Tektronix PSPL2600C Pulse Generator

User Manual

071-3417-00

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User Manual

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Contacting Tektronix

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USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page v, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Do not use the provided power cord for other products.

Use proper voltage setting. Before applying power, make sure that the line selector is in the proper position for the source being used.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be

connected to earth ground. Before making connections to the input or output terminals of the product, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not float the common terminal above the rated voltage for that terminal.

The measuring terminals on this product are not rated for connection to mains or Category II, III, or IV circuits.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Use proper fuse. Use only the fuse type and rating specified for this product.

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

This document provides information for installing and using the Tektronix PSPL2600C Pulse Generators.

These pulse generators provide high amplitude positive or negative pulses with convenient front panel control. The output has fast edge rates, smooth transitions and minimal overshoot and ringing. Adjustable output levels are obtained using internal step attenuators, ensuring consistent signal shape at all settings. The outputs are designed for a 50 Ω impedance, but can safely drive any load from a short circuit to an open.

Features

- Front panel operation
- Internal, external, or manual trigger modes
- Continuously variable repetition rate and duration settings

Models

PSPL2600C. Pulse generator, 400 ps, 45 V, 1 to 100 ns

Options

PSPL2600C TURBO. Supports 50 V, 250 ps rise times

Documentation

The following documentation is available:

- This PPG2600C Pulse Generator User Manual
- Product datasheets (PDF versions only, downloadable from the Tektronix Web Site)

Check the Tektronix Web Site for additional product documentation at www.Tektronix.com.

Getting started

Your instrument was carefully inspected electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit. Report damage to the shipping agent immediately. Save the original packing carton for possible future shipment.

The following items are included with every instrument order:

- Pulse generator with line cord
- Rack mount/handle kit
- Printed user manual
- Accessories as ordered

Power requirements

CAUTION. *The pulse generator can be damaged by static discharge or applied voltages. To avoid damaging the pulse generator, take appropriate precautions when using the instrument. Always discharge the coaxial cables and connectors before connecting them to the pulse generator or instrument-under-test.*

CAUTION. *Operating the instrument on an incorrect line voltage can cause damage, possibly voiding the warranty. To avoid this, operate the instrument with the correct line voltage.*

The instrument has an AC Mains Voltage Selector switch on the rear panel used to select the proper voltage, power, and frequency selection. The following table describes the switch selections and fuse information for your instrument. Check to ensure the operating voltage in your area is compatible.

Table 1: Line voltage selector switch settings

Mains voltage	Switch positions	Frequency	Power	Fuse type and rating
100 V	AD	50 Hz	65 VA	5 x 20 T 800 mA, 250 V
115 V	AC	60 Hz	42 VA	3AG-SB 750 mA, 250 V
230 V	BC	50 Hz	65 VA	5 x 20 T 400 mA, 250 V

Ventilation

CAUTION. *Observe the following precautions to maintain proper ventilation:*

Do not block any cooling vents.

Do not position any devices adjacent to the instrument that force air (heated or unheated) into or onto the instrument's surfaces or cooling vents. This additional airflow could compromise accuracy performance.

When rack mounting the instrument, ensure there is adequate airflow around the instrument rear and sides to ensure proper cooling. Adequate airflow enables air temperatures within approximately one inch of the instrument surfaces to remain within specified limits under all operating conditions.

Environmental ratings

The following table describes the maximum operating environment ratings for your instrument.

Table 2: Maximum operating environment ratings

Feature	Description
Temperature	0 to 40 °C (32 to 104 °F)
Humidity	80% for temperatures up to 31 °C (88 °F) decreasing linearly to 50% at 40 °C (104 °F)
Altitude	2000 m (6562 ft.)

Front panel controls and connectors

The front panel of the PSPL2600 is shown in the following figure. The Power switch is located on the front left side of the instrument. The power indicator adjacent to the switch lights up when the instrument is on.

