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# PS 503A
# DUAL
# POWER SUPPLY

## INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

Serial Number _____

070-1834-01

First Printing SEPT 1974

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# OPERATING INSTRUCTIONS

## INTRODUCTION

### Description

The PS 503A is a dual 0 to 20 V dc constant-voltage, current-limited, floating power supply. It is designed to operate in the high-power compartment of the TM 504 or TM 506 Power Module. In the high-power compartment, it provides a floating dual 0 to 20 V dc at 1.0 A. Operating in a standard compartment of a TM 500 Series Power Module, the PS 503A supplies a floating dual 0 to 20 V dc at 400 mA.

The supply is designed for conveniently powering complementary and linear integrated circuits such as operational and differential amplifiers as well as differential comparators. A ground referenced +5 V auxiliary supply (suitable for bipolar logic, light-emitting diodes, incandescent displays and similar applications) is also included. With the floating supply available for powering discrete interface circuits and level shifting, the PS 503A can be used for many digital/analog applications.

The plus and minus outputs from the dual floating power supplies are independently variable or both variable at a constant ratio by a common control. Each supply provides either a plus or minus 0 to 20 V dc with respect to the common terminal. By connecting across the plus and minus terminals, the PS 503A can provide 0 to 40 V dc. Either terminal may be grounded or floated to 350 V (dc + peak ac). Each supply also features continuously variable current limiting from less than 50 mA to 400 mA (standard compartment) or 1 A (high power compartment) at both 20 V and 40 V output.

The presence and variability of the output voltage is verified by the VOLTS indicator light on the front panel. The brightness of this light varies with output voltage. A panel-mounted light-emitting diode (LED) indicates when the PS 503A is operating in a standard compartment of a TM 500 Series Power Module and the output current is limited to a maximum of 400 mA. Other panel-mounted, light-emitting diodes indicate when either the + or − supply goes into current-limiting. Hard limiting is indicated by maximum brightness of the light-emitting diode as well as a dimming of the VOLTS indicator light if the supply output voltage is above approximately 10 V. These functions are easily verified by momentarily shorting the output of the supply.

### Installation and Removal

**CAUTION**

*Turn the power module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry. Because of the high current drawn by the PS 503A, it is also recommended that the power module be turned off before removing the PS 503A. Refer to Fig. 1-2. Check to see that the plastic barriers on the interconnecting jack of the selected power module compartment match the cut-outs in the PS 503A circuit board edge connector.*

Align the PS 503A chassis with the upper and lower guides of the selected compartment. Push the module in and press firmly to seat the circuit board in the interconnecting jack.

To remove the PS 503A, pull on the release latch located in the lower left corner, until the interconnecting jack disengages and the PS 503A will slide out.

### Controls and Connectors

Refer to Fig. 1-3. Even though the PS 503A is fully calibrated and ready to use, the functions and actions of the controls and connectors should be reviewed before attempting to use it. Press the OUTPUT button to apply power to the PS 503A.

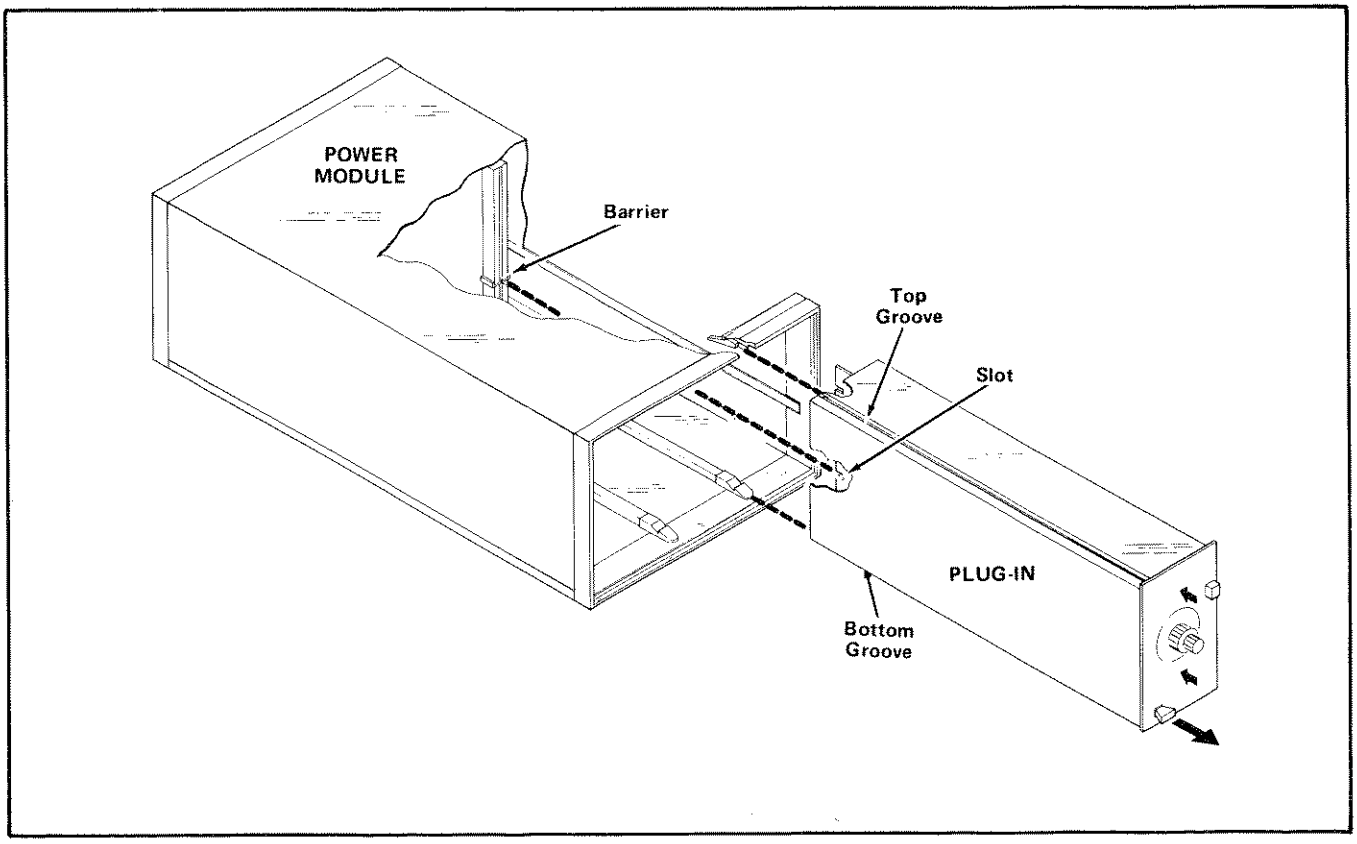



**Fig. 1-2. Plug-in module installation/removal.**

## OPERATING CONSIDERATIONS

### Overheating

The PS 503A is designed to operate at an ambient temperature from 0°C to +50°C. However, when operating several power supplies in a multi-plug-in power module, especially at low output voltages, or when operating close to other heat-producing equipment, internal temperature may exceed safe limits and actuate a thermal cutout in the power module. Refer to the power module instruction manual for more complete information.

