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User Manual

Tektronix

PS2520, PS2520G, PS2521 & PS2521G Programmable Power Supplies

070-9196-01

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IEC 801-4 Electrical Fast Transient/Burst Immunity
IEC 801-5 Power Line Surge Immunity

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EN 55011 Class A Radiated and Conducted Emissions

EN 50081-1 Emissions:

EN 60555-2 AC Power Line Harmonic Emissions

EN 50082-1 Immunity:

IEC 801-2 Electrostatic Discharge Immunity
IEC 801-3 RF Electromagnetic Field Immunity
IEC 801-4 Electrical Fast Transient/Burst Immunity
IEC 801-5 Power Line Surge Immunity

"...conformity with the following standards:

following the provisions of the Directives of the Council of the European Union:

Low Voltage Directive 73/23/EEC: Amended by 93/68/EEC."

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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.

Only qualified personnel should perform service procedures.

Injury Precautions

Use Proper Power Cord

To avoid fire hazard, use only the power cord specified for this product.

Avoid Electric Overload

To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.

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.

Do Not Operate Without Covers

To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Use Proper Fuse

To avoid fire hazard, use only the fuse type and rating specified for this product.

Do Not Operate in Wet/Damp Conditions

To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in Explosive Atmosphere

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Avoid Exposed Circuitry

To avoid injury, remove jewelry such as rings, watches, and other metallic objects. Do not touch exposed connections and components when power is present.

Product Damage Precautions

Use Proper Power Source

Do not operate this product from a power source that applies more than the voltage specified.

Use Proper Voltage Setting

Before applying power, ensure that the line selector is in the proper position for the power source being used.

Provide Proper Ventilation

To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Safety Terms and Symbols

Terms in This Manual

These terms may appear in this manual:

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

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

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.

Symbols on the Product

The following symbols may appear on the product:

DANGER
High Voltage

Protective Ground
(Earth) Terminal

ATTENTION
Refer to
Manual

Double
Insulated

Certifications and Compliances

CSA Certified Power Cords

CSA Certification includes the products and power cords appropriate for use in the North America power network. All other power cords supplied are approved for the country of use.

Preface

This manual provides installation and operating instructions for the PS2520, PS2520G, PS2521, and PS2521G Programmable Power Supplies. The manual is organized as follows:

- *Getting Started* lists the product features, and describes how to install the power supply.
- *Operating Basics* provides an overview of the front and rear panel and details each operating task step by step. This section also provides a practical example of each control setting.
- The *Appendices* list product specifications and other reference information.

Refer to the *PS2520G and PS2521G Programmer Manual* (070-9197-XX) for information on how to set up and use the PS2520G and PS2521G Programmable Power Supplies over the IEEE-488 General Purpose Interface Bus (GPIB).

Preface

Getting Started

This section describes the features of the PS2520, PS2520G, PS2521, and PS2521G Programmable Power Supplies.

Be sure to set up your power supply using the installation instructions at the end of this section.

Product Description

The PS2520, PS2520G, PS2521, and PS2521G are programmable DC power supplies. All four power supplies have the following features:

- Three outputs allow independent, series, or parallel operation
- Automatic series or parallel tracking
- Easy to set, push-button controls
- Data entry using the keypad, up/down keys
- Four-digit displays for both voltage and current
- Overvoltage and overcurrent protection
- Display readouts for memory, output, and error code display
- Precision digital-to-analog converter for high resolution
- High stability, low drift output
- Memory storage and recall
- Automatic sequencing with timer
- Diagnostic self-test at power on

In addition, the PS2520G and PS2521G power supplies include a GPIB interface that allows you to program and operate the power supply from a remote location over the General Purpose Interface Bus (GPIB).

For a complete list of specifications, refer to *Appendix A: Specifications* on page 27.

Installation

Use the following installation procedure to properly configure and turn on the power supply for the first time:

1. Check the line voltage setting on the rear panel. If the line voltage setting does not match the line voltage of your area, change the line voltage setting as shown in Figure 1.

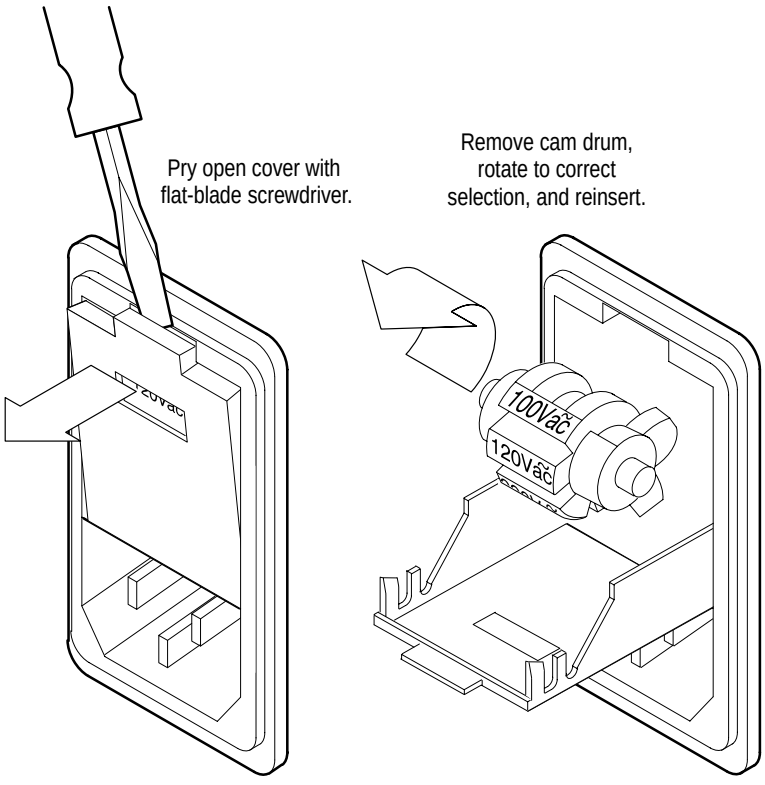


Figure 1: Changing the Line Voltage Setting

CAUTION. *To avoid damaging the instrument, make sure the line voltage setting and fuse type match the line voltage of your area.*

2. Identify the fuse and replace it if necessary with the type specified in *Appendix C: Replaceable Parts* on page 37. See Figure 2 to replace the fuse.

