A/N6031A, M9330A/M9331A, or N8241A/N8242A wideband arbitrary waveform generator externally. For improved signal quality using an advanced pre-distortion algorithm, an Agilent X-Series (EXA, MXA, or PXA) signal analyzer or an Agilent PSA or ESA spectrum analyzer is also required.
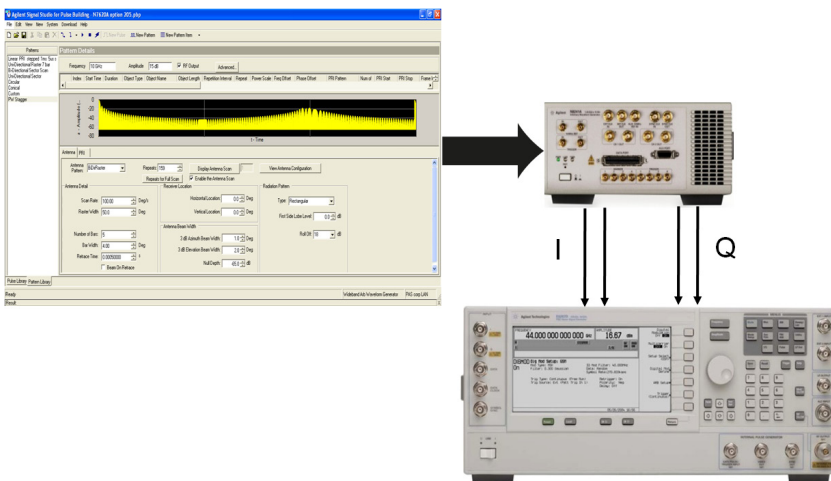

Figure 1. Pulse building configuration for wideband, high frequency

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Pulse Building Software Overview

Signal Studio software for pulse building utilizes the fast sample rate and play-back capability of the selected arbitrary waveform generator to achieve flexible pulse shaping. Custom pulse profiles are precisely defined with down to 1 ns resolution between waveform sample points.

Signal Studio for pulse building also features the unique ability to synchronize the I/Q modulation with the analog pulse modulator. This ensures that the flex-ible pulse shaping enabled by the internal baseband generator is not achieved at the cost of dynamic range. Pulses created with the software yield an on/off ratio of over 80 dB.

Create a pulse library

Use the software to define and archive a library of unique pulses using four simple techniques:

- Select a built-in trapezoidal or raised cosine pulse type and set rise/fall time, pulse width, and pulse width jitter
- Select custom pulse profile and enter amplitude points in the table editor to define the pulse profile
- Select custom I/Q and enter I/Q waveform samples in the table editor to define the pulse profile
- Select custom profile or custom I/Q and import ASCII user-file pulse defini-tions of pulse signal recordings or pulses created in other signal creation environments, such as Agilent ADS, Agilent SystemVue, and MATLAB

