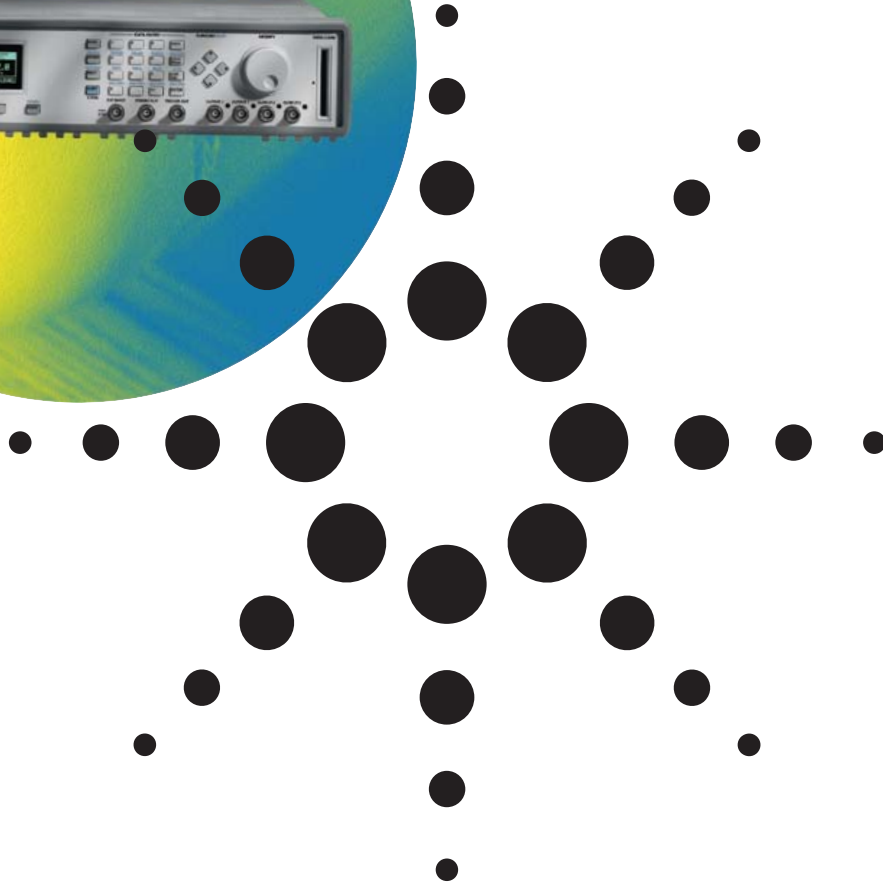
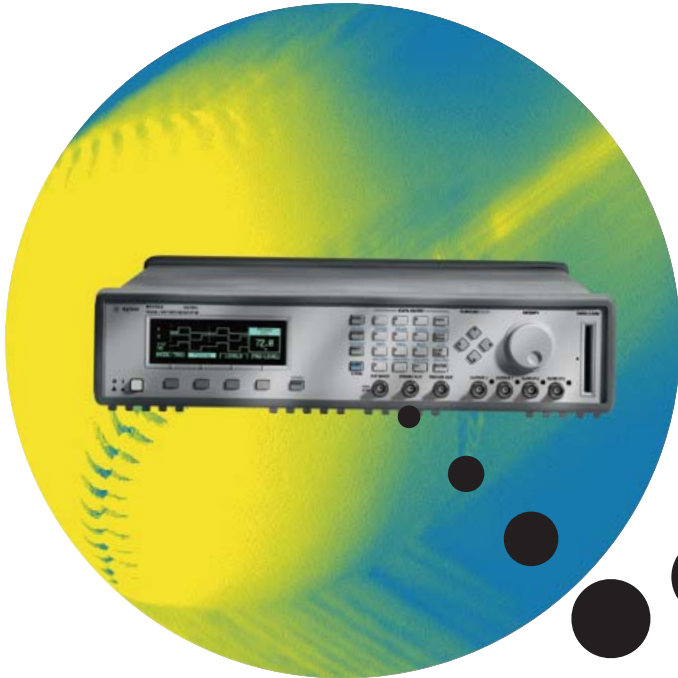