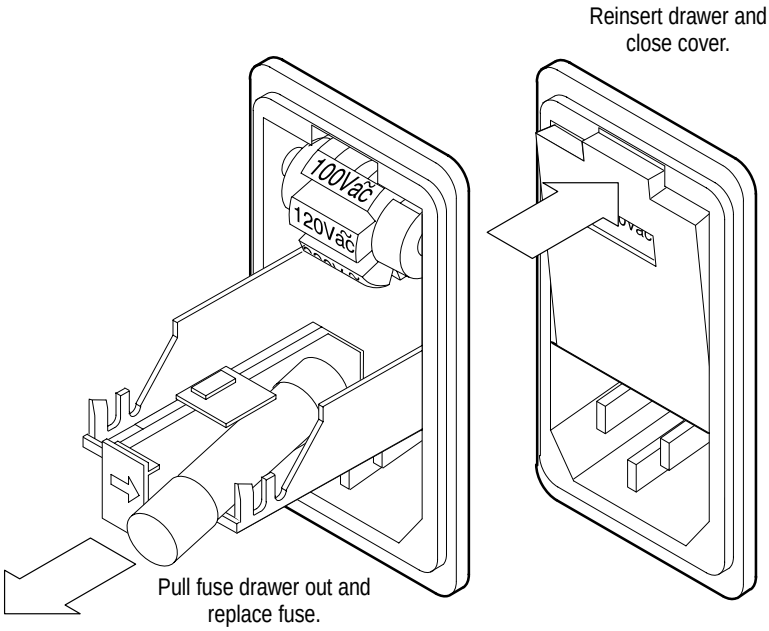


Figure 2: Replacing the Line Fuse

3. Place the power supply on a level surface. Leave at least 10 cm (4 in) clearance around the cabinet for cooling.

4. Connect the power cord to the connector on the rear of the power supply and plug the other end into a wall receptacle.

5. Turn the power on. The display indicators will flash briefly. The voltage and current readouts show the output settings. You should also hear the cooling fan running whenever the power is on.

The power supply performs a diagnostic self test at power on. If the diagnostic self test detects a problem, the unit displays an error code number in the form “Err –xxx.” If you encounter an error code, refer to *Troubleshooting* on page 32.

General Procedure

Use the following general procedure to connect one or more of the power supply outputs to a load. This procedure allows you to use the power supply safely. More information about each step is in *Operating Basics* on page 5.

1. Turn the power supply off and remove any connections on the outputs.
2. Turn the power supply on.
3. Select the output you want to configure. Refer to *Selecting the Output* on page 7.
4. Set the protection levels for the selected output. Refer to *Setting the Protection Levels* on page 8.
5. Set the voltage and current limit for the selected output. Refer to *Setting Voltage and Current Limits* on page 9.
6. Repeat steps 3 through 5 for the remaining outputs.
7. Turn the power supply supply off.
8. Connect the output(s) to the load(s). Refer to *Connecting the Outputs* on page 11.
9. Turn the power supply on.
10. Enable the outputs. Refer to *Enabling the Outputs* on page 20.

Operating Basics

This section describes how to use the front panel controls and how to make connections to the power supply.

Functional Overview

Figure 3 illustrates the front panel features of the PS2520, PS2520G, PS2521, and PS2521G Programmable Power Supplies.

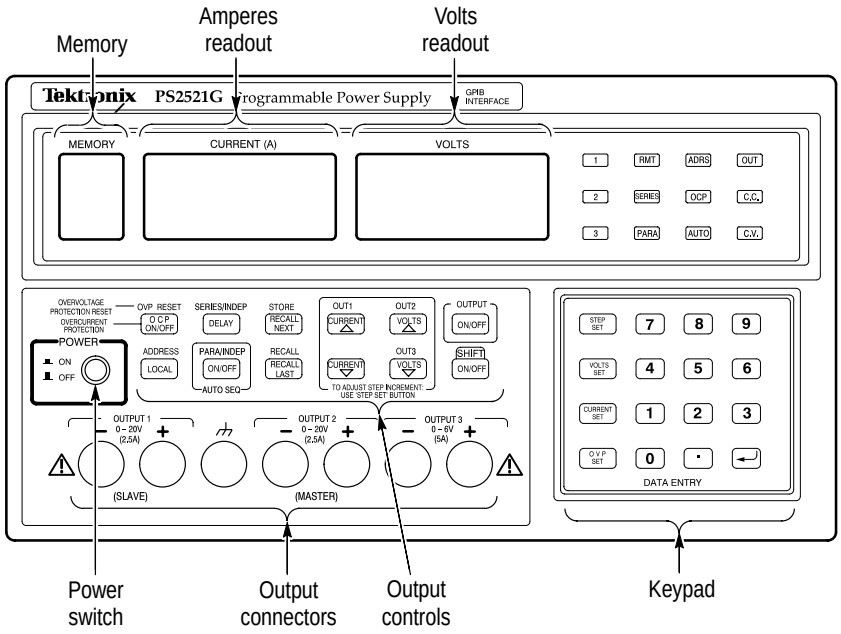


Figure 3: Front Panel Features

Figure 4 illustrates the rear panel features.

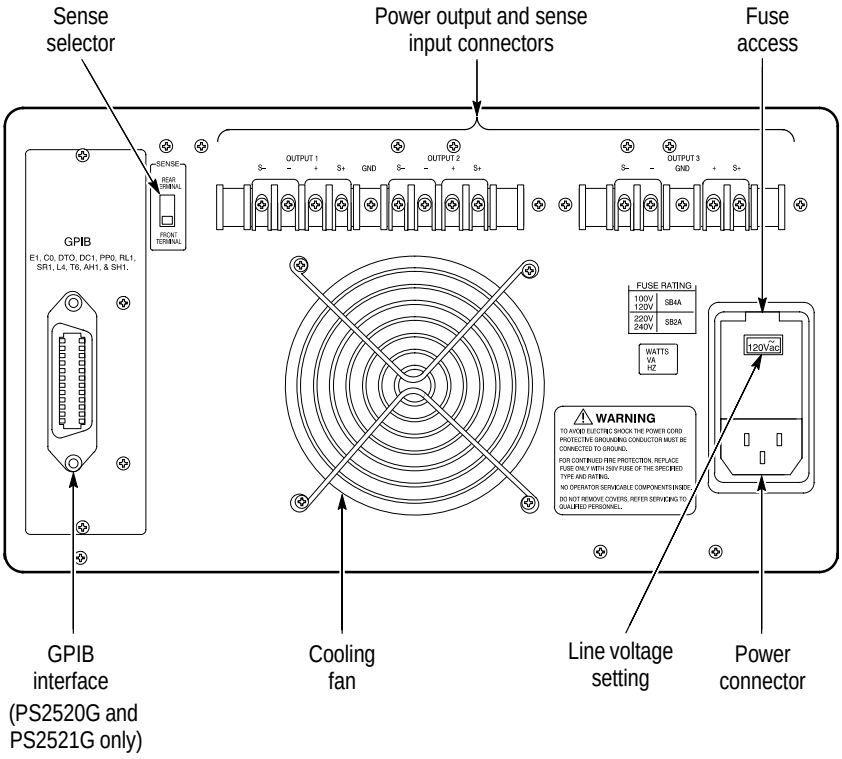


Figure 4: Rear Panel Features

Making a Control Setting

The front-panel controls allow you to set or program the amount of voltage, current, and protection for each output. To make a control setting you must press specific control buttons in the correct sequence. To enter a number, for example, you must select the function, enter the number, and then press return (◄┘). This manual presents an entry sequence of this type in the following form:

