Agilent Technologies
8133A 3 GHz Pulse Generator

Technical Specifications

The Standard in Pulse Generator Technology

Key Features

- 33 MHz to 3 GHz Frequency
- <100 ps transition times
- <5 ps pulse jitter
- ±0.5% ps Width Accuracy
- ±100 ps Width Accuracy
- ±150 ps Delay Accuracy
- 1 or 2 Output Channels
- 2^{23-1} PRBS Generation
- SCPI Programming Commands

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The need for pulse generation is fundamental to any device characterization task. The ability to emulate the pulse conditions to which the device will be subjected is essential. This emulation should include both typical and worst case conditions. Such accurate emulation requires superlative signal integrity and timing performance.

Setting Standards

The Agilent 8133A 3 GHz Pulse Generator provides pulses with programmable period from 333 ps to 30 ns, full 3 GHz pulse capability on all channels. The pulse width can be programmed too, along with a delay or the interchannel delay. At these frequency ranges the transition time performance becomes critical; less than 100 ps is specified, less than 60 ps is typical, so excellent signal integrity is assured. And last but not least, a typical jitter of 1 ps creates precise and accurate timing conditions.

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Pulse and Data Functionality

The 8133A 's standard configuration includes one pulse channel. A second channel can be added. This can be either:
· pulse/data channel (option 002)
· pulse channel (option 003)

Option 002 allows 32 bit, digital pattern generation in NRZ and RZ (50%duty cycle) mode.
Pulse/data channel 2 can also be programmed to provide a pseudo-random binary~sequence (PRBS) of data,a PRBS of 2^{23-1} , which conforms to CCITT 0.151.PRBS generation capability finds a particular application,in allowing the instrument to be used as a data source for eye diagram measurements.

Human Interface

You will particularly appreciate the interactive human interface when you are operating the Agilent 8133A on the bench. The easy access to all parameters helps you concentrate on the measurement task and react immediately to unexpected problems. The constant vernier steps for parameters allow you to increment or decrement through the entire parameter range with a fixed step-size,using only one key, which is especially helpful when doing margin testing.

The immediate error-guidance lets you know what 's wrong,with messages like "width> Period ", and how to fix it,with arrows indicating that a parameter should be increased or decreased. You can quickly recall last valid setting if you prefer.

The Agilent 8133A is available in four different configurations. The differences are timing capabilities and number of channels with different functionality.

	8133A	Option 001	Option 002	Option 003
Channel 1	Width or Delay with Square	Delay also in Width Mode	Delay also in Width Mode	Delay also in Width Mode
Channel 2			32-bit data PRBS 2^{23}-1 Divided Square	Second Pulse Channel with Width or Delay with Square

Note: option 002 and 003 contain option 001

Specifications
Specifications describe the instrument's warranted performance. Non-warranted values are described as typical. All specifications apply after a 30 minute warm-up phase with 50 Ω source/load resistance and separate channels. All specifications are valid from 0°C to 55°C ambient temperature.

Timing Characteristics

Measured at 50% amplitude at fastest transitions in continuous mode and 50 Ω source impedance.

Mainframe Output module	Agilent 8133A Pulse Channel 1	Delay Pulse Channel 1 Option 001	Pulse Channel 2 Option 003	Pulse/Data Channel 2 Option 002
Frequency Range	33.0 MHz to 3.0000 GHz			
Period Range	333 ps to 30.303 ns			
Timing resolution	3.5 digits, 1 ps best case			
RMS Jitter (period, delay, width)	less than 5 ps (1 ps typical)			10 ps (f < 2 GHz: 5ps)
Accuracy	± 0.5% (± 0.1% typical)			
Width range [1]	150 ps to (period – 150 ps) maximum 10.000 ns			
Resolution	1ps			
Accuracy	± 100 ps (± 30 ps typical)			
Duty Cycle[2]	0% to 100%			
Resolution	0.1%, best case 1			
Add. Variable delay	Pulse mode: no Square mode: 0.000 ns 10.000 ns	Pulse mode: -5.000 to + 5.000ns Square mode: -5.000 ns to 15.000 ns	[3] Pulse mode: no Square mode: 0.000 ns to 10.000 ns	
Channel 1 to Channel 2 Delay [4]			Pulse mode: -5.000 ns to + 5.000 ns Square mode: -5.000 ns to 15.000 ns	
Resolution	1 ps			
Accuracy	[5] ± 150 ps (± 30 ps typical)	[6] ± 50 ps		
Phase [7]	0° to 3600°	-3600° to 3600°	-3600° to 3600°	-3600° to 3600°
Resolution	0.1°, best case 1 ps			
Skew[8]		± 5 ns		

