Programmer Manual

Tektronix

PS2510G & PS2511G
Programmable Power Supplies

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Please check for change information at the rear of this manual.

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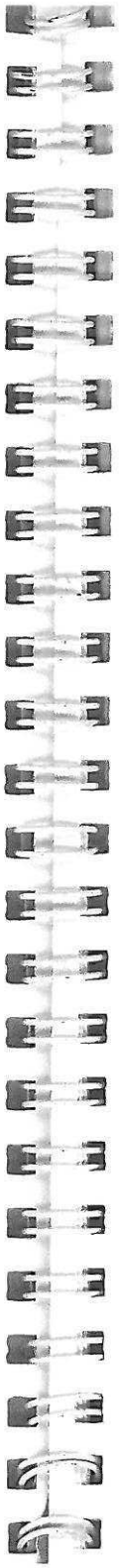

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Preface

This manual explains how to use and program the PS2510G and PS2511G Programmable Power Supplies over the General Purpose Interface Bus (GPIB). The following sections make up the body of this manual.

- *Getting Started* describes how to set up the power supply and GPIB systems.
- *Syntax and Commands* describes the structure of messages your program sends to the power supply.
- *Status and Events* describes how to use the event messages in your programs.

For more information about the GPIB, refer to the standards IEEE 488.1-1987, IEEE 488.2-1992, and SCPI-1994 (Standard Commands for Programmable Instruments).

Refer to the *PS2510, PS2510G, PS2511 & PS2511G User Manual* (070-8068-00) for product specifications, safety summary, operating and service information, and list of standard accessories for the programmable power supplies.

Getting Started

With a computer (controller), you can operate the PS2510G and PS2511G Programmable Power Supplies over the GPIB. This section explains how to perform the following tasks:

- Set up GPIB systems
- Connect the programmable power supply to a GPIB controller
- Set GPIB address of the programmable power supply
- Test the GPIB connection

Setting Up the GPIB System

Observe these rules when you set up the programmable power supply with a GPIB system:

- Each device on the bus needs a unique device address. No two devices can share the same device address.
- Do not connect more than 15 devices to any one bus.
- Connect one device for every 2 m (6 ft) of cable used.
- Do not use more than 20 m (65 ft) of cable to connect devices to a bus.
- Turn on at least two-thirds of the devices on the GPIB system while you use the system.
- Configure the devices on the system as shown in Figure 1. Do not use loop or parallel configurations.

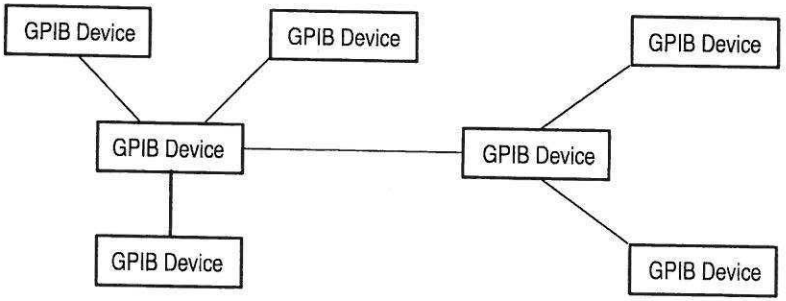

Figure 1: Typical GPIB Network Configuration

Connecting a Controller

You must have a GPIB controller, such as a PC with a GPIB card, to operate the PS2510G and PS2511G Programmable Power Supplies over the GPIB interface.

Figure 2 on page 3 shows the location or the GPIB port on the left side of the rear panel.

Connect the programmable power supply to a GPIB controller as follows:

1. Connect one end of a GPIB cable to the GPIB controller.
2. Connect the other end of the GPIB cable to the GPIB port on the programmable power supply.
3. Turn on the programmable power supply.
4. Turn on the GPIB controller.