### Load and Monitor Connections

Improper connections between the power-supply output and the load(s) or monitoring device(s) are a common cause of errors. Multiple loads or monitoring devices must be connected directly to the output terminals with separate pairs of leads as shown in Fig. 1-4. Avoid using clip leads, since their contact resistance can exceed the output impedance of the PS 503A and cause significant measurement error.

### Grounded and Floating Operation

The PS 503A is a + and −20 V "floating" supply since no internal connections are made to either the chassis or ground. The supply can thus be used as a positive or negative supply by simply connecting between the common and the negative or positive output terminal. However, there may be undesirable effects caused by grounding the supply to the chassis while the load is grounded at some point removed from the supply chassis. For example, if a remote load is connected as shown in Fig. 1-5, ground currents containing the power-line frequency could result and create excessive noise and ripple in series with the load. Thus, floating operation is recommended to ensure against problems caused by undersirable ground currents.

### Reverse Current Loading

In some bias supply and digital circuitry applications the load might behave as a current source for part of its operating cycle. Since the output circuit of a series-regulated supply is unidirectional, current will not pass in the opposite direction except through undesirable paths. The internal reverse-current diodes conduct only when the PS 503A terminal voltage reverses and therefore will not work when the voltage is correctly polarized. Connec-

**400 mA LIMIT Indicator**

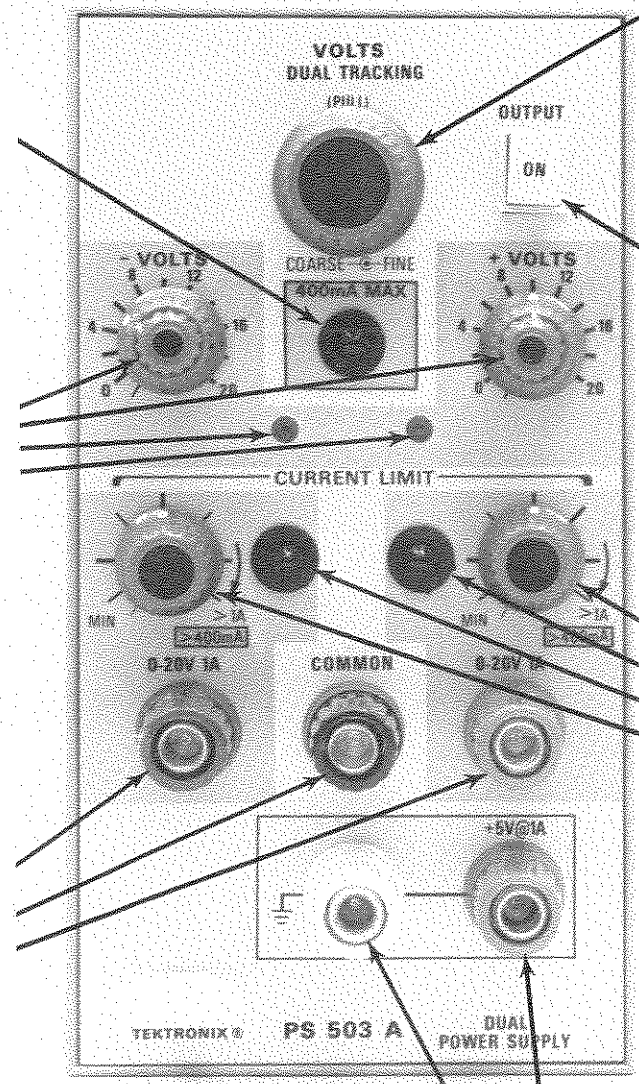
Light emitting diode indicates when PS 503A is installed in a standard compartment of a power module, limiting the current output.

**VOLTS Controls and Indicators**

Variable coarse and fine controls provide continuously variable + or − voltage selection from the respective 0-20 volt supply. The presence and variability of output voltage is verified by voltage indicator lights (OUTPUT button pressed). Brightness of lights varies with output voltage.

**Floating Output Terminals**

5-way binding post terminals that provide either a positive 0-20 volts between the binding post on the right (red) and COMMON, or a negative 0-20 volts between the binding post on the left (green) and COMMON. When the PS 503A is installed in the high power compartment of a TM 504 or TM 506 power module that has a high power compartment, the current available at either the + or − outputs is from less than 100 mA to at least 1 A. When the PS 503A is installed in a standard compartment, the current available is from less than 100 mA to at least 400 mA. 0 to 40 volt output is obtained between the + and − output terminals.




**VOLTS DUAL TRACKING Control**

When pulled out, varies both the + and − outputs from 0 volts to the value set on the + and − VOLTS controls. The ratio between the + and − outputs is maintained throughout the range of the VOLTS DUAL TRACKING control.

**OUTPUT Pushbutton**

When pressed, applies power to both 0-20V binding post terminals and the +5V binding post terminal.

**CURRENT LIMIT Controls and Indicators**

Continuously variable controls that select the + and − output current limit. Light-emitting diode indicates when hard limiting occurs.

**+5 Ground-Referenced Output Terminals**

5-way binding-post terminals that provide a ground-referenced +5 V, 1 A, fixed output.

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**Fig. 1-3. PS 503A controls and connectors.**

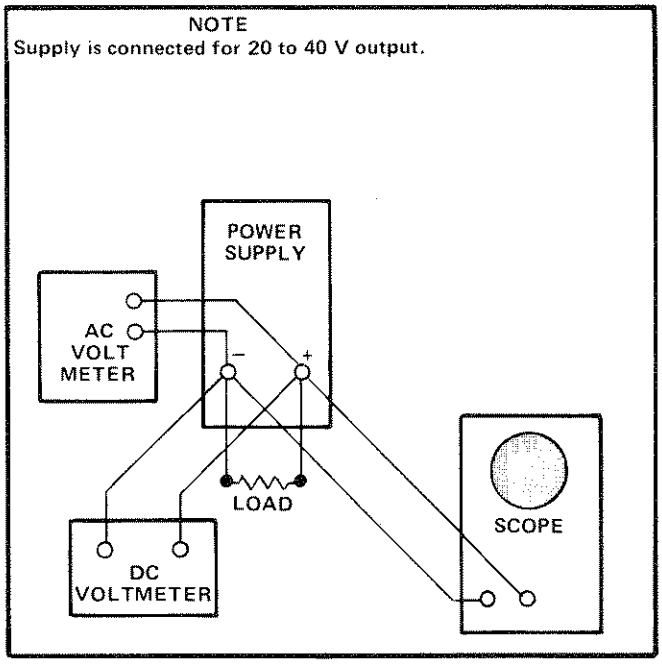



Fig. 1-4. Monitor and load connections.

ting a shunt resistor ($R_S$) as shown in Fig.1-6 provides an external, reverse-current path to the power supply sources or delivers current only.