Notes:

[1] The width can only be varied in Pulse mode. In square mode the duty cycle is fixed at 50%

[2] Width and duty cycle are mutually exclusive. Duty Cycle settings and limits are subject to the same specifications and settings as Width.

[3] Delay variation Channel 2 to Channel 1

[4] The interchannel delay between Channel 1 and Channel 2 is the programmed delay of Channel

[5] Any parameter variation

[6] Only delay variation

[7] Delay and Phase are mutually exclusive. Phase settings and limits are subject to the same specifications and settings as

[8] Delay or Phase, plus Skew must be within the Delay Range

Repeatability: is typ. four times better than accuracy.

Internal Clock Generation

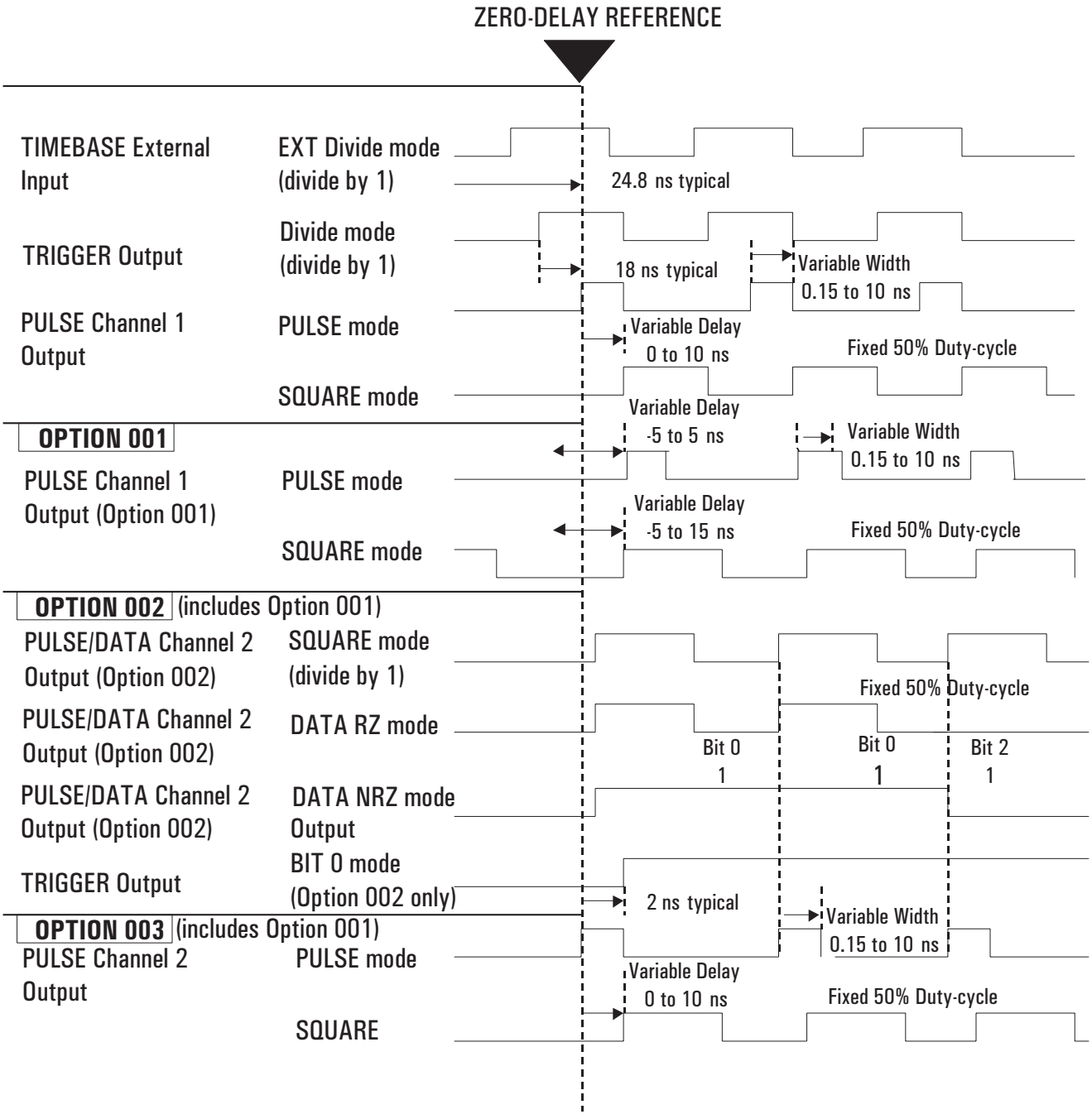
The internal clock can be set in frequency or period mode