Custom modulation can be applied to built-in or imported pulses by simply choosing from a pull-down menu of modulation types and setting basic modula-tion parameters.
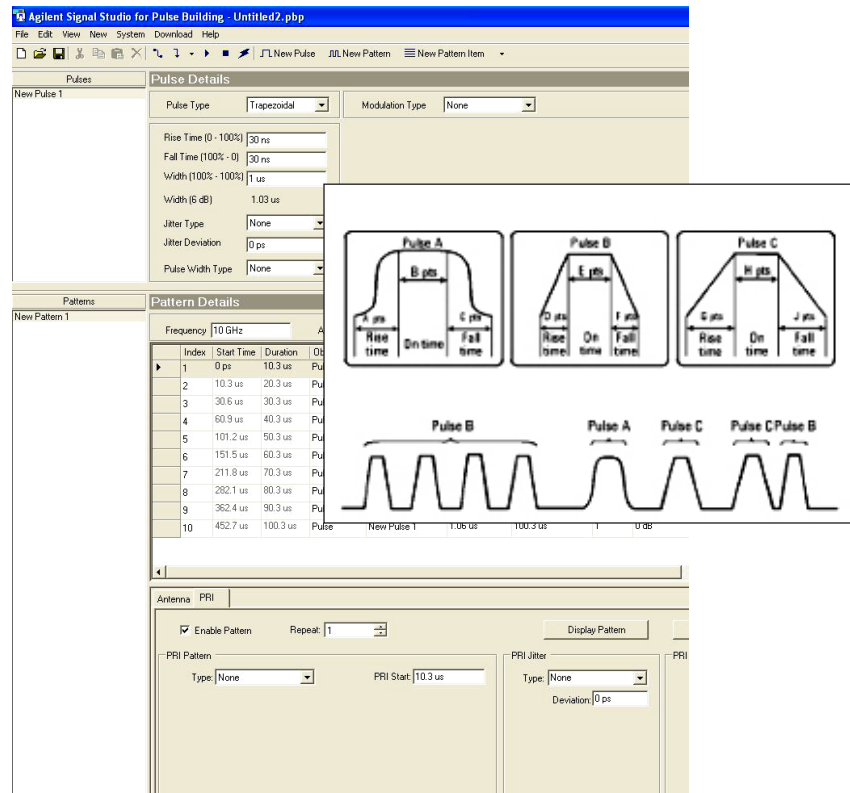
Figure 2. Create a custom pulse library

Available modulation formats:

- AM step – selectable amplitude 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 deviation up to ±40 MHz and step size

- Custom (non-linear) 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 [1]

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1.   *Part of the advanced feature set of Options 205 and 206.*

Create a pattern library

A pattern library of individual pulses can be created using this software. Also, imported signal creation environments and/or signal recordings from other sources can be recalled from the pulse library and assembled into custom pulse patterns. The accommodating feature set enables quick configuration of user-defined test patterns ranging from simple repeated pulses to complex antenna scans with numerous unique pulses. The software also supports pattern nesting, meaning once a pulse pattern has been created, it can be nested in another pattern for playback. In addition, pulse repetition interval (PRI) patterns can be generated that contain jitter components or periodic functionality - PRI wobulation.

The pattern library features a flexible interface to create, store and play back custom radar test patterns.
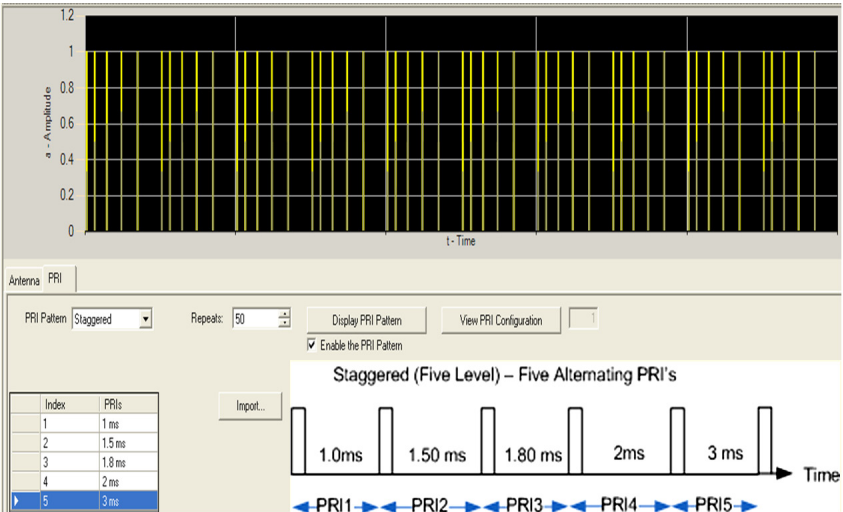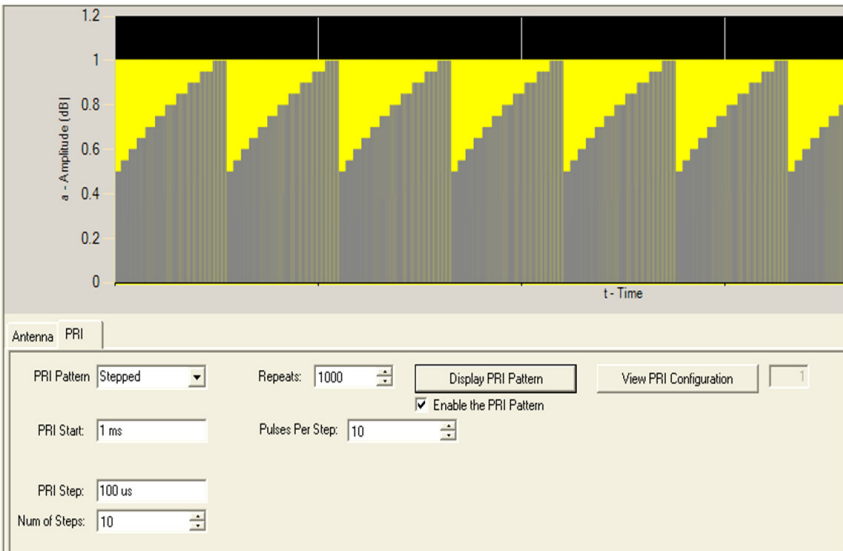