Press (function) → (number) → (return ◄┘)

Items that compose the sequence appear in order from left to right with arrows separating each item.

An example follows each sequence string to help reinforce your understanding. Examples look like this:

Example: Set the voltage to 2.34 volts.

VOLTS SET → **2.34** → (return ◄┘)

To select functions that have nomenclature above the output control buttons, you must first press the SHIFT button (see Figure 5). The shift indicator appears and remains active until you enter the function.

Example: Reset the OVP.

SHIFT → **OVP RESET**

Figure 5: SHIFT control

Selecting the Output

You must select the output before you can set the voltage, current, and protection levels for that output.

Press **SHIFT** → **OUT**(*n*) to select the output.

Example: Select Output 2.

SHIFT → **OUT2**

The output indicator for Output 2 lights, and you can set the output levels.

Setting the Protection Levels

The OVP (overvoltage protection) and OCP (overcurrent protection) settings protect against supplying excessive voltage or current to an output load. If voltage or current reaches the protection level setting, the power supply disables the outputs.

CAUTION. *To prevent damaging a circuit under test, set protection levels before you apply power to the circuit.*

Setting the OVP

The OVP (overvoltage protection) circuit automatically disables the output when the voltage on the output reaches the set level.

Press **OVP SET** → (number) → (return ◄┘) to enter the OVP level.

Example: Set the overvoltage protection for Output 1 to 6 volts:

1. **SHIFT** → **OUT1**
2. **OVP SET** → **6** → (return ◄┘)

Pressing the OVP SET again momentarily displays the OVP level and allows you to confirm the setting.

Resetting the OVP

Using the previous example, if the Output 1 voltage reaches 6 volts, the power supply automatically disables the output and displays the message “Err –013.”

To reset the OVP, correct the condition causing the overvoltage and press **SHIFT** → **OVP RESET**

Setting the OCP

Pressing OCP ON (overcurrent protection on) sets the power supply to automatically disable the outputs upon reaching the current limit. The OCP indicator appears on the display when the OCP is on.

When the OCP circuit disables the output, it displays the message "Err –012". When this happens, correct the setup and remove the error message by toggling OCP off and then on again.

When the OCP is not on, the power supply still limits the current to the set level and reduces the voltage as necessary to control the power. Refer to the following section for instructions on how to set the current limit.

Setting Voltage and Current Limits

The power supplies provide either constant voltage or constant current to a load. The voltage limit, current limit, and the size of the load connected to the output determines whether the power supply holds the voltage constant or the current constant. The appropriate indicator appears on the display to indicate whether constant voltage (C.V.) or constant current (C.C.) is active.

Using the Keypad to Set Limits

Press **VOLTS SET** → (number) → (return ◄┘) to enter the voltage limit.

Press **CURRENT SET** → (number) → (return ◄┘) to enter the current limit.

Example: Set the voltage of Output 3 to 4.2 volts with a maximum current of 0.3 amperes.

1. Select Output 3:

   SHIFT → OUT3

2. Set the voltage level of the output to 4.2 V:

   VOLTS SET → 4.2 → (return ◄┘)

3. Set the current limit of the output to 0.3 A:

   CURRENT SET → .3 → (return ◄┘)

The power supply keeps the voltage constant if the load does not require more than 0.3 amperes. The power supply indicates C.V. on the display.

Once the load tries to draw more than 0.3 amperes, however, the supply holds the current to 0.3 amperes (unless OCP is on) and allows the voltage level to vary accordingly. The power supply then indicates C.C. on the display.

Setting Voltage and Current Steps

The CURRENT and VOLTS △ (step up) and ▽ (step down) arrow keys allow you to make minor adjustments to the current and voltage settings.

The STEP SET function determines the amount that the arrow keys increment or decrement the setting when you press them.

Press **STEP SET** → **VOLTS SET** → (number) → (return↵) to set the amount of each voltage step increment and decrement.

Press **STEP SET** → **CURRENT SET** → (number) → (return↵) to set the amount of each current step increment and decrement.

NOTE*. The power supplies permit voltage steps up to 2.000 V and current steps up to 0.200 A.*

Example: Set voltage steps to 0.5 V and current steps to 0.1 A.

1. Set voltage steps to 0.5 V:

   STEP SET → **VOLTS SET** → **.5** → (return ↵)

2. Set current steps to 0.1 A:

   STEP SET → **CURRENT SET** → **.1** → (return ↵)

Press **VOLTS** △ to increase (and press **VOLTS** ▽ to decrease) the voltage limit by steps of 0.5 V.

Press **CURRENT** △ to increase (and press **CURRENT** ▽ to decrease) the current limit by steps of 0.1 A.

Press and hold the arrow key to increase the selection speed.

Connecting the Outputs

After setting the voltage and current limits, turn the power off and connect the outputs to one or more loads. The binding posts on the front outputs accept wires, spade lugs, or banana plugs. The rear output terminals provide additional output connections. You can make connections with or without reference to ground to each supply independently, in series or in parallel.

WARNING. *To avoid electrical shock and damage to circuits connected to the outputs, make sure that you turn the power supply off before making or changing output connections.*

Referencing Outputs to Ground

There are two types of power supply connections in relation to ground: isolated ground or ground referenced. Figure 6 shows both types of connections.

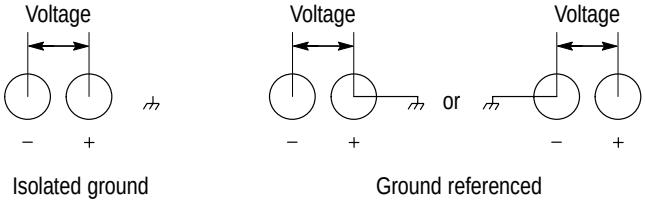


Figure 6: Isolated-Ground Connection

Use an isolated-ground connection when it is unnecessary or undesirable to connect one of the outputs to ground.