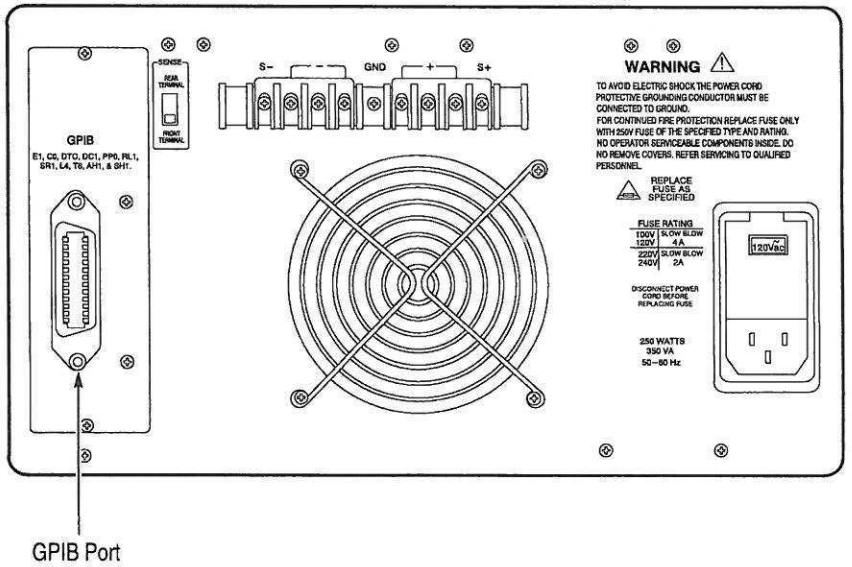

Figure 2: GPIB Port

Setting the Address

Change the GPIB address of the programmable power supply using the following procedure.

NOTE. *Each device connected to the same controller must have a unique GPIB address. The factory default address for the PS2510G and PS2511G Programmable Power Supplies is 12.*

1. Make sure the AUTO SEQ function is off. (The indicator for AUTO must be off).
2. Press the **LOCAL** button on the front panel. The readout displays "Addr XX" where XX is a number between 0 and 30 and is the present GPIB address. Enter 22 ↵ quickly
3. ~~Press **SHIFT** → **ADDR** → (number) → (return) to enter the GPIB address of the power supply.~~

Testing the GPIB Connection

To test whether the GPIB connection is working, send a GPIB query from the computer. For example, the query

```
*idn?
```

should return the name of the instrument, SCPI version and firmware version in the following form:

```
TEKTRONIX,<model>,0,SCPI:<year> FW<version>
```

If you do not get a proper response from the programmable power supply, check to make sure the power is on, all cable connections are secure, and the GPIB address is correct.

Syntax and Commands

This section provides an overview of the commands for the PS2510G and PS2511G Programmable Power Supplies. This section includes the following topics:

- A brief introduction to SCPI
- A description of the command syntax
- Instructions on how to enter commands
- A summary of commands by functional group

In addition, the section *Command Descriptions* on page 17 lists the commands alphabetically and provides a detailed description for each command.

The commands for the programmable power supplies are compatible with IEEE-488.1, IEEE-488.2, and SCPI-1994 standards.

SCPI

SCPI (Standard Commands for Programmable Instruments) is a standard created by an international consortium of the major manufacturers of test and measurement equipment. SCPI uses IEEE-488.2 syntax to provide common commands for the identical functions of various programmable instruments.

The standard simplifies the task of programming a group of instruments that use SCPI. Instead of having to learn different commands for every instrument, the programmer may use the same commands for the identical functions of each instrument.

Commands and Queries

The controller sends instructions to the instrument in the form of commands or queries. Commands modify control settings or tell the instrument to perform a specific action. Queries cause the instrument to send data or status information back to the controller. A question mark at the end of a command identifies it as a query.

Different product manuals may also use the terms "program messages" or simply "commands" to refer to commands and queries as a whole. This manual uses the word "commands" to mean any type of instruction from the controller to the programmable instrument.

Command Syntax

Any instruction that you send to an instrument that complies with SCPI must have at least three basic elements:

- Command header
- Parameter (if required)
- Message terminator or separator

Command Header

The command header has a hierarchical structure that may be represented by a command tree (Figure 3). An easy-to-remember word called a mnemonic designates each level of the hierarchy. A colon separates the levels.

The top level of the tree is the root level. A root node is a mnemonic at the root level. A root node and one or more lower-level nodes form a header path to the last node called the leaf node.

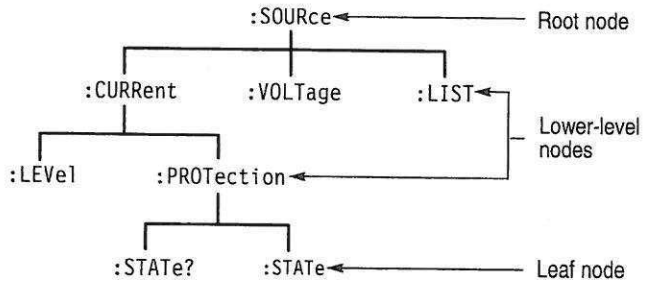

Figure 3: Tree Hierarchy

The header path and leaf node together form the command header. Figure 4 shows the command header for the leaf node indicated in Figure 3.