Agilent Technologies Pulse Pattern Generators

Digital Stimulus Solutions



**Leading pulse, pattern, data and
clock generation for all test needs in
digital design and manufacturing**



Agilent Technologies

Pulse Pattern Generators

Agilent Technologies offers a comprehensive portfolio of signal generation instruments for digital waveforms and data signals. Whether your application calls for

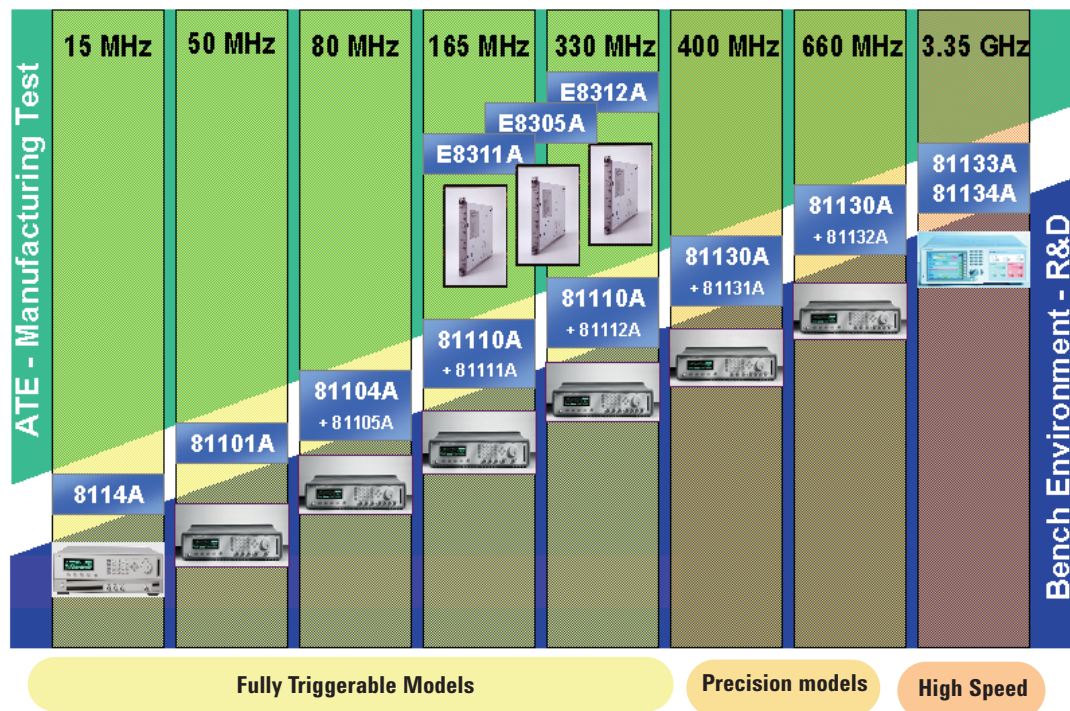
- Demanding digital pulses
- High-speed clock signals
- Square waves
- Flexible serial or
- Parallel bit patterns and data streams

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 Pattern Generator instruments. Agilent's family of Pulse Pattern Generators comprises

- Pulse Generators
- Pattern Generators
- Data Generators
- PRBS Generators
- Controllable Jitter Injection
- Timing 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 deliver the reliable and accurate results you require.



