# PicoSource® PG900 Series

## USB differential pulse generators

### Three PicoSource models

Integrated 60 ps pulse outputs: PG911
Tunnel diode 40 ps pulse heads: PG912
Both output types: PG914

### Integrated pulse outputs

Differential with deskew
60 ps transition time
2.5 V to 6 V amplitude

### Tunnel diode pulse heads

Differential with deskew
40 ps transition time
200 mV amplitude

### Advanced features

Output deskew with 1 ps resolution
Low-jitter trigger input and output
User-variable pulse width
Internal trigger clock
Trigger hold-off

### Configuration

USB 2.0 connected
Microsoft Windows compatible

### Applications

TDR/TDT network and match analysis
Spectral and flatness measurements
Timing, jitter, and crosstalk determination
Semiconductor testing
Impulse ultra-wideband radars
Laser diode drivers

# PicoSource PG900 Series

## USB differential pulse generators

The fast-transition pulse can stimulate a transmission path, device, or network with a broad-spectrum signal in a single instant. These signals, combined with differential capability, are valuable for making high-speed broadband measurements in many fields such as time domain reflectometry, semiconductor testing, gigabit interconnect and port testing, and in radar systems.

High-speed differential data is becoming the dominant measurement challenge in digital, computing, interconnect and telecommunications systems. Despite this need, cost-effective, fast-transition differential pulse generators were hard to find ... until now.

## Key specifications

### PicoSource PG911 and PG914

- Integrated 50 Ω SMA(f) step recovery diode outputs
- < 60 ps single-ended pulse transition time
- Two 2.5 V to 6 V variable amplitude outputs
- ±1 ns timing deskew in 1 ps steps
- 20 dB 10 GHz SMA(m-f) attenuators supplied fitted to SRD pulse outputs

### PicoSource PG912 and PG914

- External 50 Ω N(m) positive and negative tunnel diode pulse heads
- < 40 ps pulse transition time
- Fixed 200 mV output amplitude
- ±500 ps timing deskew in 1 ps steps
- Inter-series N(f)–SMA(m) adaptors included with pulse heads

### All PicoSource PG900 models

- Differential outputs
- 200 ns to 4 µs pulse width
- Adjustable 1 µs to 1 s internal clock period
- Typical 3.0 ps RMS jitter relative to external trigger

## A versatile, portable pulse generator

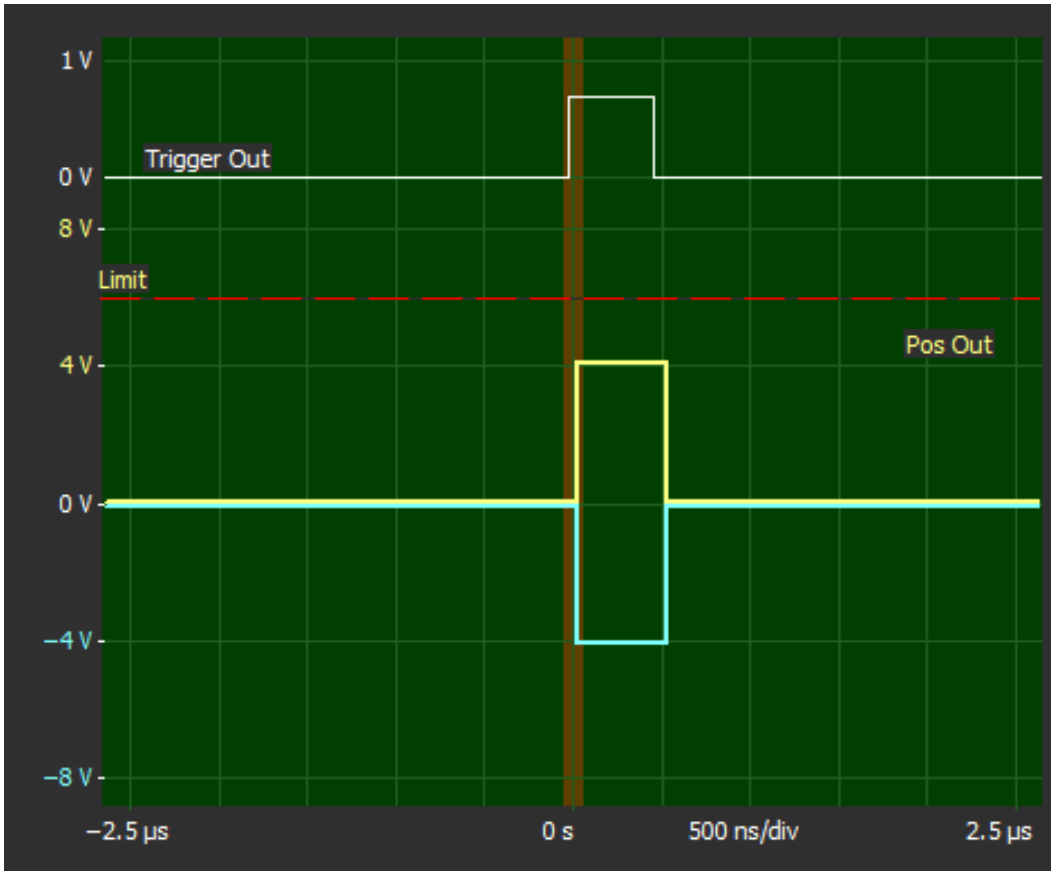
The PicoSource PG900 Series of low-jitter triggered differential USB pulse generators offer a range of advanced features:

