

INSTRUCTION MANUAL

DUAL POWER SUPPLY

PS 503

Serial Number _____



WARRANTY

All **TEKTRONIX** instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your **TEKTRONIX** Field Engineer or representative.

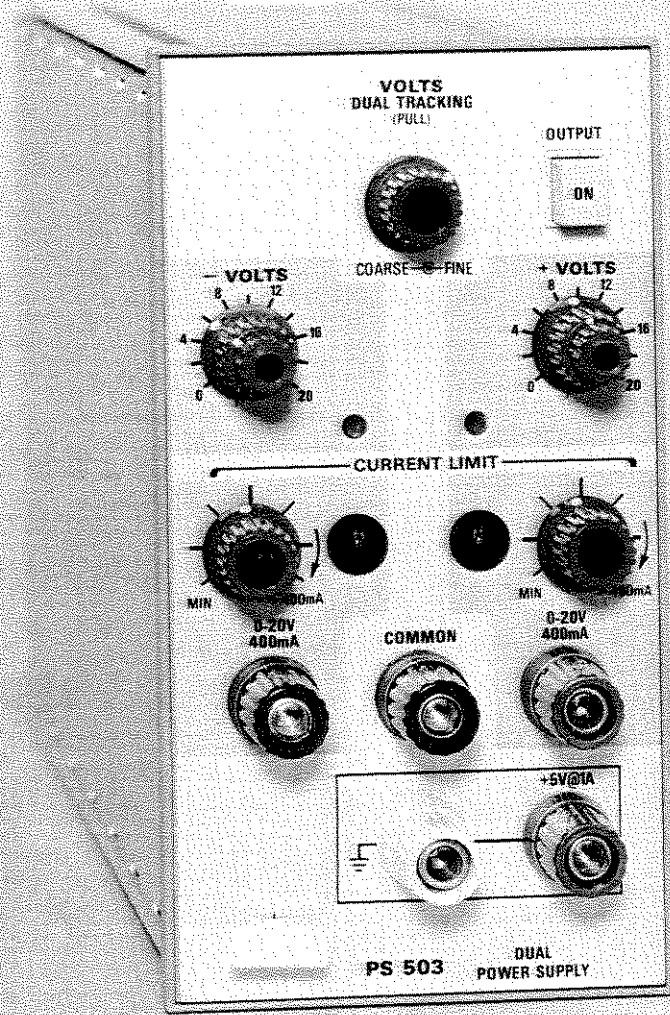
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OPERATING INSTRUCTIONS

DESCRIPTION

The PS 503 is a dual 0 to 20 V DC constant-voltage, current-limited, floating power supply that plugs into a TM 500 Series Power Module. 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 is also included which is suitable for bipolar logic, light-emitting diodes, incandescent displays and similar applications. With the floating supply available for powering discrete interface circuits and level shifting, the PS 503 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 a plus and a minus 0 to 20 VDC with respect to the common terminal. By connecting across the + and – terminals the PS 503 can also provide 0 to 40 VDC. Either terminal may be grounded or floated to 350 V (DC + peak AC). Each supply also features continuously variable current limiting from 0 to 400 mA at both 20 V and 40 V output.

The presence and variability of output voltages is verified by voltage indicator lights on the front panel. The brightness of these lights varies with output voltage.

A panel-mounted light-emitting diode indicates when the PS 503 goes into current-limiting. Hard limiting is indicated by maximum brightness of the light-emitting diode as well as a dimming of the voltage indicator light. These functions are easily evaluated by momentarily shorting the output of the supply.

OPERATION

Preparation

The PS 503 is calibrated and ready for use when received. It is designed to operate in any compartment of a TM 500 Series Power Module. Refer to the Power Module Instruction Manual for line voltage requirements and Power Module operation.

Functions of front-panel controls, indicators and connectors are described on a foldout page at the rear of this manual.

NOTE

It is recommended that the Power Module be turned off before inserting or removing the PS 503. Arcing at the connector terminals can reduce connector life. However, no internal damage will result if the supply is inserted into a live Power Module.

1. Install the PS 503 by aligning the upper and lower rails of the plug-in with the Power Module tracks and inserting until the plug-in panel is flush with the Power Module panel. To remove, pull the release latch to disengage the PS 503 from the Power Module.

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

NOTE

Before using the PS 503 for the first time read the Operating Considerations in this section regarding certain precautions and proper techniques for connecting various loads.

