KEITHLEY
A Tektronix Company

Model 2601B-PULSE

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System SourceMeter Instrument Specifications

SPECIFICATION CONDITIONS

This document contains specifications and supplemental information for the Model 2601B-PULSE System SourceMeter® 10 µs Pulser/SMU instrument. Specifications are the standards against which the Model 2601B-PULSE instrument is tested. Upon leaving the factory, the 2601B-PULSE meets these specifications. Supplemental and typical values are non-warranted, apply at 23 °C, and are provided solely as useful information.

Source and measurement accuracies are specified at the terminals of the SourceMeter instrument under these conditions:

- 18 °C to 28 °C, <70% relative humidity.
- After two-hour warmup.
- Speed normal (1 NPLC).
- A/D autozero enabled.
- Remote sense operation only or properly zeroed local operation.
- Calibration period: One year.

Pulser specification accuracies are specified at the terminals of the instrument under these conditions:

- 10 µs aperture minimum.
- Remote sense operation only.
- Total cable and DUT inductance of ≤3 µH measured at 100 kHz.

PULSER SPECIFICATIONS

PULSER SOURCE SPECIFICATIONS[1,2]

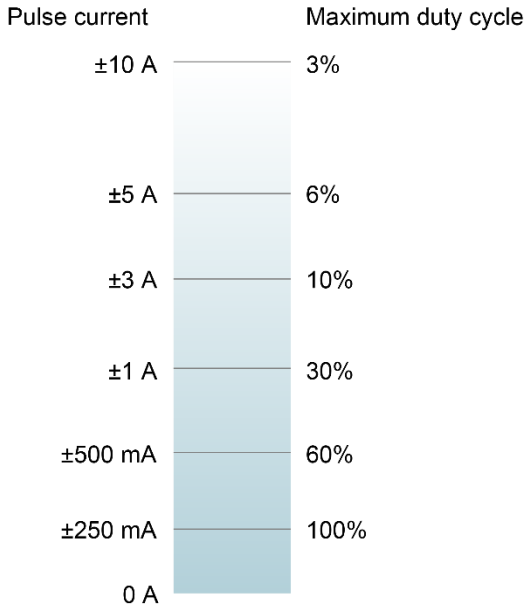
Current Pulse Termination	The current pulse terminates within 3 µs after terminal voltages exceed a bipolar, programmable abort threshold. Separate abort thresholds can be programmed for the sense terminals and the source terminals. The sense terminal threshold can be set from 5% to 200% of the selected Measure Voltage range. The source terminal threshold can be set from 2 V to 40 V, independent of range. The source threshold ignores normal transients during pulse rise and fall time. Programmable threshold uncertainty is ±5%.

[1] Full power source operation regardless of load to 28 °C ambient. Above 28 °C and/or power sink operation, refer to “Operating Boundaries” in the *Model 2601B-PULSE Reference Manual* for additional power derating information.
[2] Source valid for steady state output values. See settling time specification defining the steady state output requirement.

PULSER CURRENT SOURCE SPECIFICATIONS

Current Programming Accuracy	Range	Programming Resolution	Accuracy (1 Year) ±(% reading + amps)	Typical Noise (RMS) 10 kHz to 1 MHz
	1 A	100 µA	0.17% + 2.0 mA	380 µA
	5 A	100 µA	0.17% + 2.5 mA	1.4 mA
	10 A	100 µA	0.22% + 3.0 mA	3.1 mA[3]
Temperature Coefficient (0 °C to 18 °C and 28 °C to 50 °C)	±(0.15 × accuracy specification)/°C			
Duty Cycle Limits[4, 5]	▪ ±10 A at ±10 V pulse 3% duty cycle ▪ ±3 A at ±10 V pulse, 10% duty cycle ▪ ±1.0 A at ±10 V pulse, 30% duty cycle ▪ ±500 mA at ±10 V pulse, 60% duty cycle[6] ▪ ±250 mA at ±10 V continuous			
Current Regulation	Line: ±0.01% of range Load: ±100 µA			
Overshoot	<±0.5% of step size (typical)			

ADDITIONAL PULSER SOURCE SPECIFICATIONS

Rise Time (10% to 90%)	<1.7 µs for a full-scale step of current into any load voltage (10 V maximum).
Pulse Current and Duty Cycle[4]	Maximum duty cycle is given by: $\frac{0.3125 - \lvert I_{BIAS} \rvert}{\lvert \lvert I_{PULSE} \rvert - \lvert I_{BIAS} \rvert \rvert} * 100\%$ For I_{BIAS} ≤ 10 mA: 

[3] For pulses longer than 100 µs, there can be a thermal drift of up to 0.004% of source value. This drift is already included in the overall source accuracy specifications.
[4] Thermally limited in sink mode (quadrants 2 and 4) and ambient temperatures above 28 °C. Above 28 °C or during power sink operation, refer to "Operating Boundaries" in the *Model 2601B-PULSE Reference Manual* for additional power derating information.
[5] Duty cycles listed can only be achieved if bias current is ≤10 mA.
[6] Due to pulse width programming, minimum t_{off} of 16 µs.