External Clock

The external input signal determines the timebase of the instrument. The external period or frequency is measured and displayed, allowing the correct setting of Duty Cycle and Phase also in External Clock mode.

External Frequency Counter Period

Range: 333 ps to 30.303 ns (300 ps to 500 ns typical)
Resolution: 1 ps
Accuracy: ± 0. 1 %



Interchannel Timing Diagram

Frequency
Range: 33.0 MHz to 3.0000 GHz (2 MHz to 3.33 GHz typical)
Resolution: 100 kHz
Accuracy: ± 0. 1 %

External Input Divide
The external supplied frequency can be divided.
Divide by: (1), 2, 4, 8, 16, 32, and 64.
The internal available frequency has to be ≥33 MHz to ensure that all specifications are met.
The instrument will perform all functions down to 3 MHz, except the functions of the PULSE/DATA/ CHANNEL2.

External Input
Range: 33 MHz - 3 GHz
Interface: ac-coupled
Impedance: 50 Ω nominal
Minimum Swing
Pulse: 50% duty cycle, 300 mV, tr < 3 ns
Sine: 0 dBm
Maximum amplitude: 3 Vpp, + 20 Vdc

PULSE CHANNEL 1

Delay
Delay has no period limitations.
Fixed delay between TRIGGER Output to CHANNEL 1 Outputs: 18.8 ns nominal for trigger output divide by 1

PULSE/DATA CHANNEL 2 (# 002)

Delay
Fixed delay from TRIGGER Output to CHANNEL 2 Outputs.
Trigger on pulse: 18.8ns nominal for trigger output divide by 1

Trigger on Bit 0: - 2.0 ns before Bit 0 nominal

Data
Selects Data mode. Further selection between 32bit programmable data or PRBS is required.

Divide
In Square mode the frequency of CHANNEL 2 can be divided. Divide by: (1), 2, 4, 8, 16, 32

To meet all timing specifications, the internal (CHANNEL 2) frequency has to be ≥ 33 MHz.

32 BIT
32 bit of programmable data are selectable.

PRBS
PRBS: $2^{23}-1$,CCITT 0.151Norm

RZ / NRZ
Sets 32 bit data to Return To Zero/ Non Return to Zero mode.
RZ fixed duty cycle: 50% nominal

PULSE CHANNEL 2 (# 003)

Divide
In Pulse and Square modes, the frequency of Channel 2 can be divided by 2, 4, 8, 16, 32 or 64.
The minimum Channel 2 frequency is 1 MHz.

Level/Pulse Performance Characteristics

Mainframe	Agilent 8133A
Amplitude	0.30 V to 3.00 V
Level window	-2 V to +4 V (-3 to +4 V typical)
Level Accuracy	± 2% of amplitude ± 2% of setting ± 20 mV
Resolution	10 mV
Output connectors	SMA Connectors on the front panel
Source Impedance	50 Ω
Skew between differntial outputs	< 20 ps nominal
Max. external voltage	± 3 V nominal
Short circuit current	-120 mA max. ≤ I_{sc} ≤ 160 mA nominal
Tranisition Times (10/90)	< 100 ps (60 ps typical)
Tranisition Times(20/80)	< 60 ps (40 ps typical)
Settiling time	1 ns
Overshoot/preshoot/ringing	< 15% of amplitude ± 20 mV Differential Outputs

The output voltage can be set in amplitude/offset or high-/low level mode. Levels double when driving into open circuits.