All models at a glance

Key Applications at a Glance

Application	8114A	81101A	81104A 81105A	81111A	81110A 81112A	81131A	81130A 81132A	E8305A	VXI E8311A	E8312A	81133A	81134A	81200A
Clock Generation		•	•	•	•	•	•	•	•	•	•	•	
System Trigger Source		•	•	•	•	•	•	•	•	•	•	•	
Diodes - LEDs	•	•	•	•					•				
Laser or IR Diodes	•												
Radar Test				•	•			•	•	•			
Mixed Signal Devices			•	•	•			•	•	•			
Flash Chip Test			•	•	•			•	•				
EEPROMs	•												
High Power Semiconductors	•												
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											•	•	

Product Specifications at a Glance

Specification	8114A	81101A	81104A	81110A			81130A	VXI			81133A	81134A	81200A
			81105A	81111A	81112A	81131A	81132A	E8305A	E8311A	E8312A			
Frequency Range	1 Hz - 15 MHz	1 mHz - 50 MHz	1 mHz - 80 MHz	1 mHz - 165 MHz	1 mHz - 330 MHz	1 kHz - 400 MHz	1 kHz - 660 MHz	1 mHz - 250 MHz	1 mHz - 165 MHz	1 mHz - 330 MHz	15 MHz - 3.35 GHz	15 MHz - 3.35 GHz	1 kHz - 2.7 GBit/s
Number of Channels	1	1	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	2 ⁽¹⁾	2 ⁽¹⁾	2 ⁽¹⁾	1	2	2 - 132
Optional 2nd Channel (retrofitable)			•	•	•	•	•						max 132
Amplitude Range	1 V - 100 V	100 mV - 20 V	100 mV - 20 V	100 mV - 20 V	100 mV - 3.8 V	100 mV - 3.8 V	100 mV - 2.5 V	100 mV - 5 V	100 mV - 20 V	100 mV - 3.8 V	50 mV - 2 V	50 mV - 2 V	50 mV - 1.8 V
Differential Outputs					•	•	•			•	•	•	•
LDVS Levels											•	•	•
Triggerable	•	•	•	•	•	•	•	•	•	•			
Gate Mode	•	•	•	•	•	•	•	•	•	•			
Remotely Programmable	•	•	•	•	•	•	•	•	•	•	•	•	•
Pulse Generation	•	•	•	•	•	•	•	•	•	•	•	•	•
Pattern & Data Generation			•	•	•	•	•	•	•	•	•	•	•
PRBS Generation			•	•	•	•	•	•	•	•	•	•	•
Bursts	•	•	•	•	•	•	•	•	•	•	•	•	•
Data Bursts			•	•	•	•	•	•	•	•	•	•	•
Pattern Memory			16 kBit / channel	16 kBit / channel	16 kBit / channel	64 kBit / channel	64 kBit / channel	16 kBit / channel	16 kBit / channel	16 kBit / channel	12 MBit / channel	12 MBit / channel	8 MBit / channel
PRBS Variations (2n-1)			n = 7,8,...14	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 = 7,8,...14	n = 5,6,...32	n = 5,6,...32	n = 7,8,...31 (PRWS)
Segment Looping						4 segments, 1 looping level	4 segments, 1 looping level						Multiple segments; up to 5 looping levels
Controlled Jitter Injection											•	•	
Variable Width	•	•	•	•	•	•	•	•	•	•	•	•	•
Variable Delay	•	•	•	•	•	•	•	•	•	•	•	•	•
Glitch-Free Timing Changes (patented)		•	•	•	•			•	•	•	• ⁽²⁾	• ⁽²⁾	
Analogue Channel Add			•	•					•				
Digital Channel Add						•	•						(+)
Multi-Level Signals			•	•					•				(+)