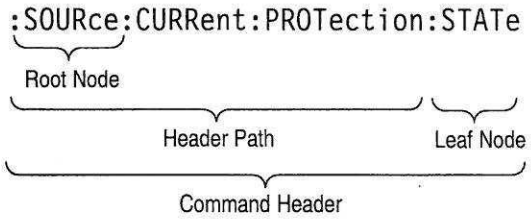

Figure 4: Command Header

Parameter

You must include values for commands that have parameters. In this manual, the < > symbols enclose the parameter type when stating the syntax of the command. For example, the syntax of the command in Figure 5 includes the "Boolean" parameter type.

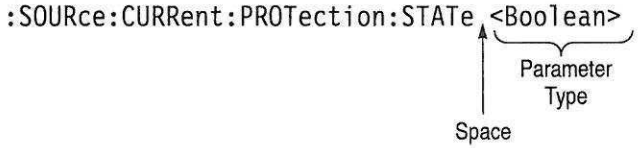

Figure 5: Command Header with Parameter

Table 1 defines the Boolean and other parameter types for the PS2510G and PS2511G Programmable Power Supplies.

Table 1: Parameter Types for Syntax Descriptions

Parameter Type	Description	Example
Boolean	Boolean numbers or values	ON or 1 OFF or 0
NR1	Integers	0, 1, 15
NR2	Decimal numbers	1.2, 3.141516, 6.5
NR3	Floating point numbers	3.1E–1, 2.01E+1
NRf	NR1, NR2, or NR3	1, 1.2, 3.1E–1
string	Alphanumeric characters (must be within quotation marks)	"No error"
MAXimumIMINimum	Special mnemonics for setting the parameter to the largest or smallest value the instrument allows.	MAX, MIN

For the actual value of the parameter type <Boolean>, you may enter 0 or OFF or you may enter 1 or ON.

For the command in Figure 5, entering 0 or OFF turns the overcurrent protection (OCP) off and entering 1 or ON turns the OCP on.

The following example includes both the header and a value for the parameter type:

```
SOURce:CURRent:PROTection:STATe OFF
```

Parameter values that appear in this manual are often separated by a vertical line. This vertical line means the same thing as the word "or." For example, values for the parameter <Boolean> are

```
0|1|OFF|ON
```

This is the same thing as saying "0 or 1 or OFF or ON." Any single value is a valid parameter.

NOTE. *Do not include the* <, >, or | *symbols when entering the actual value for a parameter.*

Message Terminator and Message Separator

In accordance with IEEE 488.2-1992, PS2510G and PS2511G Programmable Power Supplies accept any of the following message terminators:

- NL^END — New line code (0Ah) with END message
- NL — New line code
- <dab>^END — Last data byte with END message

These terminators are compatible with most controller application programs.

A semicolon separates one command from another when the commands appear on the same line. See *Entering Commands*.

Entering Commands

The standards that govern the command set for the PS2510G and PS2511G Programmable Power Supplies allow for a certain amount of flexibility when you enter command. For example, you can abbreviate many commands or combine commands into one message that you send to the programmable power supply. This flexibility, called "friendly listening," saves programming time and makes the command set easier to remember and use.

Command Characters

The programmable power supplies are not sensitive to the case of command characters. You can enter commands in either upper or lower case.

You can precede any command with white space characters. White space characters include a space or any combination of the ASCII control characters hexadecimal 00 through 1F except for the character 0A (new line). You must, however, use at least one space between the parameter and the command header.

Abbreviating Commands

Most commands have a long form and a short form. The listing for each command in this section shows the abbreviations in upper case. For example, you can enter the query `SOURce:VOLTage?` simply as `SOUR:VOLT?` (or `sour:volt?`).

The brackets around a mnemonic indicate that the programmable power supply assumes this level of the command header by default. It is not necessary, therefore, for this mnemonic to appear as part of the header when you send the command. For example, you can abbreviate the command

```
[SOURce:]VOLTage[:LEVel][:IMMediate][AMPLitude] 10
```

to

```
volt 10
```

Because the programmable power supply assumes that a command starts from the root, you have the option of beginning the initial command header with a colon (:).

Combining Commands

You can combine (concatenate) commands and queries using a semicolon (;). The programmable power supply executes concatenated commands in the order it receives them. When you concatenate queries, the programmable power supply combines the responses into a single response message. For example, if the current and voltage limits are set to 1 A and 20 V, the command

```
curr?;volt?
```

returns the message

```
0.100E+1;0.200E+2
```

If the command that follows the semicolon has a different header path from the root level, you must use a colon to force a return to the root level:

```
MEASure:CURRent?;:OUTPut:STATe?
```

If the command that follows the semicolon has the same header path, you may omit the colon and the path and state only the new leaf node. This makes it possible, for example, to shorten the concatenated query

```
:MEASure:CURRent?;:MEASure:VOLTage?
```

into

```
MEASure:CURRent?;VOLTage?
```

You can combine commands and queries into the same message. Note, for example, the following combination:

```
sour:volt 10;:sour:volt?
```

or

```
sour:volt 10;volt?
```

Summary of Commands

The tables in this section summarize the command set of the programmable power supplies. These tables divide the commands into the following functional groups:

- General Setting Commands
- Status Commands
- Miscellaneous Commands

The tables also provide a brief description of each command.