To reference an output connection to ground, do one of the following:

- Connect the positive output to the ground terminal to supply a negative voltage across the load.

- Connect the negative output to the ground terminal to supply a positive voltage across the load.

NOTE. *The ground post on the power supply internally connects to earth ground through the power supply chassis and line cord.*

Independent Operation

Independent operation allows you connect each of the three outputs to separate loads or to connect the outputs in series or in parallel with external connections. When the outputs are in the independent mode of operation, the SERIES and PARA indicators are not lighted. See Figure 7 for examples of independent output connections.

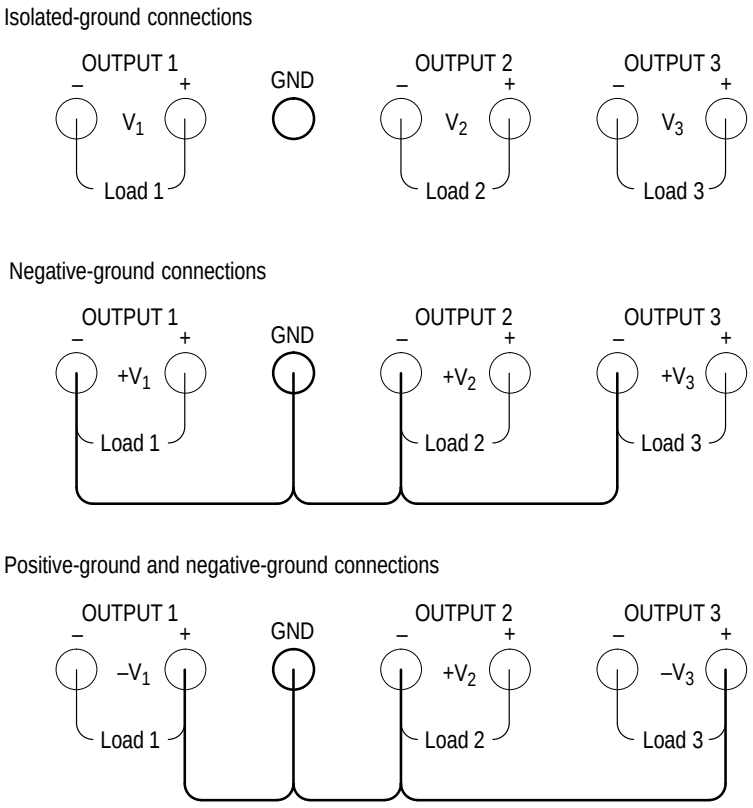


Figure 7: Examples of Independent Output Connections

External Series Connections. To achieve a potential across the load that exceeds the output of a single power supply, connect two or more power supplies in series. Figure 8 illustrates two independent power supplies connected in series. Note that the voltages of the power supplies add together but the currents do not.

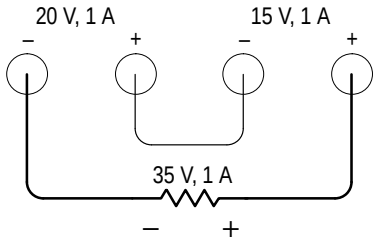


Figure 8: Connecting Power Supplies in Series

WARNING. *Voltages more than 60 VDC are a lethal shock hazard to the user. Be careful when connecting power supplies in series to achieve voltages higher than 60 VDC total or 60 VDC between any connection and earth ground.*

Refer to Figure 9 for examples of different types of series connections using the three outputs.

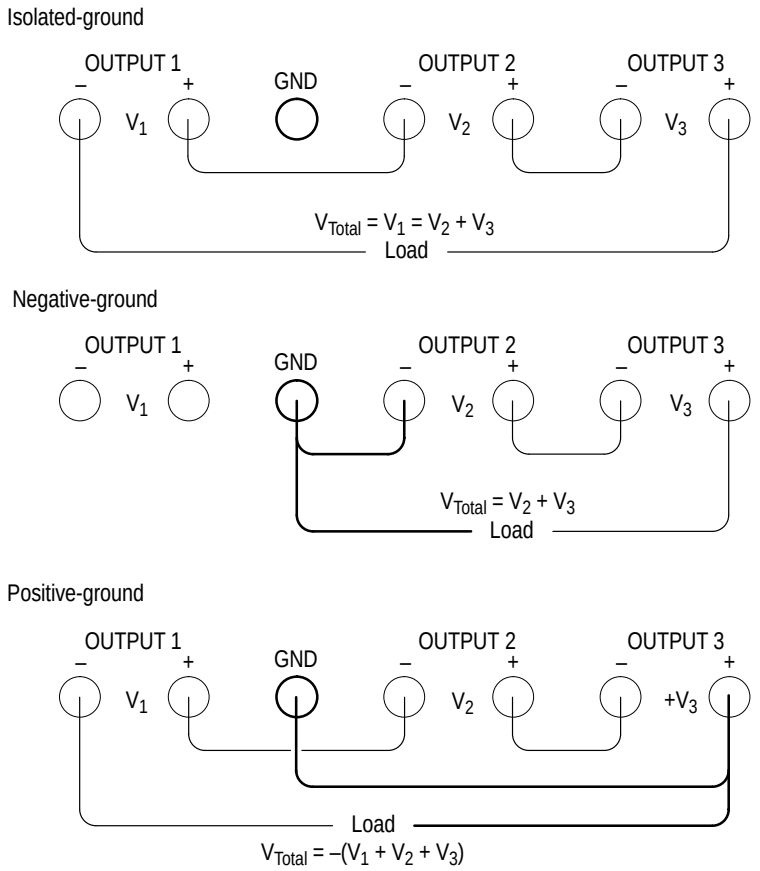


Figure 9: Examples of External Series Connections

External Parallel Connections. To supply more current than any one supply can provide individually, connect two or more power supplies in parallel. Figure 10 illustrates two power supplies externally connected in parallel. Note that the currents add together but the voltages do not. For this example the power supplies are set to independent and the SERIES and PARA indicators are not lighted.