Additional Zero-Crossing Delay	$1\ \mu s + \frac{200(ns \times A)}{\text{Pulse current (in amperes)}}$	
Current Source Output Settling Time (typical)	Time required to reach specified accuracy after the start of the pulse.	
	Current Range	**Settling Time**
	1 A	<9 µs (V_{LOAD} ≤ 10 V)
	5 A	<9 µs (V_{LOAD} ≤ 10 V)
	10 A	<9 µs (V_{LOAD} ≤ 10 V)
OUTPUT OFF Normal State	Electrical short (<1 Ω) between HI and LO. Maximum dc current from external sources during OUTPUT OFF state must be limited to <1 A.	
Remote Voltage Sense	Maximum voltage between HI and SENSE HI = ±30 V. Maximum voltage between LO and SENSE LO = ±30 V.	
Overtemperature Protection	Internally sensed overtemperature condition puts the instrument in standby mode.	
Safety Interlock	Hardware interlock (available, optional).	

Bias Current Source Specifications

Current Programming Accuracy	**Range**	**Programming Resolution**	**Accuracy (1 Year) ±(% reading + amps)**	**Typical Noise (RMS) 0.1 Hz to 100 kHz**
	250 mA	10 µA	0.17% + 1 mA	200 µA
Temperature Coefficient (0 °C to 18 °C and 28 °C to 50 °C)	±(0.15 × accuracy specification) /ºC			

Pulse Width Programming Resolution	1 µs
Pulse Width Programming Maximum	500 µs
Pulse Width Programming Minimum	10 µs
Pulse Width Programming Accuracy	±200 ns
Pulse Width Jitter	110 ns (typical)
Pulse Period Jitter	2 µs (typical)
Pulse Width Programming, Minimum t_{off}	16 µs

PULSER MEASURE SPECIFICATIONS

Voltage Measurement Specifications

Voltage Measurement Accuracy	Range	Display Resolution	Accuracy (1 Year) 23 °C ±5 °C ±(% reading + volts)[7]
	5 V	1 µV	0.05% + 2.5 mV
	10 V	10 µV	0.05% + 4 mV
Voltage Measurement Settling Time	Time required to reach specified accuracy after a source level command is processed on a fixed range.		
	Voltage Range		**Settling time (typical)**
	5 V and 10 V		<9 µs
Temperature Coefficient (0 °C to 18 °C and 28 °C to 50°C)	±(0.15 × accuracy specification)/°C		

Current Measurement Specifications

Current Measurement Accuracy	Range	Display Resolution	Accuracy (1 Year) 23 °C ±5 °C ±(% reading + amps)[7]
	1 A	1 µA	0.12% + 0.5 mA
	5 A	1 µA	0.12% + 1 mA
	10 A	10 µA	0.12% + 1 mA
Current Measurement Settling Time	Time required to reach specified accuracy after source level command is processed on a fixed range.		
	Current Range	**Settling Time (typical)**	
	1 A to 10 A	<9 µs	
Temperature Coefficient (0 °C to 18 °C and 28 °C to 50 °C)	±(0.15 × accuracy specification)/°C		

Additional Pulser Characteristics

Maximum Inductance	3 µH (cable plus device under test (DUT)), measured at 100 kHz
Common Mode Isolation	>1 GΩ <4500 pF
Overrange	100% of bias range 101% of source range 102% of measure range
Maximum Source/Sense Lead Resistance	0.5 Ω/100 Ω per lead
Sense HI/LO Input Impedance	2 MΩ (typical)
SMU-to-Pulser Transition Time	<7 ms

[7] Accuracies valid for 10 µs aperture, measurement beginning at the end of the settling time. Refer to A/D Aperture Characteristics for other apertures.

A/D Aperture Characteristics

A/D Converter Speed	1 µs	10 µs	100 µs
Effective Number of Conversions	1	10	100
Effective Number of Bits (ENOB)	Current: 12 Voltage: 14	Current: 14 Voltage: 16	Current: 15 Voltage: 18
Additional Measure Current Noise Uncertainty	±1.5 mA	0 A	0 A
Additional Measure Voltage Noise Uncertainty	±0.03% of measure voltage range	0%	0%

SMU SPECIFICATIONS

VOLTAGE ACCURACY SPECIFICATIONS[8,9]

