Agilent Technologies
Pulse Pattern and Function Arbitrary Generators
and Arbitrary Waveform Generator

For Digital and Analog Testing
Revision 1.1

Leading versatile and precise stimulus through ideal and real-world signals

Signal Sources for Design and Manufacturing

Anticipate —Accelerate —Achieve

Agilent Technologies

Sources for Analog and Digital Signals

Agilent Technologies offers a comprehensive portfolio of pulse, pattern and function arbitrary waveform.

Whether your application calls for:

- Demanding digital pulses
- High-speed clock signals
- Square waves
- Flexible serial or parallel bit patterns and data streams
- Sine waves or arbitrary waveforms
- Modulation to shape the signal your DUT needs
- Jitter and noise generation to test your device to its limits
- High-resolution waveforms for radar and satellite

Agilent Technologies provides the stimulus solution you are looking for.

Choose the performance you need from the portfolio of reliable pulse generators, the data generator platform with up to 132 parallel channels or the multi-purpose pulse function arbitrary noise generator instruments.

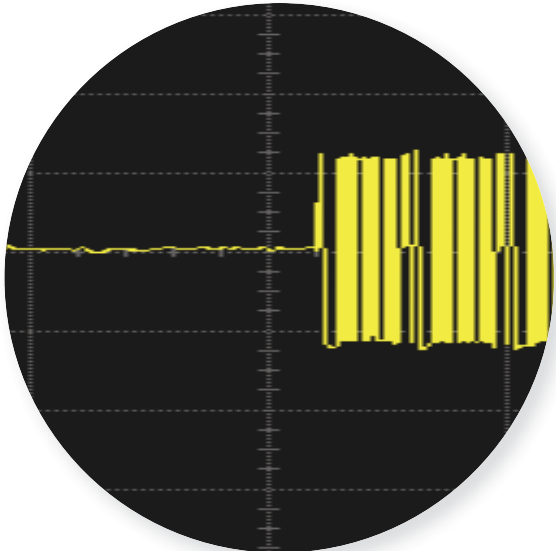Agilent's family of stimulus instruments comprises:

- Pulse generators
- Pattern generators
- Data generators
- PRBS generators
- Jitter generators
- Noise generators
- Controllable jitter injection
- Timing generators
- Function arbitrary generators
- Arbitrary waveform generators

Agilent provides the perfect signal generation instrument for your application.

Whether you:

- Require powerful pulses for the latest generation of laser diodes,
- Need to characterize a high-speed serial bus device at the physical layer, or
- Need to get a detailed insight into your system's signal integrity,

Agilent's pulse pattern generators and pulse function arbitrary noise generators deliver the reliable and accurate results you require.

Signal Sources

	Pulse pattern generator	Function arbitrary generator	Arbitrary waveform generator	
	Pulse Perfomance	Sine Wave Performance	IQ Modulation Bandwidth	
14.2 Gb/s	N4903B G13 81250A N4903B G07			High speed
7 Gb/s	N4903B G13 81250A N4903B G07			High speed
5 Gb/s			M8190A	High speed
3.35 GHz	81134A 81133A			High speed
660 MHz	81130A 81132A	to 2 GHz	81180A	Precision models
400 MHz	81130A 81131A		M9331A N8242A	Precision models
330 MHz	81160A 81110A 81112A E8312A	to 500 MHz	81160A M933xA N824xA	Precision models
165 MHz	81110A 81111A E8311A			Fully triggerable models
120 MHz	81150A	to 240 MHz	81150A	Fully triggerable models
80 MHz	81104A 81105A		33250A	Fully triggerable models
50 MHz	81101A			Fully triggerable models
30 MHz	33521A			Fully triggerable models
20 MHz		15 MHz E1441A	33220A U2761A	Fully triggerable models
10 MHz		to 10.7 MHz E1445A	33210A	Fully triggerable models

Key Applications at a Glance

	81101A	81104A 81105A	81150A	81111A	81110A 81112A	81130A 81132A	E8311A	E8312A	81133A 81134A	N4903A -G07/G13	81250A	332x0A	N6030/ N8241A	81180A
Clock generation	●	●	●	●	●	●	●	●	●	●	●	●		
System trigger source	●	●	●	●	●	●	●	●	●	●	●	●		
Diodes - LEDs	●	●		●			●							
Laser or IR diodes														
Radar test			●	●	●		●	●			●	●	●	●
Mixed signal devices		●	●	●	●		●	●				●	●	●
Flash chip test		●		●			●							
EEPROMs														
High power semi-conductors														
PRBS generation		●		●	●	●	●	●	●	●	● PRWS			
Data generation < 56 kBit		●		●	●	●	●	●	●	●	●	●		
Data generation > 56 kBit									●	●	●			
Data looping						●				●	●			
Serial bus test < 1 GBit/s	●	●		●	●	●								
High speed serial bus test > 1 GBit/s						●								
Signal integrity test			●						●	●	●	●	●	●
Jitter (stress) test			●						●	●	●	●	●	●
Noise immunity test			●						●	●		●	●	●

Specification	81101A	81104A 81105A	81150A	81160A	81111A	81110A 81112A	81131A	81130A 81132A	E8311A	E8312A	81133A 81134A	81250A	N4903A-G07/G13	3352xA/ 332xxA	U2761A	81180A
Frequency range	1 MHz - 50 MHz	1 MHz - 80 MHz	1 µHz - 120 MHz	1 µHz to 330 MHz	1 MHz - 165 MHz	1 MHz - 330 MHz	1 kHz - 400 MHz	1 kHz - 660 MHz	1 MHz - 165 MHz	1 MHz - 330 MHz	15 MHz - 3.35 GHz	1 kHz - 2.7 GBit/s	150 MHz - 13.5 GHz	1 µHz - 80 MHz	1 µHz - 20 MHz	10 Msa/s - 4.2 Gsa/s sample clock
Number of channels	1	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	2[1]	2[1]	1	2-132	1	1	1	2
Optional 2nd channel retrofitable		●			●	●	●	●				● Max 132				
Amplitude range (Volts)	100 mV - 20 V[3]	100 mV - 20 V[3]	100 mV - 20 V[4]	100 mV - 10 V[5]	100 mV - 20 V	100 mV - 3.8 V[3]	100 mV - 3.8 V	100 mV - 2.5 V	100 mV - 20 V	100 mV - 3.8 V	100 mV - 2 V	100 mV - 1.8 V	100 mV - 1.8 V	10 mV - 10 V	40 mV - 5 V	50 mV$_{pp}$ - 2 V$_{pp}$
Differential outputs			●	●			●	●	●		●	●	●			●
LDVS levels			●	●							●	●	●			
Triggerable	●	●	●	●	●	●	●		●	●		●	●	●	●	●
Gate mode	●	●	●	●	●	●	●	●	●	●						●
Remotely programmable	●	●	●	●	●	●	●	●	●	●	●	●	●			
Pulse generation	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Pattern & data generation		●	●	●	●	●	●	●	●	●	●	●				
PRBS generation		●	●	●	●	●	●	●	●	●	●	●	●			
Bursts	●	●	●	●	●	●	●	●	●	●	●		●	●		
Data bursts		●	●	●	●	●	●	●	●	●	●		●			
Memory (kBit/channel)		16 KBit /ch.	512 Ksamples/ ch. 16 Mbit pattern memory	256 Ksamples/ch 4 Mbit pattern memory for the 1-channel, 2 Mbit pattern memory for 2 channel	16 KBit /ch.	16 KBit /ch.	64 KBit /ch.	64 KBit /ch.	16 KBit /ch.	16 KBit /ch.	12 KBit /ch.	8 KBit /ch.	32 KBit /ch.	64 Ksamples/ ch.		16 and 64 Msamples/ ch.
PRBS variations (2n-1)		n = 7, 8, ... 14	2^{31}	2^{31}	n = 7, 8, ... 14	n = 7, 8, ... 14	n = 7, 8,... 15	n = 7, 8,... 15	n = 7, 8, ... 14	n = 7, 8, ... 14	n = 5, 6, ... 32	n = 7, 8, ... 31 (PRWS)	n = 5, 6, ... 32			
Segment looping			● With pattern option	● With pattern option			4 seg. 1 looping level	4 seg. 1 looping level				Mult seg; up to 5 looping levels	4 seg. 1 looping level			●
Controlled jitter injection			●	●							●		●			
Variable width	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Variable delay	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Glitch-free timing changes (patented)	●	●	●	●	●	●			●	●	Note 2 ●		●			
Analog channel add		●			●				●							
Digital channel add			●	●			●	●				●	●			
Multi-level signals		●	●	●	●				●		●		●	●	●	●
Sine waves			●	●										●	●	●
Modulation			●	●										●	●	●
Noise with adjustable crest factor			●	●												
Uncouple			●	●												●
Couple			●	●												●