Figure 1: PSPL2600C front panel controls and connectors

Repetition Rate controls

The pulse generator provides a means of setting the repetition rate from 1 to 100 kHz using the built-in rate generator. Use the Range switch to select a coarse repetition rate from 100 to 0.01 kHz, and then use the Fine vernier control to fine tune the repetition rate. The maximum repetition rate is internally limited to 100 kHz to protect the internal circuitry of the generator.

Ext trigger input

To trigger the generator from an external source through the front panel BNC connector, set the Repetition Rate Range switch to **Ext**. The external trigger input requires a pulse >1.5 V and triggers the pulse generator on positive going edge pulses.

External trigger pulses in excess of 100 kHz can be applied to the generator without damage. The trigger circuitry is equipped with a lockout gate that disables the circuitry for 8.8 µs after it has been triggered.

Use the Single Pulse toggle switch to produce single-shot pulses under manual control.

Pulse Delay control

The Delay control is a ten-turn potentiometer to obtain a high-resolution pulse delay at the main trigger output BNC connector. The delay from the trigger pulse to the output pulse is adjustable from 0 to 100 ns.

Pulse Duration control

Use the Duration control to obtain a high-resolution pulse duration (width) from 0.5 to 100 ns. The control is a ten-turn potentiometer.

Trigger outputs

Two BNC connectors provide a main trigger output and an auxiliary trigger output. Both outputs provide 800 mV pulses into 50 Ω. They provide TTL-level (>2.0 V) pulses into a high impedance.

The main trigger output connector is located directly under the Delay control and is labeled **0.8 V**. This output allows for variable delay between the trigger and the pulse.

An auxiliary trigger output labeled **115 ns** provides a pulse 115 ns prior to the pulse output.

Attenuation controls

Use these controls to adjust the attenuation of the pulse output. The Coarse control sets the output amplitude from 0 to 60 dB in 10 dB steps and the Fine control sets the amplitude from 0 to 10 dB in 1 dB steps.

Pulse polarity switch

Use this switch to set the polarity of the pulse.

Pulse Output connector

The pulse generators use SMA connector for the pulse output. The PSPL2600C provides a 14 mV to 45 V output; the PSPL2600C-TURBO provides a 16 mv to 50 V output. The instruments are designed to work into a 50 Ω load or an open circuit or short circuit.

CAUTION. *Applying an external voltage to the SMA Pulse output connector can damage the pulse generator. To avoid damaging the pulse generator use a DC block such as the PSPL5500A. For applications requiring a DC baseline offset voltage to be added to the pulse generator, use a bias tee such as the PSPL5575A. The bias tee contains DC blocking capacitors.*

Rear panel controls and connectors

The rear panel of the instrument is shown in the following figure.

Figure 2: PSPL2600C rear panel controls and connectors

- **AC line receptacle.** Connect the appropriate power cord here.
- **Fuse holder.** Refer to the fuse information in the AC Mains Voltage Selector switch settings table. (See Table 1.)
- **Line voltage selector switches.** Switch settings determine the correct voltage, power, and frequency settings for your instrument. (See Table 1.)

Pulse waveform examples

Typical pulse waveforms are shown in this section. Tektronix recommends using a wide-band sampling oscilloscope to verify these waveforms. The oscilloscope rise time must be less than 100 ps.

CAUTION. *The input circuitry of the oscilloscope can be damaged by directly connecting the output of the pulse generator to the oscilloscope. To avoid damaging the input circuitry of the oscilloscope, use attenuators to provide at least 46 dB attenuation between the output of the pulse generators and the oscilloscope.*

The following figures show typical waveforms with the duration set to 5 ns. A fixed 115 ns delay pulse is used to trigger the oscilloscope unless otherwise noted. The displays are set to 10 V/div and 1 ns/div.