### Over-voltage

The PS 503A is protected from over-voltage conditions by an over-voltage protection circuit that shuts down the power supply when the voltage rises to about 26 V dc.

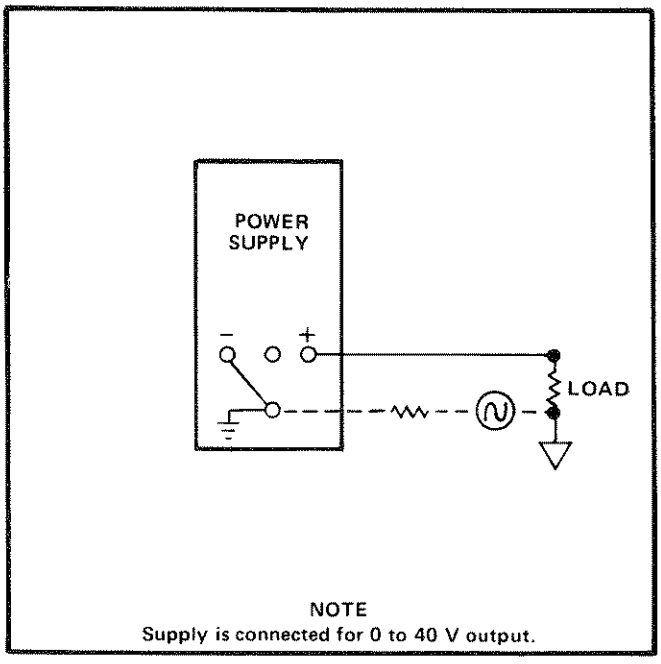



Fig. 1-5. Ground loop created by grounded remote lead.

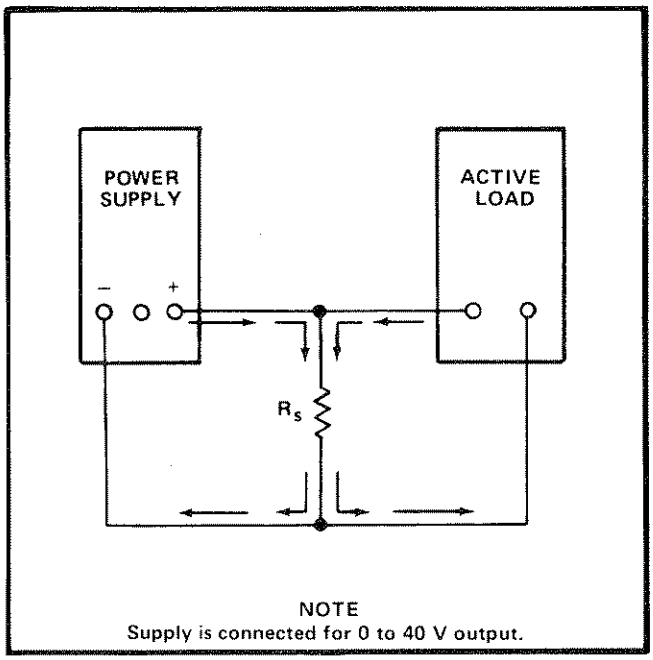



Fig. 1-6. Reverse current shunt ($R_S$) with active load.

*NOTE*

*The point at which the overvoltage protection blows the fuse may be changed for specific applications by changing the Zener diode.*

## OPERATION

The following steps demonstrate the use of the PS 503A controls and connectors.

1. Install the PS 503A into (preferably) the high-power compartment of the power module.

2. Press the OUT button to apply power to the PS 503A. Observe that the + and − VOLTS indicator lights come on (the lights will be very dim at low voltages).

### Single Supply Operation (±20 V Maximum)

1. Set the + and − VOLTS controls for approximately 2 V.

2. Turn the CURRENT LIMIT controls fully ccw (to protect the ammeter). Connect an ammeter between the common terminal and the + or − terminal and adjust the appropriate CURRENT LIMIT control for the maximum desired current output.

3. Remove the ammeter. Connect the load between the common terminal and the + or − terminal. Adjust the + or − VOLTS control for the desired output.

## Combined Supply Operation (40 V Maximum)

1. Set the + and − VOLTS control for approximately 2 V and turn the CURRENT LIMIT controls fully ccw (to protect the ammeter).

2. Connect an ammeter between the + and − terminals. First adjust one CURRENT LIMIT control for the maximum desired current output; then adjust the other CURRENT LIMIT control until the CURRENT LIMIT indicator just reaches maximum brightness, i.e., both supplies at the same CURRENT LIMIT setting.

3. Remove the ammeter. Connect the load between the + and − terminals and set the + and − VOLTS controls so that both settings added together equal the desired output voltage. (See Dual-Tracking Operation for varying the output with the VOLTS DUAL TRACKING control.)

## Dual-Tracking Operation

When pulled out, the VOLTS DUAL TRACKING control varies the output of both supplies at a constant ratio from zero to the value set on the + and − VOLTS controls. For example, if the + and − VOLTS controls are set for maximum output (approximately 20 V), both outputs can be varied from zero to 20 V with the VOLTS DUAL TRACKING control (1:1 ratio). Likewise, if one supply is set for 10 V and the other for 20 V, each 1 V change in the 10 V output will be matched by a 2 V change in the 20 V output (2:1 ratio).

Note also that no matter where the VOLTS DUAL TRACKING control is set, the outputs will return to the voltage selected by the + and − VOLTS control when the VOLTS DUAL TRACKING control is pushed in. Therefore, rapid selection of two preset outputs from each supply is achieved by merely switching the VOLTS DUAL TRACKING control in or out.

When the + and − supplies are connected as described under Combined Supply Operation, the VOLTS DUAL TRACKING control will vary the output from zero to the value selected by the + and − VOLTS controls added together.

## Stair-Step Operation

The PS 503A can be operated to provide a "stair-step" output characteristic by choosing certain load limits and control settings. For example, Fig. 1-7 shows the stair-step output from the PS 503A when a variable load ($R_L$) is connected between the + and − output terminals. With each supply set for maximum voltage and current (40 V, 1 A) the output voltage remains constant from open circuit until the load reaches approximately 40 Ω as illustrated by the solid line in Fig. 1-7. At this crossover point, the output voltage decreases with the load and the output current is limited at 1 A. Therefore, below approximately 40 Ω, both supplies act as current sources with output voltage variable with the load. Since both supplies are set for the same output voltage, each supply shares equally in the power output $I^2R$. If one supply is set for a lower output voltage than the other, output power is shared at the same ratio as the output voltage.