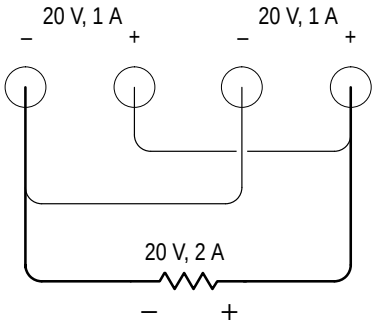


Figure 10: Connecting Power Supplies in Parallel

CAUTION. *To avoid damaging the output circuitry of the power supply, do not apply a voltage across an output that exceeds the voltage rating of that output.*

Refer to Figure 11 for examples of different types of parallel connections using the three outputs.

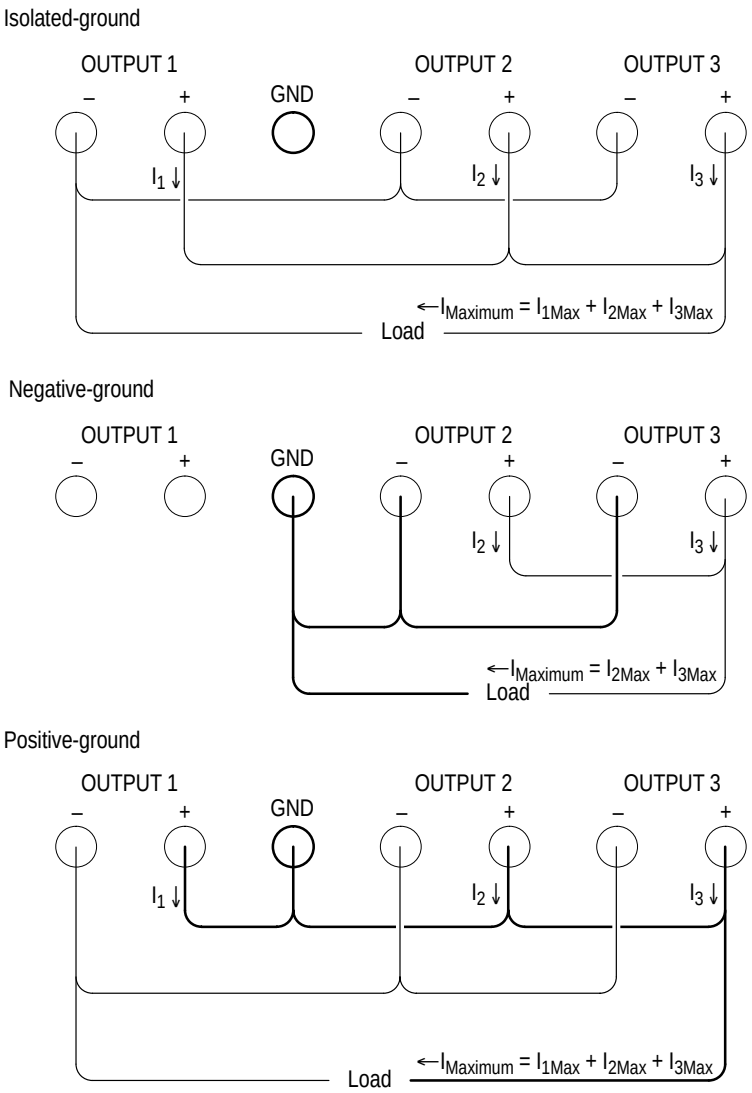


Figure 11: Examples of External Parallel Connections

Master/Slave Operation

The SERIES and PARA controls on the front panel allow you to internally connect Output 1 and Output 2 in series or parallel. When you do this, Output 2 (the master output) sets Output 1 (the slave output) to the same level as the Output 2 setting. These modes of operation are also called series tracking and parallel tracking.

Output 3 is always independent. You can connect Output 3 in series or parallel with the other outputs by using external connections only.

Table 1 shows the maximum output available for the power supplies in SERIES and PARA operation

Table 1: Maximum Output in Series and Para Modes

Model	Series	Para
PS2520, PS2520G	40 V, 2.5 A	20 V, 5 A
PS2521, PS2521G	72 V, 1.5 A	36 V, 3 A

Series Tracking. Select SERIES to internally connect Output 1 and Output 2 in series. Output 2 is the master.

Press **SHIFT** → **SERIES**

The SERIES indicator lights.

Use the Output 2 settings to control the power to the load. The Output 2 voltage setting should be one half of the total output voltage desired. (The voltage across Output 1 and Output 2 in series is twice that of Output 2.) The current setting for Output 2 controls the maximum current available to the load. See Figure 12.

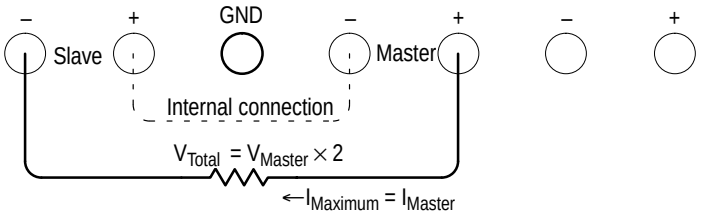


Figure 12: Series-Tracking Operation

Parallel Tracking. Select PARA to internally connect Output 1 and Output 2 in parallel. Output 2 is the master.

Press **SHIFT** → **PARA**

The PARA indicator lights.

Use the Output 2 settings to control the power to the load. The voltage across Output 1 and Output 2 in parallel is the same as the Output 2 setting. The current available from Output 1 and Output 2 in parallel is twice that of the Output 2 setting. See Figure 13.

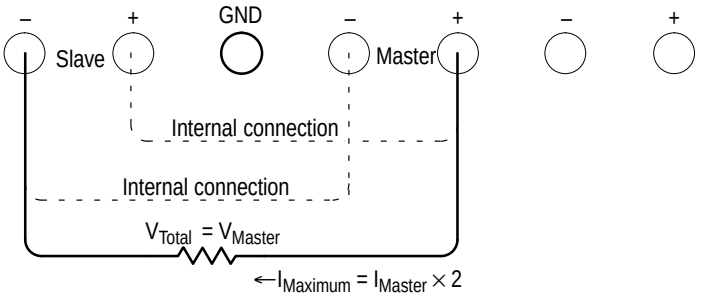


Figure 13: Parallel-Tracking Operation

Enabling the Outputs

Press the **OUTPUT ON/OFF** button (Figure 14) to enable the power to all outputs.