1. VXI modules with 2 channels per module - multiple modules can be combined in one VXI-frame for multi-channel applications
2. Glitch-free frequency changes only in "direct" clock mode with external clock source
3. 81101A, 81104A, and 81110A amplitude is 1 kΩ into 50 Ω
4. 5 Ω into 50 Ω
5. 50 Ω into open

Pulse Generation

Pulse generation and signal parameters

A pulse generator provides full control over all pulse parameters like timing, levels and edges as shown in the diagram below.

It is used to set up continuous or triggered pulse streams and offers flexibility to address the most challenging applications.

All parameters can be adjusted to meet the needs of the specific application. Pulse generation capability is provided by all models. The pulse function arbitrary noise generator provides all flexibility to generate ideal and worst-case signals. The Agilent instruments cover a frequency range from 1 µHz to 3.35 GHz and an output amplitude range from 50 mV up to 100 V.

Glitch-free timing changes

The Agilent 81101A, 81104A, 81150A, 81160A, 81133A, 81134A, 81110A and N4903B uniquely allow timing parameter changes, such as changing the frequency, without dropouts or glitches. This industry-leading feature enables continuous operation without rebooting or resetting the device under test, when measuring a PLL pull-in and hold range for instance, or to characterize a device over a sweeping clock frequency.
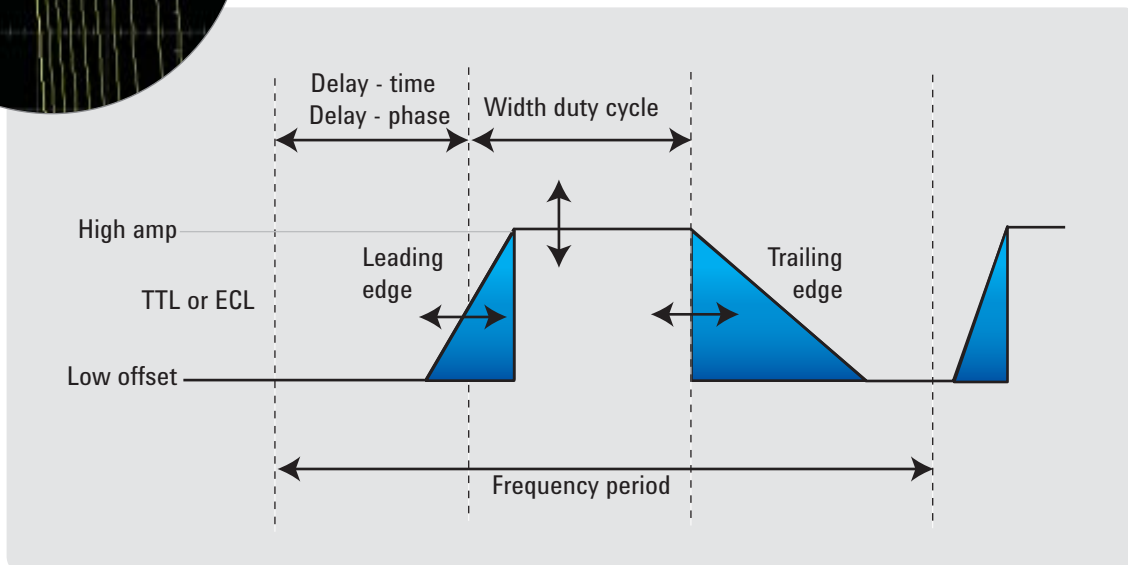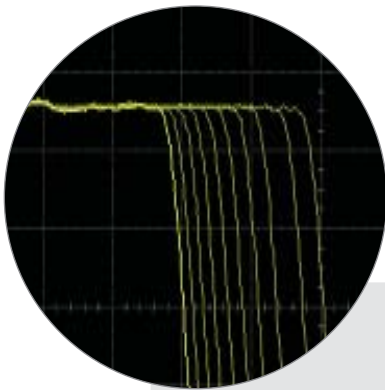
From Pulse to Pattern, Data and PRBS

Pulse pattern generators not only generate single impulses, bursts or continuous pulse streams as mentioned before.

Their pattern capability also allows the generation of data signals. This versatility is key to digital device test applications, for example for compliance tests.

In pattern mode, the same full control over the signal output is available as in the traditional pulse generation mode. This allows the generation of uncounted forms of data signals, including standard Non-return-to-zero (NRZ) signals, or data bursts with programmable pulse width with additional delay to the clock signal.

Apart from user defined data signals, standardized pseudo random binary sequences (PRBS) can also be generated.

The ability to create user-defined bit patterns, standard compliant data and PRBS make the Agilent pulse pattern generators the ideal source for:

- Stimulated eye diagram measurements
- Cross-talk measurements
- Compliance tests
- Jitter tests
- Signal integrity measurements
- Stress tests for receivers

With the VXI modules E8311A and E8312A and the 81250A data generator and analyzer platform, modular and parallel pulse and data applications can be addressed with up to 132 parallel channels. The 81130A's data looping capabilities or the 12 MBit deep memory and the PC based pattern management tool of the 81133A and 81134A enable you to generate 'real-life' data sequences for today's latest technology, like serial high-speed busses.

Pulse pattern generators provide all the tools to generate the data packets needed for digital bus device tests: integrated pattern editors, PC-based graphically enhanced data and pattern management software, segment looping features as well as hardware-generated PRBS. This enables engineers to quickly gain detailed insight into their digital bus device - including devices for:

- USB 2.0
- Serial ATA
- PCI Express
- Firewire and more

These tools allow the easy carrying out of all measurements from physical layer characterization, signal integrity, and jitter measurements, to complete standard compliance test.

Clock		Width is multiple of clock period.
NRZ	1 0 1 0 1 0 1	Signal can be delayed as required.
DNRZ		Width and delay can be set as required.
RZ		
R1		Width and delay can be set as required.

1 bit period

Typical pulser modes
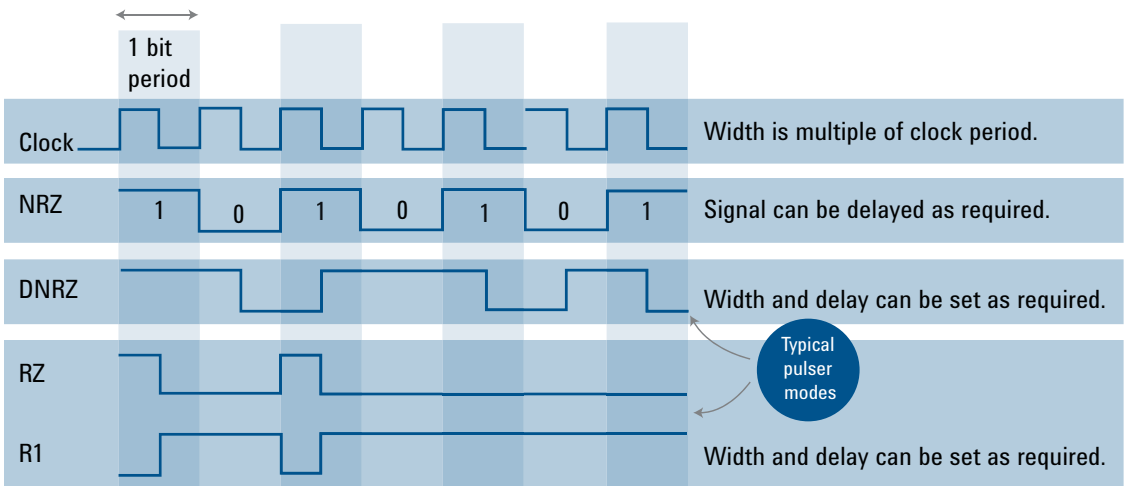
From Digital to Analog

The Agilent Technologies family of function arbitrary and arbitrary waveform generators with a wide range of possibilities to generate the signals you need. Whether you require a clean, low distortion sine wave, a variable-edge-time pulse or a complex custom waveform Agilent provides the right choice.