Now, by setting supply $E_2$ for a current limit of 0.5 A and varying the load over the same range, the supplies act as constant-voltage sources until the load reaches approximately 80 Ω. At that crossover point, the supply set for 0.5 A ($E_2$) becomes a current source and its output

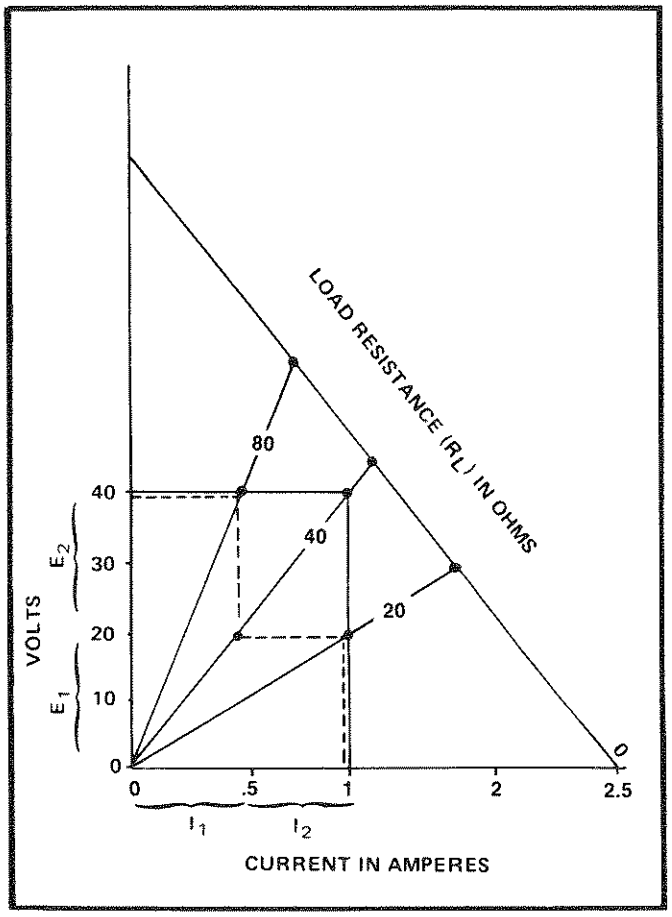



**Fig. 1-7. Output characteristics with various currents, voltages, and loads.**

voltage decreases with the load. At approximately 40 Ω and 20 V, supply $E_2$ no longer contributes to the power output. Subsequently, supply $E_1$ supplies all the output power and operates as a constant-voltage source with output current variable with the load. Then, at approximately 20 Ω, supply $E_1$ crosses over and becomes a current source at its maximum output of 1 A. Thus, by choosing the appropriate load limits and control settings, any of the four operating characteristics is possible.

A second stair-step output can be preselected and switched in or out with the VOLTS DUAL TRACKING control (see Dual-Tracking Operation for details on the function of the VOLTS DUAL TRACKING control).

## Series-Connected Supplies

The outputs of two or more PS 503A's can be connected in series as shown in Fig. 1-8 to obtain an output voltage equal to the sum of the output voltages from each supply. Each supply must be adjusted individually to obtain the desired output voltage (see Dual-Tracking Operation for varying the output of both supplies with the VOLTS DUAL TRACKING control).

*NOTE*

*The PS 503A has internal diodes connected across the output to protect the series-connected supplies against reverse polarity if the load is shorted, or one of the supplies is not on.*

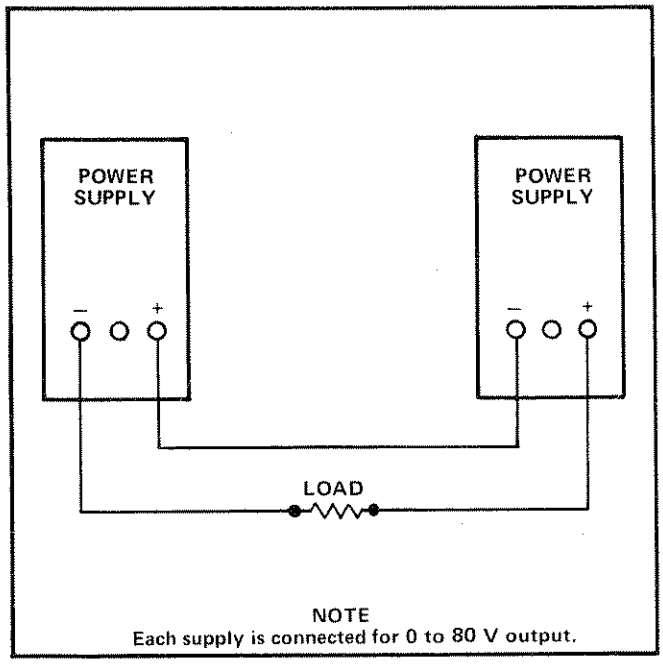



**Fig. 1-8. Supplies series-connected.**

## Parallel-Connected Supplies

**CAUTION**

*Parallel operation is not recommended unless a forward biased diode capable of handling the required current and voltage is inserted between each power supply and the load. Failure to do this may cause power supply damage.*

The outputs of two or more PS 503's can be connected in parallel as shown in Fig. 1-9 to obtain an output current equal to the sum of the output currents from each supply. Each supply must be adjusted individually to obtain the desired output current.

*NOTE*

*The + and − supplies are internally connected in series. Therefore, the + and − supplies cannot be externally connected in parallel to obtain an output current equal to the sum of the currents from each supply.*

One supply should be set for the desired output voltage and the other for a slightly higher voltage. The supply set for the desired voltage will then become a constant voltage source, while the supply with the higher voltage output becomes a current source (due to automatic crossover), which results in their output voltage decreasing to that of the supply with the lowest output voltage.