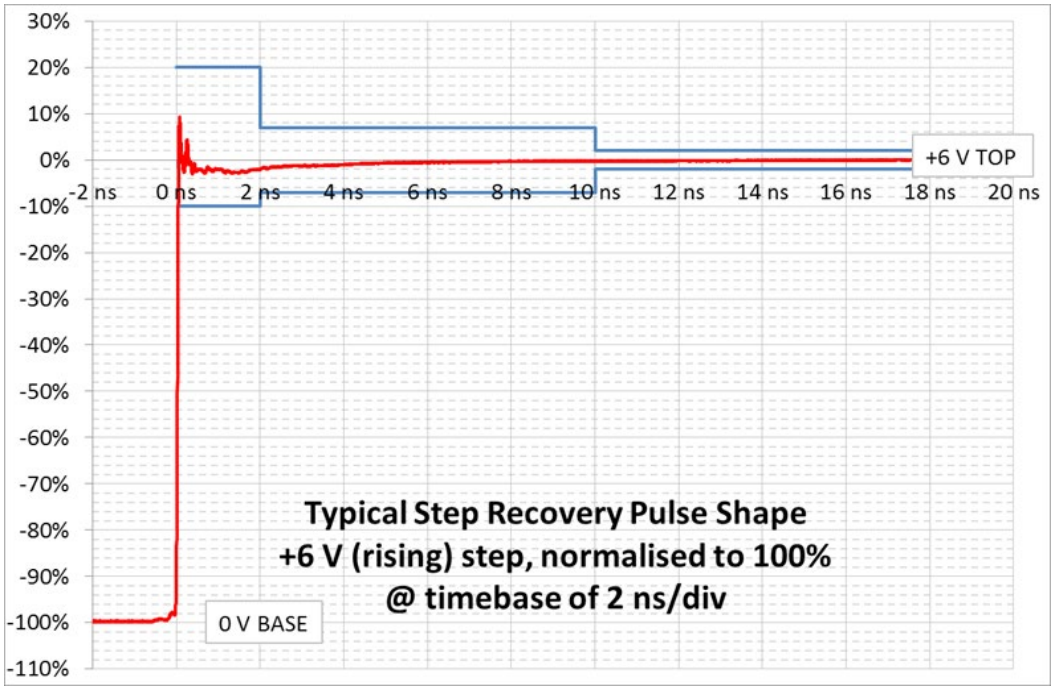
- The pulse outputs are optimized for broad spectral content (fastest transition time) to best suit spectral and time-domain transmission and reflectometry measurements
- The internal clock provides stand-alone, self-triggered operation
- Trigger input and output allow the pulse generators to source or respond to system triggers
- Differential outputs ensure that the proliferation of gigabit differential interconnects and systems (such as SATA, USB3, HDMI, Ethernet) can all be addressed

Essential to any differential measurement is the ability to adjust for small but significant velocity and path length differences that are bound to exist in any measurement setup. The PicoSource PG900 pulse generator outputs can each be adjusted (time-skewed) by 1 ns (integrated pulse outputs) or 200 ps (tunnel diode pulse heads) in 1 ps increments to deskew path differences before the measurement, or to deliberately stress a transmission path with timing skew.