The commonly used direct digital synthesis (DDS) technology that provides the precision of digitally controlled logic to increase the stability of the output signal and reduce the complexity of the generator.

Using an Agilent proprietary point-by-point technology, the Agilent 33520 Series combines the low cost of DDS with the precision found in higher cost arbitrary waveform generators. With true point-by-point, the 33520 Series reproduces each point in memory with µHz frequency resolution, full bandwidth, and < 40 ps jitter.

The U2761A is a 20 MHz USB modular function generator with arbitrary waveform capabilities. The 332x0 Series contains three instruments for 10 MHz, 20 MHz,

and 80 MHz sine waves. The 30 MHz, 16-bit 33520 Series 1 and 2 channel function/ arbitrary waveform generators use true point-by-point technology.

The 81150A and the 81160A combine different instruments to increase test efficiency while reducing test time.

Mixed signal devices require analog and digital signals in addition to modulation capabilities.

Combining different instruments like a pulse generator, function arbitrary generator, and noise generator allows you to generate the signal you need, whether it is an ideal pulse or a real-world signal.

The 81150A and the 81160A provide:

- A pulse generator with precise signals for performance verification and characterization
- A function arbitrary generator for versatile signal generation to optimize testing and for modulation to shape the signal to the DUT needs

- A noise generator to distort signals and build worst-case scenarios
- An optional pattern generator to emulate digital devices with real-world conditions.

Signal imperfections such as rise time, ringing, glitches, noise and random timing variations can be easily simulated in a controlled manner. Physics, chemistry, biomedicine, electronics, mechanics, and other fields can benefit from the versatility of an arbitrary waveform generator. Wherever things vibrate, pump, pulse, bubble, burst, or change with time, there are applications available — limited only by your ability to specify the waveform data.

The noise generators are needed to distort the signal, controlled and repeatable. Your device under test might require an arbitrary or a Gaussian distribution. A long repetition rate of 20 days (or even 26 days for the 81150A) guarantees an almost random signal with exact signal repetition. The selectable crest factor guarantees to test even serial bus standards.

81160A pulse function arbitrary noise generator

Function arbitrary and arbitrary waveform generators

Specifications	Basic waveforms	Advanced waveforms	Amplitude	Connectivity
E1441A 15 MHz	Sine and square (100 µHz to 15 MHz), triangle, sin(x)/x, ramp, noise/arbitrary (user-defined): 16 kSa, 12 bits, 40 MSa/s	AM, FM, FSK, burst, sweep, noise, exponential rise/fall		
U2761A 20 MHz, modular	Sine and square (1 µHz to 20 MHz), pulse with variable edge time (1 µHz to 5 MHz), ramp, triangle	Arbitrary (user defined): 1 µHz to 200 kHz, 64 kSa, 14 bit, 50 MSa/s AM, FM, PM, FSK, PSK, ASK, sweep, exponential rise/fall	40 mVpp to 5 Vpp (into 50 Ω) 80 mVpp to 10 Vpp (into open-circuit)	USB
33210A 10 MHz	Sine, square, pulse, triangle, ramp, noise	Optional arbitrary (user defined): 1 mHz to 3 MHz, 2 to 8 k points, 14 bits, 50 MSa/s AM, FM, PWM, burst, sweep, exponential rise/fall, negative ramp, sin(x)/x, cardiac	10 mVpp to 10 Vpp (into 50 Ω) 20 mVpp to 20 Vpp (into open-circuit)	USB, GPIB, and LAN LXI Class C
33220A 20 MHz	Sine and square (1 µHz to 20 MHz), pulse, ramp, triangle, noise, and DC	Arbitrary (user-defined): 1 µHz to 6 MHz, 2 to 64 k point, 14-bit, 50 MSa/ s AM, FM, PM, FSK, PWM, burst, sweep, exponential rise/fall, negative ramp, sin(x)/x, cardiac	10 mVpp to 10 Vpp (into 50 Ω) 20 mVpp to 20 Vpp (into open circuit)	USB, GPIB, and LAN LXI Class C
33521A, 33522A 30 MHz	1 and 2 channel sine and square (1 µHz to 30 MHz), pulse with variable edge times (8.4 ns to 1 µs) ramp, triangle Gaussian noise, PRBS, DC volts	Arbitrary (user-defined): 2 to 1 M points (16 M points optional) with up to 512 sequenced segments 16-bit amplitude, 250 MSa/s, 1 µHz resolution AM, FM, PM, FSK, BPSK, burst, sweep, sum, exponential rise/fall, Gaussian, pulse, haversine, Lorentz, sinc, cardiac	1 mVpp to 10 Vpp (into 50 Ω) 2 mVpp to 20 Vpp (into open-circuit)	LAN and USB 2.0 GPIB optional
33250A 80 MHz	Sine and square (1 µHz to 80 MHz), pulse with variable edge times (1 µHz to 5 MHz), ramp, DC	Arbitrary (user-defined): 64 K points, 12 bits, 200 MSa/s AM, FM, FSK, burst, sweep, noise, exponential rise/fall	10 mVpp to 10 Vpp (into 50 Ω) 20 mVpp to 20 Vpp (into open-circuit)	RS-232
81150A 240 MHz	120 MHz pulse, 240 MHz sine, square, triangle, sin(x)/x, ramp	Arbitrary (user-defined): 512 k points, 14 bit, 2 GSa/s FM, AM, PM, PWM, FSK, noise with selectable crest factor Pattern: user-defined and PRBS, 16 Mbit memory	100 mVpp to 10 Vpp (into 50 Ω) 200 mVpp to 20 Vpp (into open-circuit)	USB, GPIB, LAN, SCPI-1997, LXI Class C
81160A 500 MHz	330 MHz pulse, 500 MHz sine, square, triangle, sin(x)/x, ramp	Arbitrary (user defined): #001 up to 256 k points, #002 up to 128 k points per channel,14 bit, 2.5 GSa/ s FM, AM, PM, PWM, FSK, noise with selectable crest factor Pattern: user-defined and PRBS, #001 memory 4 Mbit, #002 2 Mbit per channel, arbitrary bit shaping, three level signals, sequencing	50 mVpp to 5 Vpp (into 50 Ω) 100 mVpp to 10 Vpp (into open-circuit)	USB, GPIB, LAN, SCPI-1997, LXI Class C
M933xA/N824xA 1.25 GSa/s	Sine, square, pulse, doublet and ramp (1 Hz resolution)	Arbitrary: 16 Msamples, 15- or 10-bit, 1.25 GS/s with advanced sequencing, DC-500 MHz (1 GHz IQ modulation) bandwidth. AM, FM, FSK, burst, sweep	1 to 800 mVpp (function generator), up to 1 Vpp (arbitrary waveform generator)	CompactPCI, PXI, PXIe (hybrid slot) and LXI
81180A 4.2 GSa/s	Standard sine and square waveforms at frequencies up to 500 MHz	Arbitrary waveform generator, 12-bit, 10 MS/s - 4.2 Gs/s, any arbitrary waveform, 2 GHz IQ modulation bandwidth	50 mVpp to 2 Vpp single ended, 100 mVpp to 4 Vpp differential	GPIB, LAN, USB
M8190A 12 GSa/s		Arbitrary waveforms with 2 DAC settings: 12 bit with 12 GSa/s and 14 bit with 8 GSa/s, Variable sample rate from 125 MSa/s to 8 / 12 GSa/s, 7 GHz IQ modulation bandwidth, up to 2 GSa memory per channel / Direct DAC: 350 mVpp to 700 mVpp DC coupled: 600 mVpp to 1.0 Vpp SE in a −1 V to + 3 V window AC coupled: −10 dBm to +10 dBm/ AXIe form factor with PCIe Express interface	3 selectable output amplifers: Direct DAC: −350 mV$_{pp}$ ... 700 mV$_{pp}$ DC amplifier: 500 mV$_{pp}$ ... 1.V$_{pp}$ output voltage window −1.0 V ... + 3.3 V AC amplifer 200 mV$_{pp}$ ... 2.0 V$_{pp}$	PCIe

Put a Bench in Your Bag: U2761A

U2761A USB modular one-channel function generator

The Agilent U2761A 20 MHz USB modular function generator with one channel offers the flexibility of standalone and modular operation.

