

**PWS2185, PWS2323, PWS2326, and PWS2721**  
**Linear DC Power Supplies**  
**Specifications and Performance Verification**  
**Technical Reference**



077-0482-00



**PWS2185, PWS2323, PWS2326, and PWS2721  
Linear DC Power Supplies  
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**Warning**

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries before performing service.

[www.tektronix.com](http://www.tektronix.com)

077-0482-00

**Tektronix**

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# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

## 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.

**Use proper voltage setting.** Before applying power, ensure 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, ensure that the product is properly grounded.

**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.

**Power disconnect.** The power switch disconnects the product from the power source. See instructions for the location. Do not block the power switch; it must remain accessible to the user at all times.

**Do not operate without covers.** Do not operate this product with covers or panels removed.

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

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

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

**Do not operate in wet/damp conditions.**

**Do not operate in an explosive atmosphere.**

**Keep product surfaces clean and dry.**

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

**Terms in This Manual** These terms may appear in this manual:



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

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

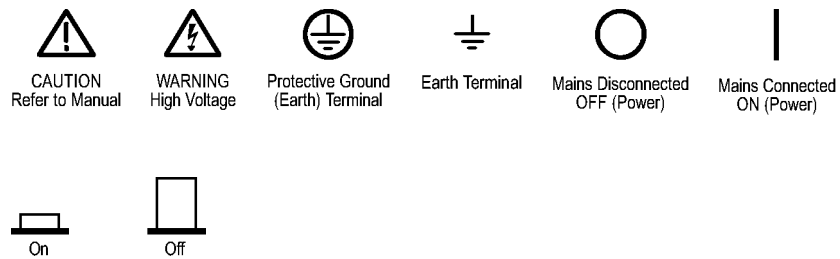
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**Symbols and Terms on the Product**

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.

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





# Specifications

This section contains specifications for the PWS2000 series instruments. All specifications are guaranteed unless noted as "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in *Performance Verification*.

**Table 1: Specifications**

Parameter	PWS2185	PWS2323	PWS2326	PWS2721
Constant voltage operation, nominal	The unit may be set to a constant voltage over a range of currents			
Voltage range	0 to 18 V	0 to 32 V	0 to 32 V	0 to 72 V
This is the range over which the output voltage is adjustable				
Voltage resolution, nominal	10 mV			
✓ Voltage setting accuracy	±(0.05% of settling + 10 mV)			
At 25 °C ±5 °C				
Current limit, nominal	Defined by the constant current setting. The changeover is automatic.			
Voltage temperature coefficient, typical	±(0.02% + 5 mV) per °C outside the 25 °C ±5 °C standard range			
Constant current operation, nominal	The unit may be set to a constant current over a range of voltages			
Current range	0 A to 5 A	0 A to 3 A	0 A to 6 A	0 A to 1.5 A
This is the range over which the output current is adjustable				
Current resolution, nominal	10 mA			
✓ Current setting accuracy	±(0.2% + 10 mA)			
At 25 °C ±5 °C				
Voltage limit, nominal	0 to 18 V	0 to 32 V	0 to 32 V	0 to 72 V
Current temperature coefficient, typical	±(0.1% + 5 mA) per °C outside the 25 °C ±5 °C standard range			
Meter, nominal	Internal measurement capability. Voltage and current are measured internally.			

**Table 1: Specifications (cont.)**

Parameter	PWS2185	PWS2323	PWS2326	PWS2721
Current readback resolution, nominal	10 mA			
✓ Current readback accuracy At 25 °C ±5 °C	±(0.1% of reading + 15 mA)			
Current readback temperature coefficient, typical	±(0.1% + 15 mA) per °C outside the 25 °C ±5 °C standard range			
✓ Voltage readback accuracy At 25 °C ±5 °C	±(0.05% of reading + 15 mV)	±(0.05% of reading + 15 mV) when VSET < 20 V ±(0.05% of reading + 120 mV) when VSET ≥ 20 V	±(0.05% of reading + 15 mV) when VSET < 20 V ±(0.05% of reading + 120 mV) when VSET ≥ 20 V	±(0.05% of reading + 15 mV) when VSET < 20 V ±(0.05% of reading + 120 mV) when VSET ≥ 20 V
Voltage readback resolution, nominal	10 mV	10 mV when VSET < 20 V 100 mV when VSET ≥ 20 V	10 mV when VSET < 20 V 100 mV when VSET ≥ 20 V	10 mV when VSET < 20 V 100 mV when VSET ≥ 20 V
Voltage readback temperature coefficient, typical	±(0.02% of reading + 15 mV) per °C outside the 25 °C ±5 °C standard range			
Maximum input VA <sub>rms</sub> , typical	350 VA	350 VA	700 VA	350 VA
✓ Line regulation – voltage	Change over the full rated input voltage: ±(0.1% + 5 mV)			
Line regulation – current, typical	Change over the full rated input voltage: ±(0.1% + 2 mA)			
✓ Load regulation – voltage	Change from 0 to 100% FS; ±(0.02% + 5 mV)	Change from 0 to 100% FS; ±(0.02% + 5 mV)	Change from 0 to 100% FS; ±(0.04% + 6 mV)	Change from 0 to 100% FS; ±(0.02% + 4 mV)
Load regulation – current, typical	Change from 10 to 90% FS; ±(0.1% + 2 mA)			
✓ Voltage ripple, 20 MHz bandwidth	< 2 mV <sub>rms</sub> and 20 mV <sub>p-p</sub> < 1.5 mV <sub>rms</sub> and 12 mV <sub>p-p</sub> , typical			
Voltage ripple, 7 MHz bandwidth	< 1 mV <sub>rms</sub> and 3 mV <sub>p-p</sub>			
✓ Current ripple, 20 MHz bandwidth	< 5 mA <sub>rms</sub>			
Isolation voltage	The product can operate properly with up to 100 VDC + pk AC between the Earth Ground terminal and any other terminal with AC limited to 3 V <sub>p-p</sub> maximum and 60 Hz maximum.			
Setup memory, nominal	20 setup locations			
Software voltage limit	The maximum settable voltage (MAX VOLT) menu entry, when set below the hardware maximum voltage limit, disallows adjusting the instrument to voltages more than the MAX VOLT limit.			