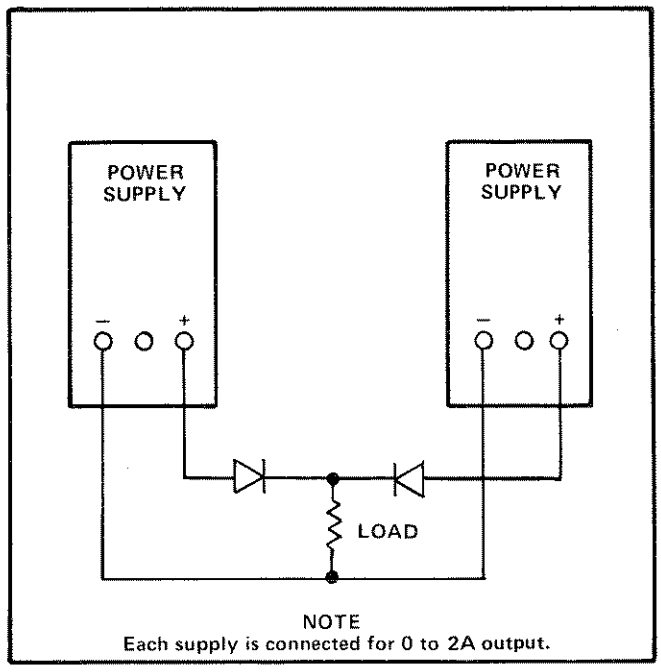



**Fig. 1-9. Supplies parallel-connected.**

# SPECIFICATION AND PERFORMANCE CHECK

## SPECIFICATION

### Performance Conditions

The electrical characteristics are valid only if the PS 503A has been calibrated at an ambient temperature between +20° C and +30° C and is operating at an ambient temperature between 0° C and +50° C unless otherwise noted.

Items listed in the Performance Requirements column are verified by completing the Performance Check in this manual. Items listed in the Supplemental Information column are not verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Table 2-1

ELECTRICAL CHARACTERISTICS

| Characteristics | Performance Requirements | Supplemental Information |
|---|---|---|
| **Plus and Minus 20 V Floating Supplies** | | |
| Voltage Outputs | | 0 V (±100 mV) to at least 20 V dc (20.1, −.1, +.4 V dc) with respect to common terminal, or 0 V to at least 40 V dc across the plus and minus terminals.<br><br>Outputs either independently variable or both variable at a constant ratio of a common control (Dual Tracking). |
| Variable Current Limiting | Less than 100 mA to at least 1A when installed in a high-power compartment.<br><br>Less than 100 mA to at least 400 mA when installed in a low power compartment. | Maximum limit; 1.5 A<br><br>Maximum limit; 600 mA |
| Minimum Resolution | | 50 mV |

Table 2-1 (cont)

| Characteristics | Performance Requirements | Supplemental Information |
|---|---|---|
| Load Regulation | Within 3 mV with a 1 A load change. | Within 1 mV with a 400 mA load change. |
| Transient Recover | | ≤20 μs for a constant voltage to recover within 20 mV for a nominal output voltage after a 400 mA change in output current. |
| Line Regulation | Within 5 mV for a ±10% line voltage change. | |
| Ripple and Noise (2 Hz to 2 MHz instrument not in current limiting.) | 3 mV peak-to-peak or less with a 1 A load. | 1 mV peak-to-peak or less with a 400 mA load (noise and ripple increase unpredictably when current is being limited). |
| Temperature Coefficent | | 0.025%/° C or less. |
| Stability | | 0.1% +5 mV (or less) of drift in 8 hours. Line voltage, load and temperature held constant. |
| Supply Isolation from Ground | | 350 V (dc + peak ac). |
| Dual Tracking Mode Offset Error | If the two supplies are set independently to any given voltage ratio, and if both supplies are then monitored and varied a given amount (by using the VOLTS DUAL TRACKING control), the two supplies will maintain the same voltage ratio as initially set within 50 mV; until one supply reaches either 0 V or 20 V. | |
| **+5 V Ground Reference Supply** | | |
| Output | 4.75 V dc to 5.25 V dc with a 5 ohm load. | Measured at a temperature between +20° C and +30° C. |
| Load Regulation | Within 100 mV with a 1 A load change. | |
| Line Regulation | Within 50 mV for a ±10% line voltage change. | Measured at a temperature between +20° C and +30° C. |
| Ripple and Noise (2 Hz to 2 MHz) | 5 mV peak-to-peak or less with a 1 A load. | |
| Long Term Stability | | 0.5% or less of drift. |
| Overload Protection | | Fixed (automatic) current limiting and over-temperature shutdown. |

**Table 2-2**

**ENVIRONMENTAL**

| Characteristics | Performance Requirements | Supplemental Information |
|---|---|---|
| Temperature | | |
| Operating | 0° C to +50° C. | |
| Storage | −40° C to +75° C. | |
| Altitude | | |
| Operating | To 15,000 feet, maximum operating temperature decreased by 1° C/1000 feet from 5000 to 15,000 feet. | |
| Storage | To 50,000 feet. | |
| Vibration | | |
| Operating and Non-Operating | With the instruments complete and operating, vibration frequency swept from 10 to 55 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015" total displacement. Hold 10 minutes at any major resonance, or if none, at 55 Hz. Total time, 75 minutes. | |
| Shock | | |
| Operating and Non-Operating | 30 g's, 1/2 sine, 11 ms duration, 3 shocks in each direction along 3 major axes, for a total of 18 shocks. | |

**Table 2-3**

**PHYSICAL**

| Characteristic | Information |
|---|---|
| Overall Dimensions (measured at maximum points) | |
| Height | 5.0 inches<br>12.7 cm |
| Width | 2.6 inches<br>6.6 cm |
| Length | 11.75 inches<br>29.7 cm |
| Net Weight (Instrument only) | 1 lb 13 oz<br>821 grams |

# PERFORMANCE CHECK

## Introduction

This procedure checks the electrical characteristics of the PS 503A that appear in the Specification portion of this section. Limits and tolerances given in the Supplemental Information column are provided for user and service information only, and should not be interpreted as requirements for this Performance Check.

The electrical characteristics are valid only if the instrument has been calibrated at an ambient temperature between +20° C and +30° C, and is operated at an ambient temperature between 0° C and +50° C unless otherwise noted.

Limits and tolerances given in this Performance Check are for the instrument under test and do not include test equipment error. Limits and tolerances in this procedure are instrument performance requirements only if stated as such in the Specification portion of this section.

## Test Equipment Required

The following test equipment, or equivalent, is required to perform the performance check and adjustment procedure. Test equipment characteristics listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerance.