Despite their small size and portability, PicoSource pulse generators have plenty of drive capability, with integrated step recovery diode outputs of up to 6 V pk each into 50 Ω. That's a powerful 12 V pk differential pulse amplitude to drive lossy paths or stress system ports. Outputs are adjustable in 10 mV steps down to 2.5 V pk. An adjustable amplitude limit is provided to protect sensitive devices, and 20 dB attenuators are supplied fitted to the pulse outputs for small-signal optimal match applications.

## Step recovery diode variable-amplitude pulse



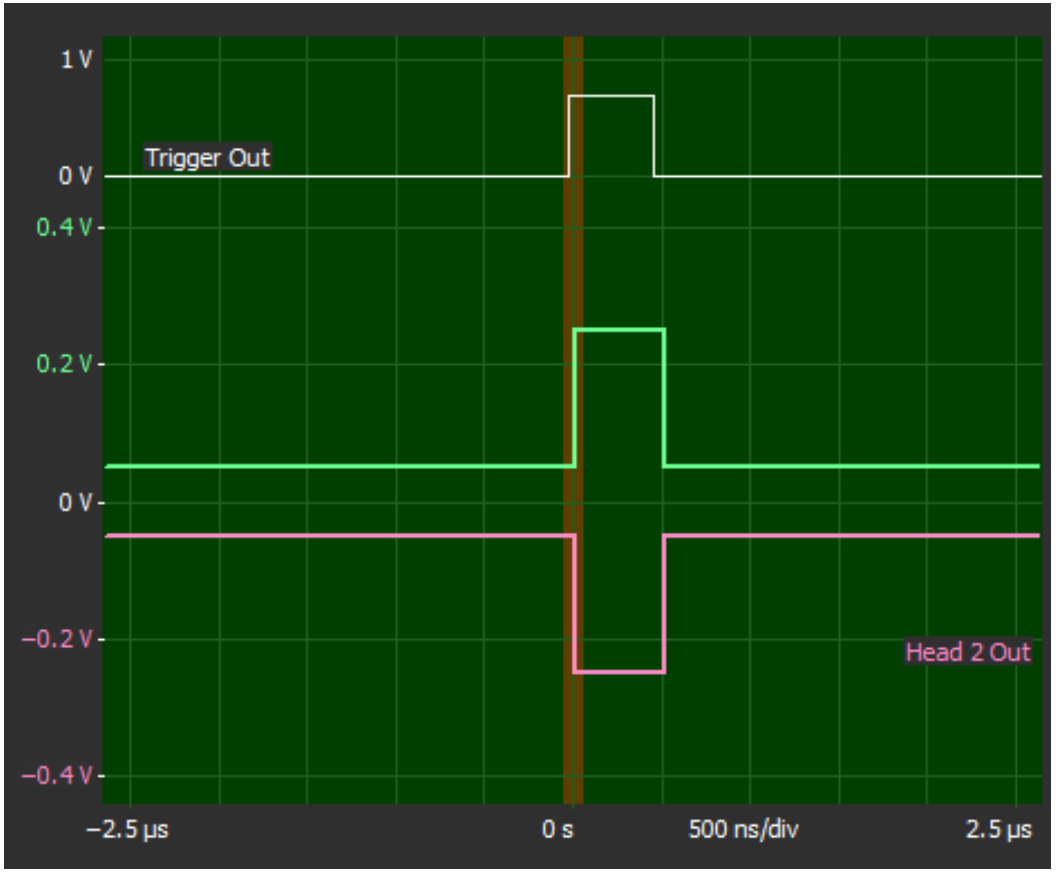



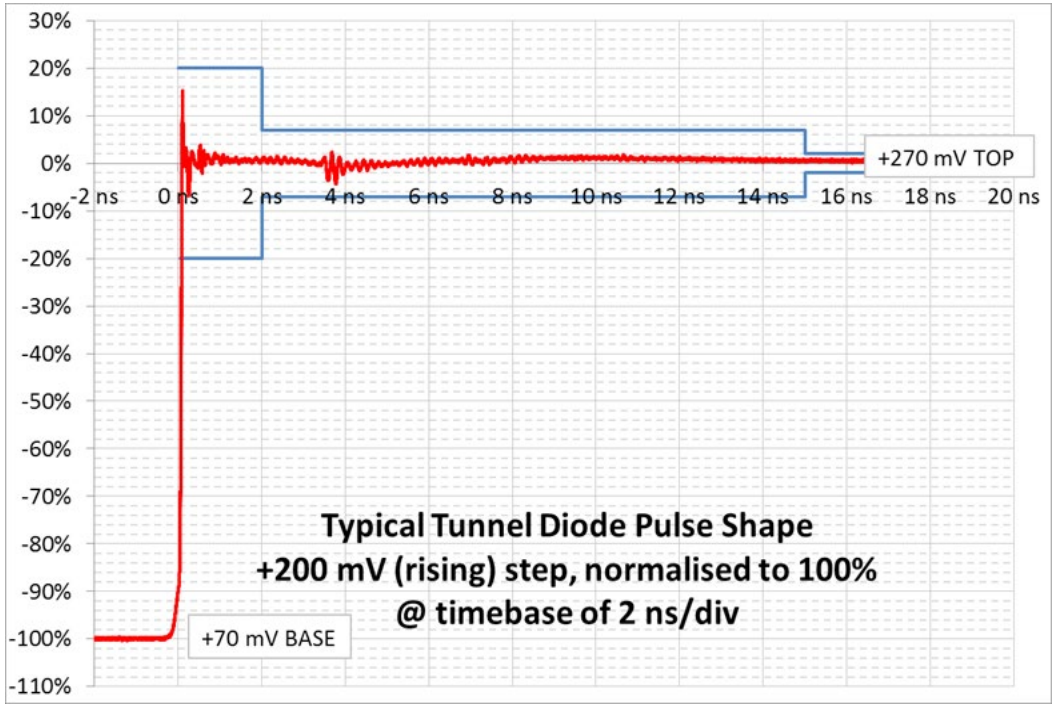

The positive (fast rise) and negative (fast fall) pulses are both ground-referenced and each pulses in opposite polarity to its selected amplitude. This amplitude (the “mark”) is held for the selected pulse width and then returns to ground. Further pulses are prevented for the selected hold-off period and thereafter repeat at 40 ns after the next received trigger. When the internal clock is selected, the pulse repeats at the selected period and hold-off is inactive. An output trigger is generated 40 ns before every pulse, however initiated.

Pulse transition time is typically 55 ps and spectral content extends to 12 GHz.

The negative (fast fall) pulse can be selected for even faster transition time by selecting “fast” rather than “smooth” mode. Pulse aberration is compromised but transition time is typically 45 ps and spectral content extends to around 14 GHz.

## Tunnel diode head fixed-amplitude pulse



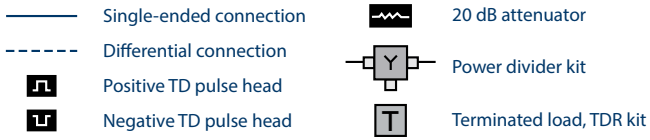




The positive (fast rise) and negative (fast fall) pulses are both DC offset referenced and each pulses in opposite polarity by its independent fixed amplitude. This amplitude (the “mark”) is held for the selected pulse width and then returns to ground. Further pulses are prevented for the selected hold-off period and thereafter repeat at 40 ns after the next received trigger. When the internal clock is selected, the pulse repeats at the selected period and hold-off is inactive. An output trigger is generated 40 ns before every pulse, however initiated.

Pulse transition time is typically 40 ps and spectral content extends to 14 GHz.

