

40 Gb/s PatternPro® Programmable Pattern Generator

PPG4001 Datasheet



The Tektronix PPG4001 PatternPro® programmable pattern generator provides stressed pattern generation for high-speed Datacom testing.

Notice to EU customers

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Key performance specifications

- Low inherent jitter (typical RJ 150 fs @40 Gb/s)
- 11 ps typical 20% to 80% rise/fall times
- Low frequency, high amplitude jitter insertion range of 10 Hz to 10 MHz at up to 5000 UI (with Option LFJIT)
- High frequency jitter insertion, including SR, RJ, and BUJ with amplitudes up to 50 ps (with Option HFJIT)
- Adjustable output voltage

Key features

- DC coupled differential data outputs
- Full rate and sub-rate multiple clock outputs
- Pattern trigger output
- Built-in adjustable clock source
- PRBS and user defined patterns
- Front panel touch screen GUI and USB computer control

Applications

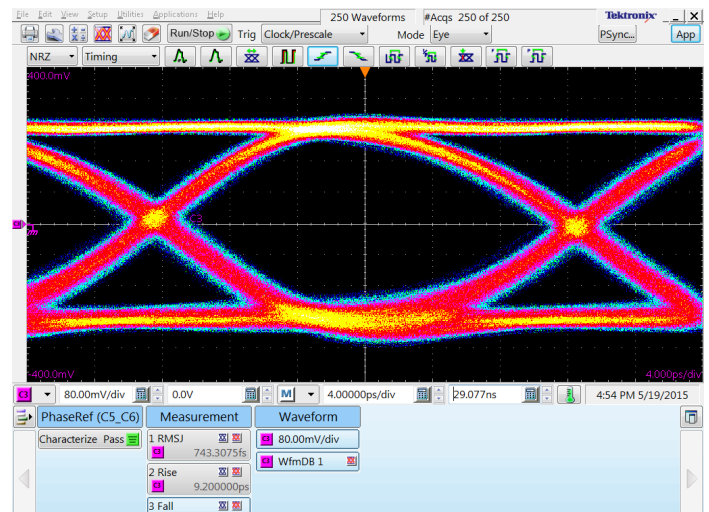
- Semiconductor device testing
- Optical component testing
- Transceiver module testing

Product description

The Tektronix PPG4001 PatternPro® programmable pattern generator provides an unparalleled combination of industry leading performance, features, and ease of use. Design validation of today's demanding high-speed applications requires instruments that produce the highest quality signals and enable programmable controls while being simple and easy to use.

Fast rise time and low jitter are critical performance parameters and the PPG4001 delivers typical 150 fs inherent RJ with 11 ps rise time. Within seconds of powering up the instrument, a first time user can be creating high-performance programmable patterns to test a DUT. In addition, the PPG4001 offers comprehensive jitter insertion for stressed receiver testing and similar applications.

The PPG4001 may be paired with the PED4001 40 Gb/s programmable error detector to provide a complete BERT system that includes control and analysis software.



Typical 40 Gb/s eye diagram

Specifications

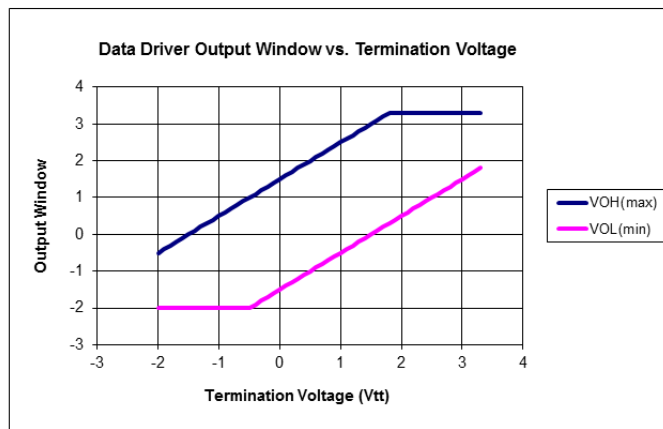
All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Data outputs

Voltage amplitude	Each positive and negative differential output is independently programmable.
Single-ended	300 mV to 1.0 V
Differential	600 mV to 2.0 V

Offset window	-2 V to +3.3 V, programmable/adjustable
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Termination voltage range	-2.0 V to +3.3 V window. Programmable/adjustable. Applied by user via 50 Ω.
	This setting is used in cases where the load being driven is terminated at a level other than zero volts. The effect of termination voltage on the output voltage is shown in the following figure. To ensure proper operation, never load the output with a termination voltage less than Voh minus 3 V.