General Setting Commands

Table 2 lists the general setting commands that control and query the control settings of the power supply. To a large extent, the commands duplicate the functionality of the front panel controls and indicators.

Table 2: General Setting Commands

Command	Description
MEASure[:SCALar]:CURRent[:DC]?	Returns actual output current.
MEASure[:SCALar]:VOLTage[:DC]?	Returns actual output voltage.
OUTPut:PROTection:CLEar	Clears overvoltage and overcurrent protection errors.
OUTPut[:STATe] <Boolean>	Sets the output state on or off.
OUTPut[:STATe]?	Returns the output state (on or off).
[SOURce:]CURRent[:LEVel] [:IMMediate][:AMPLitude] <NRf>|MAX|MIN	Sets the current limit.
[SOURce:]CURRent[:LEVel] [:IMMediate][:AMPLitude]?	Returns the current-limit setting.
[SOURce:]CURRent :PROTection:STATe <Boolean>	Sets the Overcurrent Protection (OCP) on or off.
[SOURce:]CURRent :PROTection:STATe?	Returns the state of the Overcurrent Protection (OCP) setting as either on or off.

Table 2: General Setting Commands (Cont.)

Command	Description
[SOURce:]VOLTage[:LEVel] [:IMMediate][:AMPLitude] <NRf>|MAX|MIN	Sets the voltage limit.
[SOURce:]VOLTage[:LEVel] [:IMMediate][:AMPLitude]?	Returns the voltage limit setting.
[SOURce:]VOLTage :PROTection[:LEVel] <NRf>|MAX|MIN	Sets the overvoltage protection (OVP) level.
[SOURce:]VOLTage :PROTection[:LEVel]?	Returns the overvoltage protection (OVP) setting.

Status Commands

Table 3 lists the status commands that set and query the various registers and queues that make up the status and event structure of the programmable power supplies.

Table 3: Status Commands

Command	Description
*CLS	Clears the status data structures.
*ESE <NRf>	Sets the Event Status Enable Register (ESER).
*ESE?	Returns contents of Event Status Enable Register (ESER).
*ESR?	Returns and clears the contents of Standard Event Status Register (SESR).
STATus:OPERation:CONDition?	Returns the contents of the OPERation condition register. Returns NR1.
STATus:OPERation:ENABle <NRf>	Sets the contents of the enable mask for the OPERation event register.
STATus:OPERation:ENABle?	Returns the contents of the enable mask for the OPERation event register. Returns NR1.

Table 3: Status Commands (Cont.)

Command	Description
STATus:OPERation[:EVENt]?	Returns and clears the contents of the OPERation event register.
STATus:PRESet	Presets the OPERation and QUEStionable status registers.
SYSTem:ERRor?	Reads the next item from the error/event queue.
STATus:QUEue[:NEXT]?	Reads the next item from the error/event queue (identical to SYSTem:ERRor?).
STATus:QUEStionable:CONDition?	Returns the contents of the QUEStionable condition register. Returns NR1.
STATus:QUEStionable:ENABle <NRf>	Sets the contents of the enable mask for the QUEStionable event register.
STATus:QUEStionable:ENABle?	Returns the contents of the enable mask for the QUEStionable event register. Returns NR1.
STATus:QUEStionable[:EVENt]?	Returns and clears the contents of the QUEStionable event register.
*SRE <NRf>	Sets contents of Service Request Enable Register (SRER).
*SRE?	Returns contents of Service Request Enable Register (SRER).
*STB?	Reads Status Byte Register (SBR).

Miscellaneous Commands

Table 4 lists the miscellaneous commands that control general housekeeping functions of the programmable power supplies.

Table 4: Miscellaneous Commands

Command	Description
*IDN?	Returns instrument identification.
*OPC	Reports when operation is complete by setting the Operation Complete bit in SESR.
*OPC?	Reports when operation is complete. Same as *OPC except returns a 1 to the output queue and does not set the SESR bit.
*RST	Resets the protection levels and states, resets the current and voltage levels to zero, sets the output off, and sets memory point to 00.
*TST?	Initiates internal self-test and reports results.
*WAI	Wait to continue. This command forces sequential operation of commands. This command is required by IEEE 488.1-1987. The power supply forces sequential operation of commands by design.
SYSTem:VERSion?	Returns the SCPI version level.
SYSTem:AUTO <Boolean>	Sets Auto Sequence on or off.[1]
SYSTem:AUTO?	Returns Auto Sequence mode.[1]

1 **Not SCPI standardized command.**

Command Descriptions

This section provides an alphabetical listing and a detailed description of each command. It also provides examples of each command and what the query form might return.