**Table 2: Mains power characteristics**

Parameter	PWS2185	PWS2323	PWS2326	PWS2721
Voltage	Two ranges. Bottom-panel switch selectable. 110 V: 110 VAC to 120 VAC 220 V: 220 VAC to 240 VAC			
Frequency	50/60 Hz			
Fuse rating, nominal	110 VAC setting: 5 A TH 250 V  220 VAC setting: 2.5 A TH 250 V	110 VAC setting: 5 A TH 250 V  220 VAC setting: 2.5 A TH 250 V	110 VAC setting: 6.3 A TH 250 V  220 VAC setting: 3.15 A TH 250 V	110 VAC setting: 5 A TH 250 V  220 VAC setting: 2.5 A TH 250 V

**Table 3: Mechanical characteristics**

Parameter	PWS2185	PWS2323	PWS2326	PWS2721
Weight, nominal	15.8 lbs	15.8 lbs	16.0 lbs	15.7 lbs
Includes boots, and handles	(7.1 kg)	(7.1 kg)	(7.3 kg)	(7.1 kg)
Dimensions, nominal	With boots and handle: Height: 105 mm (4.15 in) Width: 242 mm (9.52 in) Depth: 384 mm (15.12 in)  Without boots and handle: Height: 91 mm (3.57 in) Width: 217 mm (8.55 in) Depth: 362 mm (14.24 in)			
Cooling method, nominal	Fan			
Required cooling clearance	Rear of instrument must be separated by at least 5 cm (2 in) from any airflow restriction. Rear of instrument must be separated by at least 5 cm (2 in) from any airflow restrictions to assure adequate cooling. Bottom of instrument must have 1 cm (0.4 in) from any airflow restrictions. The protective boot maintains the proper bottom clearance. For rackmount configuration, follow the clearance requirements provided with the rackmount installation instructions.			
Construction materials, nominal	Chassis – Aluminum Front Panel Plastics – PC/ABS blend			

**Table 4: Environment performance**

<b>Parameter</b>	<b>All models</b>
Temperature	Operating: +0 °C to +40 °C Nonoperating: -20 °C to 70 °C
Humidity	Operating: 5% to 95% relative humidity (% RH) at up to 40 °C, noncondensing Nonoperating: 5% to 95% relative humidity (RH) at up to +40 °C, 5% to 60% RH above +40 °C up to +70 C, noncondensing
Altitude	Operating: 100% capability up to 2,000 meters. Nonoperating: Up to 4,000 meters

**Table 5: Keypad special operations**

<b>Operation</b>	<b>Key press</b>
Display the internal temperature of the instrument.	Enter + Esc + .
Perform a factory reset. All setups are erased.	Enter + Esc + 2

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# Performance Verification

This section contains performance verification procedures for the specifications marked with the ✓ symbol. Additional test equipment is required to complete the verification procedures. (See Table 14 on page 12.)

These procedures cover the PW2185, PWS2323, PWS2326, and PWS2721 models. Ignore checks that do not apply to the specific model you are testing.

Print the test record on the following pages, and use it to record the performance test results for your power supply.

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**NOTE.** *Completion of the performance verification procedure does not update the stored time and date of the latest successful adjustment. The date and time are updated only when the factory adjustment procedures are successfully completed.*

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The performance verification procedures verify the performance of your instrument. They do not adjust your instrument. If your instrument fails any of the performance verification tests, you should contact Tektronix service.



**WARNING.** *Observe all safety precautions listed in this manual before using this product and any associated instrumentation. Although some instruments and accessories are used with nonhazardous voltages, there are situations where hazardous conditions may be present. This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Before using the product, carefully read and follow all installation, operation, and maintenance information. Refer to this manual for complete product specifications. Before performing any maintenance, disconnect the line cord and all test cables. Operators of this instrument must be protected from electric shock at all times. The responsible body must make sure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit can operate at or above 1000 volts, no conductive part of the circuit may be exposed.*

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**WARNING.** *Do not loosen any screw on this product. There are no user serviceable components inside.*

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**CAUTION.** *Use properly rated load wires. All load wires must be heavy enough not to overheat when carrying the maximum short-circuit output current of the power supply. If there is more than one load, then any pair of load wires must be capable of safely carrying the full-rated short-circuit output current of the power supply.*

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## Test Record

Model	Serial	Procedure performed by	Date
<hr/>			
Test	Passed	Failed	
Self Test			
DC voltage accuracy			
DC voltage readback accuracy			
DC voltage load regulation			
DC voltage line regulation			
DC current accuracy			
DC current readback accuracy			
Voltage ripple at 7 MHz			
Voltage ripple at 20 MHz			
Current ripple at 20 MHz			