Figure 3. PRI timing — staggered

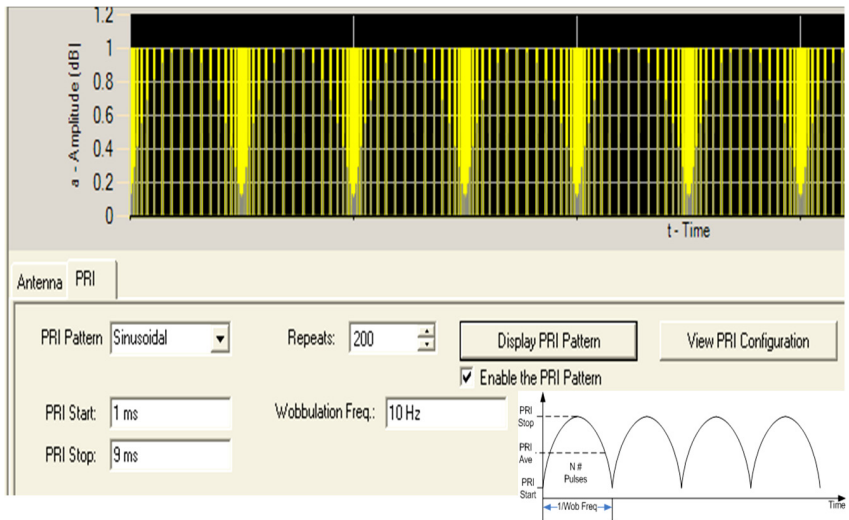*Figure 4. PRI timing — stepped*
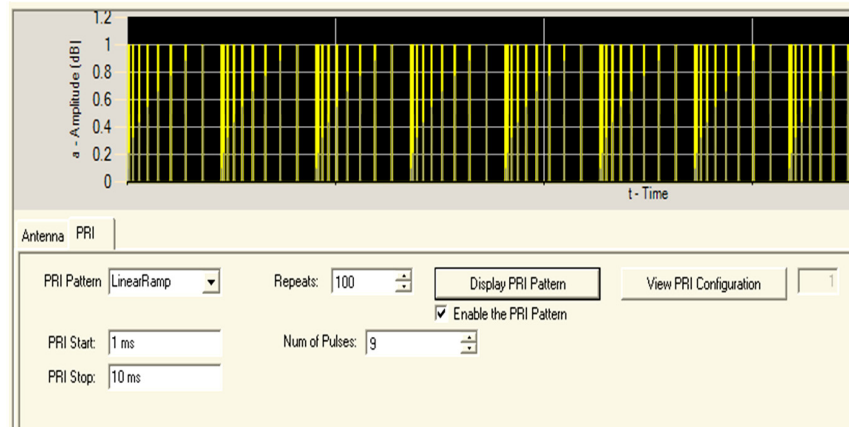
Figure 5. PRI timing – sine wobulation