*CLS (No Query Form)

Clears the following status data structures:

- Standard Event Status Register
- Operation Event Status Register
- Questionable Event Status Register
- Error/Event Queue

Syntax

```
*CLS
```

Examples

*CLS clears all event registers.

*ESE

Sets or returns the bits in the Event Status Enable Register (ESER).The ESER enables the Standard Event Status Register (SESR) to be summarized on bit 5 (ESB) of the Status Byte Register (SBR). Refer to Figure 11 on page 39 for an illustration of the ESER.

Syntax

```
*ESE <NRf>
*ESE?
```

Parameters

<NR1> is a number from 0 to 255. The binary bits of the ESER are set according to this value.

Returns

<NR1> is a number from 0 to 255 that indicates the decimal value of the binary bits of the ESER.

Examples

*ESE 48 sets the ESER to binary 0011 0000, which enables the CME and EXE bits.

*ESE? returns 129 if the ESER contains the binary value 1000 0001.

*ESR? (Query Only)

Returns and clears the contents of the Standard Event Status Register (SESR). Refer to Figure 10 on page 37 for an illustration of the SESR.

Syntax

*ESR?

Returns

<NR1> is a number from 0 to 255 that indicates the decimal value of the binary bits of the SESR.

Examples

*ESR? might return 160, showing that the SESR contains binary 1010 0000 (PON and CME bits set).

*IDN? (Query Only)

Returns the unique identification code of the power supply.

Syntax

*IDN?

Examples

*IDN? returns

TEKTRONIX,PS2511G,0,SCPI:94.0 FW:.10

MEASure[:SCALar]:CURRent[:DC]? (Query Only)

Returns actual output current.

Syntax

MEASure[:SCALar]:CURRent[:DC]?

Returns

<NR3>

Examples

MEASure:CURRent? might return 0.8E-2 to indicate that the load is drawing 0.008 A (8 mA).

MEASure[:SCALar]:VOLTage[:DC]? (Query Only)

Returns actual output voltage or sense input voltage.

Syntax

MEASure[:SCALar]:VOLTage[:DC]?

Returns

<NR3>

Examples

MEASure:VOLTage? might return 0.367E+1 to indicate the voltage at the output is 3.67 volts.

*OPC

The command form (*OPC) sets the operation complete bit (bit 0) in the Standard Event Status Register (SESR) when all pending operations finish.

The query form (*OPC?) tells the programmable power supply to place an ASCII 1 in the Output Queue when it completes all pending operations.

Syntax

```
*OPC
*OPC?
```

Returns

1

OUTPut:PROTection:CLEar (No Query Form)

Resets (clears) the Overvoltage Protection. This command duplicates the function of the OVP RESET button.

Syntax

```
OUTPut:PROTection:CLEar
```

OUTPut[:STATe]

Enables or disables the output of the power supply. ON (enabled) is signified by a 1 and OFF (disabled) by a 0. The query form returns a 1 if the output is on and a 0 if the output is off.

Syntax

```
OUTPut:STATe <Boolean>
OUTPut:STATe?
```

Parameters

0|1|OFF|ON

Returns

0|1

Examples

OUTPut:STATe ON enables the power supply output.

OUTPut:STATe? returns 1 if the power supply output is enabled.

*RST (No Query Form)

Resets the control settings of the programmable power supply to a set of known states but does not purge stored settings. Refer to Table 5 for the reset state of the control settings.

Table 5: State of Control Settings after *RST

Front Panel Control	Related Command	State
OUTPUT	OUTPut[:STATe]	OFF
CURRENT SET	[SOURce]:CURRent[:LEVel] [:IMMediate][:AMPLitude]	0
VOLTS SET	[SOURce]:VOLTage[:LEVel] [:IMMediate][:AMPLitude]	0
OCP ON/OFF	[SOURce]:CURRent:PROTection :STATe	ON
DELAY	—	0
AUTO SEQ	SYSTem:AUTO	OFF
RECALL (memory location)	—	00
OVP SET	[SOURce:]VOLTage:PROTection [:LEVel]	MAXimum (PS2510G= 38.5 V PS2511G= 22.5 V)

Syntax

```
*RST
```

[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]

Sets the current limit. The query form returns the current limit setting.