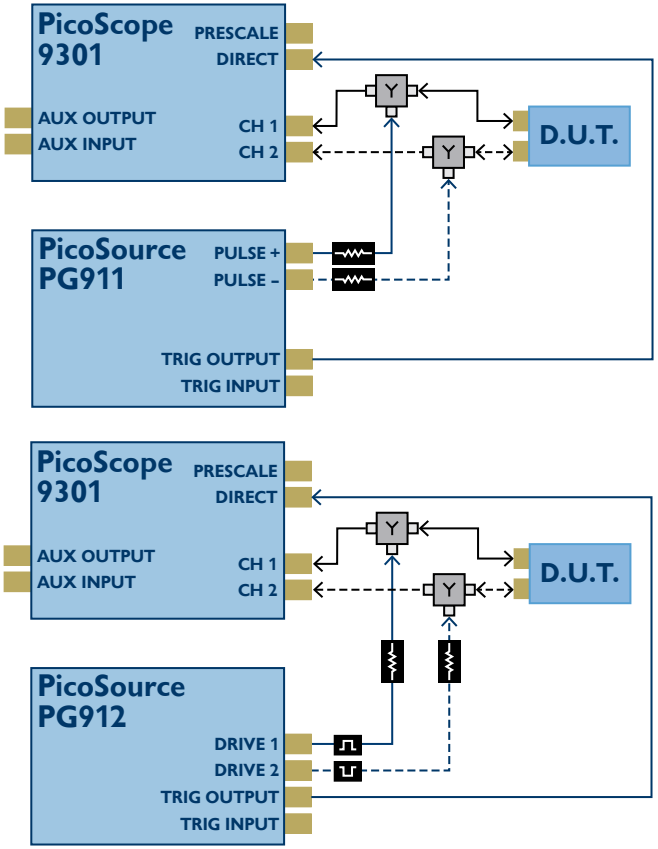
## Connection diagrams

The following diagrams demonstrate differential and single-ended TDR and TDT setup options for a PicoSource pulse generator, PicoScope 9300 Series sampling oscilloscope, and the device under test (DUT). In all setups shown, the PG911 or PG912 pulse generator can be replaced by a PicoSource PG914.



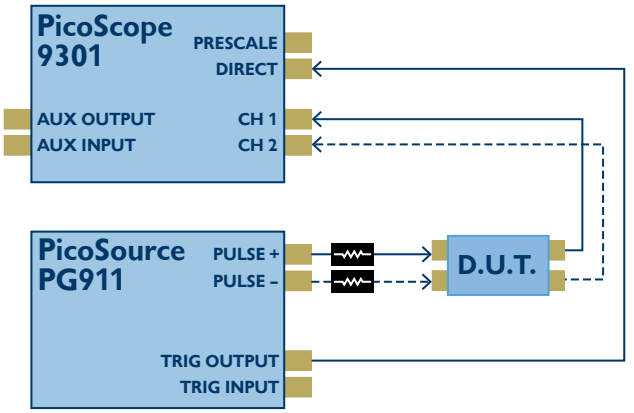

## TDR applications

PicoSource pulse generators can be used to realize time domain reflectometry with a PicoScope 9300 Series sampling oscilloscope without that function (PicoScope 9301, 9302, 9321 and 9341).



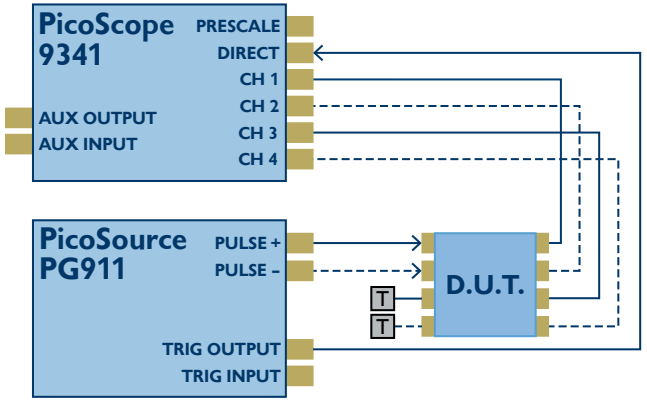

## TDT applications

PicoSource pulse generators can also be used to realize time domain transmission (TDT) with a PicoScope 9300 sampling oscilloscope without that function (PicoScope 9301, 9302, 9321, and 9341). They also offer the versatility of a remotely-placed signal generator for long line or installed system testing when used with any of the PicoScope 9300 models.




## TDT and crosstalk application

PicoSource pulse generators can be used with a PicoScope 9341 four-channel sampling oscilloscope for simultaneous time domain transmission and crosstalk assessment.



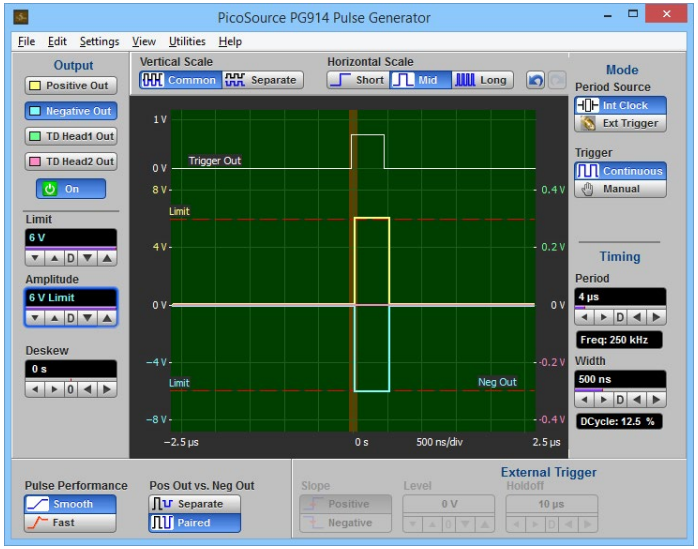

## Single-ended measurements

Single-ended measurements can be performed with a two-channel sampling oscilloscope. Differential measurements can also be tackled by first measuring transmission and then changing connections for crosstalk measurement. Unconnected ports should be correctly terminated in this case.