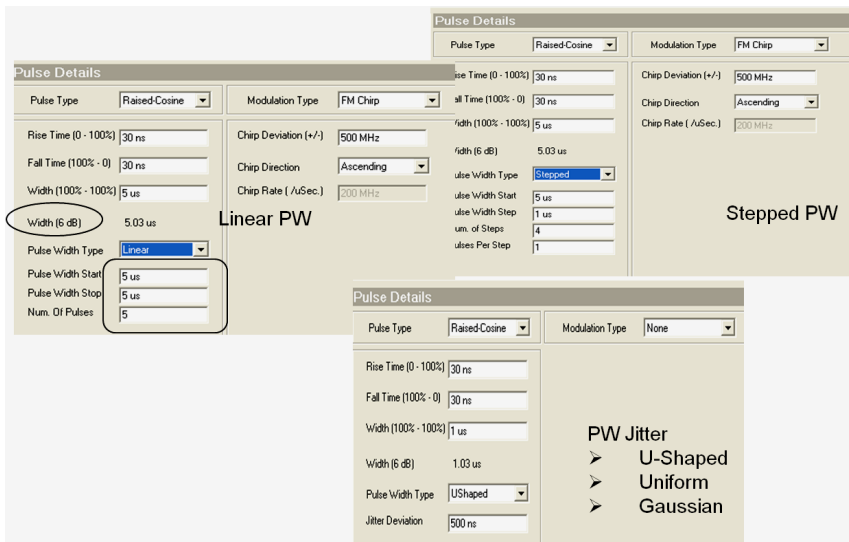*Figure 6. PRI timing - linear ramp*

Figure7. Pulse width patterns

When creating patterns, the following parameters can be set for each pulse and/or nested pattern:

- Number of repetitions

- Repetition interval

- Repetition interval jitter with user-defined maximum deviation

- PRI patterns (bursted, linear ramp, staggered, stepped) [1]

- PRI wobulation (sawtooth, sinusoidal, triangular) [1]

- Amplitude scaling, frequency offset, and phase offset

- Additional off time

1. *Part of the advanced feature set of Options 205 and 206*

This level of pattern definition flexibility, combined with the pattern nesting capability, significantly simplifies the configuration of complex pulse patterns without having to calculate, format, and sequence your own arbitrary waveform files. Using the pulse building software, custom radar receiver test signals are easily created, including sensitivity/selectivity test patterns, frequency agile pulse patterns (within the RF modulation bandwidth of the AWG), and antenna scan patterns.

Set marker and trigger signals

Signal start, pulse start, and pulse gate marker and trigger signals can be applied to any pulse pattern. User-defined routing allows each marker/trigger signal to be independently applied to the event 1, event 2 and event 3 ports of the PSG vector signal generator.

Figure 8. Instrument control showing ALC, trigger, amplitude, and frequency offset