Rise/fall time	Scope bandwidth can impact the measured signal rise time.
20 to 80%	11 ps, typical
10 to 90 %	16 ps, typical

Data output jitter	Measured at 40 Gb/s with 2 ¹¹ -1 PRBS at 500 mV _{p-p} , single ended
Total jitter (1E-12)	7 ps _{p-p} , typical
Random jitter	200 fs, RMS, typical

Connector type	2.4 mm
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Output impedance	
50 Ω	Single-ended
100 Ω	Differential

Clock outputs

Full rate clock output	AC coupled, single-ended
Frequency	20 GHz to 40 GHz
Amplitude	500 mV _{p-p} , typical
Connector type	2.4 mm
Half rate clock output	AC coupled, differential
Amplitude	400 mV _{p-p} , typical
Connector type	2.4 mm
/n clock output	AC coupled, single ended
Programmable divider	n = 2, 4, 8, 16
Amplitude	500 mV _{p-p} , typical
Connector type	2.4 mm
Trigger output	Programmed as pattern trigger or clock/n (with n = multiples of 128)
Amplitude	-500 mV to 0 V, DC coupled
Connector type	SMA

Data patterns

Pattern type	Data (from memory) or PRBS
Data rate	Programmable/adjustable
Range	4 Gb/s to 40 Gb/s
Resolution	10 kb/s
Accuracy	±5 ppm
PRBS pattern lengths	
2⁷ - 1 bits	Polynomial = $X^7 + X^6 + 1$
2⁹ - 1 bits	Polynomial = $X^9 + X^5 + 1$
2¹¹ - 1 bits	Polynomial = $X^{11} + X^9 + 1$
2¹⁵ - 1 bits	Polynomial = $X^{15} + X^{14} + 1$
2²³ - 1 bits	Polynomial = $X^{23} + X^{18} + 1$
2³¹ - 1 bits	Polynomial = $X^{31} + X^{28} + 1$
Data pattern depth	
Range	2 to 4,194,304 bits
Resolution	1 bit
Programmable error insertion	Error insertion can be enabled with either single bit error insertion or at a programmable rate.
Single bit errors	Yes
Programmable bit errors	10 ⁻³ to 10 ⁻¹⁵ BER

Jitter insertion

High frequency jitter insertion option	Add-on option for the instrument. Sum of external, internal sine, internal noise, and BUJ. Exceeding the range can generate errors.
Total modulation range	50 ps _{p-p}
Built-in sine source	Programmable from either the front panel touch screen or remote control.
Frequency range	5 kHz to 100 MHz
Amplitude range	0 to 50 ps _{p-p}
Accuracy	±10%, typical
Built-in random noise source	Programmable from either the front panel touch screen or remote control.
Amplitude range	0 to 5 ps _{RMS}
Accuracy	±10% typical
Built-in BUJ source	Programmable from either the front panel touch screen or remote control.
Amplitude range	0 to 50 ps _{p-p}
Modulation data rates	100 Mb/s to 2.5 Gb/s
PRBS sequences	7,9,11,15,23,31
Filter values	25/50/100 MHz filters
External modulation input	DC coupled, 3 dB bandwidths
Frequency range	DC to 100 MHz
Amplitude range	0 to 50 ps _{p-p}
Maximum input	5 V _{p-p}

Jitter insertion

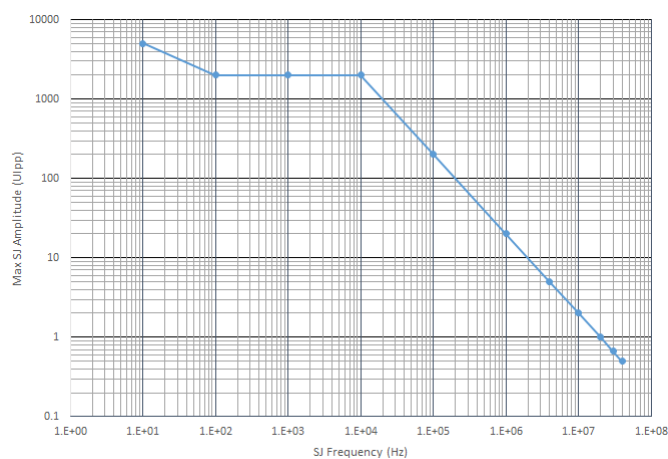
Low frequency jitter insertion
(Option LFJIT)

Add-on option.