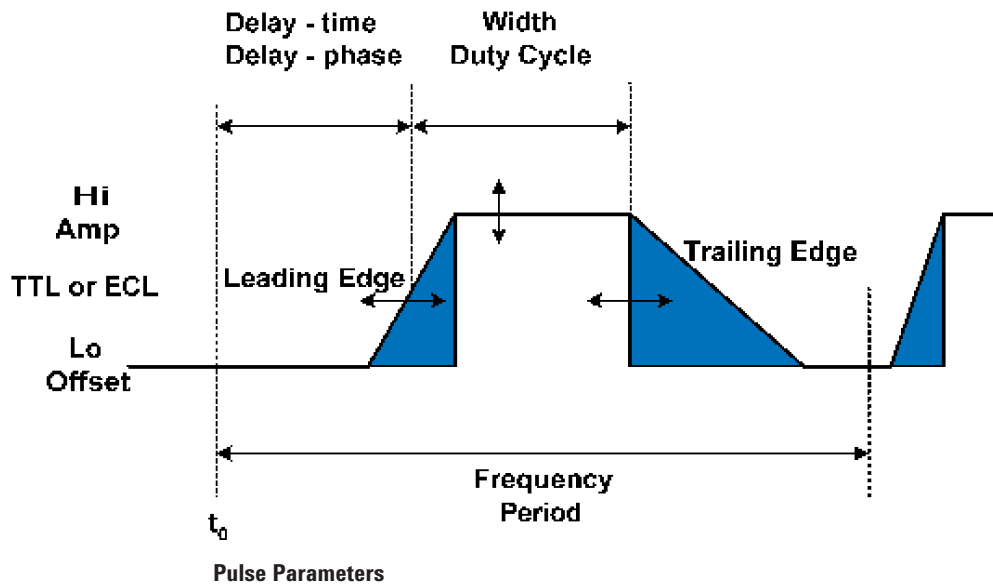
(1) - VXI modules with 2 channels per module - multiple modules can be combined in one VXI-frame for multi-channel applications

(2) - Glitch-free frequency changes only in "direct" clock mode with external clock source

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. As opposed to arbitrary waveform generators, the specified maximum frequency is NOT a sampling rate. Instead, it is the maximum frequency of the rectangular output waveform.

Pulse generation capability is provided by all models. The Agilent instruments cover a frequency range from 1 mHz to 3.35 GHz and an output amplitude range from 50 mV up to 100 V.

Glitch Free Timing Changes

The Agilent 81101A, 81104A and 81110A 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.



Glitch-free timing changes

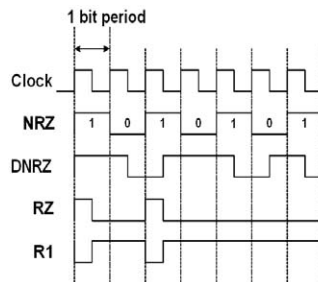
From Pulse to Pattern, Data and PRBS

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



- Width is multiple of clock period .
- Signal can be delayed as required .
- Width and delay can be set as required .
- Typical pulser modes .
- Width and delay can be set as required .

Data Generation Parameters

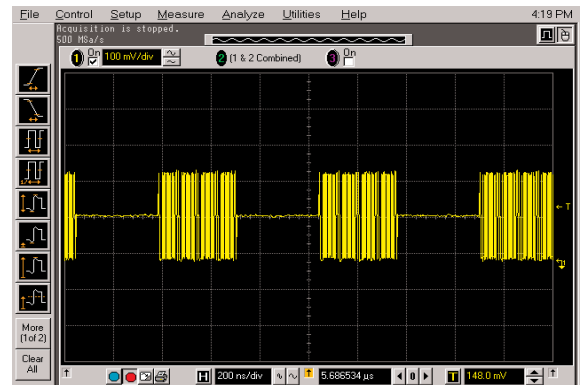
With the VXI modules E8305A, E8311A and E8312A and the 81200 Data Generator and Analyzer Platform, modular and parallel pulse and data applications can be addressed with up to 132 parallel channels.

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.

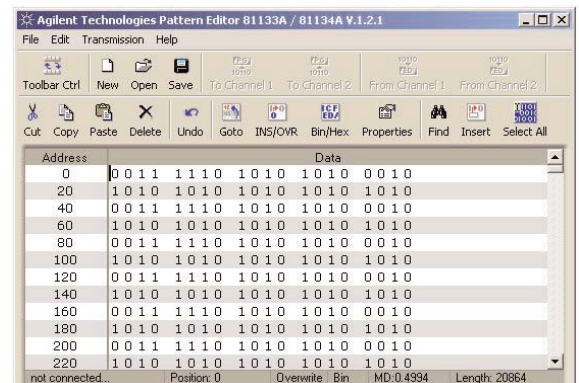
Pulse pattern generators provide all the tools to generate the data packets needed for digital bus device tests: Integrated Pattern Editors, PC-based graphically enhanced Data and Pattern Management Software, segment looping features as well as hardware-generated PRBS. This enables engineers to quickly 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 tests.