Antenna scan modulation

Advanced Options 205 and 206 enable antenna scan modulation patterns which can be applied to each pulse in the pattern. Accurate amplitude values are automatically varied based on the multitude of various scan and modulation parameters provided. The antenna beam shape can be adjusted to desired configurations. It is also possible to import custom antenna patterns for user specific antennas and do full or partial scans based on the parameters selected. Available patterns have a wide range or parameter variability enabling users to experiment with different mechanical sweep parameters as well as electrical characteristics to optimize performance or test a wider range of performances.
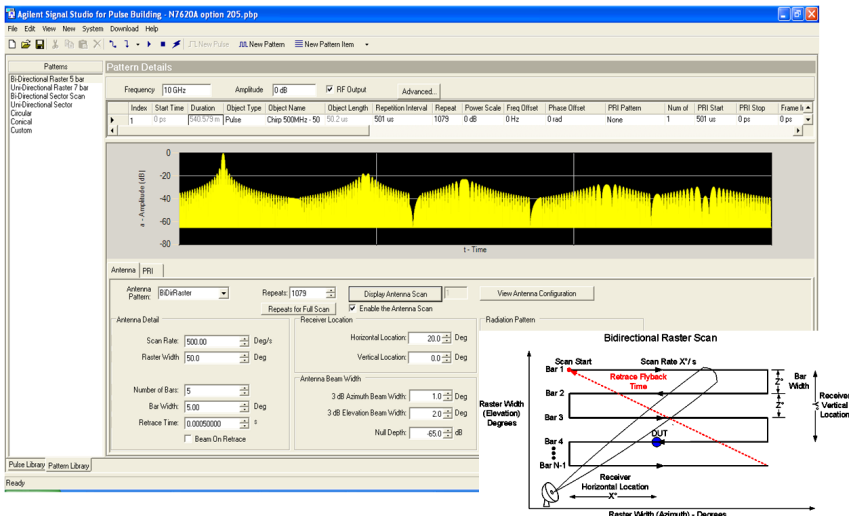

Figure 9. Advanced antenna scanning options

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Utilize the COM-based API

The COM-based API is provided to enable systematic and efficient configuration of complex radar receiver test patterns. It allows programmatic setting of pulse and pattern parameters by importing custom data sets or using programming loops and mathematical functions rather than manually entering data in the Signal Studio graphical user interface. The entire signal configuration and playback process can easily be automated in your own programming environment using the API. Visual Basic programming examples are provided in the software's built-in help system.

CSV file import/export feature

Pulse building Options 205 and 206 offer the capability to import or export complex pulse scenarios from CSV files (Comma Separated Values), which can be saved from Excel spreadsheets. The CSV file uses a revision number control so that it can be modified in the future. This capability offers a simple way to both save and share key signal properties. Editing the parameters in the CSV format is simple and can be used by technicians to efficiently switch key parameters for faster testing. Easily edit patterns, change repetition values for each pattern, adjust RF offset values, add a multitude of antenna scan patters, or modify structure of the pulse.
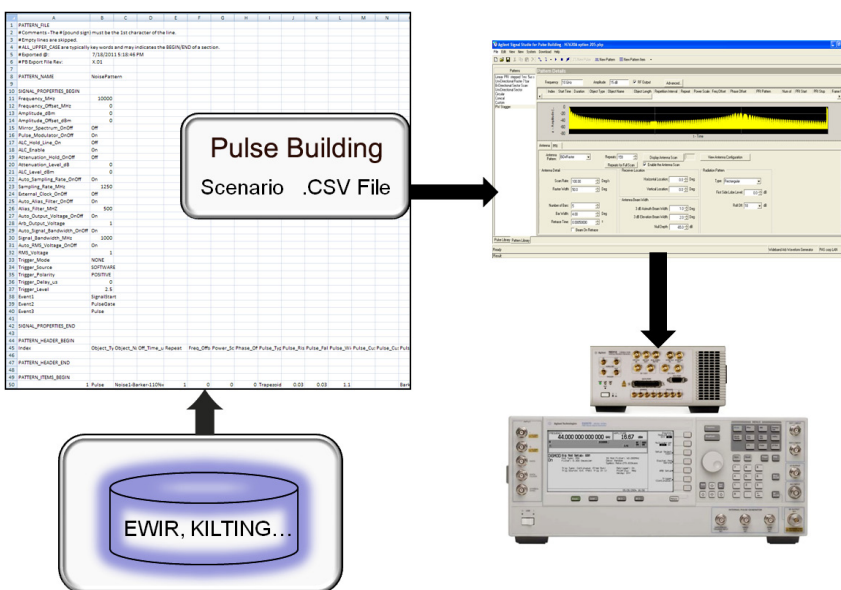
Figure 10. Scenario data base import/export

Attain improved signal quality

Automatic hardware configurations enable users to quickly download and play waveforms in arbitrary waveform generators or signal generators with exceptional fidelity. In addition, pulse building enables the ability to override the hardware automatic configuration features to further optimize performance. For example, the user can adjust I/Q skew and I/Q gain balance for image suppression that can improve fidelity to the point where calibration may not be required for wideband signal generation.