Range	Source			Measure	
	Programming Resolution	**Accuracy ±(% reading + volts)**	**Typical Noise (peak-to-peak) 0.1 Hz to 10 Hz**	**Display Resolution**	**Accuracy[10] ±(% reading + volts)**
100 mV	5 µV	0.02% + 250 µV	20 µV	100 nV	0.015% + 150 µV
1 V	50 µV	0.02% + 400 µV	50 µV	1 µV	0.015% + 200 µV
6 V	50 µV	0.02% + 1.8 mV	100 µV	1 µV	0.015% + 1 mV
40 V	500 µV	0.02% + 12 mV	500 µV	10 µV	0.015% + 8 mV

CURRENT ACCURACY SPECIFICATIONS[8]

Range	Source			Measure	
	Programming Resolution	**Accuracy ±(% reading + amps)**	**Typical Noise (peak-to-peak)** 0.1 Hz to 10 Hz	**Display Resolution**	**Accuracy[10] ±(% reading + amps)**
100 nA	2 pA	0.1% + 100 pA	5 pA	100 fA	0.08% + 100 pA
1 µA	20 pA	0.03% + 800 pA	25 pA	1 pA	0.025% + 500 pA
10 µA	200 pA	0.03% + 5 nA	60 pA	10 pA	0.025% + 1.5 nA
100 µA	2 nA	0.03% + 60 nA	3 nA	100 pA	0.02% + 25 nA
1 mA	20 nA	0.03% + 300 nA	6 nA	1 nA	0.02% + 200 nA
10 mA	200 nA	0.03% + 6 µA	200 nA	10 nA	0.02% + 2.5 µA

[8] For temperatures 0 °C to 18 °C and 28 °C to 50 °C, accuracy is degraded by ±(0.15 × accuracy specification)/°C for normal mode only. High-capacitance mode accuracy is applicable at 18 °C to 28 °C.

[9] Add 50 µV to source accuracy specifications per volt of HI lead drop.

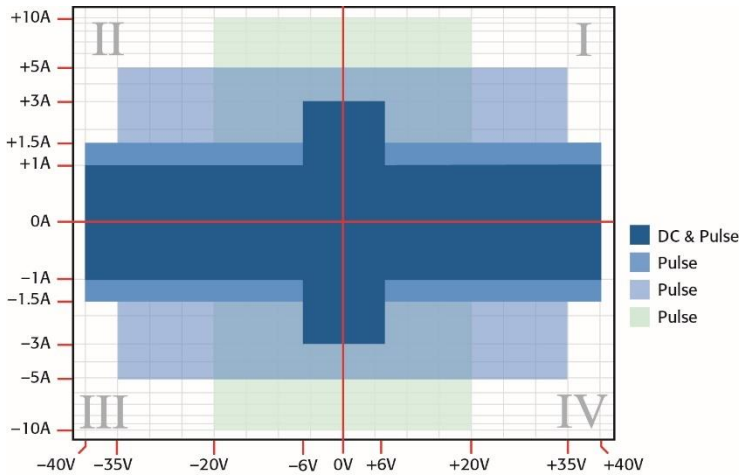
[10] Derate accuracy specification for NPLC setting <1 by increasing the error term. Add appropriate typical percent of reading term for resistive loads using the table below.

NPLC Setting	100 mV Range	1 V to 40 V Ranges	100 nA Range	1 µA to 100 mA Ranges	1 A to 3 A Ranges
0.1	0.01%	0.01%	0.01%	0.01%	0.01%
0.01	0.08%	0.07%	0.1%	0.05%	0.05%
0.001	0.8%	0.6%	1%	0.5%	1.1%

Range	Source			Measure	
	Programming Resolution	**Accuracy ±(% reading + amps)**	**Typical Noise (peak-to-peak)** 0.1 Hz to 10 Hz	**Display Resolution**	**Accuracy[10] ±(% reading + amps)**
100 mA	2 µA	0.03% + 30 µA	600 nA	100 nA	0.02% + 20 µA
1 A	20 µA	0.05% + 1.8 mA	70 µA	1 µA	0.03% + 1.5 mA
3 A	20 µA	0.06% + 4 mA	150 µA	1 µA	0.05% + 3.5 mA
10 A[11]	200 µA	0.5% + 40 mA	N/A	10 µA	0.4% + 25 mA

DC POWER SPECIFICATIONS

	Voltage	Current
Maximum Output Power and Source/Sink Limits[12]	40.4 W maximum ▪ ±(40.4 V at ±1.0 A) ▪ ±(6.06 V at ±3.0 A) ▪ Four-quadrant source or sink operation	40.4 W maximum ▪ ±(1.01 A at ±40 V) ▪ ±(3.03 A at ±6 V) ▪ Four-quadrant source or sink operation



Refer to Pulse Characteristics for pulsing details, such as duty cycle and pulse width.