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 volts), both outputs can be varied from zero to 20 volts with the VOLTS DUAL TRACKING control (1:1 ratio). Likewise, if one supply is set for 10 volts and the other for 20 volts, each 1 volt change in the 10 volt output will result in a 2 volt change in the 20 volt 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 controls 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 503 can be operated to provide a "stair-step" output characteristic by choosing certain load limits and control settings. For example, Fig. 1-1 shows the stair-step output from the PS 503 when a variable load (R_L) is connected between the + and - output terminals. With each supply set for maximum voltage and current (40 V, 400 mA) the output voltage remains constant from open circuit (∞) until the load reaches approximately 100 Ω as illustrated by the solid line in Fig. 1-1. At this crossover point, the output voltage decreases with the load and the output current is limited at 400 mA. Therefore, below approximately 100 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

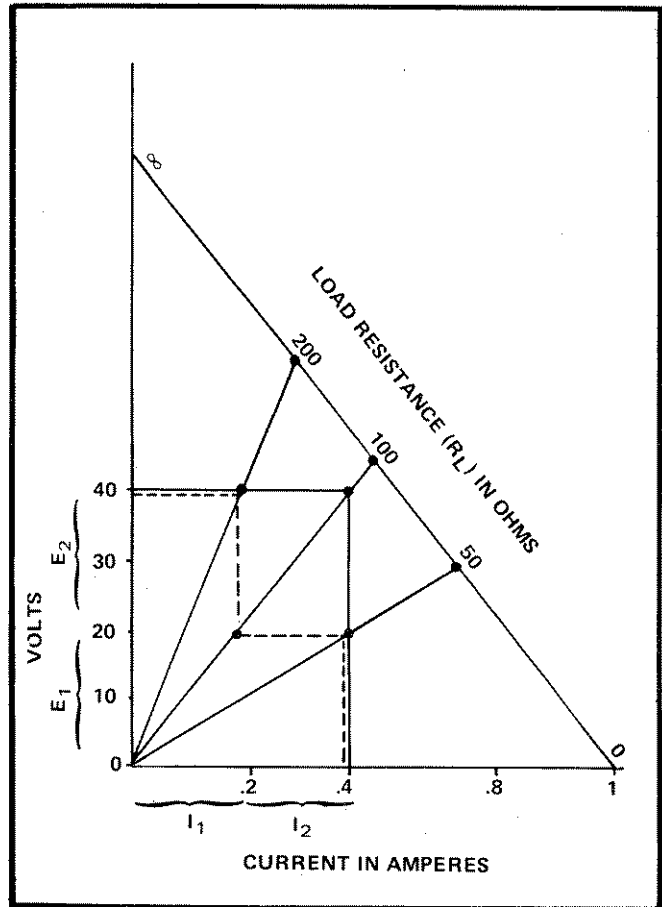


Fig. 1-1. Stair-step output characteristics with various currents, voltages, and loads.

shares equally in the power output ($I^2 R$). 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 200 mA and varying the load over the same range, the supplies act as constant voltage sources until the load reaches approximately 200 Ω . At that crossover point, the supply set for 200 mA (E_2) becomes a current source and its output voltage decreases with the load. At approximately 100 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 50 Ω , supply E_1 crosses over and becomes a current source at its maximum output of 400 mA. 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).

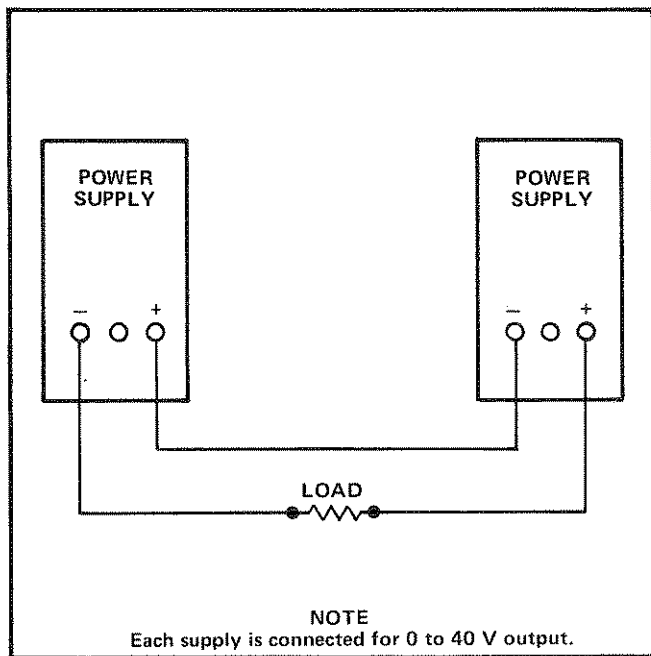


Fig. 1-2. Supplies series-connected to provide 80 V, 400 mA output.