When combined with an Agilent X-Series or PSA signal/spectrum analyzer, the Signal Studio for pulse building software applies pre-distortion to the calculated waveform to improve image rejection and optimize RF flatness over a 1 GHz bandwidth. The analyzer is required to gather the signal generator calibration data needed to determine the appropriate pre-distortion coefficients. This process is fully automated by the Signal Studio pulse building software. Corrections can also be applied to pulses imported to the software using custom profile or custom I/Q user files.

Software Performance Characteristics

Pulse properties	
Modulation on pulse	
Am step	Step size: user-defined
Barker	Order 2, 3, 4, 5, 7, 11, 13
BPSK	Bit pattern: alternating 01
	Step size: user-defined
Custom BPSK	Bit pattern: user-defined
	Step size: depends on number of bits in bit pattern
FM chirp	User defined: consult hardware specifications
Custom (non-linear) FM chirp	Polynomial coefficient representation of the instantaneous frequency versus time.
FM step	User defined: consult hardware specifications
Custom QPSK	Bit pattern: user-defined
QPSK	Step size: user-defined
Polyphase [1]	P1, P2, P3, P4, Frank
Custom phase pattern [1]	User defined
Antenna scan and modulation properties [1]	
Scan type	None, circular, conical, custom, bidirectional raster, unidirectional raster, bidirectional sector
Pattern properties	
Pattern objects	Pulse, pattern, or off-time
Repetition interval jitter	Type: Gaussian, uniform, u shape [1]
	Deviation resolution: 10 ns
PRI wobulation [1]	None, sawtooth, triangular, sinusoidal
PRI patterns [1]	Linear ramp, staggered, step
Pulse width type	Constant, Gausian jitter, uniform jitter [1], linear ramp [1], stepped [1]
Number of repetitions	Up to 64 k * 16 k if same pattern object is re-used
Pattern length	Unique pulses: up to 16,000
	Hardware is generally limiting factor, please consult hardware documentation
Hardware properties and specifications	
Please consult hardware specification guide or data sheet	

1. *Advanced feature, requires Option 205 or 206*

Ordering Information

To take full advantage of the N7620A Signal Studio for pulse building software, the following signal generation configurations are recommended. The N7620A software utilizes configurations that fall into one of three categories – internal baseband generator, external baseband generator, and external baseband generator with wideband option.

Model-option	Description and related hardware	Licenses type	Notes
N7620A-101	License for internal baseband generator, E4438C signal generator	Fixed, perpetual license	Does not include advanced features
N7620A-102	License for internal baseband generator, E8267C/D signal generator	Fixed, perpetual license	Does not include advanced features
N7620A-117	License for N603XA/M933X AWG, external baseband generator (also with wideband I/Q)	Fixed, perpetual license	Does not include advanced features
N7620A-118	License for N8241A/ N8242A AWG, external baseband generator (also with wideband I/Q	Fixed, perpetual license; Option SL1 not supported with this application	Does not include advanced features

Ordering Information (continued)

Model-option	Description and related hardware	Licenses type	Notes
N7620A-205	License for advanced features for pulse building - PSG and ESG signal generators	Fixed, perpetual license	For internal arbitrary waveform generators, provides additional capabilities for new levels of realism to pulsed signal simulation. This option includes pulse width and PRI patterns, jitter and wobulation signal impairments, antenna radiation patterns and antenna scan patterns. Option 205 also adds the ability to import or export pattern files from a spreadsheet using a CSV (Comma Separated Variables) file format. Requires Option 101 or 102. Upgrade is available for any version of pulse building.
N7620A-206	License for advanced features for pulse building - wide band ARBs	Fixed, perpetual license	For external arbitrary waveform generators, provides additional capabilities for new levels of realism to pulsed signal simulation. This option includes pulse width and PRI patterns, jitter and wobulation signal impairments, antenna radiation patterns and antenna scan patterns. Option 206 also adds the ability to import or export pattern files from a spreadsheet using a CSV (Comma Separated Variables) file format. Requires Option 117 or 118. Upgrade is available for any version of pulse building.