ADDITIONAL SOURCE CHARACTERISTICS

Noise **10 Hz to 20 MHz**	<20 mV peak-to-peak, <3 mV_{RMS} ▪ 6 V range
Transient Response Time	<70 µs for the output to recover to within 0.1% for a 10% to 90% step change in load.
Overshoot	Voltage: ▪ <±0.1% + 10 mV ▪ Step size = 10% to 90% of range, resistive load, maximum current limit/compliance Current: ▪ <±0.1% ▪ Step size = 10% to 90% of range, resistive load ▪ See Current source output settling time for additional test conditions

[11] 10 A range is accessible in SMU extended range mode only. Accuracy specifications for 10 A range are typical.
[12] Full power source operation regardless of load to 28 °C ambient temperature. Above 28 °C or power sink operation, refer to "Operating boundaries" in the *Model 2601B-PULSE Reference Manual* for additional power derating information.

<table>
<tr><td>Range Change Overshoot</td><td colspan="2">Voltage:[13]
▪ <300 mV + 0.1% of larger range
▪ Overshoot into a 100 kΩ load, 20 MHz bandwidth
Current:[14] <300 mV/R_{LOAD} + 5% of larger range</td></tr>
<tr><td>Guard Offset Voltage</td><td colspan="2"><4 mV
▪ Current <10 mA</td></tr>
<tr><td>Remote Sense Operating Range[15]</td><td colspan="2">Maximum voltage between HI and SENSE HI = 3 V
Maximum voltage between LO and SENSE LO = 3 V</td></tr>
<tr><td>Voltage Output Headroom</td><td colspan="2">40 V range
▪ Maximum output voltage = 42 V – (total voltage drop across source leads)
Maximum 1 Ω per source lead
6 V range
▪ Maximum output voltage = 8 V – (total voltage drop across source leads)
Maximum 1 Ω per source lead</td></tr>
<tr><td>Overtemperature Protection</td><td colspan="2">Internally sensed overtemperature condition puts the instrument in standby mode</td></tr>
<tr><td>Limit/Compliance</td><td colspan="2">Bipolar limit (compliance) set with a single value
Voltage:[16] Minimum value is 10 mV; accuracy is the same as voltage source
Current:[17] Minimum value is 10 nA; accuracy is the same as current source</td></tr>
<tr><td rowspan="5">Voltage Source Output Settling Time</td><td colspan="2">Time required to reach within 0.1% of final value after source level command is processed on a fixed range</td></tr>
<tr><td>Voltage Range</td><td>Settling Time</td></tr>
<tr><td>100 mV</td><td><50 µs</td></tr>
<tr><td>1 V</td><td><50 µs</td></tr>
<tr><td>6 V</td><td><110 µs</td></tr>
<tr><td>40 V[18]</td><td><150 µs</td></tr>
<tr><td rowspan="9">Current Source Output Settling Time</td><td colspan="2">Time required to reach within 0.1% of final value after source level command is processed on a fixed range
Values below for $I_{OUT} \times R_{LOAD}$ = 1 V unless noted</td></tr>
<tr><td>Current Range</td><td>Settling Time</td></tr>
<tr><td>100 nA</td><td><20 ms</td></tr>
<tr><td>1 µA</td><td><2 ms</td></tr>
<tr><td>10 µA</td><td><500 µs</td></tr>
<tr><td>100 µA</td><td><150 µs</td></tr>
<tr><td>1 mA</td><td><100 µs</td></tr>
<tr><td>10 mA to 1 A</td><td><80 µs (R_{LOAD} >6 Ω)</td></tr>
<tr><td>3 A</td><td><80 µs (current <2.5 A, R_{LOAD} >2 Ω)</td></tr>
</table>

[13] Add 200 mV for the 6 V to 40 V change.
[14] With source settling set to `SETTLE_SMOOTH_100NA`.
[15] Add 50 µV to source accuracy specifications per volt of HI lead drop.
[16] For sink operation (quadrants II and IV) without sink mode enabled, add 10% of compliance range and ±0.02% of limit settling to the corresponding voltage source accuracy specifications. For the 100 mV range, add an additional 60 mV of uncertainty. Specifications apply with sink mode enabled.
[17] For sink operation (quadrants II and IV) without sink mode enabled, add 0.06% of limit range to the corresponding current limit accuracy specifications. Specifications apply with sink mode enabled.
[18] Add 150 µs when measuring on the 1 A range.

ADDITIONAL MEASUREMENT CHARACTERISTICS

Contact Check Specifications[19]	**Speed**	**Maximum Measurement Time to Memory for 60 Hz (50 Hz)**	**Accuracy (1 year) ±(% reading + ohms)**
	Fast	1 ms (1 ms)	5% + 10 Ω
	Medium	4 ms (5 ms)	5% + 1 Ω
	Slow	35 ms (42 ms)	5% + 0.3 Ω
Current Measure Settling Time[20]	Time required to reach within 0.1% of final value after source level command is processed on a fixed range Values below for V_{OUT} = 1 V		
	Current Range	**Settling Time**	
	1 mA	<100 µs	
Input Impedance	>10 GΩ		

ADDITIONAL CHARACTERISTICS

Maximum Load Capacitance	**Normal Mode** 10 nF	**High-Capacitance Mode** 50 µF
Common Mode Isolation	>1 GΩ <4500 pF	
Sense HI Input Impedance	>10 GΩ	
Maximum Sense Lead Resistance	1 kΩ for rated accuracy	
Overrange	101% of source range 102% of measure range	

[19] Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.
[20] Compliance equal to 100 mA.