It offers eleven standard signals as well as arbitrary waveforms. It relies on direct digital synthesis (DDS) to create stable, accurate output of low-distortion sine waves. The U2761A also provides square waves with fast rise and fall times up to 20 MHz and linear ramps up to 200 kHz. For simulation of real-world signals, use the waveform editor to create arbitrary waveforms with 14-bit resolution up to 200 kHz.

Internal modulation eliminates the need for a separate modulation source. Linear and logarithmic sweeps are also built in, with sweep rates from 1 ms to 500s. With the included IVI-COM drivers, this instrument is compatible with popular development environments. Hi-Speed USB 2.0 compatibility makes connection to a PC quick an easy.

Key features
U2761A

- 20 MHz sine and square waveforms
- 10 mVPP to 10 VPP amplitude range
- Pulse generation with variable period, pulse width and amplitude
- Sine, square, ramp, triangle, pulse, noise and DC waveforms
- AM, FM, PM, ASK, FSK, PSK signals
- 14-bit, 64 k points, 50 MSa/s arbitrary

Complementary products

- U2781A USB modular
- Product chassis

The Basics: 81101A

81101A 50 MHz pulse generator

The Agilent 81101A 50 MHz pulse generator is the instrument of choice for cost efficient pulse and clock generation.

It provides flexibility and full control over all the parameters needed for system clock applications.

The variable transition times range (5 ns to 200 ms) can be set individually for rising and falling edges. In combination with the unique capability to change the timing parameters without glitches, this provides full control over the stimulus signal.

The 81101A is the perfect entry-level instrument for signal generation. And because the portfolio of Agilent Technologies' 81100A pulse pattern generators is designed for compatibility, your equipment can grow with your needs. The 81101A, 81104A, 81110A and 81130A share the same user interface, compatible programming commands and much more!

Complementary products

* D/MSO 601x
* D/MSO 6030
* InfiniiVision 7000 Series oscilloscope
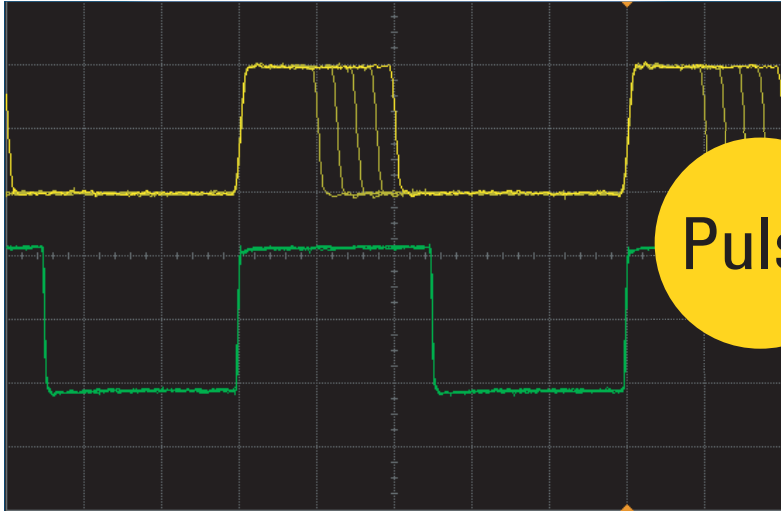
Flexible pulse generation

81101A pulse generator

D/MSO 6030 oscilloscope

Key features 81101A

* 1 channel
* Up to 20 Vpp (1 kΩ into 50 Ω)
* Variable transition times between 5 ns and 200 ms
* Internal and external clocking
* 1 mHz to 50 MHz repetition rate
* Glitch-free timing changes
* Triggerable or internal PLL
* Single ended outputs

Signal Sources Brochure

The Basics: 81104A

81104A pulse pattern generator with 81105A output channel(s)

81104A pulse pattern generator

The Agilent 81104A pulse pattern generator offers flexible pulse, data, and PRBS generation with a frequency range up to 80 MHz.

The 81104A can be configured with one or two 81105A output channels. Single channel instruments can easily be upgraded with a second output channel.

The 81104A allows you to generate multi-level signals, using its analog channel-add function. In addition to pulse generation, the 81104A also supports user-defined data patterns as well as pseudo random binary sequences.

Complementary products

- D/MSO 6030
- D/MSO 601x
- DSO 1000
- D/MSO 9000 Series
- InfiniiVision 7000 Series oscilloscope

Pulse Pattern DATA PRBS

Key features
81104A with 81105A

- 1 or 2 channels
- Up to 20 Vpp (1 kΩ into 50 Ω)
- Internal and external clocking
- 1 mHz - 80 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Data patterns
- Pseudo random binary sequence (PRBS) generation
- Variable transition times between 3 ns and 200 ms
- Single-ended outputs
- Analog channel addition
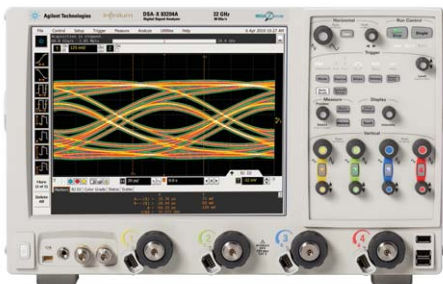
D/MSO 9000 Series oscilloscope

The Basics: 33200 and 33500 Series

The Agilent 33200 and 33500 function/ arbitrary waveform generators are economical instruments used to create signals up to 80 MHz. With their ability to produce functions (sine, square, pulse, etc.) as well as user-defined arbitrary waveforms, these instruments are versatile additions to any electronics bench or test system.

The 33200 Series offers three bandwidths: 10 MHz, 20 MHz, and 80 MHz for the 33210A, 33220A, and 33250A, respectively. They all use the direct digital synthesis (DDS) technology explained earlier to produce both the functions as well as the arbitrary waveforms. By using DDS, these instruments can produce signals with very high frequency resolution while having low distortion. All instruments in the 33200 Series provide standard functions, arbitrary waveforms, modulation, sweep, burst, and triggered outputs. Also, they can be

Function Arbitrary

synchronized to another Function/ Arbitrary Waveform generator or to a user-supplied 10 MHz clock.

The one and two channel 33500 Series sets a new standard in the 30 MHz function/arbitrary waveform generator class of products. Based on a proprietary Agilent technology, these instruments offer true point-by-point waveform generation. The 33500 Series provides standard functions, arbitrary waveforms, modulation, sweep, burst, triggered outputs, synchronization to an external reference, and 2-channel operation (33522A).

Complementary products

- Infiniivision 7000 oscilloscopes
- Infiniivision 2000 X and 3000 X oscilloscopes
- 34410A and 34411A digital multimeters
- 53200 Series universal/RF counters

Key features
33200 Series

- Low distortion functions and arbitrary waveforms
- Choice of bandwidths – 10 MHz, 20 MHz, and 80 MHz
- Textual and graphical display in a 2U x ½ rack package
- Standard connectivity – GPIB, USB and LAN (33210A/20A), and RS-232 (33250A)
- Free waveform editing software

Key features
33500 Series

- True point-by-point technology for the highest signal fidelity in its class
- 30 MHz, 16-bit, 250 MSa/s waveform generation
- Large display with built-in waveform editor in a 2U x ½ rack package
- Standard connectivity – USB, LAN, and optional GPIB
- Free waveform editing software plus optional Waveform Builder Pro software

Signal Sources Brochure

81150A Pulse Function Arbitrary Noise Generator

www.agilent.com/find/81150

Pulse Function Arbitrary Noise

81150A pulse function arbitrary noise generator

The Agilent 81150A pulse function arbitrary noise generator enables reliable and repeatable measurements. It is the instrument of choice for pulse and clock generation.