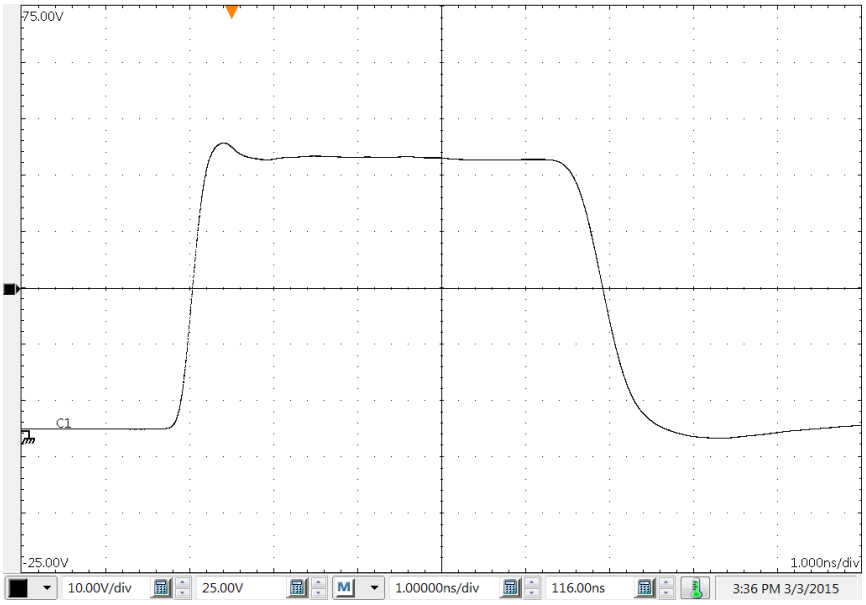

Figure 3: Positive pulse

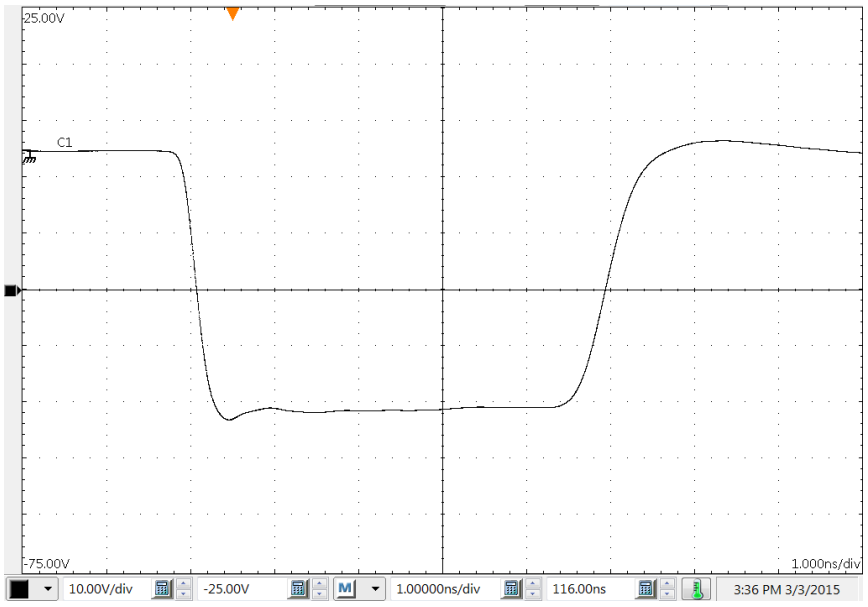

Figure 4: Negative pulse

The following figures show typical positive and negative waveforms with the pattern generator Duration control set to minimum. The displays are set to 10 V/div and 1 ns/div.