HIGH-CAPACITANCE MODE[21, 22, 23]

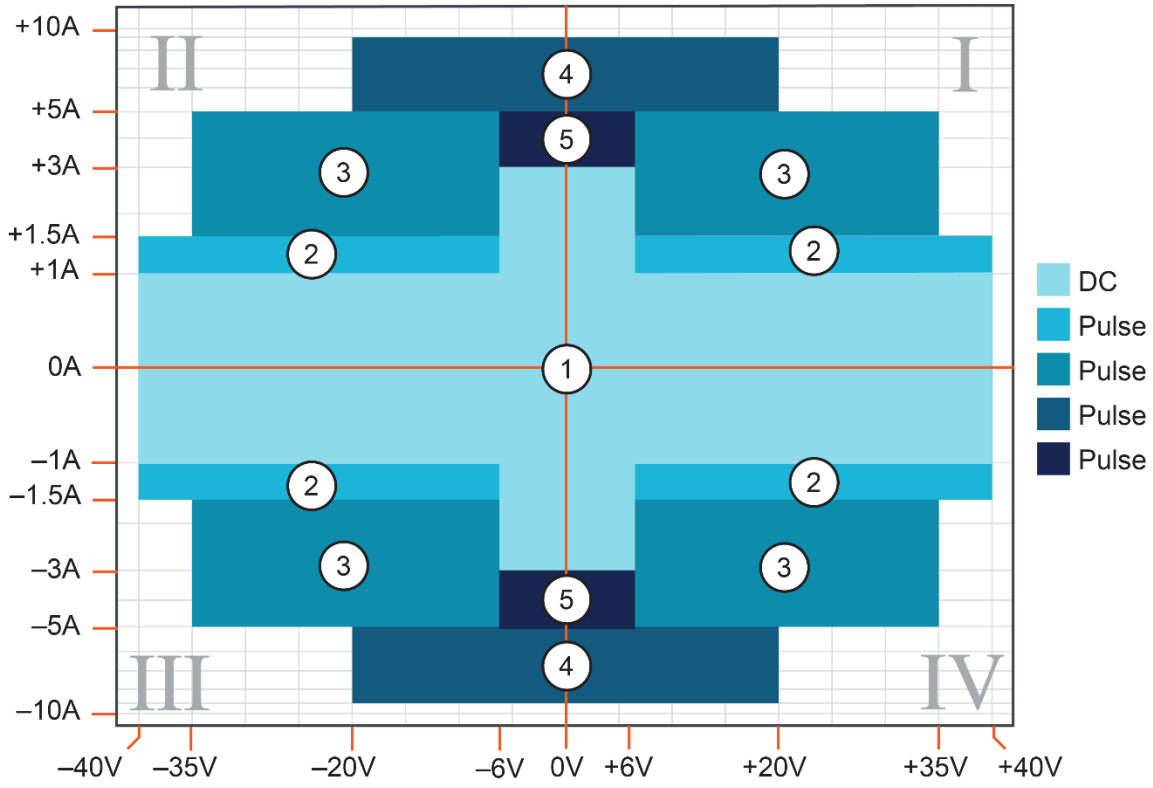
Accuracy Specifications	Accuracy specifications are applicable in both normal and high-capacitance modes.	
Voltage Source Output Settling Time	Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Current limit = 1 A	
	Voltage source range	**Settling time with C_{LOAD} = 4.7 µF**
	100 mV	<200 µs
	1 V	<200 µs
	6 V	<200 µs
	40 V	<7 ms
Current Measure Settling Time	Time required to reach within 0.1% of final value after source level command is processed on a fixed range. Values below for V_{OUT} = 1 V unless noted	
	Current range	**Settling time**
	1 µA	<230 ms
	10 µA	<230 ms
	100 µA	<3 ms
	1 mA	<3 ms
	10 mA and 100 mA	<100 µs
	1 A and 3 A	<120 µs (R_{LOAD} >2 Ω)
Capacitor Leakage Performance using the KIHighC Factory Script[24]	200 ms at 50 nA ▪ Load = 5 µF in parallel with 10 MΩ ▪ Test: 5 V step and measure	
Mode Change Delay	Current ranges of 100 µA and above: ▪ 11 ms delay for both in and out of high-capacitance mode Current ranges below 100 µA: ▪ 250 ms delay into high-capacitance mode ▪ 11 ms delay out of high-capacitance mode	
Voltmeter Input Impedance	10 GΩ in parallel with 3300 pF	
Noise **10 Hz to 20 MHz**	<30 mV peak-to-peak ▪ 6 V range	
Source Range Change Overshoot	Voltage: ▪ <400 mV + 0.1% of larger range ▪ Overshoot into a 100 kΩ load, 20 MHz bandwidth	