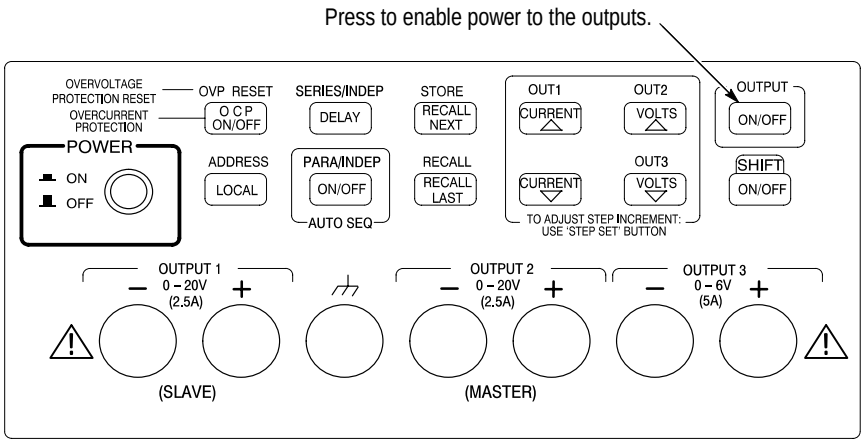


Figure 14: Output On/Off Button

The OUT indicator appears and all outputs are active.

Press the **OUTPUT ON/OFF** button again to disable the outputs and remove power from the load or loads connected to the output terminals.

Sensing the Output Level

Although the front and rear output terminals simultaneously supply power, the power supply senses the voltage level internally from either the front or rear terminals. Use the SENSE selector located on the rear panel to select the appropriate sense input. See Figure 15.

As the length of the output leads or the amount of output current increases, the amount of voltage drop across the output leads also increases. In this case, the internal sense connection does not accurately measure the voltage across the load. To compensate for

this problem the power supply has auxiliary sense inputs on the rear panel. Using these inputs, as illustrated in Figure 15, bypasses the voltage dropped across the output leads and senses the voltage directly across the load. It is best to use a shielded two-wire cable for this connection to prevent extraneous noise from affecting the sense measurement.

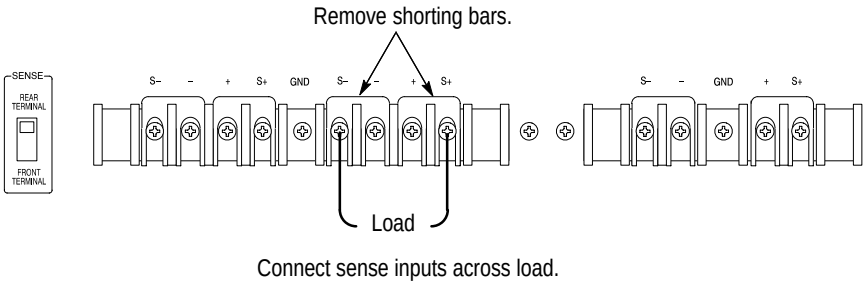


Figure 15: Connecting the Auxiliary Sense Inputs

Storing and Recalling Settings

The power supplies allow you to store voltage and current settings in as many as 50 different memory locations (00 – 49). Each location stores the settings for all three outputs. You can recall the settings of any location individually or you can step through the settings for each memory location in sequence.

Storing a Setting

The Store function saves the front panel settings for OVP, voltage limit, current limit, and delay timer in a specific memory location. (The section that describes the delay timer operation begins on page 24.)

Press **SHIFT** → **STORE** → (memory location number) → (return ◄↵) to store the settings in memory.

Example: Store the power supply settings for all three outputs in memory location 01:

SHIFT → **STORE** → **1** → (return ◄┘)

Recalling an Individual Setting

The Recall function recalls the settings stored in a specific memory location.

Press **SHIFT** → **RECALL** → (memory location number) → (return ◄┘) to recall a particular setting from memory.

Example: Recall the settings for all three outputs from memory location 01:

SHIFT → **RECALL** → **1** → (return ◄┘)

Storing and Recalling a Sequence of Settings

To create an automatic test routine, you can program the power supply to sequence through the settings stored in two or more consecutive memory locations. You can recall the sequence of stored settings either manually or automatically.

Manual Sequencing. Manual sequencing allows you to step through the stored settings one at a time by pressing the RECALL NEXT or RECALL LAST buttons.

1. Press **SHIFT** → **STORE** → (memory location number) → (return ◄┘) to store a setting. Repeat for each new setting, using a consecutive memory location for each setting.
2. Press **SHIFT** → **RECALL** → (first memory location) → (decimal point) → (last memory location) → (return◄┘) to specify the first through last memory locations in the sequence.
3. Press **RECALL NEXT** to recall the next memory location in the sequence. Press **RECALL LAST** to recall the previous memory location in the sequence.

Example: Store three new settings for Output 1 and manually recall the settings in sequence:

- Store 1 V, 0.1 A in memory location 01.
- Store 2 V, 0.15 A in memory location 02.
- Store 3 V, 0.15 A in memory location 03.
- Recall the settings of each memory location in order (01 – 03).

1. Select Output 1:

SHIFT → **OUT1**

2. Set the voltage limit to 1 V and the current limit to 0.1 A:

VOLTS SET → **1** → (return ◄┘)

CURRENT SET → **.1** → (return ◄┘)

3. Store this setting in memory location 01:

SHIFT → **STORE** → **1** → (return ◄┘)

4. Set the voltage limit to 2 V and the current limit to 0.15 A:

VOLTS SET → **2** → (return ◄┘)

CURRENT SET → **.15** → (return ◄┘)

5. Store this setting in memory location 02:

SHIFT → **STORE** → **2** → (return ◄┘)

6. Store 3 V, 0.15 A in memory location 03:

VOLTS SET → **3** → (return ◄┘)

SHIFT → **STORE** → **3** → (return ◄┘)

Note the current limit setting for location 03 is the same as location 02; therefore, you do not have to re-enter the current limit setting.

7. Set the sequence for memory locations 01 through 03:

SHIFT → **RECALL** → **1.3** → (return ◄┘)

8. Recall the settings in memory locations 01, 02, and 03 in that order:

   SHIFT → **RECALL** → **1** → (return ◄┘)

   RECALL NEXT → **RECALL NEXT**

Pressing RECALL NEXT recalls the next memory location in the sequence. (RECALL LAST recalls the previous memory location.)

Automatic Sequencing. To automatically output a sequence of stored settings, you must store the delay time along with the other settings for each memory location. The minimum delay time setting is 1 second; the maximum is 65535 seconds.

1. Press **DELAY** → (seconds) → (return ◄┘) to specify the delay time for a sequence step.
2. Press **SHIFT** → **STORE** → (memory location number) → (return ◄┘) to store a setting.
3. Repeat steps 1 and 2 for each new setting, using a consecutive memory location for each setting.
4. Press **SHIFT** → **RECALL** → (first memory location) → (decimal point) → (last memory location) → (return ◄┘) to specify the first through last memory locations in the sequence.
5. Press **AUTO SEQ ON** → **OUTPUT ON** to automatically output the settings in sequence.