## PicoSource PG900 pulse control software for Windows

PicoSource pulse generators are connected by USB, and controlled by the supplied PicoSource PG900 software. This straightforward application runs on Microsoft Windows and features a clear graphical display of the pulse, limits and trigger settings as they are applied. Default and user pulse settings can be saved for future use, and the software can be tested in demonstration mode.

PicoSource PG900 software can be downloaded from www.picotech.com.




## Front and rear panels

### PicoSource PG911

SRD pulse outputs

Trigger output and input

### PicoSource PG912

TD pulse head drive outputs

Trigger output and input

### PicoSource PG914

SRD pulse outputs

TD pulse head drive outputs

Trigger output and input

### All models

DC power input

USB port

Signal ground terminal

| PicoSource PG900 Series pulse generator specifications | | |
|---|---|---|
| **PicoSource PG911 and PG914** | | |
| **INTEGRATED STEP RECOVERY DIODE PULSE OUTPUTS** | | |
| Pulse outputs | Positive-going (fast rise) and negative-going (fast fall) outputs returning to 0 V.<br>Adjustable amplitude and timing parameters. Fast transition on leading edge. | |
| Output impedance | 50 Ω | |
| Output connector | SMA(f) | |
| Output amplitude | Adjustable 2.5 V to 6 V in 10 mV steps | |
| Output accuracy | ±10% | |
| Output amplitude limit | 2.5 V to 6 V, adjustable in 100 mV increments | |
| Output protection limit | ±10 V DC, or AC peak | |
| Duty cycle limit | 50% maximum (for 2.5 V to 4 V amplitude)<br>20% maximum (up to 6 V amplitude) | |
| Differential deskew range | Adjustable in 1 ps steps over 2 ns range | |
| | **POSITIVE OR NEGATIVE-GOING, SMOOTH MODE** | **NEGATIVE-GOING, FAST MODE** |
| Pulse transition time | < 60 ps (10% to 90%) | < 50 ps (10% to 90%) |
| Pulse aberrations | < +20%, −10% for first 2 ns<br>< ±7% to 10 ns<br>< ±2% to (pulse width−50 ns) | < +40%, −10% |
| Trailing edge transition time | < 8 ns (10% to 90%) | |
| **PicoSource PG912 and PG914** | | |
| **DRIVE OUTPUTS WITH TUNNEL DIODE PULSE HEADS** | | |
| Positive tunnel diode pulse head | Positive-going (fast rise) output on < 70 mV pedestal.<br>Fixed amplitude and adjustable timing parameters.<br>Fast transition on leading edge. | |
| Negative tunnel diode pulse head | Negative going (fast fall) output on < −70 mV pedestal.<br>Fixed amplitude and adjustable variable timing parameters.<br>Fast transition on leading edge. | |
| Output impedance | 50 Ω, ±2 Ω | |
| Output connector | N(m) | |
| Output amplitude | Fixed 200 mV | |
| Output protection limit | ±0 V DC, or AC peak, except open or short circuit reflection of the source signal. No prolonged reverse bias allowed. | |
| Output accuracy | ±25% | |
| Differential deskew range | Adjustable in 1 ps steps over 200 ps minimum, 300 ps typical | |
| Pulse transition time | < 40 ps (10 % to 90%) | |