Table 6: DC voltage accuracy

Instrument	DUT voltage	Test current	Min	Measured	Max
0% Test Voltage					
PWS2185	0 V	2.5 A	-0.0100 V	_____	0.0100 V
PWS2323	0 V	1.5 A	-0.0100 V	_____	0.0100 V
PWS2326	0 V	3 A	-0.0100 V	_____	0.0100 V
PWS2721	0 V	0.75 A	-0.0100 V	_____	0.0100 V
25% Test Voltage					
PWS2185	4.5 V	2.5 A	4.48775 V	_____	4.51225 V
PWS2323	8 V	1.5 A	7.98600 V	_____	8.01400 V
PWS2326	8 V	3 A	7.98600 V	_____	8.01400 V
PWS2721	18 V	0.75 A	17.98100 V	_____	18.01900 V
50% Test Voltage					
PWS2185	9 V	2.5 A	8.9855 V	_____	9.0145 V
PWS2323	16 V	1.5 A	15.9820 V	_____	16.0180 V
PWS2326	16 V	3 A	15.9820 V	_____	16.0180 V
PWS2721	36 V	0.75 A	35.9720 V	_____	36.0280 V
75% Test Voltage					
PWS2185	13.5 V	2.5 A	13.483250 V	_____	13.516750 V
PWS2323	24 V	1.5 A	23.978000 V	_____	24.022000 V
PWS2326	24 V	3 A	23.978000 V	_____	24.022000 V
PWS2721	54 V	0.75 A	53.963000 V	_____	54.037000 V
100% Test Voltage					
PWS2185	18 V	2.5 A	17.9810 V	_____	18.0190 V
PWS2323	32 V	1.5 A	31.9740 V	_____	32.0260 V
PWS2326	32 V	3 A	31.9740 V	_____	32.0260 V
PWS2721	72 V	0.75 A	71.9540 V	_____	72.0460 V

Table 7: DC voltage readback accuracy

Instrument	DUT voltage	Test current	Measured voltage	Voltage readout	Absolute difference	Maximum difference
0% Test Voltage						
PWS2185	0 V	2.5 A	_____	_____	_____	0.01500 V
PWS2323	0 V	1.5 A	_____	_____	_____	0.01500 V
PWS2326	0 V	3 A	_____	_____	_____	0.01500 V
PWS2721	0 V	0.75 A	_____	_____	_____	0.01500 V
25% Test Voltage						
PWS2185	4.5 V	2.5 A	_____	_____	_____	0.01725 V
PWS2323	8 V	1.5 A	_____	_____	_____	0.01900 V
PWS2326	8 V	3 A	_____	_____	_____	0.01900 V
PWS2721	18 V	0.75 A	_____	_____	_____	0.02400 V
50% Test Voltage						
PWS2185	9 V	2.5 A	_____	_____	_____	0.01950 V
PWS2323	16 V	1.5 A	_____	_____	_____	0.02300 V
PWS2326	16 V	3 A	_____	_____	_____	0.02300 V
PWS2721	36 V	0.75 A	_____	_____	_____	0.13800 V
75% Test Voltage						
PWS2185	13.5 V	2.5 A	_____	_____	_____	0.02175 V
PWS2323	24 V	1.5 A	_____	_____	_____	0.13200 V
PWS2326	24 V	3 A	_____	_____	_____	0.13200 V
PWS2721	54 V	0.75 A	_____	_____	_____	0.14700 V
100% Test Voltage						
PWS2185	18 V	2.5 A	_____	_____	_____	0.02400 V
PWS2323	32 V	1.5 A	_____	_____	_____	0.13600 V
PWS2326	32 V	3 A	_____	_____	_____	0.13600 V
PWS2721	72 V	0.75 A	_____	_____	_____	0.15600 V

Table 8: DC voltage line regulation

Instrument	Min line	Max line	Nom line	Nom – Min	Max – Nom	Largest	Max value
PWS2185	_____	_____	_____	_____	_____	_____	0.0230 V
PWS2323	_____	_____	_____	_____	_____	_____	0.0370 V
PWS2326	_____	_____	_____	_____	_____	_____	0.0370 V
PWS2721	_____	_____	_____	_____	_____	_____	0.0770 V



Table 9: DC voltage load regulation

Instrument	Min load	Ref load	Max load	Ref – Min	Max – Ref	(Max – Ref) / 0.98	Largest	Max value
PWS2185	_____	_____	_____	_____	_____	_____	_____	0.00860 V
PWS2323	_____	_____	_____	_____	_____	_____	_____	0.01140 V
PWS2326	_____	_____	_____	_____	_____	_____	_____	0.01880 V
PWS2721	_____	_____	_____	_____	_____	_____	_____	0.01840 V

Table 10: DC current accuracy

Instrument	Test voltage	DUT current	Min	Measured current	Max
0% Test Current					
PWS2185	9 V	0.0 A	-0.01000 A	_____	0.01000 A
PWS2323	16 V	0.0 A	-0.01000 A	_____	0.01000 A
PWS2326	16 V	0.0 A	-0.01000 A	_____	0.01000 A
PWS2721	36 V	0.0 A	-0.01000 A	_____	0.01000 A
25% Test Current					
PWS2185	9 V	1.25 A	1.23750 A	_____	1.26250 A
PWS2323	16 V	0.75 A	0.73850 A	_____	0.76150 A
PWS2326	16 V	1.5 A	1.48700 A	_____	1.51300 A
PWS2721	36 V	0.375 A	0.36425 A	_____	0.38575 A
50% Test Current					
PWS2185	9 V	2.5 A	2.48500 A	_____	2.51500 A
PWS2323	16 V	1.5 A	1.48700 A	_____	1.51300 A
PWS2326	16 V	3 A	2.98400 A	_____	3.01600 A
PWS2721	36 V	0.75 A	0.73850 A	_____	0.76150 A
75% Test Current					
PWS2185	9 V	3.75 A	3.73250 A	_____	3.76750 A
PWS2323	16 V	2.25 A	2.23550 A	_____	2.26450 A
PWS2326	16 V	4.5 A	4.48100 A	_____	4.51900 A
PWS2721	36 V	1.125 A	1.11275 A	_____	1.13725 A
100% Test Current					
PWS2185	9 V	5 A	4.98000 A	_____	5.02000 A
PWS2323	16 V	3 A	2.98400 A	_____	3.01600 A
PWS2326	16 V	6 A	5.97800 A	_____	1.51300 A
PWS2721	32 V	1.5 A	1.48700 A	_____	6.02200 A