Special test devices are used where necessary to facilitate the procedure. Most of these are available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

**Table 2-4**

**LIST OF TEST EQUIPMENT REQUIREMENTS**

| Description | Performance Requirements | Application | Example |
|---|---|---|---|
| Oscilloscope | Bandwidth, dc to 2 MHz; minimum deflection factor, 1 mV/div; sweep rate, 10 ms/div to 1 μs/div. | Used throughout procedure to provide display. | Tektronix 5110, 5B10N Oscilloscope System. |
| Digital voltmeter | Range, zero to 1000 volts; accuracy, within 0.1%. | Voltage measurements. | Tektronix DM 501 Digital Multimeter.[a] |
| Power Module | Four compartments or more, with one high-power compartment. | All tests. | Tektronix TM 504 or TM 506. |
| Autotransformer with ac voltmeter | Capable of supplying an output voltage from 90 to 132 volts, ac; 120 W of power at the upper limits. | Regulation and ripple checks. | General Radio W10MTR3W Variac Autotransformer. |
| Coaxial cable | Impedance, 50 Ω; length, 42 inches; connectors, bnc. | Provides signal interconnection. | Tektronix Part No. 012-0057-01. |
| Patch cord (2 required) | Banana-plug-jack to banana-plug-jack; length, 18 inches. | Provides signal interconnection. | Tektronix Part No. 012-0031-00 (black), 012-0039-00 (red). |

Table 2-4 (cont)

| Description | Performance Requirements | Application | Example |
|---|---|---|---|
| Adapter | Bnc female to dual-banana plugs. | Provides signal interconnection. | Tektronix Part No. 103-0090-00. |
| Load resistor | 20 Ω, 20 W, 5%, (two 10 Ω, 10 W in series). | Load tests. | Tektronix Part No. 308-0246-00. |
| Load resistor | 5 Ω, 5 W, 5%. | Load tests. | Tektronix Part No. 308-0179-00. |
| Resistor (2 required) | 4.99 kΩ, 1/2 W, 1% or better. | Dual tracking detector test. | Tektronix Part No. 323-0260-00. |
| 1X passive probe | Compatible with 5A-series amplifiers used in oscilloscope. | Provides signal interconnection. | Tektronix P6028 Probe. |

*Requires TM 500-Series Power Module.

## Preliminary Procedure

1. Ensure that all test equipment and the PS 503A under test are suitably adapted to the line voltage to be applied. Refer to the installation section of the power module manual.

2. Be certain that the POWER switch on the power module is off and that the OUTPUT pushbutton on the PS 503A is in the out position.

3. Install the PS 503A in the far right (high power) compartment of the power module.

4. Connect the power module to the autotransformer and connect the autotransformer to the line voltage source. Set the autotransformer voltage output control for zero volt output.

5. Set all front-panel controls on the PS 503A fully counterclockwise (ccw). Apply power to the power module and press in the OUTPUT pushbutton on the PS 503A. Push the PS 503A VOLTS DUAL TRACKING control in.

6. Adjust the autotransformer to the nominal line voltage and check that the two VOLTS indicator lights on the PS 503A are on.

7. Set the vertical deflection factor for 1 mV/div and sweep rate for 5 ms/div on the test oscilloscope. Use ac coupling for the vertical amplifier unit during this procedure.

8. Connect all test equipment to a suitable line voltage source.

9. Turn on all test equipment and allow at least twenty minutes for the equipment to warm-up and stabilize.

*NOTE*

*During warm-up time, attach banana pins to the leads of the 20 Ω and 5 Ω load resistors so that they can be inserted in the holes of the dual-banana adapter. This allows the load resistors to be connected as close as possible to the output terminals on the PS 503A so contact resistance is kept to a minimum.*

## Performance Check Procedure

### 1. Check 0-20 Volt Output Voltage

a. Check that all controls on the PS 503A front panel are fully ccw and that the 400 mA MAX indicator light is off (this light should remain off as long as the PS 503A is installed in the high-power compartment of the power module). Also check that both CURRENT LIMIT indicator lights are off. (For instruments SN B022064-below, these lights may be on; if so, adjust the appropriate CURRENT LIMIT control cw just enough to turn them off).

b. Set the digital voltmeter to the 2 volts dc range. Use patch cords to connect the +20 V floating output terminals of the PS 503A to the digital voltmeter input terminals; connect the red patch cord from the 0—20V red binding post to the digital voltmeter high input terminal, and the black patch cord from the COMMON (black) binding post to the digital voltmeter low input terminal.

c. Check that the PS 503A + VOLTS controls are fully ccw and check for a meter reading of .0000, within ±100 mV.

d. Set the digital voltmeter to the 200 volts dc range and set the PS 503A + VOLTS controls fully cw.

e. Check—for a meter reading of at least +20.1 volts, but less than +20.4 volts.

f. Adjust the PS 503A + VOLTS controls fully ccw and move the red patch cord from the 0—20V red binding post to the 0—20V green binding post on the PS 503A.

g. Repeat parts 1c through 1e, using the PS 503A — VOLTS controls to check the —20 V supply.

h. Set the PS 503A — VOLTS controls fully ccw and move the red patch cord back to the 0—20V red binding post on the PS 503A. Check to be certain that all PS 503A front-panel controls are fully ccw.

### 2. Check Variable Current Limiting

a. Adjust the PS 503A + VOLTS controls for +5.0 V output. Move the red patch cord to the PS 503A 0—20V green binding post and adjust the PS 503A — VOLTS controls for —5.0 V output. Move the red patch cord back to the PS 503A 0—20V red binding post.

b. Disconnect the red patch cord from the digital voltmeter high input terminal and set the digital voltmeter to the 2000 mA dc range. Reconnect the red patch cord to the digital voltmeter high input terminal.

c. Check—for a current reading of less than 100 mA for the +20 V supply. The PS 503A + CURRENT LIMIT light should be on.

d. Move the red patch cord from the PS 503A 0—20V red binding post to the PS 503A 0—20V green binding post.

e. Check—for a current reading of less than 100 mA for the —20 V supply. The PS 503A — CURRENT LIMIT light should be on.

f. Rotate the PS 503A — CURRENT LIMIT control fully cw.

g. Check—for a current reading of more than 1000 mA, but less than 1500 mA for the —20 V supply.

h. Reconnect the red patch cord to the PS 503A 0—20V red binding post and rotate the PS 503A + CURRENT LIMIT control fully cw.

i. Check—for a current reading of more than 1000 mA, but less than 1500 mA for the +20 V supply.

j. Set all controls on the PS 503A front panel fully ccw and retain the digital voltmeter connections to the PS 503A.

### 3. Check Load Regulation

a. Disconnect the red patch cord from the digital voltmeter input terminal and set the digital voltmeter to the 20 volts dc range. Reconnect the red patch cord to the digital voltmeter high input terminal; the meter reading should indicate approximately zero volts. Both CURRENT LIMIT lights on the PS 503A front panel should be off and remain off during the load regulation check.

b. Rotate the CURRENT LIMIT control on the PS 503A fully cw.

c. Adjust the PS 503A + VOLTS fine and coarse controls for a meter reading between +19.900 and +19.980 volts. Note and record the exact open-circuit voltage reading before applying the adapter (with load resistor attached) in part d of this step.

d. Insert the leads of the 20 Ω, 5% resistor into the holes of a dual-banana plug adapter and connect the adapter to the patch cord jacks, which remain connected to the PS 503A 0—20V red and the COMMON binding post terminals. Observe correct polarity for the adapter (GND to COMMON).

e. CHECK—that the meter reading does not change more than 3 mV (three counts of the most right-hand digit).