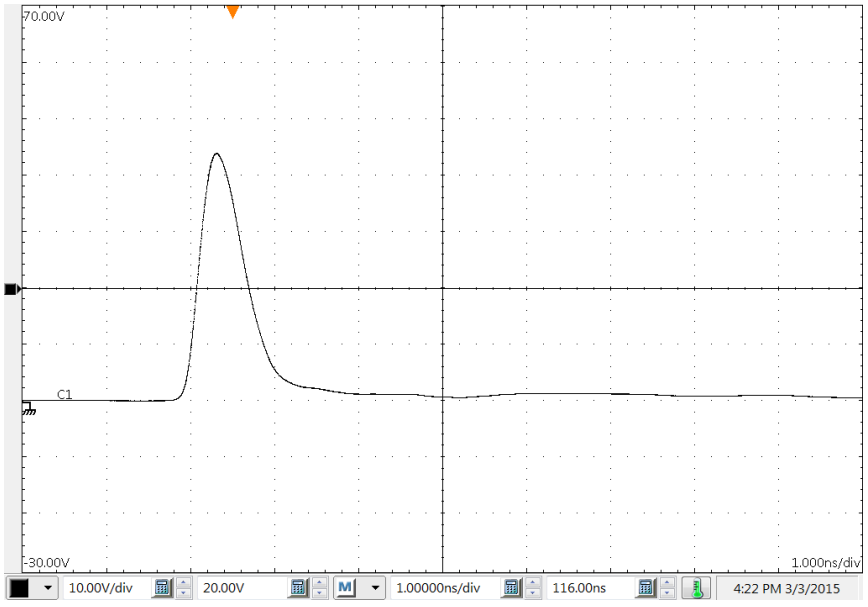

Figure 5: Minimum duration positive pulse

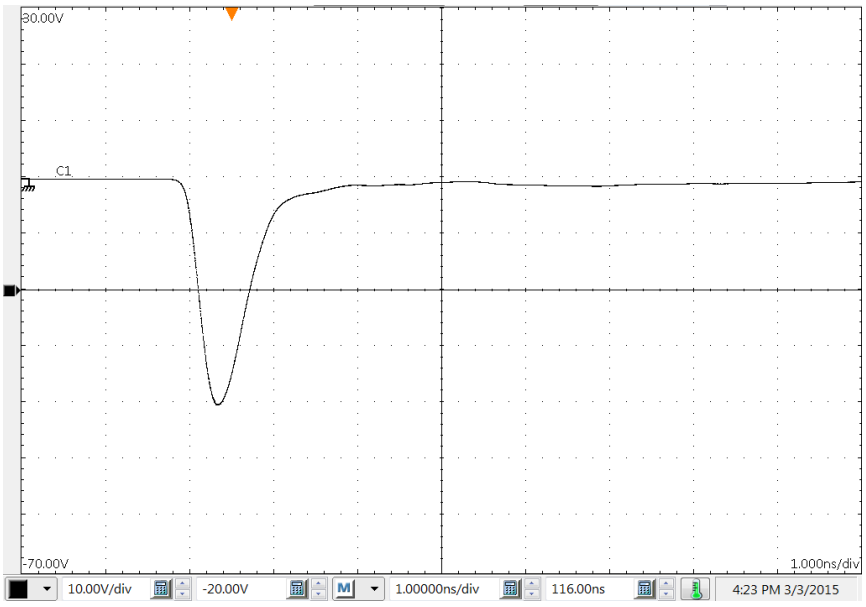

Figure 6: Minimum duration negative pulse

The following figures show typical leading edge and trailing edge waveforms. The displays are set to 10 V/div and 200 ps/div.