Syntax

```
[SOURce:]CURRent[:LEVel][:IMMediate]
[:AMPLitude] <NRf>|MAXimum|MINimum
[SOURce:]CURRent[:LEVel][:IMMediate]
[:AMPLitude]?
```

Parameters

<NRf> ranges from 0 to 3.500 (amps) for the PS2510G or 0 to 7.000 for the PS2511G.

Returns

<NR3>

Examples

SOURce:CURRent 1.5 sets the current limit to 1.5 amps.

SOURce:CURRent? returns 0.1000E+1 if the current limit setting is 1 amp.

[SOURce:]CURRent:PROTection:STATe

Sets the overcurrent protection on or off. The query form returns the state of the overcurrent protection as either on or off.

Syntax

```
[SOURce:]CURRent:PROTect:STATe <Boolean>
[SOURce:]CURRent:PROTect:STATe?
```

Parameters

0|1|OFF|ON
OFF or 0 sets overcurrent protection off. ON or 1 sets overcurrent protection on.

Returns

0|1

Examples

SOURce:CURRent:PROTect:STATe OFF sets the overcurrent protection off.

SOURce:CURRent:PROTect:STATe? returns 1 if the overcurrent protection is on.

[SOURce:]VOLTage:[:LEVel][:IMMediate][:AMPLitude]

Sets the voltage limit of the power supply. The query form returns the voltage limit setting.

Syntax

```
[SOURce:]VOLTage <NRf>|MAXimum|MINimum
[SOURce:]VOLTage?
```

Parameters

<NRf> is a positive integer or real number from 0 to 37.00 volts for the PS2510G or 0 to 21.00 for the PS2511G.

Returns

<NR3>

Examples

SOURce:VOLTage 3.5 sets the voltage limit to 3.5 volts.

SOURce:VOLTage? returns 0.200E+1 if the voltage limit setting is 2 volts.

[SOURce:]VOLTage:PROTection[:LEVel]

Sets the overvoltage protection level. The query form returns the present setting of the overvoltage protection circuit.

Syntax

```
[SOURce:]VOLTage:PROTection[:LEVel] <NRf>|MAXimum|
MINimum
[SOURce:]VOLTage:PROTection[:LEVel]?
```

Parameters

<NRf> ranges from 0 to 38.50 volts for the PS2510G or 0 to 22.50 for the PS2511G.

Returns

<NR3>

Examples

VOLTage:PROTection 24.5 sets the overvoltage protection to 24.5 volts.

VOLTage? returns 0.3100E+2 if the overvoltage protection setting is 31 volts.

*SRE

(Service Request Enable) sets the contents of the Service Request Enable Register (SRER). The query form returns the contents of the SRER. Refer to Figure 12 on page 40 and Table 7 on page 37 for an explanation of each bit in the SRER.

Syntax

*SRE <NRf>
*SRE?

Parameters

<NRf> is an integer from 0 to 255.

Returns

<NR1>

Examples

*SRE 8 sets bits of the SRER to 0000 1000.

*SRE? returns 2 if the if the SRER is set to 0000 0010.

STATus:OPERation:CONDition? (Query Only)

Returns the contents of the OPERation register. The PS2510G and PS2511G Programmable Power Supplies, however, do not use the OPERation register to report any conditions.

Reading the OPERation register does not affect its contents.

Syntax

STATus:OPERation:CONDition?

Returns

<NR1>

Examples

STATus:OPERation:CONDition? returns 0.

STATus:OPERation:ENABle

Sets or returns the contents of the OPERation Enable Register. Even though this is a 16-bit register, only 15 bits (bit 0 through bit 14) are used. Bit 15 always reads 0.

Syntax

STATus:OPERation:ENABle <NRf>
STATus:OPERation:ENABle?

Parameters

<NR1> is an integer from 0 to 32727

Returns

<NR1>

Examples

STATus:OPERation:ENABle 32727 sets all 15 bits of the register high.

STATus:OPERation:ENABle? returns 0 if all 15 bits of the register are low.

STATus:OPERation[:EVENt]?

Returns and clears the contents of the OPERation register. The response is a decimal value that summarizes the binary values of the set bits.

Syntax

```
STATus:OPERation[:EVENt]?
```

Returns

```
<NR1>
```

Examples

`STATus:OPERation:EVENt?` returns 0.

STATus:PRESet (No Query Form)

Sets the OPERation and QUESTionable enable registers to zero.

Syntax

```
STATus:PRESet
```

STATus:QUEue[:NEXT]? (Query Only)

Reads the next item from the Error and Event Queue. Refer to the error codes in Table 9 on page 42.

Syntax

```
STATus:QUEue[:NEXT]?
```

Returns

```
<NR1>,<string>
```

Examples

`STATus:QUEue?` returns 0, `"No error"` if there are no errors in the queue.