*NOTE*

*If the reading on the digital voltmeter changes by more than 3 mV, another 20 Ω, load resistor having a resistance value closer to 20 Ω should be used, or the voltage output from the PS 503A can be reduced to +19.000 (step 3c).*

f. Remove the adapter (with load resistor) from the PS 503A patch cord jacks. Move the red patch cord to the 0—20V green binding post terminal.

g. Adjust the PS 503A − VOLTS fine and coarse controls for a meter reading between −19.900 and −19.980 volts. Note and record the exact open-circuit voltage reading before applying the adapter (with load resistor attached) in part h of this step.

h. Insert the leads of the 20 Ω, 5% resistor into the holes of a dual-banana adapter and connect the adapter to the patch cord jacks, which remain connected to the PS 503A 0—20V green and the COMMON binding post terminals. Observe correct polarity for the adapter (GND to COMMON).

i. Check—that the meter reading does not change more than 3 mV (three counts of the most right-hand digit).

**4. Check Line Regulation**

a. Note the exact voltage reading displayed on the digital voltmeter with the adapter and load resistor still attached to the PS 503A 0—20V green and COMMON binding post terminals (−19.900 to −19.980 volts).

b. Adjust the autotransformer 10% below and 10% above the nominal line voltage setting.

c. Check—that the voltage reading displayed on the digital voltmeter does not change more than ±5 mV (5 counts) for each 10% line voltage change. Readjust the autotransformer to the nominal line voltage.

d. Remove the adapter (with load resistor) from the patch cord jacks. Move the red patch cord to the 0—20V red binding post terminal. Reconnect the adapter (with load resistor) to the patch cord jacks. Observe correct polarity for the adapter (GND to COMMON).

e. Note the exact voltage reading displayed on the digital voltmeter with the adapter and load resistor still attached to the 0—20V red and COMMON binding post terminals (+19.900 to +19.980 volts).

f. Adjust the autotransformer 10% below and 10% above the nominal line voltage setting.

g. Check—that the voltage reading displayed on the digital voltmeter does not change more than ±5 mV (5 counts) for each 10% line voltage change. Readjust the autotransformer to the nominal line voltage.

**5. Check Ripple and Noise**

a. Disconnect the patch cords from the PS 503A 0—20V red and COMMON binding post terminals and reconnect the dual-banana adapter (with load resistor) directly to the 0—20V red and COMMON binding post terminals; observe correct polarity of the adapter (GND to COMMON).

b. Connect the output of the adapter to the vertical input of the oscilloscope, using a 42-inch bnc cable. Set the oscilloscope vertical deflection factor for 1 mV/div (calibrated).

c. Slowly adjust the autotransformer output voltage 10% below and then 10% above the nominal line voltage.

d. Check—the signal display on the oscillosocpe for less than 3 mV peak-to-peak (within three vertical divisions) at all points of the specified voltage limits.

e. Readjust the autotransformer to the nominal line voltage.

f. Connect the adapter (with load resistor attached) to the PS 503A 0—20V green and COMMON binding post terminals; observe correct polarity of the adapter (GND to COMMON).

g. Repeat steps 5c through 5e to check the ripple and noise of the PS 503A −20 V supply.

h. Readjust the autotransformer to the nominal line voltage and disconnect all connections from the PS 503A.

**6. Check Dual Tracking Mode Offset Error**

a. Pull out the PS 503A VOLTS DUAL TRACKING control and set it fully ccw to ensure minimum output voltage while connecting the resistors.

b. Connect the two 4.99 kΩ, 1% resistors in series between the PS 503A 0—20V green and 0—20V red binding post terminals. Do not connect the junction of the two resistors to the COMMON terminal or the chassis.

c. Connect the black patch cord from the digital voltmeter low terminal to the PS 503A COMMON binding post, and the red patch cord from the digital voltmeter high terminal to the PS 503A 0—20V red binding post.

d. Set the PS 503A VOLTS DUAL TRACKING control fully cw and adjust the PS 503A + VOLTS controls for a meter reading of +18 V, ±0.1 volt.

e. Connect the red patch cord to the 0—20V green binding post and adjust the PS 503A − VOLTS controls for a meter reading of −18 V, ±0.1 volt.

f. Disconnect the red patch cord from the 0—20V green binding post and connect it to the junction of the two 4.99 kΩ, 1% resistors. Check that the digital voltmeter indicates a dc voltage less than 1 V.

g. Set the digital voltmeter to the 2-volts dc range and adjust either the + VOLTS or − VOLTS controls on the PS 503A to obtain a meter reading of 0 V dc (±100 mV).

h. Adjust the PS 503A VOLTS DUAL TRACKING control slowly from cw to ccw.

i. Check—that the meter reading remains within ±25 mV of zero volts.

j. Set the PS 503A VOLTS DUAL TRACKING control fully ccw and push the control knob in. Disconnect both patch cords and the two resistors from the binding post terminals.

**7. Check +5 Volt Output Voltage**

a. Connect the digital voltmeter between the +5V@1A ground referenced red binding post and the ground white binding post.

b. Push in the OUTPUT button and check that the two VOLTS indicator lights are on.

c. Check—for a meter reading of +4.75 to +5.25 volts.

d. Connect a 5 Ω, resistor between the +5V@1A ground referenced red binding post and the ground (white) binding post.

e. Check—that the meter reading does not change by more than 100 mV.

**8. Check +5 Volt Output Voltage Regulation**

a. Adjust the autotransformer output voltage from the low limit to the high limit as indicated in Table 2-5.

b. Check—that the digital voltmeter reading does not change more than 50 mV for a plus 10% or minus 10% line voltage change.

c. Disconnect the digital voltmeter.

d. Connect the probe of the test oscilloscope between the +5V binding post and the ground (white) binding post.

e. Adjust the autotransformer output voltage from the low limit to the high limit as indicated in Table 2-5.

f. Check—the test oscilloscope display for not more than 5 mV peak-to-peak ripple and noise.

g. Return the autotransformer to the nominal line voltage setting.

h. Disconnect the test oscilloscope probe from the binding posts.

i. Press and release the PS 503A OUTPUT button to turn off the power to the PS 503A.