Series-Connected Supplies

The outputs of two or more PS 503 's can be connected in series as shown in Fig. 1-2 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 503 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.

Parallel-Connected Supplies

The outputs of two or more PS 503 's can be connected in parallel as shown in Fig. 1-3 to obtain an output current equal to the sum of the output currents from each supply (800 mA maximum). 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.

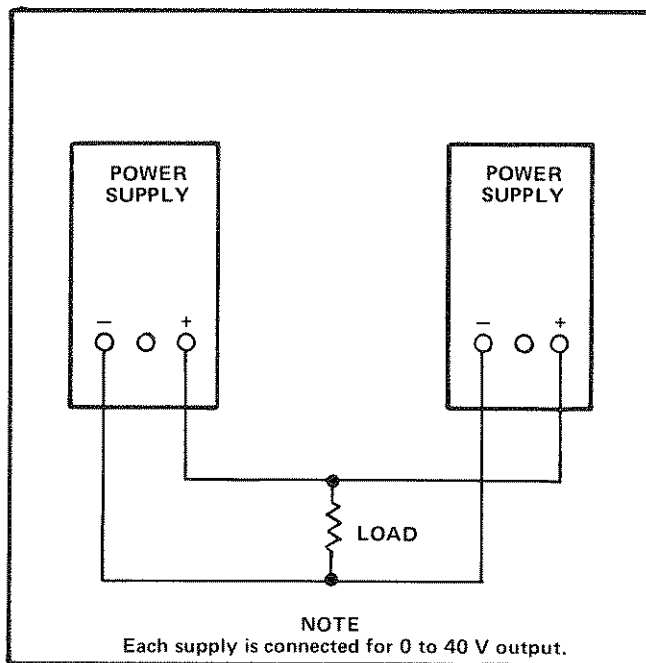


Fig. 1-3. Supplies parallel-connected to provide 40 V, 800 mA output.

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.

OPERATING CONSIDERATIONS

Overheating

The PS 503 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) and/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 503 and cause significant measurement error.

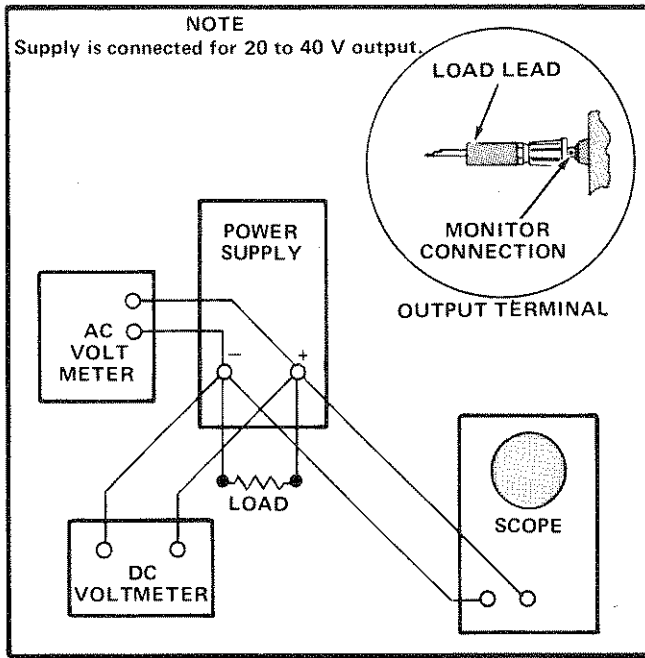


Fig. 1-4. Monitor and load connections.

Grounded and Floating Operation

The PS 503 is a "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

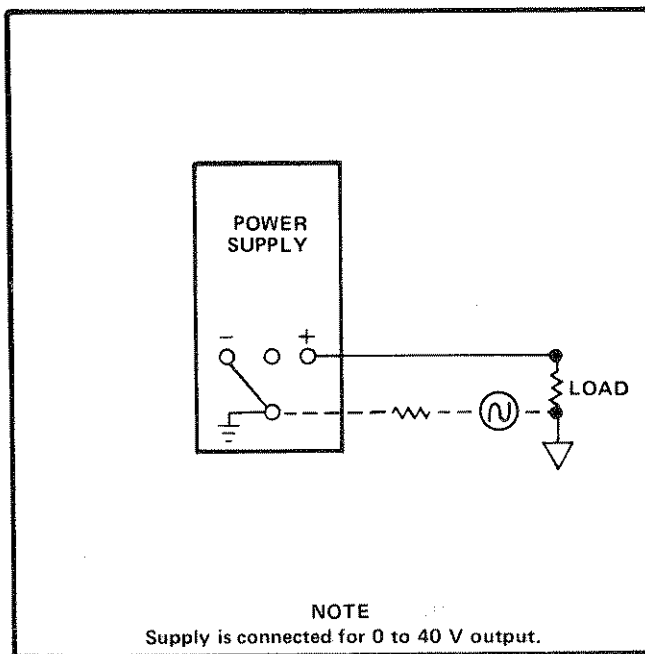


Fig. 1-5. Ground loop created by grounded remote load.