It offers flexible pulse, clock and trigger generation with highest signal quality and with a frequency range up to 120 MHz. It is therefore a perfect fit for all system clock or trigger applications.

It combines the benefits of a pulse generator, a noise generator and a function arbitrary generator. The pattern generator is optional and allows sending ideal and real-world pattern. The arbitrary bit shaping lets you emulate overshoot, asymmetric delay and duty cycle distortion up to 120 Mbit/s.

1. RMS = root mean square

With high quality pulses test your DUT without any effects generated by the source. Achieve complete control over timing parameters including trigger ability with fixed latency and glitch-free change of timing. The different modulation capabilities up to 10 MHz, combined with the precision digital noise functionality, allow you to build real-world signals, simply and quickly. Use real-life signals for worst case scenarios e.g., reproducible noise.

The selectable crest factor (voltage peak/RMS[1]) combined with the long repetition period of 26 days helps you to stress your device to its limits but keeping the test results repeatable. The enhanced trigger capabilities are there to measure exactly when needed.

Complementary products

- InfiniiVision 7000 Series oscilloscope

Key features 81150A

- 1 or 2 channels
- 1 µHz – 120 MHz pulse with variable rise/fall time
- 1 µHz – 240 MHz sine waveform outputs
- Precise digital noise: crest factor (peak/RMS) selectable: 3.1, 4.8, 6.0, 7.0
- Noise repetition: 26 days
- Pulse, sine, square, ramp, noise, and arbitrary waveforms
- Triggerable
- FM, AM, PM, FSK, PWM modulation capability
- Full control of all pulse parameters (rise/fall/width, etc.)
- Differential outputs
- Ideal and arbitrary bit shaped pattern up to 120 Mbit/s
- Three level signals
- PRBS 2^{31}
- 16 Mbit pattern
- Integration in Matlab, Agilent 33503A BenchLink Waveform Builder Pro

81160A Pulse Function Arbitrary Noise Generator

www.agilent.com/find/81160

Pulse Function Arbitrary Noise

81160A pulse function arbitrary noise generator

The Agilent 81160A pulse function arbitrary noise generator tackles a new speed class up to 500 MHz, offering at the same time the well-proven flexibility and quality in signal generation of the 81150A pulse function arbitrary noise generator.

Complementary products

- DSO/ MSO 9104A
- InfiniiVision 7000 Series oscilloscope
- DSO/ MSO 9064A

Like the 81150A, the 81160A allows high-precision pulse, clock and trigger generation and addresses the same vast spectrum of applications: digital and mixed signal device test, capture and reproduce live signals, radar distance test, sensor simulation and disc drive tests – to name only a few.

Functionality like glitch-free change of timing parameters allows frequency changes without drop-outs or glitches so that tests can be performed without interruptions or time-consuming repetitions.

Plug and play solutions with minimal cabling, low space overhead also maximize test efficiency.

The optional pattern generator is available with a data rate up to 330 Mbit/ s (Option 330) and up to 660 Mbit/s (Option 660).

Key features 81160A

- 1 or 2 channels
- 1 µHz – 330 MHz pulse with variable rise/fall time
- 1 µHz – 500 MHz sine waveform outputs
- Precise digital noise: crest factor (peak/RMS) selectable: 3.1, 4.8, 6.0, 7.0
- Noise repetition: 20 days
- Pulse, sine, square, ramp, noise, and arbitrary waveforms
- Triggerable
- FM, AM, PM, FSK, PWM modulation capability
- Full control of all rise parameters (rise/ fall/ width, etc.)
- Differential outputs
- Ideal and arbitrary bit shaped pattern up to 330 Mbit/ s (Opt 001) and 660 Mbit/ s (Opt 002)
- Three level signals
- PRBS 2^{31}
- 4 Mbit pattern for Opt 001, 2 Mbit pattern per channel for Opt 002

The Lab Standard: 81110A

81110A 165/330 MHz pulse generator

81110A pulse generator

The Agilent 81110A pulse pattern generator is the industry-standard for pulse, pattern, data and PRBS generation up to 165/330 MHz.

It provides high quality signals and leading flexibility that meets virtually all application needs. This instrument is a must for all labs.

The 81110A with one or two 81111A 165 MHz output channels provides pulse, pattern, data and PRBS generation up to 165 MHz with an amplitude of up to 20 Vpp and an output impedance of 1kΩ into 50 Ω. With the same user interface and programming commands, it is the natural upgrade from the 81101A and 81104A.

The 81110A with 81111A output channels is used in countless applications, flash chip test, communication equipment, aerospace defence and automotive test as well as many other high-end applications.

Alternatively, the Agilent 81110A pulse pattern generator with one or two Agilent 81112A 330 MHz output modules is also the right choice for a broad range of test applications. Instead of variable transitions, 800 ps or 1.6 ns edges are selectable. The output impedance is 50 Ω and provides up to 3.8 Vpp into 50 Ω. Internal channel addition is not available.

81111A and 81112A output channels can not be combined in one and the same 81110A.

DSO 80304B oscilloscope

81110A pulse pattern generator with 81111A 165 MHz output channel(s)

**Key features
81110A with 81111A**

- 1 or 2 channels
- Up to 20 Vpp (1 kΩ into 50 Ω)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- 1 mHz to 165 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Data patterns
- Pseudo random binary sequence (PRBS) generation

Complementary products

- D/MSO 9000
- D/MSO 6050/8064A
- D/MSO 6100/8104A
- D/MSO 6030 oscilloscopes
- InfiniiVision 7000 Series oscilloscope

81110A pulse pattern generator with 81112A 330 MHz output channel(s)

**Key features
81110A with 81112A**

- 1 or 2 channels
- Up to 3.8 Vpp (50 Ω into 50 Ω)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 mHz to 330 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Differential outputs
- Data patterns
- Pseudo random binary sequence (PRBS) generation

Complementary products

- D/MSO 9000
- D/MSO 6100/8104A
- D/MSO 6050/8064A
- DSO 80304B oscilloscopes
- InfiniiVision 7000 Series oscilloscope

E8311A and E8312A

www.agilent.com/find/pulse

The Agilent E8311A and E8312A pulse pattern generators combine the 81110A's versatility and performance in the modular and flexible VXI form factor (C-size, 1 slot).

The specifications of the E8311A and E8312A match those of the 81110A with 81111A and 81112A output channels. All VXI pulse pattern generators have identical programming syntax and pattern capabilities - enabling a quick and easy transition from lab to production.

Key features
E8311A, E8312A

	E8311A	E8312A
Frequency range	1 mHz to 165 MHz	1 mHz to 330 MHz
Number of channels	2 channels	
Data pattern	16 kbit/channel user defined; PRBS $2^n - 1$, $n = 7, 8, ... 14$ RZ, NRZ, DNRZ	
Variable delay range	0.00 ns to 999.5 s	
Period RMS-jitter	0.001% $\pm$ 15 ps	
Amplitude range	100 mV$_{pp}$ to 20.0 V$_{pp}$	100 mV$_{pp}$ to 3.8 V$_{pp}$
Transition time range (10/90)	2.00 ns to 200 ms programmable	800 ps or 1.6 ns selectable

PRBS
Data
Pattern
Pulse

Clean and Precise: 81130A

81130A pulse pattern generator with 81131A 400 MHz output channel(s)

The Agilent 81130A 400 MHz pulse pattern generator with one or two 81131A output channels is the instrument of choice for advanced applications that require even higher precision signals and timing accuracy.