Data burst generated with a Pulse Pattern Generator displayed on an Agilent Infiniium Oscilloscope.



PC-based Pattern Management Tool for 81133A/34A

81101A and 81104A

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, 81130A share the same user interface, compatible programming commands and much more!



Flexible pulse generation

Key Features 81101A

- 1 channel
- Up to 20 Vpp (into 50 Ohm)
- 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



81101A 50 MHz Pulse Generator

Complementary products:
D/MS06030, 54622/4x and 54621x
Oscilloscopes



The Basics

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.

Key Features 81104A with 81105A

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- 1 MHz to 80 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Complex data patterns
- Pseudo Random Binary Sequence (PRBS) generation



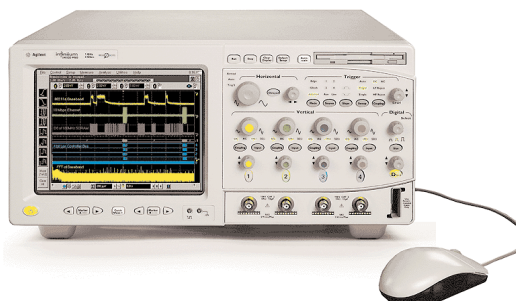
PRBS

Data

Pattern

Pulse

81104A Pulse Pattern Generator with 81105A Output Channel(s)



Complementary products -
D/MSO6050, 54830/31x, D/MSO6030 and
54622/4x Oscilloscopes

81110A

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.



Key Features 81110A with 81111A

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- 1 MHz to 80 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

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. 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 defense and automotive test as well as many other high-end applications.



81110A Pulse Pattern Generator with 81111A 165 MHz Output Channel(s)

**Complementary products -
54852/3A, D/MS06100, 54832/33x,
D/MS06050, 54830/31x and D/MS06030
Oscilloscopes**



PRBS

Data

Pattern

Pulse

The Lab Standard

The Agilent **81110A Pulse Pattern Generator** with one or two **81112A 330 MHz output channels** provides up to two differential output channels with fast transition times for a broad range of tests.



Key Features 81110A with 81112A

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- 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

PRBS

Data

Pattern

Pulse

81110A Pulse Pattern Generator with 81112A 330 MHz Output Channel(s)



**Complementary product -
54852/3A, D/MSO6100, 54832/33x,
D/MSO6050, 54830/31x and
D/MSO6030 Oscilloscopes**

81130A

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.

Key Features 81130A with 81131A

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- 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



Precision
Timing

PRBS

Data

Pattern

Pulse

81130A Pulse Pattern Generator with 81131A 400 MHz Output Channel(s)

Complementary products -
54854A, 54852/3A and
D/MS06100, 54832/33x
Oscilloscopes



Clean and Precise

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.



Key Features 81130A with 81132A

- 1 or 2 channels
- Up to 2.5 Vpp (into 50 Ohm)
- Fixed transition times 500 ps typ.
- 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 2.0 pre-compliance testing
- Pseudo Random Binary Sequence (PRBS) generation

Precision
Timing

PRBS

Data

Pattern

Pulse



81130A Pulse Pattern Generator with 81132A 660 MHz Output Channel(s)



Complementary products -
54655A, 54854A and
54852/3A Oscilloscopes

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 cross-over 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!