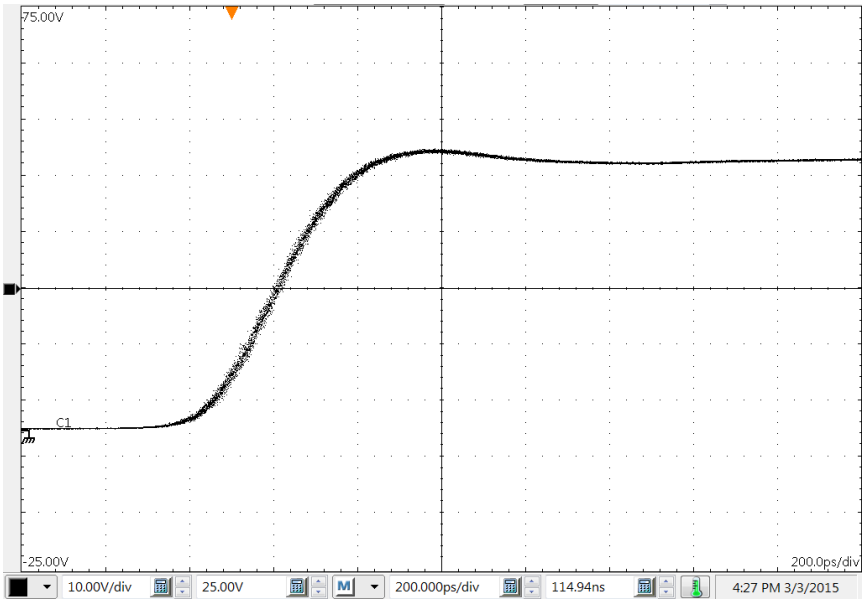

Figure 7: Leading edge waveform

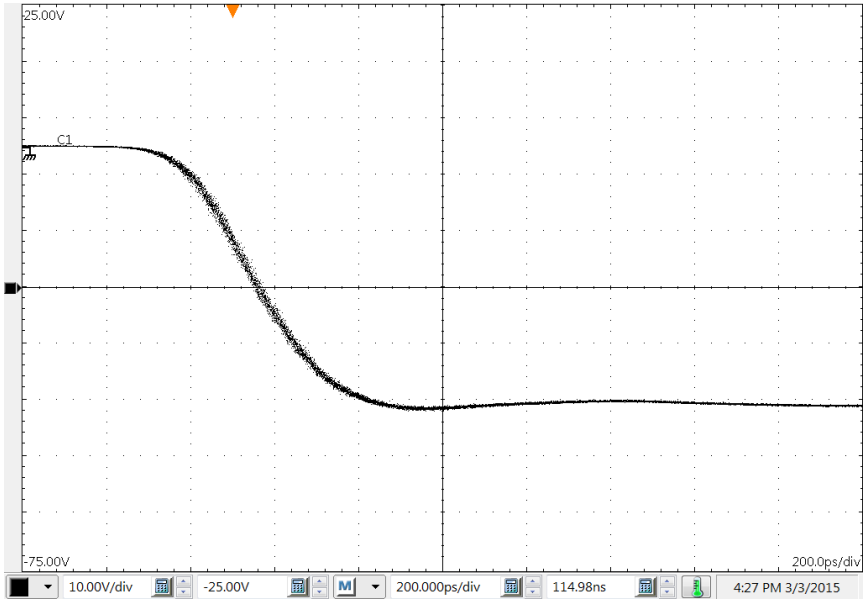

Figure 8: Trailing edge waveform

The following figures show typical pulses with various pulse waveform durations. The displays are set to 10 V/div and 20 ns/div.

Figure 9: 20 ns duration pulse waveform

Figure 10: 50 ns duration pulse waveform.