[21] High-capacitance mode specifications are for dc measurements only.
[22] 100 nA range is not available in high-capacitance mode.
[23] High-capacitance mode uses locked ranges. Autorange is disabled.
[24] Part of KI Factory scripts. See the *Model 2601B-PULSE Reference Manual* for details.

SUPPLEMENTAL CHARACTERISTICS

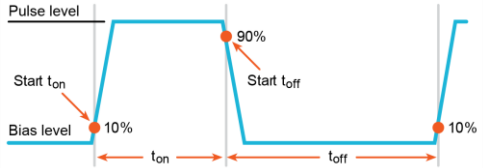
The following specifications are supplemental characteristics that provide additional information about instrument functions and performance. These characteristics are nonwarranted specifications; they describe the typical performance of the 2601B-PULSE.

PULSE CHARACTERISTICS



Pulse Region Specifications			
Quadrant Region	**Region Maximums**	**Maximum Pulse Width[25]**	**Maximum Duty Cycle[26]**
1	1 A at 40 V	DC, no limit	100%
1	3 A at 6 V	DC, no limit	100%
2	1.5 A at 40 V	100 ms	25%
3	5 A at 35 V	4 ms	4%
4	10 A at 20 V	1.8 ms	1%
5	5 A at 6 V	10 ms	10%

[25] Times measured from the start of pulse to the start off-time; see figure below.



[26] Thermally limited in sink mode (quadrants 2 and 4) and ambient temperatures above 28 °C. See power equations in the *Model 2601B-PULSE Reference Manual* for more information.

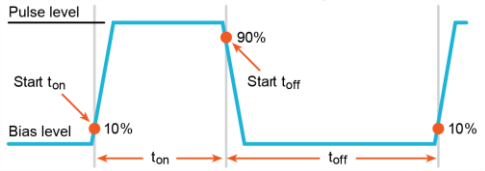
<table>
<tr><td>Minimum Programmable Pulse Width[27]</td><td>100 µs
NOTE: Minimum pulse width for settled source at a given I/V output and load can be longer than 100 µs.
<table>
<tr><th>Source Value</th><th>Load</th><th>Source Settling (% of Range)</th><th>Minimum Pulse Time to Settle</th></tr>
<tr><td>6 V</td><td>2 Ω</td><td>0.2%</td><td>150 µs</td></tr>
<tr><td>20 V</td><td>2 Ω</td><td>1%</td><td>200 µs</td></tr>
<tr><td>35 V</td><td>7 Ω</td><td>0.5%</td><td>500 µs</td></tr>
<tr><td>40 V</td><td>27 Ω</td><td>0.1%</td><td>400 µs</td></tr>
<tr><td>1.5 A</td><td>27 Ω</td><td>0.1%</td><td>1.5 ms</td></tr>
<tr><td>3 A</td><td>2 Ω</td><td>0.2%</td><td>150 µs</td></tr>
<tr><td>5 A</td><td>7 Ω</td><td>0.5%</td><td>500 µs</td></tr>
<tr><td>10 A</td><td>2 Ω</td><td>0.5%</td><td>200 µs</td></tr>
</table></td></tr>
<tr><td>Pulse Width Programming Resolution</td><td>1 µs</td></tr>
<tr><td>Pulse Width Programming Accuracy</td><td>±5 µs</td></tr>
<tr><td>Pulse Width Jitter</td><td>2 µs</td></tr>
</table>

SMU MEASUREMENT SPEED CHARACTERISTICS[28]

MAXIMUM SWEEP OPERATION RATES, OPERATIONS PER SECOND FOR 60 HZ (50 HZ)

A/D Converter Speed (NPLC)	Trigger Origin	Measure to Memory Using User Scripts	Measure to USB Using User Scripts	Source Measure to Memory Using User Scripts	Source Measure to USB Using User Scripts	Source Measure to Memory Using Sweep API	Source Measure to USB Using Sweep API
0.001	Internal	20000 (20000)	9800 (9600)	6700 (6700)	6600 (6600)	13400 (13400)	6450 (6450)
0.001	Digital I/O	7400 (7400)	7250 (7250)	5500 (5500)	5400 (5400)	13400 (13400)	6500 (6500)
0.01	Internal	5000 (4300)	3900 (3400)	3300 (3000)	3300 (2900)	4400 (3800)	4400 (3800)
0.01	Digital I/O	3400 (3100)	3400 (3000)	2900 (2700)	2900 (2600)	4400 (3800)	4400 (3800)
0.1	Internal	580 (480)	560 (470)	550 (465)	550 (460)	570 (480)	570 (480)

[27] Times measured from the start of pulse to the start off-time; see figure below.