Table 11: DC current readback accuracy

DVM range	Test current	Measured current	Current readout	Absolute difference	Maximum difference
0% Test Current					
PWS2185	0 A	_____	_____	_____	0.015000 A
PWS2323	0 A	_____	_____	_____	0.015000 A
PWS2326	0 A	_____	_____	_____	0.015000 A
PWS2721	0 A	_____	_____	_____	0.015000 A
25% Test Current					
PWS2185	1.25 A	_____	_____	_____	0.01625 A
PWS2323	0.75 A	_____	_____	_____	0.01575 A
PWS2326	1.5 A	_____	_____	_____	0.01650 A
PWS2721	0.375 A	_____	_____	_____	0.015375 A
50% Test Current					
PWS2185	2.5 A	_____	_____	_____	0.01750 A
PWS2323	1.5 A	_____	_____	_____	0.01650 A
PWS2326	3 A	_____	_____	_____	0.01800 A
PWS2721	0.75 A	_____	_____	_____	0.01575 A
75% Test Current					
PWS2185	3.75 A	_____	_____	_____	0.01875 A
PWS2323	2.25 A	_____	_____	_____	0.01725 A
PWS2326	4.5 A	_____	_____	_____	0.01950 A
PWS2721	1.125 A	_____	_____	_____	0.016125 A
100% Test Current					
PWS2185	5 A	_____	_____	_____	0.020000 A
PWS2323	3 A	_____	_____	_____	0.018000 A
PWS2326	6 A	_____	_____	_____	0.021000 A
PWS2721	1.5 A	_____	_____	_____	0.016500 A

**Table 12: Voltage noise at 20 MHz**

Instrument	Voltage test load R <sup>1</sup>	Measured rms	Maximum rms	Measured pk - pk	Maximum pk - pk
PWS2185	4 $\Omega$	_____	2 mV	_____	20 mV
PWS2323	12 $\Omega$	_____	2 mV	_____	20 mV
PWS2326	6 $\Omega$	_____	2 mV	_____	20 mV
PWS2721	60 $\Omega$	_____	2 mV	_____	20 mV

<sup>1</sup> Load R must be rated at 100 W minimum

**Table 13: Current noise at 20 MHz**

Instrument	Current test load R <sup>1</sup>	Measured rms	Maximum rms
PWS2185	1 $\Omega$	_____	5 mV
PWS2323	1 $\Omega$	_____	5 mV
PWS2326	1 $\Omega$	_____	5 mV
PWS2721	1 $\Omega$	_____	5 mV

<sup>1</sup> Load R must be rated at 100 W minimum

## Performance Verification Procedures

### Performance Verification Conditions

The following conditions must be met before performing these procedures:

1. The Device Under Test (DUT) and all test equipment must have been operating continuously for 20 minutes in an environment that meets the operating range specifications for temperature and humidity.
2. The procedures are intended to be used in sequence. If it is necessary to partially test the DUT using an individual test, a 20 minute warm-up period is required for the individual test.
3. You must connect the DUT and the test equipment to the same AC power circuit. Connect the DUT and test instruments into a common power strip if you are unsure of the AC power circuit distribution. Connecting the DUT and test instruments into separate AC power circuits can result in offset voltages between the equipment, which can invalidate this performance verification procedure.
4. The AC Power Source for the DUT must match the Voltage Selector switch setting located on the bottom of the DUT.

DUT voltage selector switch	AC source voltage
110	115 V
220	230 V



**WARNING.** Some procedures use hazardous voltages. To prevent electrical shock, always power off instruments before touching exposed circuitry. Read and follow the precautions in the General Safety Summary.

### Equipment Required

These procedures use external equipment to directly check warranted characteristics. The following table lists the required equipment.

Table 14: Test equipment

Description	Minimum requirements	Examples
1. Connectors	Connectors for hook up wire assemblies and test resistors, item numbers 5, 6, 9, and 10. <ul style="list-style-type: none"> <li>■ (Qty. 6) #10 fork lugs similar to Tyco part number 52951</li> <li>■ (Qty, 14) Stackable, gold plated, banana plugs/jacks similar to Pomona model 4897-0. Used for lower current connections, and connection to the load resistors (items 9 and 10) used for noise testing.</li> </ul>	
2. AC power source	Variable AC output from 90 to 265 VAC with at least 600 VA capacity	Kikusui PCR2000M

Table 14: Test equipment (cont.)