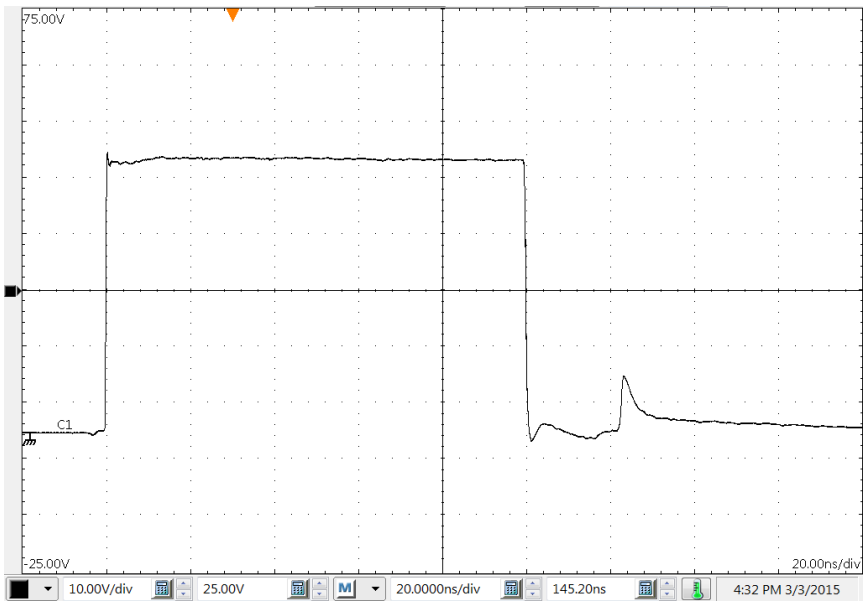

Figure 11: 100 ns duration pulse waveform

The following figures show typical histogram measurements of the timing jitter. The displays are set to 10 V/div and 50 ps/div.

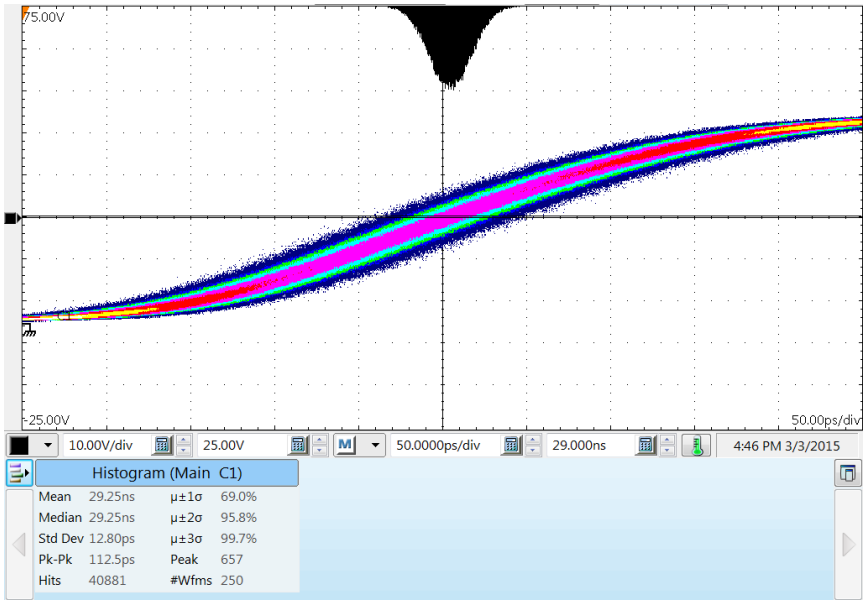

Figure 12: Adjustable delay trigger, jitter measures 12.8 ps_{rms}

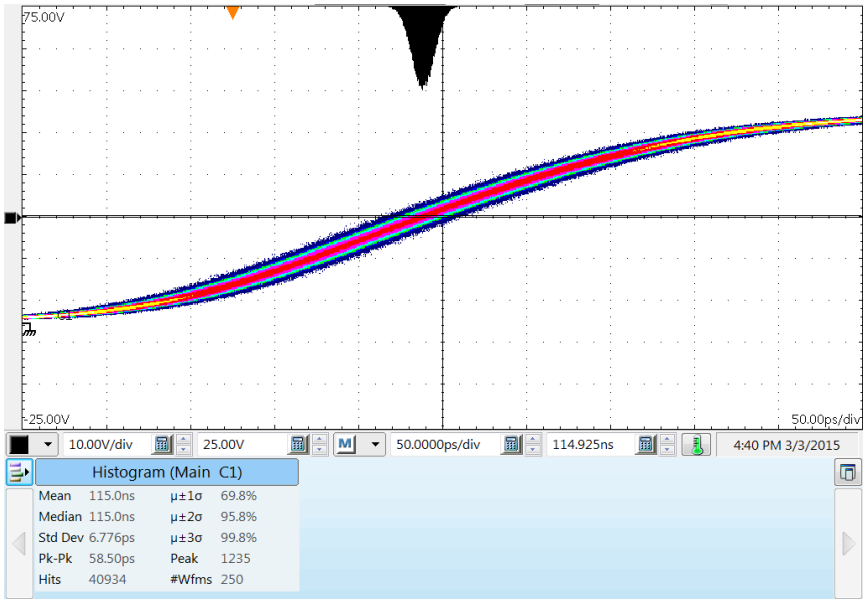

Figure 13: Fixed 115 ns delay trigger, jitter measures 6.8 ps_{rms}

The following figure shows an adjustable duration waveform from 1 ns to 100 ns. The display is set to 10 V/div and 500 ps/div.