The specifications below apply when the data rate equals the internal clock rate frequency of 20 to 40 GHz. For each frequency octave below, the internal clock rate, the specifications below will be reduced by half. Thus when the data rate is 10 to 19.99999 Gb/s, the values below will be divided by 2. When the data rate is 5 to 9.99999 Gb/s, the values will be divided by 4.

SJ modulation range curve
points

Parameter	Value
10 Hz f_{mod}	5000 $U_{\text{I,p-p}}$
100 Hz f_{mod}	2000 $U_{\text{I,p-p}}$
1 kHz f_{mod}	2000 $U_{\text{I,p-p}}$
10 kHz f_{mod}	2000 $U_{\text{I,p-p}}$
100 kHz f_{mod}	200 $U_{\text{I,p-p}}$
1 MHz f_{mod}	20 $U_{\text{I,p-p}}$
4 MHz f_{mod}	5 $U_{\text{I,p-p}}$
10 MHz f_{mod}	2 $U_{\text{I,p-p}}$
20 MHz f_{mod}	1 $U_{\text{I,p-p}}$
30 MHz f_{mod}	0.67 $U_{\text{I,p-p}}$
40 MHz f_{mod}	0.5 $U_{\text{I,p-p}}$



Trigger system

Trigger waveform

Pattern mode

1 pattern per trigger for pattern length = multiple of 128

128 patterns per trigger for other pattern lengths

Clock/n mode

128 through $(2^{32} - 128)$, n= any multiple of 128 in that range

Duty cycle

50%, for either Pattern or Clock/n

High level

0 V, typical

Low level

-500 mV, typical

Output impedance

50 Ω , DC-coupled

Connector type

SMA

Clock inputs

Frequency range	10 GHz to 20 GHz, half rate
Input signal	500 mV _{p-p} , typical, AC coupled
Maximum input signal	800 mV _{p-p}
Input impedance	50 Ω, AC-coupled

Reference clock

Input frequency range	10 MHz
Input signal	1 V _{p-p} , typical, 50% duty square wave
Maximum input signal	5 V _{p-p} , ±10 V DC, Damage threshold
Input impedance	50 Ω, AC-coupled
Output signal	1.2 V _{p-p} , typical, Square wave
10 MHz reference input/output	Yes, BNC connector

Data error insertion

Error insertion types	Single or rate-based
Error insertion rate	
Range	1 x 10 ⁻³ to 10 ⁻¹⁵ BER
Resolution	3 digits

Control interfaces

Front panel touchscreen GUI	Yes, edit all instrument settings.
Computer programmable interface	USB TMC, program all instrument settings.

Physical characteristics

Front panel width (with mounting tabs)	48.3 cm (19.0 in)
Height	13.3 cm (5.25 in)
Width	45.1 cm (17.75 in)
Depth (rack mount)	35.1 cm (13.8 in)
Weight	11.1 kg (24.5 lbs)
Operating temperature	0 °C to 40 °C (32 °F to 104 °F)

Ordering information

Models

PPG4001 40 Gb/s programmable pattern generator, 1 channel

Options

PPG4001 LfJIT Low frequency jitter option for the PPG4001

PPG4001 HfJIT High frequency jitter option for the PPG4001

Power plug options

Opt. A0 North America power plug (115 V, 60 Hz)

Opt. A1 Universal Euro power plug (220 V, 50 Hz)

Opt. A2 United Kingdom power plug (240 V, 50 Hz)

Opt. A6 Japan power plug (100 V, 50/60 Hz)

Opt. A10 China power plug (50 Hz)

Opt. A11 India power plug (50 Hz)

Opt. A99 No power cord

Manuals

071-3413-xx Printed PPG/PED Installation & Safety instructions

077-1089-xx PPG4001 User manual, PDF-only, downloadable from Tektronix.com



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Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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