Description	Minimum requirements	Examples
3. Electronic load	Variable DC Load capable of 6 ADC and 75 VDC	B&K Precision 8510
4. DC voltmeter	Voltage measurement at 12 mV through 72 V to better than 100 ppm accuracy with the ability to multiply the result by a scalar.	Tektronix DMM4040
5. High current hook up wire (High current connections are indicated with bold lines in the setup illustrations)	18 AWG (minimum) hookup wire assemblies. To perform all tests, the following wire assemblies need to be created: <ul style="list-style-type: none"> <li>■ #10 fork lug to #10 fork lug, Qty 2, (included in Guildline 92301 if used)</li> <li>■ Stackable Banana to #10 fork lug, Qty 2</li> </ul> Wire lengths are not critical.	
6. Low current hook up wire (Low current connections are indicated with light lines in the setup illustrations)	22 AWG (minimum) hookup wires To perform all tests, the following wire assembly needs to be created: <ul style="list-style-type: none"> <li>■ Banana plug to Banana plug, Qty 2</li> </ul> Wire lengths are not critical.	
7. 50 mΩ precision shunt resistor	0.050 Ω ±100 ppm at 25 W ±4 ppm/°C temperature coefficient	Guildline 9230A-50
8. Current sense resistor cabling	Kelvin 4 terminal measuring cables for shunt resistor to voltmeter	Guildline 92301 cable set
9. Load resistor for Voltage Noise testing	Loading resistors for high current in voltage mode, and high voltage in current mode All resistors should be rated for at least 100 W. Ohms tolerance within 5%. Resistor composition is not critical. To perform the tests as illustrated, both leads of the load resistor require a Banana plug/jack (or equivalent) to connect to the power supply.	
	PWS2185 4 Ω	HL10006E5R000JJ
	PWS2323 12 Ω	HL10006E10R00JJ
	PWS2721 60 Ω	HL10006E12R00JJ
	PWS2326 6 Ω	HL10006E40R00JJ
10. Load Resistor for Current Noise testing	1 Ω, 100 W, 5% To perform the tests as illustrated, both leads of the load resistor require a Banana plug/jack (or equivalent) to connect to the power supply.	Vishay/Dale HL10006Z1R000JJ
11. Oscilloscope	20 MHz bandwidth limited oscilloscope at 1 mV/division	Tektronix DPO3012
12. Oscilloscope probe	Low capacitance 1 MΩ/10 MΩ 1X/10X 6 MHz/200 MHz probe	Tektronix P2220. Used for transient response test.
13. Oscilloscope probe	Low capacitance 10 MΩ 500 MHz probe	Tektronix P6139A. Used for transient response test.

**Table 14: Test equipment (cont.)**

<b>Description</b>	<b>Minimum requirements</b>	<b>Examples</b>
<b>14.</b> Coaxial cable	50 $\Omega$ BNC, male-to-male	Tektronix part number 012-0482-00
<b>15.</b> BNC adapter	BNC female to banana breakout	Pomona Electronics 3073

**Self Test** This procedure uses internal routines to verify that the DUT functions and passes its internal self tests. No test equipment or hookups are required. Start the self test with these steps:

1. Disconnect all cables from the DUT outputs.
2. Power on the DUT. The front-panel display will light up briefly while the DUT performs its power-on self test. All the display annunciators will light up at once.
3. Review the display with all the annunciators. Visually check if there are any strokes lost on any annunciator.



4. If the EEPROM is damaged or the latest operation data in the EEPROM is missing, the display appears as follows:

*ERR EEPROM*

5. If the calibration data in the EEPROM is missing, the display appears as follows:

*ERROR CAL*

6. If there is no response when you power on the DUT, verify that there is AC power to the DUT, verify the power-line voltage settings, and verify that the correct power-line fuse is installed. If you need more help, contact Tektronix.
7. Power off the DUT.

**Check DC Voltage  
Accuracy and DC Voltage  
Readback Accuracy**

**Equipment Required**

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(Item 2) AC Power Source	(Item 5) High current hook up wire (bold line connections)
(Item 3) Electronic Load	(Item 6) Low current hook up wire (fine line connections)
(Item 4) DC Voltmeter	

---

1. Set up the equipment as shown. (See Figure 1.)

---

**NOTE.** *Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.*

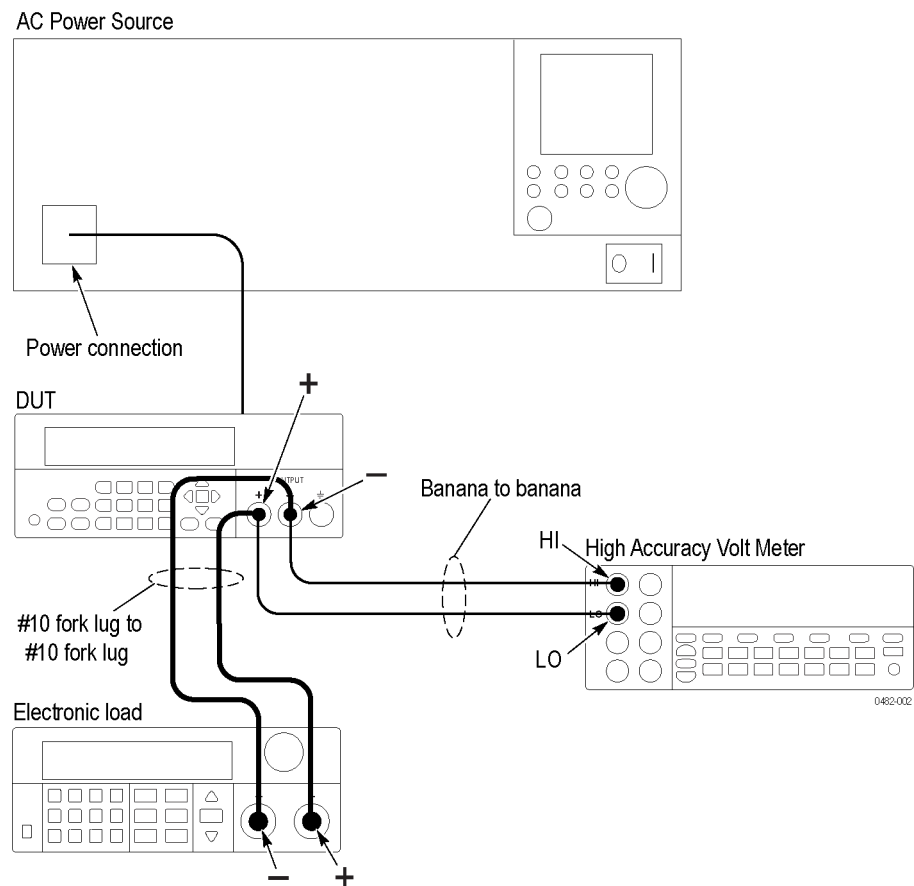
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**NOTE.** *To assure accurate measurements, the voltmeter must connect as close as possible to the front panel of the DUT. A solution is to use fork lugs between the electronic load and the DUT, and banana plugs between the DUT and voltmeter. An alternative solution is to use fork lugs for both connections at the DUT.*