[28] Exclude current measurement ranges less than 1 mA.

A/D Converter Speed (NPLC)	Trigger Origin	Measure to Memory Using User Scripts	Measure to USB Using User Scripts	Source Measure to Memory Using User Scripts	Source Measure to USB Using User Scripts	Source Measure to Memory Using Sweep API	Source Measure to USB Using Sweep API
0.1	Digital I/O	550 (460)	550 (460)	520 (450)	540 (450)	570 (480)	570 (480)
1	Internal	59 (49)	59 (49)	59 (49)	59 (49)	59 (49)	59 (49)
1	Digital I/O	59 (48)	59 (49)	59 (49)	59 (49)	59 (49)	59 (49)

MAXIMUM SINGLE MEASUREMENT RATES, OPERATIONS PER SECOND FOR 60 HZ (50 HZ)

A/D Converter Speed (NPLC)	Trigger Origin	Measure to USB	Source Measure to USB	Source Measure Pass/Fail to USB
0.001	Internal	2100 (2100)	1600 (1600)	1600 (1600)
0.01	Internal	1800 (1650)	1400 (1200)	1300 (1150)
0.1	Internal	480 (410)	450 (390)	400 (380)
1.0	Internal	58 (48)	57 (48)	57 (48)

Maximum Measurement Range Change Rate	>7000 per second for >10 µA. When changing to or from a range ≥1 A, maximum rate is > 2200 per second.
Maximum Source Range Change Rate	>400 per second >10 µA. When changing to or from a range ≥1 A, maximum rate is >190 per second.
Maximum Source Function Change Rate	>1000 per second.
Command Processing Time	<1 ms. ▪ Maximum time required for the output to begin to change after receiving the `smua.source.levelv` or `smua.source.leveli` attribute.

TRIGGERING AND SYNCHRONIZATION CHARACTERISTICS

TRIGGERING

Trigger In to Trigger Out	0.5 µs
Trigger In to Source Change[29]	10 µs
Trigger Timer Accuracy	±2 µs
Source Change[29] after LXI Trigger	280 µs

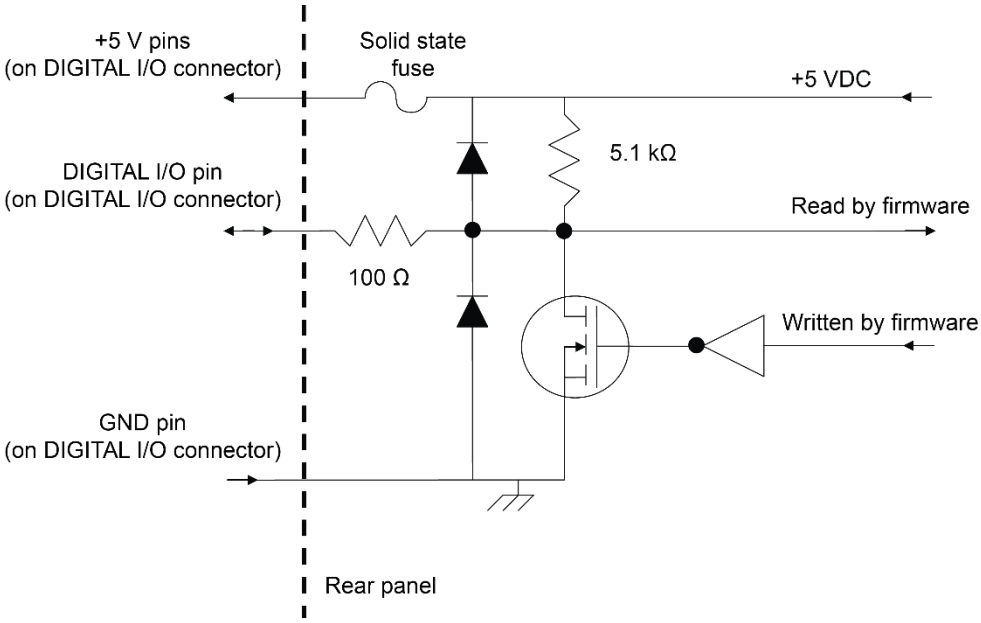
Synchronization

Multi-node Synchronized Source Change[29]	<0.5 µs
Single-Node Synchronized Source Change[29]	<0.5 µs

[29] Fixed source range with no polarity change.