It offers a wide channel delay range and of course, full control of the pulse width. On top of which, enhanced data generation and pattern segment looping features allow you to generate complex data patterns.

81130A pulse pattern generator

90000 Series oscilloscope

Key features 81130A with 81131A

- 1 or 2 channels
- Up to 3.8 Vpp (50 Ω into 50 Ω)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 kHz to 400 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Complex data patterns and pattern segment looping
- Pseudo random binary sequence (PRBS) generation
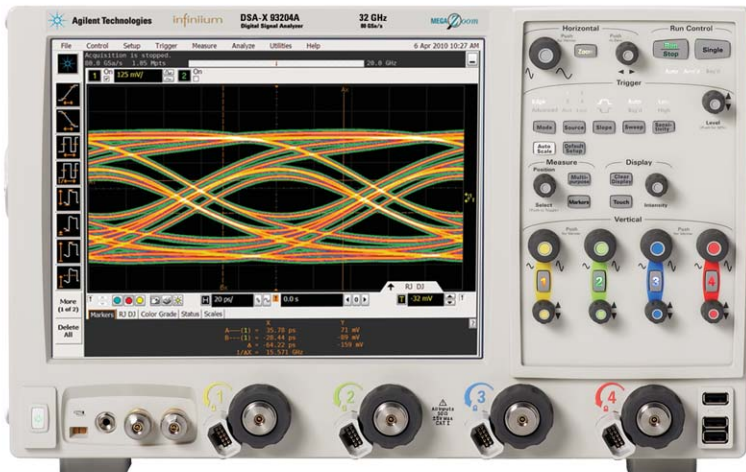
Complementary products

- D/MSO 9000 and 90000 Series
- D/MSO 6100/8104A
- InfiniiVision 7000 Series oscilloscope

Signal Sources Brochure

81130A pulse pattern generator with 81132A 660 MHz output channel(s)

The Agilent 81130A pulse pattern generator with one or two 81132A 660 MHz output channels offers enhanced performance compared to the 81130A with 81131A output channels.

It is Agilent's recommended data generator for USB compliance tests. Data rates up to 1.32 Gbit/s can be achieved by the digital channel add feature, offering stimulus signals for Gigabit ethernet test, for example.

Complementary products

- D/MSO 9000 and 90000 Series
- InfiniiVision 7000 Series oscilloscope

Key features
81130A with 81132A

- 1 or 2 channels
- Up to 2.5 Vpp (50 Ω into 50 Ω)
- Fixed transition times 500 ps typical
- Internal and external clocking
- 1 kHz to 660 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Up to 1.32 Gbit/s data generation
- Complex data patterns and pattern segment looping e.g. for USB pre-compliance testing
- Pseudo random binary sequence (PRBS) generation

Precision Timing PRBS, Data Pattern, Pulse

M9330A and M9331A PXI-H Arbitrary Waveform Generators

www.agilent.com/find/modular

www.agilent.com/find/m9330a

www.agilent.com/find/ m9331a

The Agilent M9330A and M9331A with their high resolution and high sampling rate deliver unprecedented performance in arbitrary waveform creation.
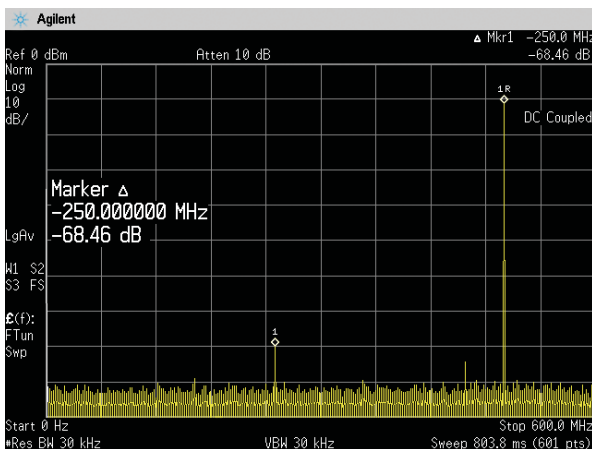
Arbitrary

The M9330A provides the most realistic waveforms for radar, satellite and frequency agile communication systems, thanks to its 15-bit vertical resolution and 1.25 GSa/ s sampling rate. At the same speed, with 10 bit vertical resolution, the M9331A is ideal for compliance testing of digital radios targeted for use with communication standards such as MB-OFDM ultra wide-band, 802.11n, MIMO and proprietary wideband formats.

Complementary products

- E 8267D PSG vector signal generator
- M9392A PXI vector signal analyzer
- M9202A PXIe IF digitizer: 12-bit, 2 GSa/s, 1 GHz
- M9018A 18-slot PXIe chassis
- M9021A PXIe system interface
- N7509A waveform generation toolbox for wideband signal simulation
- N7619A Signal Studio for multiband OFDM UWB
- N7620A Signal Studio for pulse building

Key features
M9330A and M9331A

- 1 or 2 channels
- Amplitude range of 1 or 2 mVpp to 800 mVpp, 1 Vpp
- Triggerable
- Gate mode
- Remotely programmable
- Pulse generation
- Memory of 8 or 9 and 16 MSa/channel
- Modulation
- Radar test
- Mixed signal devices
- Signal integrity test
- Jitter (stress) test
- Noise immunity test

Signal Sources Brochure

Complex Real-World Signals: 81180A

High bandwidth, high-resolution arbitrary waveform generation helps you test with confidence

The Agilent 81180A arbitrary waveform generator provides 4.2 GSa/s, 2 GHz I/Q modulation bandwidth and 12 bit vertical resolution for applications where waveform resolution is an issue. With 2 GHz I/Q modulation bandwidth it's a perfect complement to the E8267D PSG vector signal generator. The up conversion to higher carrier frequencies requires a reliable and precise modulation source. Any signal distortion gets multiplied by each of the test instruments making it difficult to pinpoint a DUT failure. The more precise the foundation is the more you test your device and not your source.

Complementary products

- In conjunction with PSG or other up converter Agilent 90000 X Series, DSO and DSA 9000 Series
- For direct RF carrier frequency DSO and DSA 90000 or 9000 Series

Key features 81180A

- 1 or 2 channels, coupled or uncoupled
- Two 2-channel systems can be synchronized to form a 4 channel system
- Three software-selectable amplifiers optimized for
  - I/Q applications with 1 GHz per channel, differential, DC coupled output
  - Maximum bandwidth and flatness for direct RF applications with AC output bandwidth to 1.5 GHz
  - Time domain applications with low overshoot and jitter
- 16 M points or 64 M points per channel combined with advanced sequencing to make best usage of memory
  - Integration in Matlab, NI LabVIEW, Agilent Signal Studio[1] and Agilent 33503A BenchLink Waveform Builder Pro

1. Integration in Signal Studio pulse builder and multi tone is planned

Enhance your Reality: M8190A

The impossible becomes possible: 8 GSa/s arbitrary waveform generation with 14 bit vertical resolution

From low-observables radar to high-density communications, testing is more realistic with precision arbitrary waveform generation. Take reality to the extreme: An Agilent AWG is the source of greater fidelity delivers 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. Get bits and bandwidth — and enhance your reality.

High-quality signal generation is the foundation of reliable and repeatable measurements. The Agilent M8190A ensures accuracy and repeatability with 14-bit resolution up to 8 GSa/s sampling rage and excellent vertical resolution gives you confidence that you are testing your device not the signal source.

Capability such as easy switching between 14-bit output at 8 GSa/s and 12-bit output at 12 GSa/s help you handle multiple applications and measurement requirements.

Because every application calls for different signal characteristics, The Agilent M8190A contains three amplifiers that are optimized for I/Q signals, IF/RF or time domain signals.

Highly realistic testing often requires long play times and long single scenarios. 2 GS/ of memory combined with advanced sequencer capabilities allow you to use the memory efficiently and effectively.