---





**Figure 1: Voltage accuracy and regulation test setup**

2. Set the voltmeter as follows:
  - a. Set to measure DC volts.
  - b. Set to auto range.
  - c. Verify that the Analyze  $mX+b$  function is disabled, assuring that volts are being read.
3. Power on the electronic load and set as follows:
  - a. Set to Constant Current.
  - b. Set to draw a constant current at the test current specified for the DUT in the table for checking DC Voltage Accuracy. (See Table 6 on page 7.)
4. Set the DUT to the full scale (FS) output current.
5. Set the DUT to 0% of the FS output voltage (0 V).
6. Turn the DUT output on.

7. Enter the voltmeter reading into the table for checking DC voltage accuracy. (See Table 6 on page 7.)
8. Enter the voltmeter reading into the table for checking DC voltage readback accuracy. (See Table 7 on page 8.)
9. Enter the DUT readback voltage into the table for DC voltage readback accuracy. (See Table 7 on page 8.)
10. Calculate the difference of the two measurements taken in steps 8 and 9 and enter the absolute value under the difference column of the table. (See Table 7 on page 8.)
11. Increase the DUT output voltage by 25% of the FS output voltage.
12. Repeat steps 7 through 11 until you complete testing at 100% of FS.

## Check DC Voltage Line Regulation

This check procedure uses the same test setup as the previous procedure. (See Figure 1 on page 17.)

1. Change the AC Power Source output to the minimum voltage specified in the following table.

---

**NOTE.** *Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.*

---

DUT voltage selector switch	AC Power Source voltage
110	98 V
220	196 V

2. Set the voltmeter as follows:
  - a. Set to measure DC volts.
  - b. Set to auto range.
  - c. Verify that the Analyze mX+b function is disabled, assuring that volts are being read.
3. Set the electronic load as follows:
  - a. Set to Constant Current.
  - b. Set to draw the specified test current.

Instrument	Test current
PWS2185	2.5 A
PWS2323	1.5 A
PWS2326	3.0 A
PWS2721	0.75 A

4. Set the DUT to 100% of the full scale (FS) output current.
5. Set the DUT to 100% of the FS output voltage.
6. Turn the DUT output on.
7. Enter the voltmeter reading into the table for checking DC Voltage Line Regulation under the Min column for your product. (See Table 8 on page 8.)

8. Change the AC Power Source output to the maximum voltage specified in the following table.

DUT voltage selector switch	AC Power Source voltage
110	132 V
220	264 V

9. Enter the voltmeter reading into table for checking DC Voltage Line Regulation under the Max column for your product. (See Table 8 on page 8.)

10. Change the AC Power Source output to match the Voltage Selector switch setting of the DUT.

DUT voltage selector switch	AC Power Source voltage
110	115 V
220	230 V

11. Enter the voltmeter reading into table for checking DC Voltage Line Regulation under the Nom column for your product. (See Table 8 on page 8.)

12. Calculate the two values:  $Nom - Min$  and  $Max - Nom$ . Enter the values into the appropriate columns. (See Table 8 on page 8.)

13. Enter the largest of the two values calculated in step 12 into the Largest column. (See Table 8 on page 8.)

## Check DC Voltage Load Regulation

This check procedure uses the same test setup as the previous procedure. (See Figure 1 on page 17.)

---

**NOTE.** *Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.*

---

1. Set the voltmeter as follows:
  - a. Set to measure DC volts.
  - b. Set to auto range.
  - c. Verify that the Analyze mX+b function is disabled, assuring that volts are being read.
2. Set the electronic load as follows:
  - a. Set to Constant Current.
  - b. Set to draw 0 Amps.
3. Set the DUT to 100% of the full scale (FS) output current.
4. Set the DUT to 100% of the FS output voltage.
5. Turn the DUT output on.
6. Enter the voltmeter reading into the table for checking DC Voltage Load Regulation under the minimum load column for your product. (See Table 9 on page 9.)
7. Increase the electronic load to the reference load test current value.

Instrument	Reference load test current
PWS2185	2.5 A
PWS2323	1.5 A
PWS2326	0.75 A
PWS2721	3.0 A

8. Enter the voltmeter reading into the table for checking DC Voltage Load Regulation under the reference load column for your product. (See Table 9 on page 9.)

9. Increase the electronic load to the maximum load test current value.

<b>Instrument</b>	<b>Reference load test current</b>
PWS2185	4.9 A
PWS2323	2.94 A
PWS2326	1.47 A
PWS2721	5.88 A

10. Enter the voltmeter reading into the table for checking DC Voltage Load Regulation under the maximum load column for your product. (See Table 9 on page 9.)
11. Calculate the three values: Ref – Min, Max – Ref, and (Max – Ref)/0.98. Enter the values into the appropriate columns. (See Table 9 on page 9.)
12. Enter the largest of the three values calculated in step 11 into the Largest column.