**Table 2-5**

**POWER MODULE UNIVERSAL TRANSFORMER**

| Line Selector Block Position | Regulating Ranges | |
|---|---|---|
| | 110-Volts Nominal | 220-Volts Nominal |
| L | 90 VAC to 110 VAC | 180 VAC to 220 VAC |
| M | 99 VAC to 121 VAC | 198 VAC to 242 VAC |
| H | 108 VAC to 132 VAC | 216 VAC to 264 VAC |
| Line Fuse Data | 1.6 A slow-blow | 0.8 A slow-blow |

**9. Check Variable Current Limiting**

a. Turn the power off to the TM 500 Series Power Module and remove the PS 503A from the high-power compartment and install the PS 503A in the low-power compartment.

b. Turn on the power to the power module and press the PS 503A OUTPUT button in. Set all front panel controls fully ccw and allow approximately three minutes for the equipment to stabilize.

c. Check—that the 400 mA MAX indicator light is on.

d. Adjust the PS 503A + VOLTS and − VOLTS coarse controls to the 4 V position (leave the fine controls fully ccw).

e. Set the digital voltmeter to the 2000 mA position and connect the black patch cord from the digital voltmeter low terminal to the PS 503A COMMON binding post and the red patch cord from the digital voltmeter high terminal to the PS 503A 0—20V red binding post.

f. Set the PS 503A + and − CURRENT LIMIT controls fully cw.

g. Check—that the digital voltmeter indicates a current reading of more than 400 mA, but less than 600 mA. The + CURRENT LIMIT light should be on.

h. Move the red patch cord from the 0—20V red binding post to the 0—20V green binding post.

i. Check—that the digital voltmeter display indicates a current reading of more than 400 mA, but less than 600 mA. The − CURRENT LIMIT light should be on.

j. Set the PS 503A − CURRENT LIMIT control fully ccw.

k. Check—that the digital voltmeter indicates a current reading of less than 100 mA. The − CURRENT LIMIT light should remain on.

l. Move the red patch cord from the 0—20V green binding post to the 0—20V red binding post and set the PS 503A + CURRENT LIMIT control fully ccw.

m. Check—that the digital voltmeter indicates a current reading of less than 100 mA. The + CURRENT LIMIT light should be on.

n. Turn off all power to the power module. Push and release the PS 503A OUTPUT button and set all other front-panel controls fully ccw.

o. This completes the Performance Check Procedure for the PS 503A.

# ADJUSTMENT

## Introduction

This adjustment procedure is to be used to restore the PS 503A to original performance specifications. Adjustment need not be performed unless the instrument fails to meet the requirements listed in the Specification section, or the Performance Check cannot be completed satisfactorily.

## Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

## Test Equipment Required

The test equipment listed in Table 2-4 or equivalent, is required for adjustment of the PS 503A. Specifications given for the test equipment are the minimum necessary for accurate adjustment and measurement. All test equipment is assumed to be correctly calibrated and operating within specification.

If other test equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the equipment used.

## Preparation

a. Remove the left-hand and right-hand side covers of the PS 503A to gain access to the component side of the circuit boards. Pull the rear end of the side cover outward from the side of the instrument (the cover snaps into place).

b. Install the PS 503A into the far right (high power) power module compartment, or if appropriate, connect the PS 503A to the power module by means of the flexible plug-in extender. If a flexible extender is used, current limiting switch S95 must be engaged in the maximum current (HI) position. See Fig. 3-1 for switch location.

c. Set the power module for the line voltage to be applied (see power module manual) and connect it to the autotransformer, then connect the autotransformer to the line voltage source. Be sure that the power switch is off.

d. Install all TM 500-series equipment, including the PS 503A into the power module.

e. Connect all test equipment to a suitable line voltage source.

f. Turn on all test equipment and allow at least twenty minutes for the equipment to warm-up and stabilize.

g. Set the autotransformer to the nominal line voltage setting.

## Initial Control Settings

Set the following controls during warm-up time:

**PS 503A Dual Power Supply**

| | |
|---|---|
| − VOLTS (coarse and fine) | fully ccw |
| + VOLTS (coarse and fine) | fully cww |
| CURRENT LIMIT | |
| Plus supply | fully ccw |
| Minus supply | fully ccw |
| VOLTS DUAL TRACKING | pushed in and fully ccw |

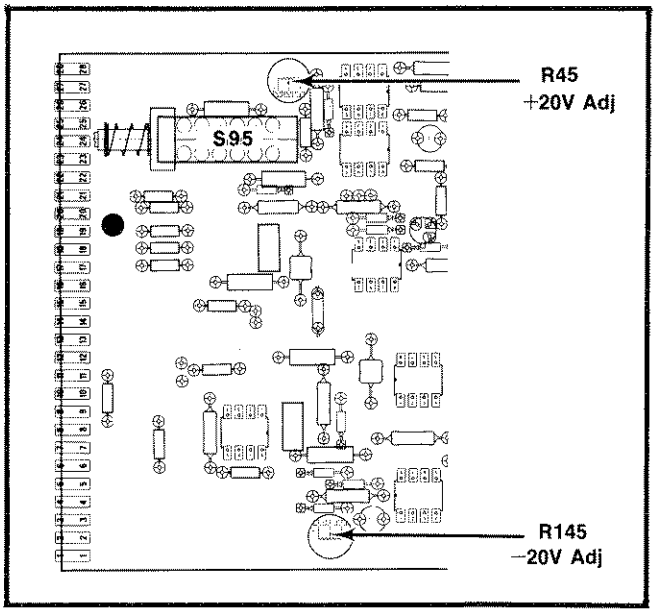



**Fig. 3-1. Location of +20 V and −20 V adjustment.**

## 1. Adjust 20 Volt Output Voltages

a. Check—that all controls on the PS 503A front panel are fully ccw and the 400 mA MAX indicator light is off (this light should remain off as long as the PS 503A is installed in the high-power compartment of the power module). Also check that both CURRENT LIMIT indicator lights are off. (For instruments SN B022064-below, these lights may be on; if so, rotate the appropriate CURRENT LIMIT control cw just enough to turn them off).

b. Set the digital voltmeter to the 2 volts dc range and check for a meter reading of zero volts, ±100 mV.

c. Set the digital voltmeter to the 200 volts dc range. Use patch cords to connect the plus 20 V floating output terminals of the PS 503A to the digital voltmeter input terminals; red patch cord from the 0—20V red binding post to the digital voltmeter high input terminal, and the black patch cord from the COMMON (black) binding post to the digital voltmeter low input terminal.

d. Turn the PS 503A + VOLTS fine and coarse controls fully cw.

e. Adjust—R45, +20 Adj, for a meter reading of +20.2 volts, ±0.1 volt. See Fig. 3-1 for adjustment location.

f. Adjust the PS 503A + VOLTS fine and coarse controls fully ccw and move the red patch cord from the 0—20V red binding post to the 0—20V green binding post.

g. Turn the PS 503A − VOLTS fine and coarse controls fully cw.

h. Adjust—R145, −20 Adj, for a meter reading of −20.2 volts, ±0.1 volt. See Fig. 3-1 for adjustment location.

i. Adjust the PS 503A − VOLTS fine and coarse controls fully ccw.

j. This completes the adjustment portion of this procedure. However, to verify satisfactory performance after adjustment, perform the complete Performance Check procedure as specified in Section 2 of this manual.

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