STATus:QUEStionable:CONDition? (Query Only)

Returns the contents of the QUEStionable condition register. Reading the QUEStionable condition register does not affect its contents. This query returns a decimal value that summarizes the binary values of the set bits.

Syntax

```
STATus:QUEStionable:CONDition?
```

Returns

```
<NR1>
```

STATus:QUEStionable:ENABle

Sets or returns the contents of the enable register for the QUEStionable event register. Even though this is a 16-bit register, only 15 bits (bit 0 through bit 14) are used. Bit 15 always reads 0.

Syntax

```
STATus:QUEStionable:ENABle <NR1>
STATus:QUEStionable:ENABle?
```

Parameters

`<NR1>` is a positive integer from 0 to 32727

Returns

```
<NR1>
```

Examples

`STATus:QUEStionable:ENABle 32727` sets all 15 bits of the register high.

`STATus:QUEStionable:ENABle?` returns 0 if all 15 bits of the register are low.

STATus:QUEStionable[:EVENt]?

Returns and clears the contents of the QUEStionable event register. Reading the QUEStionable register using the query form resets the register. The query returns a decimal value that summarizes the binary values of the set bits.

Syntax

```
STATus:QUEStionable[:EVENt]?
```

Returns

<NR1>

Examples

STATus:QUEStionable:EVENt? returns 2 if only bit number 1 is set.

*STB? (Query Only)

(Read Status Byte) query returns the contents of the Status Byte Register (SBR) using the Master Summary Status (MSS) bit. Refer to Figure 9 on page 36.

Syntax

*STB?

Returns

<NR1>

Examples

*STB? returns 96 if the SBR contains the binary value 01100000.

SYSTem:AUTO

Sets or returns automatic sequence setting.

Syntax

SYSTem:AUTO <Boolean>
SYSTem:AUTO?

Parameters

0|1|OFF|ON
OFF or 0 sets AUTO off, ON or 1 sets AUTO on.

Returns

0|1

Examples

SYSTem:AUTO 1 sets AUTO SEQ on.

SYSTem:ERRor? (Query Only)

Returns the error code and error string.

Syntax

SYSTem:ERRor?

Returns

<NR1>, <string>

Examples

SYSTem:ERRor? returns -300, "Device-specific error; overvoltage protection error" if the overvoltage protection circuit has disabled the outputs.

SYSTem:VERSion? (Query Only)

Returns the SCPI version the power supply complies to.

Syntax

SYSTem:VERSion?

Returns

1994.0

*TST? (Query Only)

(Self Test) Tests RAM, ROM, DAC, and ADC components.

Syntax

*TST?

Returns

0|-300

Examples

*TST? returns a 0 if the test is successful.

*TST? returns a –300 if the test fails.

*WAI (No Query Form)

WAI ("wait") prevents the power supply from executing further commands or queries until all pending operations finish. This command allows you to synchronize the operation of the power supply with your application program.

Syntax

```
*WAI
```


Status and Events

The PS2510G and PS2511G Programmable Power Supplies provide a status and event reporting system for the GPIB interface. Various registers and queues make up this system. This section explains how these registers and queues work to inform you of certain significant events.

System Structure

Figure 6 on page 32 is a simplified diagram of the status and event reporting system. In reality, each component of the diagram represents a set of registers and queues that read, report, or enable the occurrence of certain events within the system.

Status reporting begins when a specific event in the programmable power supply sets a bit in a *status register*. Reading the status registers tells you what types of events have occurred.

Each bit in the status register corresponds to a bit in an *enable register*; the enable bit must be high for the event to be reported to the Status Byte Register.

The Output Queue stores and reports query responses. The Error/Event Queue stores and reports error messages.

A Service Request (SRQ) is the last event to occur. The SRQ requests an interrupt on the GPIB to report events to the system controller.

The following sections explain the registers and queues in greater detail.