   Example: Recall the previously stored memory locations 01 and 02 and set the delay times for each as follows:
   01: 3 seconds
   02: 7 seconds
   Set the test loop for memory locations 01 and 02.

1. Recall the settings in memory location 01:

   SHIFT → **RECALL** → **1** → (return ◄┘)

2. Set the delay time to 3 seconds:

   DELAY → **3** → (return ◄┘)

3. Store this setting back into memory location 01:

   SHIFT → **STORE** → **1** → (return ◄┘)

4. Recall the settings in memory location 02:

   SHIFT → **RECALL** → **2** → (return ◄┘)

5. Set the delay time for memory location 02:

   DELAY → **7** → (return ◄┘)

6. Store this setting back into memory location 02:

   SHIFT → **STORE** → **2** → (return ◄┘)

7. Specify the sequence to contain only locations 01 through 02:

   SHIFT → **RECALL** → **1.2** → (return ◄┘)

8. Set the power supply to automatically output and repeat this sequence starting with memory location 01:

   AUTO SEQ ON → **OUTPUT ON**

The AUTO and OUT indicators appear and the sequence starts running.

Setting the GPIB Address

If you have a PS2520G or PS2521G Programmable Power Supply, use the ADDRESS/LOCAL control to set or read the GPIB address of the power supply. Refer to the *PS2520G and PS2521G Programmer Manual* for more details.

Appendix A: Specifications

Tables 2 through 5 list the specifications of the PS2520, PS2520G, PS2521, and PS2521G Programmable Power Supplies.

Table 2: Operating Characteristics

Name	Characteristic
Independent Output Ratings	PS2520 and PS2520G: two outputs 0 to 36 V, 0 to 1.5 A and one output 0 to 6 V, 3 A PS2521 and PS2521G: two outputs 0 to 20 V, 0 to 2.5 A one output 0 to 6 V, 0 to 5 A
Series Tracking Output Rating	PS2520 and PS2520G: 0 to 72 V, 0 to 1.5 A PS2521 and PS2521G: 0 to 40 V, 0 to 2.5 A
Parallel Tracking Output Rating	PS2520 and PS2520G: 0 to 36 V, 0 to 3 A PS2521 and PS2521G: 0 to 20 V, 0 to 5 A
Maximum OVP	PS2520 and PS2520G: 38.5 V on 36 V outputs 7.0 V on 6 V output PS2521 and PS2521G: 22.5 V on 20 V outputs 7.0 V on 6 V output
Load Effect	Voltage: ≤ 3 mV, rear output; ≤ 6 mV, front output Current: ≤ 3 mA (≤ 6 mA if rating current > 3.5 A)
Source Effect	Voltage: ≤ 3 mV Current: ≤ 3 mA
Resolution	Voltage: 10 mV (20 mV if rating voltage > 36 V) Current: 1 mA (2 mA if rating current > 3.5 A) OVP: 10 mV (20 mV if rating voltage > 36 V)

Table 2: Operating Characteristics (Cont.)

Name	Characteristic
Program Accuracy (25 ± 5° C)	Voltage: ≤ 0.05% + 25 mV (+50 mV if rating voltage > 36 V)
	Current: ≤ 0.2% + 10 mA
	OVP: ≤ 2% + 0.6 V
Ripple and Noise 20 Hz to 20 MHz	Voltage Ripple: 1 mV_{RMS}/3 mV_{p-p}
	Voltage Noise: 2 mV_{RMS}/30 mV_{p-p}
	Current: ≤ 3 mA_{RMS} (≤ 5 mA_{RMS} if rating current > 3.5 A)
Temperature Coefficient (0° C to 40° C)	Voltage: ≤ 100 ppm + 3 mV
	Current: ≤ 150 ppm + 3 mA
Readback Resolution	Voltage: 10 mV (20 mV if rating voltage > 36 V)
	Current: 1 mA (2 mA if rating current > 3.5 A)
Readback Accuracy (25 ± 5° C)	Voltage: ≤ 0.05% + 25 mV (+50 mV if rating voltage > 36 V)
	Current: ≤ 0.2% + 10 mA
Response Time	10% to 90% (up): ≤ 100 ms
	90% to 10% (down): ≤ 100 ms (≥ 10% rating load)
Readback Temperature Coefficient	Voltage: ≤ 100 ppm + 10 mV (+20 mV if rating voltage > 36 V)
	Current: ≤ 150 ppm + 10 mA
Drift[1]	Voltage: ≤ 0.03% + 6 mV
	Current: ≤ 0.1% + 6 mA
Series Tracking	
tracking error	Voltage: ≤ 0.1% + 50 mV
load effect	Voltage: ≤ 50 mV
source effect	Voltage: ≤ 3 mV

Table 2: Operating Characteristics (Cont.)

Name	Characteristic
Parallel Tracking	
program accuracy (25 ± 5° C)	Voltage: ≤ 0.05% + 25 mV (+50 mV if rating voltage > 36 V)
	Current:: ≤ 0.2% + 20 mA OVP: ≤ 2% + 0.6 V
load effect	Voltage: ≤ 3 mV rear output (≤ 6 mV front output)
	Current: ≤ 6 mA (≤ 12 mA if rating current > 3.5 A)
source effect	Voltage: ≤ 3 mV
	Current: ≤ 6 mA
GPIB Capability IEEE-488.2 (optional)	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E1
Memory Locations (Store and Recall)	00 – 49 (50 locations)
Timer	Setting Time: 1 to 65535 seconds
	Resolution: 1 second

1 **Change in output over an 8-hour interval under constant line, load, and ambient temperature following a 30-minute warmup.**

Table 3: Electrical Characteristics

Name	Description
Power Source	100, 120, and 220 VAC, ± 10% 50 – 60 Hz 240 VAC –10% + 4.2% 50 – 60 Hz
Safety	ETL listed to UL 1244 Certified to CSA–C22.2 No 231–M89

Table 4: Environmental Characteristics

Name	Description
Storage Temperature	–10° C to +70° C (+14° F to +158° F)
Operating Temperature	0° C to +40° C (+32° F to +104° F)

Table 5: Physical Characteristics

Name	Description
Overall Dimensions	Width: 255 mm (10.0 in) Height: 145 mm (5.7 in) Depth: 346 mm (13.6 in)
Weight	10 kg (22 lbs)

Appendix B: Maintenance

This appendix provides information for the basic maintenance of the power supply. Electronic maintenance on the power supply must be performed by a trained technician. However, an operator can perform some basic and routine maintenance.