| PicoSource PG900 Series pulse generator specifications | |
|---|---|
| Pulse aberrations | < ±20%, for first 2 ns<br>< ±7% to 15 ns<br>< ±2% to (pulse width – 50 ns) |
| Trailing edge transition time | < 8 ns (10% to 90%) |
| Dimensions (each pulse head) | 80 mm x 28 mm x 25 mm |
| Weight (each pulse head) | 125 g |
| **All models and outputs** | |
| **PULSE TIMING** | |
| Pulse trigger source | External input, manual single shot event or internal clock |
| Jitter relative to leading edge | 3.0 ps RMS typical. 3.5 ps RMS maximum. |
| Post-trigger delay to pulse leading edge | Fixed 42 ns ±2 ns<br>Allows leading-edge capture on sampling oscilloscopes |
| Pulse width and accuracy | 200 ns to 4 µs ±10% ±50 ns, adjustable in steps of 25 ns |
| Pulse width jitter | < 150 ppm of width RMS |
| External trigger hold-off | Adjustable 1 µs to 1.3 ms in steps of 200 ns, to maximum of 345 ms in steps of < 15 ppm |
| **INTERNAL CLOCK SPECIFICATION** | |
| Period and accuracy | Adjustable 1 µs to 1 s, ±100 ppm ±10 ns in steps of 200 ns |
| **EXTERNAL TRIGGER INPUT SPECIFICATION** | |
| Impedance | 50 Ω ±1% |
| Connector | SMA(f) |
| Maximum input level | +16 dBm, or ±2 V DC or AC pk |
| Bandwidth | 1 GHz, DC coupled |
| Trigger polarity | Selectable rising or falling edge |
| Trigger level | Selectable –1 V to +1 V in steps of 1 mV |
| Sensitivity | < 50 mV pk-pk DC to 100 MHz, rising linearly to 100 mV pk-pk at 1 GHz |
| Minimum pulse width | 500 ps at 100 mV pk-pk |
| **EXTERNAL TRIGGER OUTPUT SPECIFICATION** | |
| Trigger output pulse | Fixed amplitude and timing parameters, positive edge polarity, trigger is leading edge |
| Impedance | 50 Ω, ±0.5 Ω |
| Connector | SMA(f) |
| Amplitude and offset | > 700 mV fixed, on logic low of 0 V ± < 100 mV |
| Pulse width | 500 ns, ±100 ns |
| Trigger to trigger output delay | 4 ns, ±1 ns |
| Trigger to trigger output jitter | 2.5 ps RMS typical. 3 ps RMS maximum. |
| Transition time | < 400 ps (10% to 90%) |

| PicoSource PG900 Series pulse generator specifications | |
|---|---|
| **GENERAL SPECIFICATIONS** | |
| AC to DC adaptor | 5 V ±5% at 1.6 A, 8 W, universal plug (adaptor included) |
| PC connection | USB 2.0 (USB 1.1 and USB 3.0 compatible), 1.8 m USB 2.0 lead included |
| PC requirements | Windows XP SP3 to Windows 8 |
| Operating temperature range | +5 °C to +35 °C |
| Storage temperature range | –20 °C to +50 °C |
| Temperature range for stated specifications | +15 °C to +25 °C or $T_{CAL}$ (temperature of calibration) ±5 °C |
| Operating humidity range | < 85% RH (non-condensing) at +35 °C |
| Storage humidity range | < 95% RH (non-condensing) |
| Altitude range | Up to 2000 m |
| Pollution degree | 2 |
| Ingress protection | IP20 |
| Dimensions (instrument) | 190 mm W x 180 mm D x 40 mm H |
| Weight (instrument) | 560 g |
| Compliance | FCC (EMC), CE (EMC and LVD) |
| Warranty | 5 years |

Specifications describe guaranteed performance over the stated temperature range and apply after the instrument's temperature has been stabilized in one hour of continuous operation. All specifications are subject to change without notice.

Factory calibration cycle. For optimum performance, the instrument should have a complete verification of specifications once every 12 months.

## Optional accessories

| Order code | Model name | Description | | USD* | EUR* | GBP* |
|---|---|---|---|---|---|---|
| TA237 | TA237 14 GHz 25 ps TDR kit | 18 GHz 50 Ω SMA(m-m) within-series adaptor<br>18 GHz SMA(f) reference short<br>18 GHz SMA(f) reference load | | 329 | 289 | 229 |
| TA238 | TA238 14 GHz power divider kit | 18 GHz 50 Ω SMA(f-f-f) 3-resistor 6 dB power divider<br>2 x 10 cm precision coaxial SMA(m-m) cable<br>For use with a PicoScope 9300 Series oscilloscope | | 539 | 479 | 379 |
| TA181 | TA181 attenuator 3 dB | 10 GHz 50 Ω SMA (m-f) | | 75 | 67 | 53 |
| TA261 | TA261 attenuator 6 dB | 10 GHz 50 Ω SMA (m-f) | | 75 | 67 | 53 |
| TA262 | TA262 attenuator 10 dB | 10 GHz 50 Ω SMA (m-f) | | 75 | 67 | 53 |
| TA173 | TA173 attenuator 20 dB | 10 GHz 50 Ω SMA (m-f) | | 75 | 67 | 53 |
| TA172 | TA172 inter-series adaptor | 18 GHz, 50 Ω N(f) -SMA(m) | | 129 | 119 | 92 |
| TA170 | TA170 connector saver adaptor | 18 GHz 50 Ω SMA(m-f) | | 20 | 18 | 14 |
| TA263 | TA263 precision high-flex unsleeved coaxial cable | 60 cm, SMA(m-m)<br>< 1.7 dB loss @ 10 GHz | | 75 | 67 | 53 |