### Check DC Current and DC Current Readback Accuracy

#### Equipment Required

(Item 2) AC Power Source	(Item 5) High current hook up wire (bold line connections)
(Item 3) Electronic Load	(Item 7) High Accuracy 0.05 Ω Resistor
(Item 4) DC Voltmeter	(Item 8) Current Shunt Resistor Cabling

1. Set up the equipment as shown. (See Figure 2.)

**NOTE.** Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.

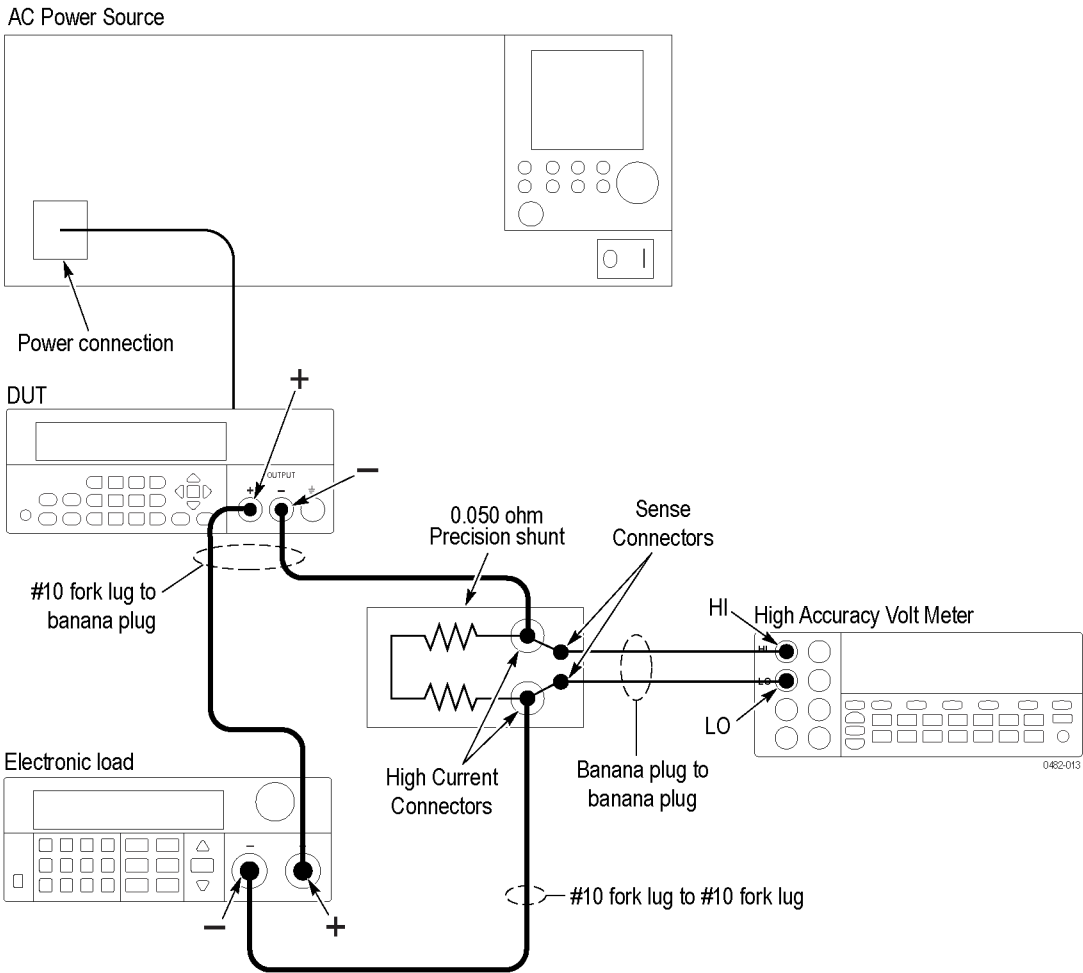


Figure 2: DC current test setup

- 2.** Set the voltmeter as follows:
  - a.** Set to measure DC volts.
  - b.** Set to auto range.
  - c.** Set to show amps (instead of volts) by multiplying the voltmeter result by 20.
    - Press Analyze button
    - Press mX+B
    - Press mX
    - Set the value to 20
    - Enable scaling
- 3.** Set the electronic load as follows:
  - a.** Set to Constant Voltage.
  - b.** Set to the specified voltage for your DUT. (See Table 10 on page 9.)
- 4.** Set the DUT to 0% of the full scale (FS) output current.
- 5.** Set the DUT to 100% of the FS output voltage.
- 6.** Turn the DUT output on.
- 7.** Enter the voltmeter reading into the table for checking DC current accuracy. (See Table 10 on page 9.)
- 8.** Enter the voltmeter reading into the table for checking DC current readback accuracy. (See Table 11 on page 10.)
- 9.** Enter the DUT readback current readout into the table for checking current readback accuracy under the current readout column. (See Table 11 on page 10.)
- 10.** Calculate the difference of the two measurements taken in steps 8 and 9. Enter the calculated value into the difference column of the table. (See Table 11 on page 10.)
- 11.** Increase the DUT output current by 25% of the FS output current.
- 12.** Repeat steps 7 through 11 until you complete testing at 100% of the FS output current.
- 13.** Power off the DUT and test equipment.



## Check Voltage Noise (20 MHz)

### Equipment Required

(Item 5) High current hook up wire (bold line connections)	(Item 14) Coaxial cable (BNC M-M)
(Item 9) Load Resistor	(Item 15) BNC F-to-Banana
(Item 11) Oscilloscope	

1. Plug the DUT into your local line power from the mains.
2. Plug the test oscilloscope into the same mains outlet as the DUT.

**NOTE.** Some AC Power Sources create large amounts of high frequency noise on the power line that the instrument may not fully reject. Noise directly on the mains is typically better controlled.