Complementary products

- In conjunction with PSG or other up converter
- Agilent 90000 X Series
- DSO and DSA 9000 Series
- For direct RF carrier frequency
- DSO and DSA 90000 or 9000 Series

Key features M8190A

- Precision AWG with two DAC settings
  - 14 bit 8 Gsa/s
  - 12 bit with 12 Gsa/s
- Variable sample rate from 125 MSA/s to 8/12 Gsa/s
- Up to 2 GSa memory per channel with advanced sequencing
- Three amplifiers for different applications
- IQ signals:
  - Differential output
  - Spurious free dynamic range up to 80 dBc typical
  - Harmonic diction up to
  - 72 dBc typical
- Time domain applications
  - Transition time (20/80) 50 ps
  - Differential output
  - Amplitude 600 mV ... 1.0 Vpp in an output window −1.0 V ... +3.3 V
- IF /RF
  - 50 MHz to 5 GHz bandwidth
- Single ended, AC coupled output
- Output power −10 dBm ...+10 dBm
- 2 U AXIe module

High Speed, High Fidelity: 81133A/81134A

The Agilent 81133A and 81134A 3.35 GHz pulse pattern generators provide the ultimate timing accuracy and signal performance.
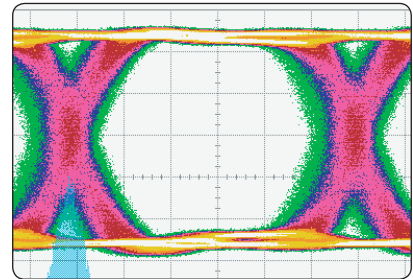
With their unrivaled performance, they are the perfect clock, pulse, data, pattern and PRBS sources for all applications up to 3.35 GHz. In addition, the instruments allow you to control the signal quality at speeds from 15 MHz up to 3.35 GHz. Sample applications comprise crossover point adjustments and jitter insertion using the delay control input. Their high quality signals and low intrinsic jitter enable you to perform quick and reliable measurements with accurate and repeatable results. With the 12 Mbit pattern memory per channel, the 81133A and 81134A enable you to generate the long data patterns required to test today's high speed interfaces, like PCI Express or Serial

ATA and many more. The PC-based pattern management software is a very convenient tool to edit and save data patterns on any computer. It also allows you to load patterns easily into the generator. The jitter-insertion capabilities enable jitter tolerance tests. Target applications of the 81133A and 81134A include physical layer characterization, signal integrity and jitter tests. In addition the 81134A is Agilent's recommended solution for PCI Express® and Serial ATA compliance tests.
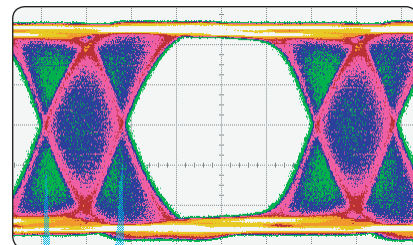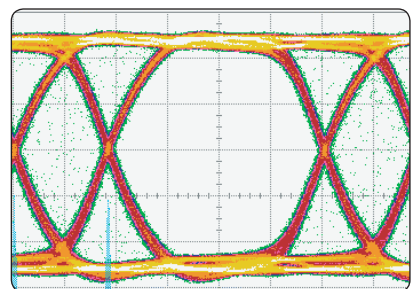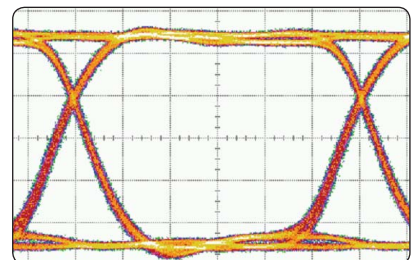
Jitter modulated with noise

Jitter modulated with sine-wave

Jitter modulated with rectangle-wave

Variable cross over point at 70%

Precision Timing PRBS, Data Pattern, Pulse Jitter
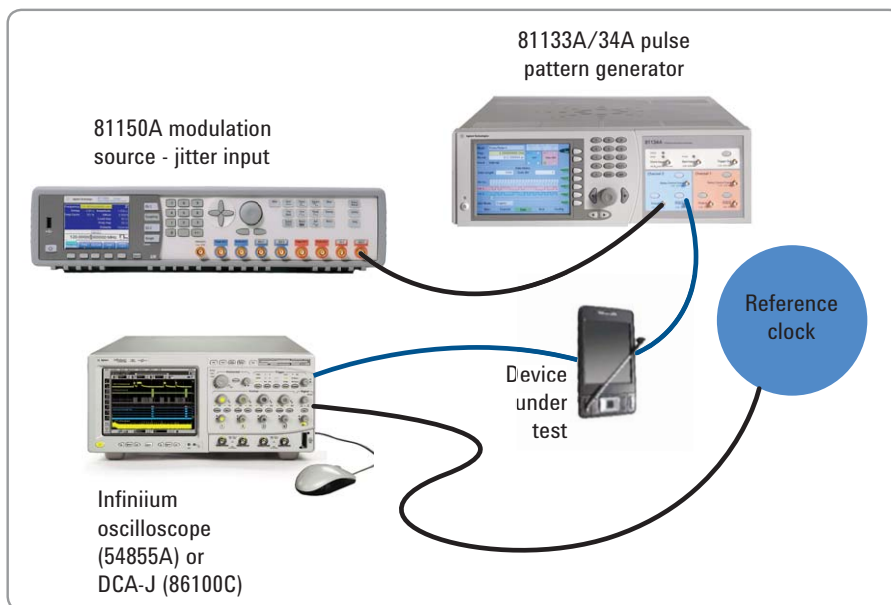
81134A pulse pattern generator

Key features
81133A with 81134A

- 1 channel (81133A) or 2 channels (81134A)
- 50 mV$_{pp}$ up to 2 Vpp amplitude (50 Ω into 50 Ω)
- Programmable termination voltage
- Adjustable transition times between 60 ps and 120 ps
- 15 MHz to 3.35 GHz repetition rate
- Total jitter typically less than 2 ps
- 12 Mbit pattern memory per channel
- PC-based pattern management software
- 1.5 ps typical RMS jitter
- Differential outputs
- Complex data patterns e.g. for PCI Express, SATA
- Pseudo random binary sequence (PRBS) generation
- Delay modulation: −250 ps to 250 ps, −25 ps to 25 ps selectable (up to 500, 50 ps ps total jitter)
- Modulation frequency: 0 - 200 MHz
- Additional variable crossover between 30% − 70% typical
- NRZ/RZ/R1 signal formats over the full frequency range

Complementary products

- DSO, DSA 90000 Series

81133A/34A pulse
pattern generator

81150A modulation
source - jitter input

Reference
clock

Device
under
test

Infiniium
oscilloscope
(54855A) or
DCA-J (86100C)

Perform stress tests by modifying the amount and shape of jitter by using the delay control input and an external modulation source.

Signal Sources Brochure

J-BERT N4903B Pattern Generator
7 Gb/s and 12.5 Gb/s

The Agilent N4903B J-BERT pattern generator options for data rates up to 7 Gb/s and 12.5 Gb/s provide an accurate and flexible stimulus for stimulating high-speed digital devices.

The N4903B generates user-definable NRZ-patterns or PRBS with variable data rate and output amplitude. It offers built-in and calibrated jitter injection to stress receiver ports of high-speed digital devices and boards. Design and test engineers can quickly and accurately stimulate serial high-speed ports, as used in DisplayPort, PCI Express, SATA, fully-buffered DIMM, Fibre Channel, CEI, 10 Gigabit Ethernet, XFP/XFI, SFP/SFP+ designs. The J-BERT pattern generator can be used in combination with the de-emphasis signal converter to compensate for channel degradations. For signal analysis it is complemented by oscilloscopes, built-in error detectors and other analyzers. The N4903B pattern generator can be upgraded to a full bit error ratio tester when test needs change.