Limit
Maximum high and low levels into 50 W can be limited to protect the device under test. Pushing the limit key declares present levels as limits which then cannot be exceeded as long as this mode is active.

Complement (not #002 PULSE/ DATA CHANNEL 2)
Normal/complement selectable

Data (only #002 PULSE/DATA CHANNEL2)
Provides logical complement of data

Disable
Relays connect/disconnect outputs

Connector Type
SMA (f) for all outputs and inputs

TRIGGER Output
Conditions: fout > 33MHz

Trigger Channel Output
The output voltage can be set in amplitude/offset or high- and low level mode (50 Ω to 0 V).
Amplitude: (0.20 V typical) 0.50 V to 1.80 V nominal
Level Window: -4.00 V to +4.00 V
Resolution: 10 mV
Format: fixed Duty Cycle 50% nominal
Prop. delay External Input to Trigger Channel Output: 6 ns nominal for trigger output divide by 1 Maximum external voltage: ± 4 V

Transition Times
20% - 80% of amplitude: < 100 ps (< 60 ps typical)

Disable
A relay connects/disconnects the trigger output

Divide
The trigger output frequency can be divided.
Divide by: (1), 2, 4, 8, 16, 32, 64

Minimum output frequency: 33 MHz (3 MHz typical)

Bit 0 (PULSE/DATA CHANNEL 2 only)
The trigger output is synchronized to Bit 0 of the 32 bit word in data mode. It's a square wave signal divided by 32 with respect to the timebase frequency.

Rearpanel Connectors
Agilent8133A: CHANNEL 1 ~ Output, CHANNEL 1 - Input
Option 002: CHANNEL 2 - Output, CHANNEL 2 - Input, Start/Stop - Input
Option 003: CHANNEL 2 - Output, CHANNEL 2 ~ Input

CHANNEL X Output amplitude: 2 Vpp, ac-coupled
CHANNEL X Input amplitude: max. 2.5 Vpp, ac-coupled, min. 1.0 Vpp, ac-coupled
50% duty cycle
For proper operation the CHANNEL X Outputs and Inputs have to be connected through the supplied rigid coaxial links.

Start/Stop Input
Interface: dc-coupled
Impedance: 50n nominal
Transitions: < 1 ns
Start level: 0 V (default)
Stop level: - 0.4 V

The Start/Stop Input is used for the PULSE/DATA CHANNEL 2 to hold the data stream to setup a data pattern and to start data generation on a specific bit.

Additional Features
Non-volatile Memory
Current settings are saved on power-down. Additionally 20 complete settings can be stored.

GP-IB Capabilities
All modes and parameters are programmable. Operates according to IEEE standard 488.1 and 488.2, 1987. Conforms to the Standard Commands for Programmable Instruments (SCPI) 1992.0.

General Information
Environmental
Storage temperature: -40°C to +70°C
Operating temperature: O°C to 55°C
Humidity (0' C to 40' C): 95% R.H.

Power
110-120/220-240Vrms, ± 10%, 25OVA max., 47-63Hz

Weight
Net: 21.5 kg (48 lb)
Shipping: 29.0 kg (65 lb)

Dimensions
(HxWxD) 145 mm x 426 mm x 525 mm
(5.7 in x 16.75 in x 20.65 in)

Ordering Information

Agilent 8133A 3 GHz Pulse Generator

Option 001 Delay CHANNEL 1

Option 002 PULSE/DATA CHANNEL 2

Option 003 PULSE CHANNEL 2

Option 004 Standard Instrument

Note: Option 002 and Option 003 contain Option 001

Accessories

Agilent 1250-1462 Adapter SMA (m) to SMA (f)

Agilent 8120-4948 50 Ω Cable, SMA (m-m)

Agilent 8710-1582 Torque Wrench 5 in/lbs

Agilent 8493A Series Attenuators

Agilent 11667B Power Splitter

Agilent 15435A Transition Time Converter 150 ps

Agilent 15432B Transition Time Converter 250 ps

Agilent 15433B Transition Time Converter 500 ps

Agilent 15434B Transition Time Converter 1000 ps

Agilent 15438A Transition Time Converter 2000 ps