Use the same mains outlet for both the DUT and test oscilloscope to avoid ground loops which may cause noise.

3. Power on the DUT and test oscilloscope.

**NOTE.** Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.

4. Set up the equipment as shown. (See Figure 3.)

Use the appropriate load resistor depending on the model of the DUT. (See Table 12 on page 11.)

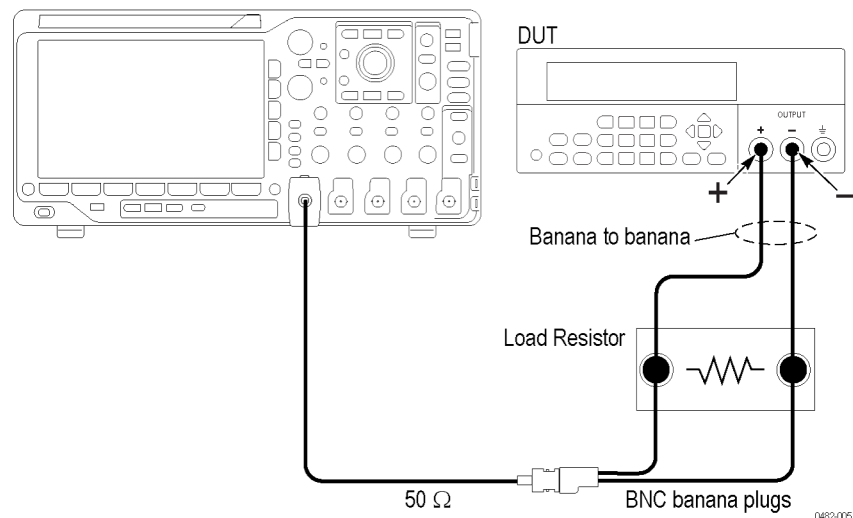


Figure 3: 20 MHz voltage noise test setup

5. Set the oscilloscope as follows:
  - a. 1 mV/division
  - b. 1 M $\Omega$  input resistance
  - c. 20 MHz bandwidth (BW) limit
  - d. AC Coupled
  - e. Auto-trigger
  - f. 1 ms/div
  - g. Set to measure  $V_{p-p}$  and  $V_{RMS}$
6. Set the DUT to the 100% FS output voltage.
7. Set the DUT to the 100% FS output current.
8. Turn the DUT output on.



**WARNING.** *Do not touch the load resistor. The load resistor may become hot enough to cause burns.*

---

9. Enter the oscilloscope measurements into the table for checking voltage noise at 20 MHz. (See Table 12 on page 11.)

## Check Current Noise

### Equipment Required

(Item 5) High current hook up wire (bold line connections)	(Item 11) Oscilloscope
(Item 10) 1 $\Omega$ Load Resistor	(Item 13) Oscilloscope 10X probe

1. Plug the DUT into your local line power from the mains.
2. Plug the test oscilloscope into the same mains outlet as the DUT.

**NOTE.** Some AC Power Sources create large amounts of high frequency noise on the power line that the instrument may not fully reject. Noise directly on the mains is typically better controlled.

Use the same mains outlet for both the DUT and test oscilloscope to avoid ground loops which may cause noise.

3. Power on the DUT and test oscilloscope.

**NOTE.** Ensure the warm-up criteria has been met as described in the Performance Verification Conditions.

4. Set up the equipment as shown. (See Figure 4.)

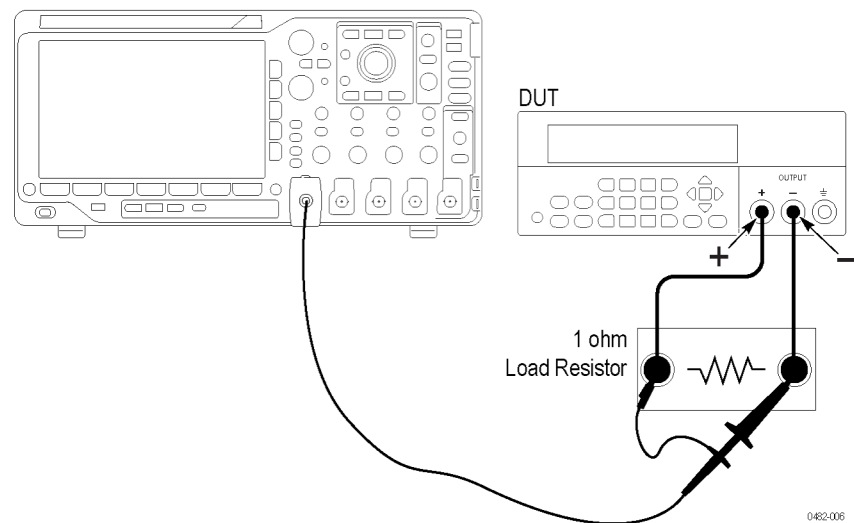


Figure 4: 20 MHz current noise test setup

5. Set the oscilloscope as follows:
  - a. 1 mV/division
  - b. 1 M $\Omega$  input resistance
  - c. 20 MHz bandwidth (BW) limit
  - d. AC Coupled
  - e. Auto-trigger
  - f. 1 ms/div
  - g. Set to measure  $V_{p-p}$  and  $V_{RMS}$
6. Set the DUT to the 100% FS output voltage.
7. Set the DUT to the 100% FS output current.
8. Turn the DUT output on.



**WARNING.** *Do not touch the load resistor. The load resistor may become hot enough to cause burns.*

---

9. Enter the oscilloscope measurements into the table for checking current noise. (See Table 12 on page 11.)
10. Power off the DUT and test equipment.

*This completes the performance verification procedure.*