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 insure against problems caused by undesirable 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 503 terminal voltage reverses and therefore will not work when the voltage is correctly polarized. Connecting a shunt resistor (R_s) as shown in Fig. 1-6 provides an external reverse current path so the power supply sources or delivers current only.

Overvoltage

The PS 503 is not protected from overvoltage conditions. Component failure in the PS 503 could result in load damage if external protection is not provided. Likewise, if the load (or other instruments connected to the load) produce a voltage across the PS 503 terminals which is the same polarity but of greater amplitude, damage may result depending on the amount of overvoltage and the impedance of the load.

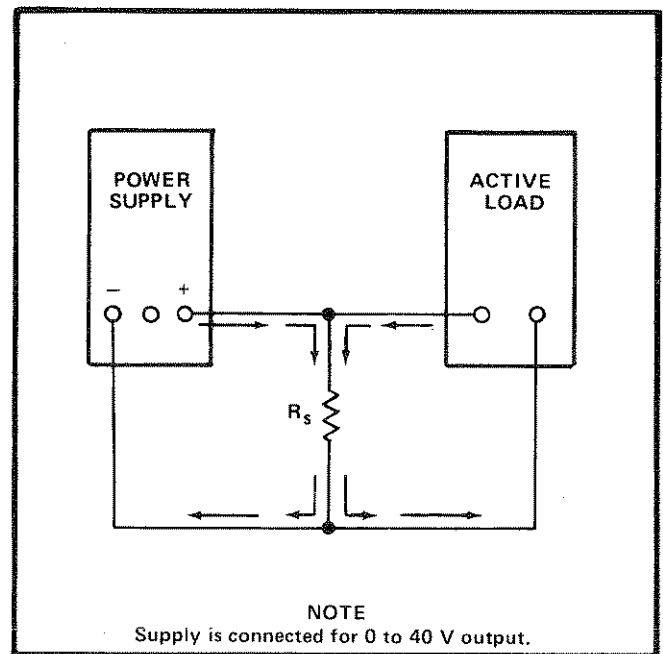


Fig. 1-6. Reverse current shunt (R_s) with active load.

ELECTRICAL CHARACTERISTICS

Performance Conditions

The electrical characteristics are valid only if the instrument 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.

20 V Floating Supplies

OUTPUTS: 0 to at least 20 VDC with respect to the common terminal or 0 to 40 VDC across the plus and minus terminals. Outputs either independently variable or both variable at a constant ratio by a common control. Both supplies insulated for 350 V (DC + peak AC) above ground. Each supply has continuously variable current-limiting from 0 to at least 400 mA.

MINIMUM RESOLUTION: 10 mV.

LOAD REGULATION: Within 1 mV with a 400 mA load change.

LINE REGULATION: Within 5 mV for a ±10% line voltage change.

RIPPLE AND NOISE: 0.5 mV P-P or less, 0.1 mV RMS or less.

TEMPERATURE COEFFICIENT: 0.01%/°C or less.

STABILITY: 0.1% + 5 mV or less drift in 8 hours at constant line, load and temperature.

TRANSIENT RECOVERY TIME: 20 μ s or less for a constant voltage to recover within 20 mV of nominal output voltage after a 400 mA change in output current.

+5 V Ground-Referenced Supply¹

OUTPUT (+20°C to +30°C): 4.8 VDC to 5.2 VDC at 1 A.

LOAD REGULATION: Within 100 mV with a 1 A load change.

LINE REGULATION (+20°C to +30°C): Within 50 mV for a ±10% line voltage change.

RIPPLE AND NOISE (1 A): 5 mV P-P or less, 100 μ V RMS or less.

STABILITY: 0.5% or less drift.

OVERLOAD PROTECTION: Automatic current limiting and over-temperature shutdown.

¹For additional information refer to National Semiconductor Corp. specifications for the LM309K 5 V Regulator Integrated Circuit.

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