| Order code | Model name | Description | | USD* | EUR* | GBP* |
|---|---|---|---|---|---|---|
| TA264 | TA264 precision high-flex unsleeved coaxial cable | 30 cm, SMA(m-m)<br>< 1.1 dB loss @ 10 GHz | | 65 | 58 | 46 |
| TA265 | TA265 precision sleeved coaxial cable | 30 cm, SMA(m-m)<br>< 1.1 dB loss @ 10 GHz | | 65 | 58 | 46 |

* Prices correct at the time of publication. Sales taxes not included. Please contact Pico Technology for the latest prices before ordering.

## Kit contents

**PicoSource PG911**

**PicoSource PG912**

**PicoSource PG914**

| ALL KITS CONTAIN: | | | | |
|---|---|---|---|---|
| PicoSource PG900 software disk • Quick Start Guide • AC to DC adaptor 5 V DC at 2 A, universal input<br>USB 2.0 cable 1.8 m • SMA/PC3.5/2.92 wrench • Storage and carry case | | | | |
| **Order code** | **Description** | **PG911** | **PG912** | **PG914** |
| Not available separately | Positive 40 ps tunnel diode pulse head (attached to the device) | | • | • |
| Not available separately | Negative 40 ps tunnel diode pulse head (attached to the device) | | • | • |
| TA172 | 12 GHz N(f) to SMA(m) adaptor (2 pack) | | • | • |
| TA173 | 10 GHz 20 dB SMA(m-f) attenuator (2 pack) | • | | • |
| Not available separately | 50 Ω coaxial SMA(m-m) pulse drive cable 60 cm (2 pack) | | • | • |

## Ordering information

### Pulse generators

| Order code | Model name | Description | USD* | EUR* | GBP* |
|---|---|---|---|---|---|
| PP977 | PicoSource PG911 | 50 Ω SMA(f) < 60 ps differential pulse outputs, 2.5 V to 6 V variable amplitude | 7995 | 6635 | 6035 |
| PP978 | PicoSource PG912 | 50 Ω N(m) < 40 ps positive and negative tunnel diode pulse heads, > 200 mV fixed amplitude | 10 415 | 8645 | 7855 |
| PP979 | PicoSource PG914 | Dual-mode generator with both of the above outputs | 12 825 | 10 645 | 9675 |

* Prices are correct at the time of publication. Sales taxes not included. Please contact Pico Technology for the latest prices before ordering.

## More RF products from Pico...

**PicoConnect 900 Series**
9 GHz passive probes

**PicoScope 9300 Series**
Sampling scopes and TDR to 25 GHz

**PicoScope 9404-05**
Sampler extended real time scopes

**PicoVNA 106**
Making vector network analysis accessible

**PicoSource AS108**
8 GHz agile synthesizer

**UK global headquarters:**

Pico Technology
James House
Colmworth Business Park
St. Neots
Cambridgeshire
PE19 8YP
United Kingdom

☎ +44 (0) 1480 396 395
✉ sales@picotech.com

**North America regional office:**

Pico Technology
320 N Glenwood Blvd
Tyler
Texas 75702
United States

☎ +1 800 591 2796
✉ sales@picotech.com

**Asia-Pacific regional office:**

Pico Technology
Room 2252, 22/F, Centro
568 Hengfeng Road
Zhabei District
Shanghai 200070
PR China

☎ +86 21 2226-5152
✉ pico.china@picotech.com



Errors and omissions excepted. *Pico Technology*, *PicoSource* and *PicoScope* are internationally registered trademarks of Pico Technology Ltd. *PicoConnect* and *PicoVNA* are registered trademarks of Pico Technology Ltd.

*Windows* is a registered trademark of Microsoft Corporation in the United States and other countries.

MM070.en-8. Copyright © 2015–2019 Pico Technology Ltd. All rights reserved.


www.picotech.com