PC Requirements

Parameter	Requirement
Operating system	Windows® XP SP3 (32 bit), Vista SP1 (32 bit)
CPU	1 GHz (> 2 GHz recommended)
RAM	2 GB (> 4 GB recommended)
Video RAM	128 MB (512 MB recommended)
Other	Microsoft® Internet Explorer, .NET Framework 4.0

Hardware Configurations

Model-Option	Description	Notes
E4438C ESG vector signal generator		
E4438C-503, -504 or -506	Frequency range from 250 kHz to 3, 4 or 6 GHz	One required
E4438C-601 or -602	Internal baseband generator, 8 (Opt 601) or 64 (Opt 602) Msa memory with digital bus capability	One recommended
E4438C-403	Calibrated AWGN	Recommended
E8267C/D PSG vector signal generator		
E8267D-520, -532, -544	Frequency range from 250 kHz to 20, 31.8, or 44 GHz	One required
E8267D-UNW	Narrow pulse modulation	Required
E8267D-601 or -602	Internal baseband generator, 8 (Opt 601) or 64 (Opt 602) Msa memory with digital bus capability	One recommended
E8267D-403	Calibrated AWGN	Recommended
N8241/N8242A arbitrary waveform generator		
N8241A-125	1.25 giga-samples per second sample rate	Required
N603XA/M933XA arbitrary waveform generator		
N603XA-016	16 M memory	Recommended
M9330A-125	Clock opetartion 1.25 G Sa/s	Required (only for M9330A)
Upconversion options		
Optional configuration with wideband ARB (supporting N824XA, N603XA, or M9330A) with vector upconversion using differential IQ. This solution enables 1 GHz of bandwidth for carrier frequencies up to 43.5 GHz		
8267D/C -015, -H16, -016, or -HBQ	PSG signal generator	One required
N8212A-UNW and -016	Vector upconverter	Required

Hardware Configurations (continued)

Model-Option	Description
Signal and spectrum analyzer platforms	
For improved signal quality using an advanced pre-distortion algorithm, an Agilent signal or spectrum analyzer is required. Go to **www.agilent.com/find/sa** to select the model that best fits your application.	
E4402B, E4404B, E4405B, E4407B	ESA spectrum analyzer
E4440A, E4443A, E4445A, E4446A, E4447A, E4448A	PSA spectrum analyzer
N9010A-503, -507, -513 or -526	EXA signal analyzer
N9020A-503, -508, -513 or -526	MXA signal analyzer
N9030A-503, -507, -513 or -526	PXA signal analyzer

Additional Resources

Websites

- Signal studio for pulse building
  www.agilent.com/find/n7620a
  This page also references links to online documentation, including release notes and user guide.

  www.agilent.com/find/N7620b
  This page includes information on the updated version of the Signal Studio for Pulse Building software

- Signal creation software
  www.agilent.com/find/signalstudio

- Signal generators and sources
  www.agilent.com/find/sg

- Signal and spectrum analyzers
  www.agilent.com/find/sa

- Arbitrary waveform generators
  www.agilent.com/find/awg

Related literature

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

- Agilent E8267D PSG Vector Signal Generator,
  Data Sheet, literature number 5989-0697EN

- Agilent E4438C ESG Vector Signal Generator,
  Data Sheet, literature number 5988-4039EN

- Agilent N8241A Arbitrary Waveform Generator,
  Technical Overview, literature number 5989-2595EN

- Agilent M9330A Arbitrary Waveform Generator,
  Data Sheet, literature number 5990-6426EN

- Agilent N6030A Arbitrary Waveform Generator,
  Technical Overview, literature number 5889-1475EN