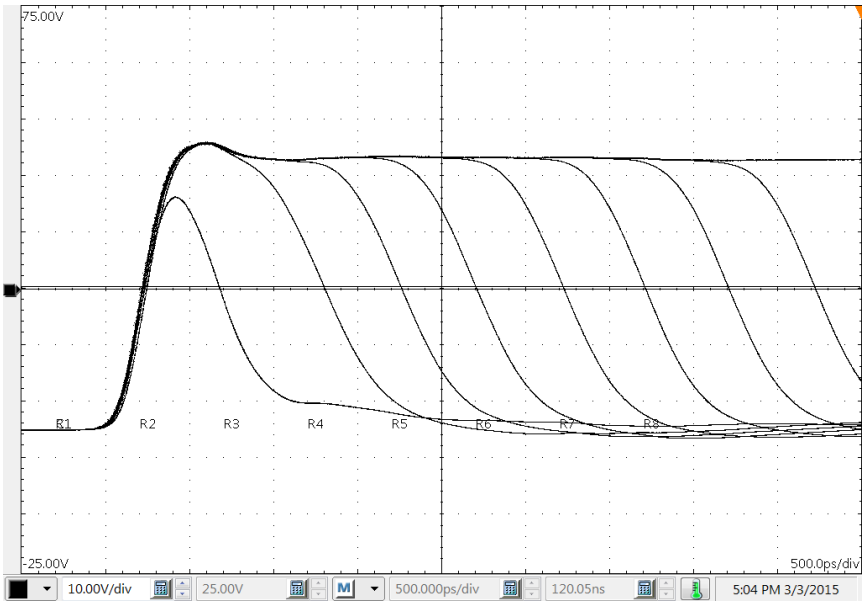

Figure 14: Adjustable duration waveform

Specifications

Specifications listed in this manual are those which applied at the time of printing. Tektronix reserves the right to change specifications at any time without notice and without incurring any obligation to incorporate new features in products previously sold. Tektronix also reserves the right to discontinue products at any time without notice.

NOTE. *The performance parameters listed in the following tables are typical values, parameters are guaranteed at 23 °C (±3 °C) when maximum and/or minimum limits are given.*

Table 3: Model overview

Parameter	PSPL2600C	PSPL2600C-TURBO
Amplitude range into 50 Ω [1]	14 mV to 45 V, ≥40 V min.	16 mV to 50 V, ≥45 V min.
Transition time, leading edge (10 – 90) [1]	400 ps, ≤500 ps max	250 ps, ≤ 350 ps max.
Transition time, trailing edge (10 – 90%) [1]	1 ns, ≤1.8 ns max.	800 ps, ≤1 ns max.
Topline overshoot	≤2%	< 4%
Attenuation	0 to 70 dB, 1 dB steps	
Polarity	Positive or negative	
Baseline	0 V	
Reflection coefficient	-30% during pulse, +50% after pulse. Improves with increasing attenuation	
Source impedance (nominal)	50 Ω	
Duration (FWHM)	< 1 ns to 100 ns, continuously adjustable	
Baseline precursor	< ±2%	
Topline perturbations	< ±2%	
Spurious pulse at 115 ns	+6% with duration ≤ 20 ns, +30% for pulse duration = 100 ns	

[1] Parameters listed are for positive polarity pulse. Negative polarity pulse amplitude is typically 1 dB less and the rise times and fall times are typically 75 ps slower.