Complementary products

- 86100C DCA-J Infiniium wide-bandwidth oscilloscope
- N4916B de-emphasis signal converter with option clock doubler
- DSO, DSA 90000 Series
- DSO 90000 X Series

Key features
N4903B G07, G13

- Data rates between 150 Mb/s and 7 Gb/s or 12.5 Gb/s provide sufficient margin
- Fastest transition times < 20 ps
- Low jitter < 9 ps pp for accurate measurements
- Differential outputs on data and clock with variable amplitude between 50 mV and 1.8 V
- Pattern with NRZ format, 32 Mbit user pattern, PRBS, block and loop sequencer
- Built-in and calibrated jitter injection: SJ, PJ, RJ, BUJ (Option J10) to generate eye closures of > 0.5 UI p.15 DS min. 0.125 UI for 620 to 844 Mb/s
- External jitter injection via delay control input up to 1 GHz
- Interference channel with switchable ISI traces and sinusoidal interference (Option J11) to emulate channel degradations
- SSC clocking (Option J11) for computer bus clocks
- Sub-rate clock output to generate reference clocks
- Upgrade path to add jitter, SSC, and analysis functionality

J-BERT N4903B pattern generator

N4916A de-emphasis signal converter
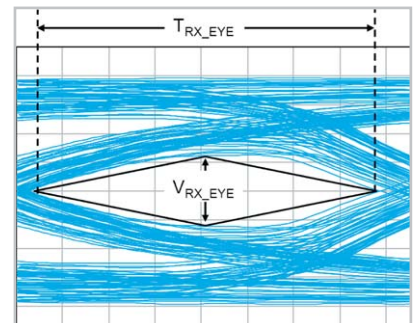
J-BERT N4903B pattern generator allows to generate calibrated jitter for receiver tolerance tests.

Jitter
PRBS
Pattern
Clock
Sequences

For a Parallel World: 81250

www.agilent.com/find/81250

The Agilent 81250 data generator/analyzer platform is the right choice for functional and parametric test applications on digital subsystems, ICs and boards, during development or manufacturing.

The 81250 is a flexible and scalable platform which, depending on the configuration, offers up to 66 synchronous input and output channels. The frequency covers 333 kHz to 13.5 GHz. The 81250 data generator and analyzer is freely configurable to fit application needs either as a stand alone data generator or a platform with any number of generator and analyzer channels. In addition, the Agilent 81250 can be combined with other standard VXI modules or systems. With up to 64 Mbit memory depth per channel and full control of the pulse parameters for each individual channel, maximum stress can be applied to a DUT. The 81250 data generator/analyzer platform is the ideal tool throughout the design verification process – from first turn-on through operational check and characterization of design margins, to detailed analysis of critical design parts.

Key features 81250

- Up to 132 channels (RZ, NRZ) within one clock group, depending on the configuration
- PRBS and PRWS (pseudo random word sequence) up to $2^{31}-1$
- 333 kbit/s to 13.5 Gbit/s data rate
- Sequencing with 5 looping levels
- Branching on internal and external events
- Variable delays, levels and transition times can be independently set for each channel
- EXOR channel edition

Data
PRBS
Pattern
Pulse

81250 generator/analyzer platform

Signal Sources Brochure

Transition/Time Converters

www.agilent.com/find/time_converter

Models 15432B, 15433B, 1534B, 15435A, 15438A, and N4915A Option 001

These converters have been designed to convert the transition times of instruments with fast, fixed transition times, to slower, fixed transition/times

All transition times are measured between 10% and 90% of amplitude.

The design of these converters ensures very low signal reflection (far beyond the 3 dB point).

Reducing the signal transition times also increases the overall pulse-performance for overshoot/reflection sensitive applications.

The converters are fitted with two SMA connectors, one male, one female.
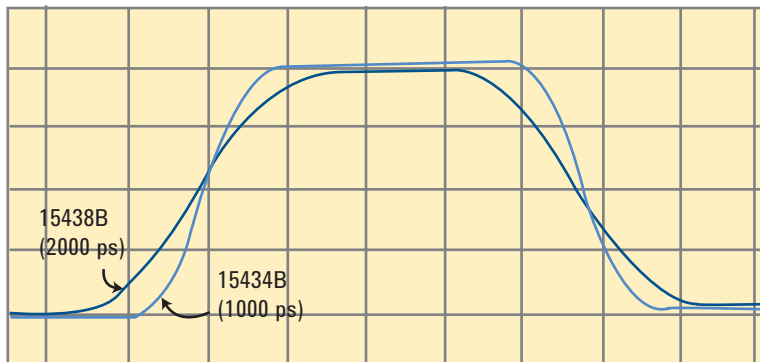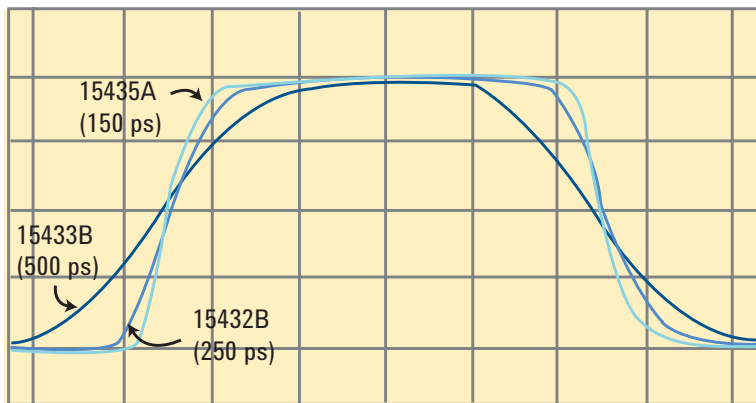
Key features

- Converter: 15435A, 15432B, 15433B, 15434B, 5438A, N4915A Option 001
- Output transition time 47 ps, 150 ps, 250 ps, 500 ps, 1000 ps, 2000 ps
- 3 dB point 2.1 GHz, 1.3 GHz, 640 MHz, 370 MHz, 190 MHz
- Input voltage < 10 Vpp
- Insertion loss < 0.2 dB
- Overshoot and ringing < 3 %

Related Literature

Publication title	Pub number
Agilent Technologies 81133A and 81134A, 3.35 GHz Pulse Pattern Generators, Data Sheet	5988-5549EN
Agilent Technologies 81100 Family Pulse Pattern Generators, Technical Specifications	5980-1215E
Agilent 81100 Family of Pulse Pattern Generators: Radar Distance Test to Airborne Planes, Product Note 1	5968-5843E
Agilent 81100 Family of Pulse Pattern Generators: The Dual Clock Gbit Chip Test, Product Note 2	5968-5844E
Agilent 81100 Family of Pulse Pattern Generators: Magneto-Optical Disk Drive Research, Product Note 3	5968-5845E
Agilent 81100 Family of Pulse Pattern Generators: Simulation of Jittering Synchronization Signals for Video Interfaces, Product Note 4	5968-5846E
PCI Express RX Design Validation with 81133A / 81250	5988-7432EN
USB 2.0 Pre-Compliance Testing with Agilent Infiniium, Application Note 1400	5988-6219EN
81150A and 81160A Pulse Function Arbitrary Noise Generator Data Sheet	5989-6433EN
Flexible Signal Conditioning with the Help of the Agilent 81134A Pulse Pattern Generator	5989-8094EN
Jitter Generation and Jitter Measurements with the Agilent 81134A Pulse Pattern Generator and 54855 Infiniium Oscilloscope	5988-9411EN
Automated USB 2.0 Receiver Compliance Test and Characterization with the Agilent N5990A Software Platform	5989-6232EN
J-BERT N4903BA Data Sheet	5989-2899EN
Agilent 81150A and 81160A Pulse Function Arbitrary Noise Generators Applications	5989-7860EN
Agilent 81150A and 81160A Pulse Function Arbitrary Noise Generators Demo Guide	5989-7718EN
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Transferring Arbitrary Waveform Data to the 33200A Family of Function/Arbitrary Waveform Generators	5989-9760EN
Agilent USB Modular Products Data Sheet	5989-9923EN

www.axiestandard.org
AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. Agilent is a founding member of the AXIe consortium.

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LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Agilent is a founding member of the LXI consortium.

www.pxisa.org
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For other unlisted countries:
www.agilent.com/find/contactus
Revised: January 6, 2012

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www.agilent.com/find/pulse

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