Key Features 81133A and 81134A

- 1 channel (81133A) or 2 channels 81134A)
- 50 mV up to 2 Vpp amplitude (into 50 Ohm)
- Programmable termination voltage
- Transition times < 90 ps (adjustable between 70 ps-120 ps typ.)
- 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 typ. 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 (up to 500 ps total jitter)
- Modulation Frequency: 0-200 MHz
- Additional variable crossover between 30%-70% typ.
- NRZ/RZ/R1 signal formats over the full frequency range.

Jitter

Precision Timing

PRBS

Data

Pattern

Pulse

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.

Complementary products -
DSO80000/DCA-J, 54655A and
54854A Oscilloscopes



High Speed, High Fidelity

The jitter-insertion capabilities enable jitter tolerance tests. Target applications of the 81133A and 81134A include physical layer characterisation, signal integrity and jitter tests. In addition the 81134A is Agilent's recommended solution for PCI Express and Serial ATA compliance tests.

33250A Modulation Source



81133A/34A Pulse Pattern Generator

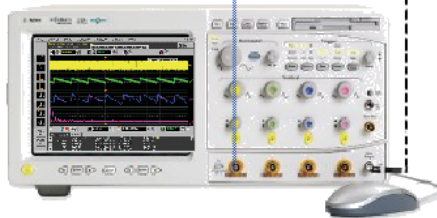


Jitter Input

Device Under Test

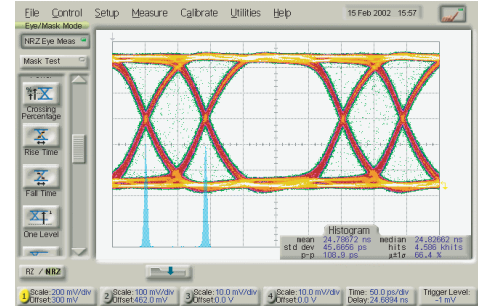


Reference Clock

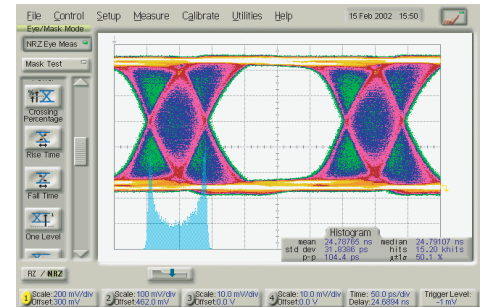


Infiniium Oscilloscope (54855A) or DCA-J (86100C)

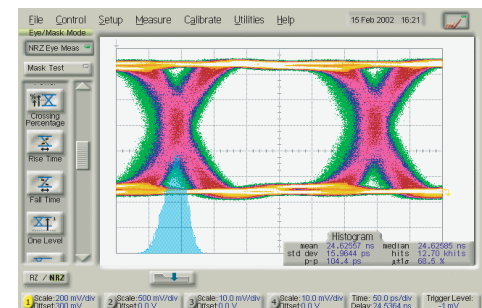
Perform stress tests by modifying the amount and shape of jitter by using the Delay Control Input and an external modulation source.



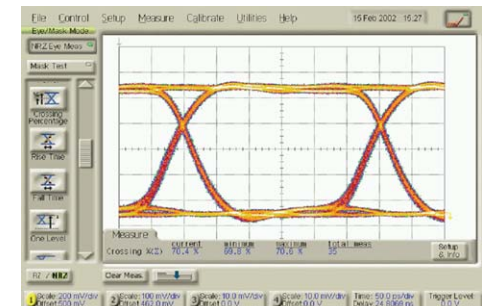
Jitter modulated with Rectangle-Wave



Jitter modulated with Sine-Wave



Jitter modulated with Noise



Variable Cross Over point at 70%



81133A & 81134A 3.35 GHz Pulse Pattern Generators

8114A: The Real Power

For tests on devices that require high voltages or currents the Agilent **8114A Pulse Generator** is the instrument you need. It has the power required for measurements of laser or IR diodes and other applications with pulses up to 100 Volts, 2 Amperes and 15 MHz. In addition, it can also be used as a pulsed current source.

The Agilent 8114A offers the same look and feel as well as the same programming syntax as the 81100A series to ease your work with different pulse pattern generators from Agilent Technologies.