GENERAL SPECIFICATIONS

IEEE-488	IEEE Std 488.1 compliant. Supports IEEE Std 488.2 common commands and status model topology.
RS-232	▪ Baud rates from 300 bps to 115,200 bps. ▪ Programmable number of data bits, parity type, and flow control (RTS/CTS hardware or none). ▪ When not programmed as the active host interface, the 2601B-PULSE can use the RS-232 interface to control other instruments.
Ethernet	RJ-45 connector, 10/100BaseT, Auto-MDIX.
LXI Compliance	Version 1.5 LXI Device Specification 2016 compliant.
LXI Timing	**Total output trigger response time:** 245 µs minimum, 280 µs typical, (not specified) maximum. **Receive LAN[0-7] event delay:** Unknown. **Generate LAN[0-7] event delay**: Unknown.
Expansion Interface	▪ The TSP-Link® expansion interface allows TSP-enabled instruments to trigger and communicate with each other. ▪ Category 5e or higher LAN crossover cable type. ▪ Three meters (9.84 ft) maximum between each TSP-enabled instrument. ▪ A maximum of 32 TSP-Link nodes can be interconnected. ▪ Each source-measure instrument uses one TSP-Link node.
USB Control (Rear)	**USB 2.0 device:** USB-TMC488 protocol.
USB File System (Front)	**USB 2.0 host:** Mass storage class device.
Power Supply	100 V ac to 240 V ac, 50 Hz or 60 Hz (autosensing), 240 VA maximum.
Cooling	Forced air; side intake and rear exhaust. One side must be unobstructed when rack mounted.
Warranty	1 year.
EMC	Conforms to European Union EMC Directive.
Safety	NRTL listed to UL61010-1:2008 and CSA C22.2 No. 61010-1. Conforms to European Union Low Voltage Directive.
Environment	For indoor use only. **Altitude:** Maximum 2000 m (6562 ft) above sea level. **Operating:** 0 °C to 35 °C at up to 70% relative humidity; at 35 °C to 50 °C, derate 3% relative humidity per °C. **Storage:** -25 °C to 65 °C.
Dimensions	**2601B-PULSE only:** 105 mm × 235 mm × 445 mm (4.1 in. high × 9.25 in. wide × 17.5 in. deep). **2601B-PULSE with 2601B-P-INT attached:** 105 mm × 235 mm × 503 mm (4.1 in. high × 9.25 in. wide × 19.82 in. deep).
Weight	**2601B-PULSE only:** 5.9 kg (13 lb). **2601B-PULSE with 2601B-P-INT attached:** 6.4 kg (14 lb).

Digital I/O Interface	 **Connector:** 25-pin female D **Input/output pins:** 14 open drain I/O bits **Absolute maximum input voltage:** 5.25 V **Absolute minimum input voltage:** –0.25 V **Maximum logic low input voltage:** 0.7 V, +850 µA **Minimum logic high input voltage:** 2.1 V, +570 µA **Maximum source current (flowing out of digital I/O bit):** +960 µA **Maximum sink current at maximum logic low voltage (0.7 V):** –5.0 mA **Absolute maximum sink current (flowing into digital I/O pin):** –11 mA **5 V power supply pins:** Limited to 250 mA total, solid-state fuse protected

SUPPLEMENTAL INFORMATION

Front-Panel Interface	Two-line vacuum fluorescent display (VFD) with keypad and navigation wheel.
Display	▪ Show error messages and user-defined messages. ▪ Display source and limit settings. ▪ Show current and voltage measurements. ▪ View measurements stored in dedicated reading buffers.
Keypad Operations	▪ Change host interface settings. ▪ Save and restore instrument setups. ▪ Load and run factory and user-defined test scripts that prompt for input and send results to the display. ▪ Store measurements into dedicated reading buffers.
Programming	Embedded Test Script Processor (TSP®) accessible from any host interface; responds to high-speed test scripts comprised of remote commands and statements (for example, branching, looping, and math); able to execute test scripts stored in memory without host intervention.
Minimum User Memory Available	16 MB (approximately 250,000 lines of TSP code).

Reading Buffers	Nonvolatile memory uses dedicated storage areas reserved for measurement data. Reading buffers are arrays of measurement elements. Each element can store the following items: ▪ Measurement ▪ Source setting (at the time the measurement was made) ▪ Measurement status ▪ Range information ▪ Timestamp Reading buffers can be filled using the front-panel STORE key, and retrieved using the RECALL key or host interface.
Buffer Size, with Timestamp and Source Setting	>60,000 samples.
Buffer size, without Timestamp and Source Setting	>140,000 samples.

TIMING

Timer	Free-running 47-bit counter with 1 MHz clock input. Reset each time instrument power is turned on. If the instrument is not turned off, the timer is automatically reset to zero (0) every four years.
Timestamp	TIMER value is automatically saved when each measurement is triggered.
Resolution	1 µs.
Timestamp Accuracy	±100 ppm.