Table 4: Trigger and timing

Parameter	Value
Adjustable delay	0 to 100 ns
Adjustable delay jitter, RMS	≤35 ps
Fixed trigger delay	115 ns
Fixed trigger delay jitter, RMS	≤12 ps
Repetition rate	1 Hz to 100 kHz continuously adjustable
External trigger input level	TTL pulse required, level > 1.5 V, + slope, > 10 ns duration
External trigger impedance	430 Ω
Trigger output into 50 Ω	0.8 V
Trigger in/out delay	200 ns

Table 5: General specifications

Parameter	Description
Accessories included	Power cord, front handles, rack mount kit, instruction manual
Front panel controls	Power, repetition rate range, rep. rate vernier, delay, duration, polarity, and attenuation
Power supply (mains)	100, 115, or 230 VAC, ±10% switch selectable, 50 or 60 Hz
Power consumption	42 VA (60 Hz), 65 VA (50 Hz)
Operating environment	Indoors, 0 to 50 °C, <80% rh
Temperature	40 °C (104 °F); low limit of 0 °C (32 °F)
Humidity	80% for temperatures up to 31 °C (88 °F), decreasing linearly to 50% at 40 °C (104 °F)
Elevation	2000 m (6562 ft.)
Dimensions	17 x 13 x 3.25 in. (43.2 x 33.0 x 8.3 cm)
Weight	15 lbs (6.8 kg)
Connectors	SMA output, BNC for trigger in and trigger output
Warranty	One year

User service

This section describes high-level service information and procedures for your instrument.

Service offerings

Tektronix provides service to cover repair under warranty and other services that are designed to meet your specific service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service your instruments. Services are provided at Tektronix Service Centers and on-site at your facility, depending on your location.

Warranty repair service

Tektronix warrants this product as described in the warranty statements at the front of this manual. Tektronix technicians provide warranty service at most Tektronix service locations worldwide. The Tektronix product catalog lists all service locations worldwide.

Calibration and repair service

In addition to warranty repair, Tektronix Service offers calibration and other services that provide cost-effective solutions to your service needs and quality standards compliance requirements. Tektronix instruments are supported worldwide by the leading-edge design, manufacturing, and service resources of Tektronix to provide the best possible service.

General care

Protect the instrument from adverse weather conditions. The instrument is not waterproof.

CAUTION. *To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents.*

Preventive maintenance

Preventive maintenance mainly consists of periodic cleaning. Periodic cleaning reduces instrument breakdown and increases reliability. Clean the instrument as needed, based on the operating environment. Dirty conditions may require more frequent cleaning than computer room conditions.

Clean the exterior surfaces

Clean the exterior surfaces with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.

To avoid damaging the instrument follow these precautions:

- Avoid getting moisture inside the instrument during external cleaning and use only enough solution to dampen the cloth or swab.
- Do not wash the front-panel power switch. Cover the switch while washing the instrument.
- Use only deionized water when cleaning. Use a 75% isopropyl alcohol solution as a cleanser and rinse with deionized water.
- Do not use chemical cleaning agents; they may damage the instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

Fuse replacement

The instrument is protected by a fuse placed in series with the power line input. The fuse is conservatively rated and should never open through the life of the instrument. A blown fuse would generally indicate a problem with the instrument which requires factory service. It is recommended that you arrange to have the instrument serviced if you experience a blown fuse.

Repack the instrument for shipment

If the instrument is to be shipped to a Tektronix service center for repair, attach a tag showing the following information:

- Name of the product owner
- Address of the owner
- Instrument serial number
- A description of the problems encountered and/or service required

When packing an instrument for shipment, use the original packaging. If it is unavailable or not fit for use, contact your Tektronix representative to obtain new packaging.

Compliance information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

Safety compliance

This section lists the safety compliance information.

Equipment type Test and measuring equipment.

Safety class Class 1 – grounded product.

Pollution degree descriptions A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree rating Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).
- Category III. In the building wiring and distribution system.
- Category IV. At the source of the electrical supply to the building.

NOTE. *Only mains power supply circuits have an over voltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.*

Mains overvoltage category rating

Overvoltage category II (as defined in IEC 61010-1).