Key Features 8114A

- 1 channel
- Up to 100 Vpp (into 50 Ohm) or 2 A
- Clean, reliable pulses with variable pulse width and 7 ns transition time
- External Synchronization and gating
- 15 MHz repetition rate and a counted burst mode
- Load compensation
- Optional variable pulse baseline (25 V)
- Device protection to avoid accidental damage



8114A 15 MHz High Power Pulse Generator

Complementary products -
54622/24 A/D 100 MHz



E8305A, E8311A & E8312A

The Agilent **E8305A, 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 E8305A, E8311A, E8312A			
	E8305A	E8311A	E8312A
Frequency range	1 mHz to 250 MHz	1 mHz to 165 MHz	1 mHz to 330 MHz
No. of channels	2 channels	2 channels	2 channels
Data pattern	16kbit/channel user defined; PRBS 2 ⁿ -1, n=7,8,...14 RZ, NRZ	16kbit/channel user defined; PRBS 2 ⁿ -1, n=7,8,...14 RZ, NRZ, DNRZ	
Variable delay range	0.00 ns to 999.5 s	0.00 ns to 999.5 s	
Period RMS-jitter	0.001 % + 15 ps	0.001 % + 15 ps	
Amplitude range	100 mV to 5 V	100 mV to 20.0 V	100 mV to 3.8 V
Transition time range (10/90)	1,3 ns to 200 ps programmable	2.00 ns to 200 ms programmable	800 ps or 1.6 ns selectable



E8305A, E8311A & E8312A Pulse Pattern Generators

81200: For a Parallel World

The Agilent **81200 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 81200 is a flexible and scalable platform which, depending on the configuration, offers up to 132 channels (RZ, NRZ). The data rate range covers 1 kBit/s to 2.7 GBit/s. The 81200 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 81200 can be combined with other standard VXI modules or systems.

With up to 8 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 81200 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 81200

- Up to 132 channels (RZ, NRZ) within one clock group, depending on the configuration
- PRBS and PRWS (pseudo random word sequence) up to $2^{31}-1$
- 1 kbit/s to 2.7 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 addition



PRBS

Data

Pattern

Pulse



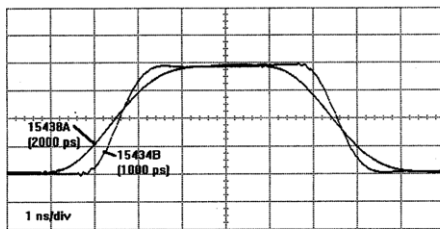
81200 Data Generator/Analyzer

Transition-Time Converters

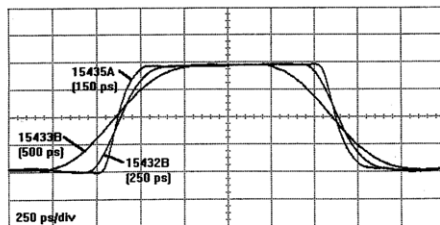
Models 15432B/15433B/15434B/15435A/15438A

These converters have been designed to convert the transition times of instruments with fast, fixed transition times, to slower, fixed transition-times (150 ps, 250 ps, 500 ps, 1 ns, 2 ns). This reduces signal bandwidth which may be necessary during the development of some devices. 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.



15434B and 15438A Output Pulses



15435A, 15432B and 15433B Output Pulses

Key Features

Typical Characteristics

- Converter: 15435A, 15432B, 15433B, 15434B, 15438A
- Output Transition Time 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 V_{pp}
- Insertion Loss < 0.2 dB
- Overshoot and Ringing < 3 %



15432B/15433B/15434B/15435A/15438A

Related Literature

	Publication 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 Technologies 8133A 3 GHz Pulse Generator, Technical Specifications	5980-1214E
• Agilent Technologies 8114A 100 V/2 A Programmable Pulse Generator, Technical Specifications	5980-1213E
• 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

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