Cleaning

To clean the power supply, use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the instrument, since it may leak into the cabinet and cause damage.

Do not use chemicals containing benzine, benzene, toluene, xylene, acetone, or similar solvents.

Do not use abrasive cleaners on any portion of the frequency counter.

Warranty Service

The power supplies are covered by a standard Tektronix one-year warranty. The warranty statement appears at the front of this manual. If the power supply fails during the warranty period, return it to Tektronix for free servicing (subject to conditions of the warranty statement).

To arrange for warranty service or to get an estimate on a product that is out of warranty, call your local Tektronix office. If you are within the continental U.S., you may call 1-800-TEK-WIDE (1-800-835-9433) for assistance. When you call, have the serial number of the power supply available. The serial number is located on the left side of the rear panel.

Repackaging for Shipment

If your instrument must be returned for servicing, use the original packing materials if possible. If the original materials are unfit or unavailable, repackage the power supply in the following manner:

1. Use a sturdy shipping carton made of corrugated cardboard that has an interior size of at least 15 cm (6 in) greater than the instrument size in all directions.
2. Enclose the following information:
   - Owner's name and address
   - Name and phone number of a person that Tektronix should contact
   - Serial number of the instrument
   - Description of the problem
3. Completely wrap the power supply with polyethylene sheeting (or equivalent material) to protect the outside finish and keep harmful substances out of the power supply.
4. Cushion the instrument on all sides with 8 cm (3 in) of padding material or urethane foam tightly packed between the carton and the instrument.
5. Seal the shipping carton with an industrial stapler or strapping tape.
6. Call your local Tektronix office for shipping instructions. If you are within the continental U.S., you may call 1-800-TEK-WIDE (1-800-835–9433) for assistance.

Troubleshooting

If the power supply does not function properly, refer to Table 6 to eliminate operating faults.

WARNING. *To prevent electrical shock, unplug the power cord and disconnect the outputs before changing the line fuse or line voltage setting.*

Table 6: Troubleshooting Steps

Symptom	Possible Causes
Supply does not power on	■ Power cord not connected properly; check connections. ■ Line voltage selection not correct; check setting. ■ Fuse blown; disconnect line cord and see page 2 to open cover and replace fuse. Use the proper fuse for the line voltage setting. See page 37 for fuse part numbers.
No output or incorrect output	■ Leads not properly connected to the positive and negative outputs. ■ The output is not enabled ("OUT" indicator is not lighted); press the **OUTPUT** button. ■ The power supply settings are not appropriate for the output load. The power supply is functioning normally by limiting either current or voltage. Check load or disconnect output to verify.
Error Message ("Err...")	■ Setup error; check error number against error description in Table 7 on page 34. ■ Overvoltage protection tripped; correct the cause and clear error (**OVP RESET**). Set overvoltage protection to a higher value if necessary. ■ Overcurrent protection tripped; correct the cause and clear the error (**OCP OFF**).

The power supply indicates an error in setup or operation by displaying the message "Err –xxx" on the front panel. Table 7 lists each message number and explains what the error code means.

Table 7: Error Messages

Front Panel Error Code	Description
0	“No error”
–001	“Self-test failed; CPU test error”
–002	“Self-test failed; RAM test error”
–003	“Self-test failed; ROM test error”
–005	“Self-test failed; DAC/ADC test error”
–012	“Device-specific error; Overcurrent protection error”
–013	“Device-specific error; Overvoltage protection error”
–016	“Data out of range; Voltage too large”
–017	“Data out of range; Current too large”
–018	“Data out of range; Voltage too small”
–019	“Data out of range; Current too small”
–064	“Setting conflict; Timer setting error”
–065	“Setting conflict; Overvoltage protection setting error”
–066	“Setting conflict; Address setting error”
–067	“Setting conflict; Voltage setting error”
–068	“Setting conflict; Current setting error”
–069	“Setting conflict; Recall setting error”
–070	“Setting conflict; Store setting error”
–091	“Device-specific error; Calibration current full-scale error”
–092	“Device-specific error; Calibration voltage full-scale error”

Table 7: Error Messages (Cont.)

Front Panel Error Code	Description
–093	"Device-specific error; Calibration overvoltage protection full-scale error"
–094	"Device-specific error; Calibration overvoltage protection offset error"

Appendix B: Maintenance

Appendix C: Replaceable Parts

Replaceable parts may be ordered directly from your authorized Tektronix dealer.

Standard Accessories

The items listed in Table 8 are shipped with the power supply:

Table 8: Standard Accessories

Accessory	Tektronix Part Number
Fuse,3AG, 4A, 250V,SB (90 – 132 V operation)	159-0149-00
User Manual	070-9196-XX
Programmer Manual (PS2520G and PS2521G only)	070-9197-XX
Three sets of test leads	196-3384-XX
115V Power Cord	Refer to Table 10

Optional Accessories

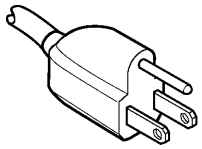
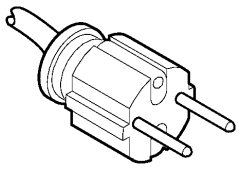
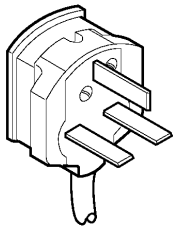
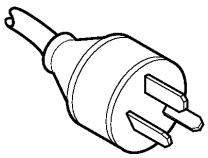
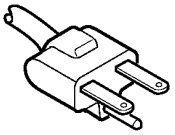
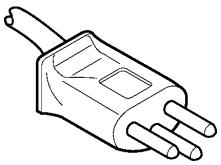
The items listed in Table 9 are available as optional accessories:

Table 9: Optional Accessories

Accessory	Tektronix Part Number
Fuse,3AG, 2A, 250V,SB (198 – 250 V operation)	159–0023–00
230V Power Cords	Refer to Table 10

The following power cords are available.

Table 10: Accessory Power Cords

Plug Configuration	Normal Usage	Tektronix Part Number
	North America 115 V	161-0104-00
	Europe 230 V	161-0104-06
	United Kingdom 230 V	161-0104-07
	Australia 230 V	161-0104-05
	North America 230 V	161-0104-08
	Switzerland 230 V	161-0167-00

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