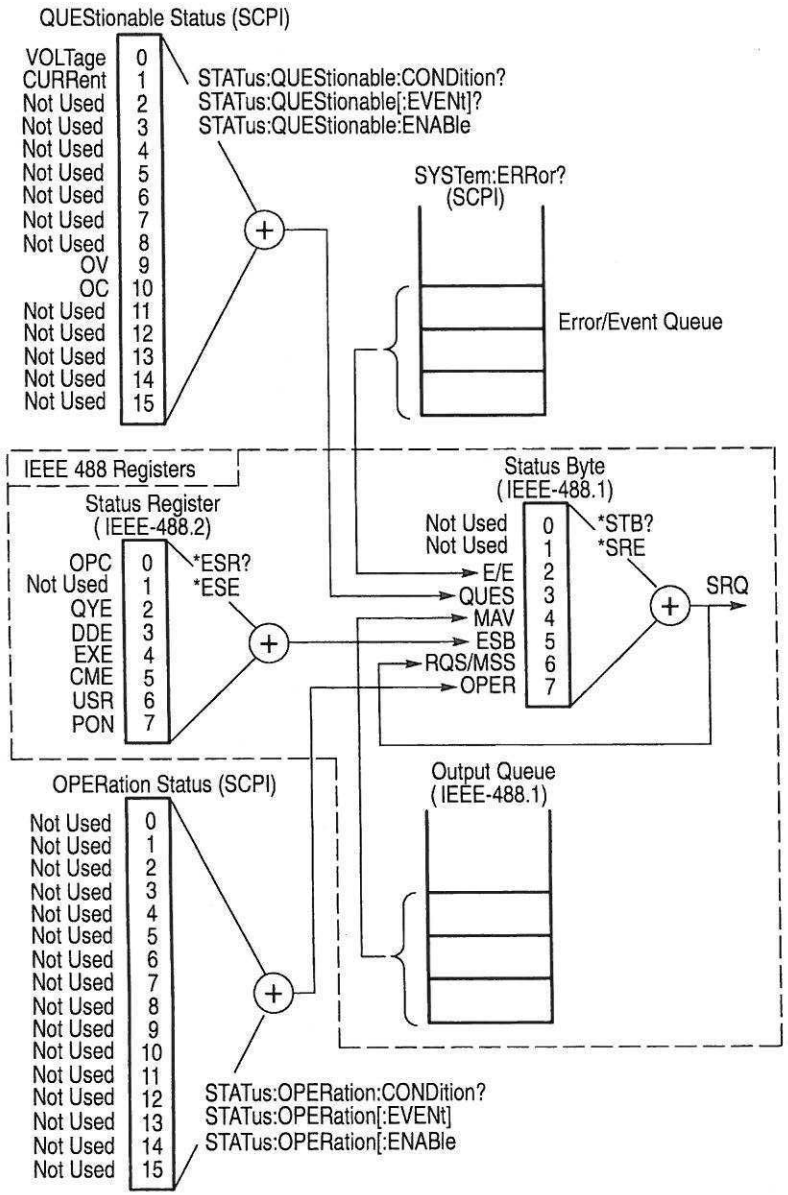

Figure 6: Status and Event System for the PS2510G and PS2511G

Status Registers

The status registers consist of the following SCPI defined registers:

- OPERation Status Registers (CONDition, EVENt, and ENABle)
- QUEStionable Status Registers (CONDition, EVENt, and ENABle)

The IEEE-488.1 and IEEE-488.2 standards define the following status registers:

- Status Byte Register (SBR)
- Standard Event Status Register (SESR)

SCPI Status Registers

The STATus subsystem (Figure 7) is the hierarchical set of commands that read the SCPI defined status registers.

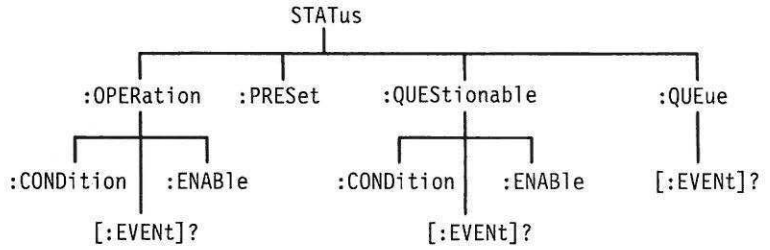

Figure 7: STATus Hierarchy of SCPI Defined Registers

The lower-level nodes :OPERation and :QUEStionable each have three 16-bit registers: CONDition, EVENt, and ENABle. Figure 8 shows the sequential relationship between these three types of registers and the commands that relate to each register.

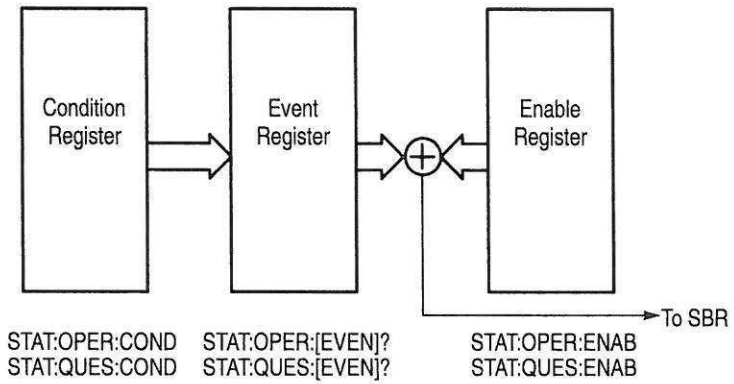

Figure 8: Status Registers and Related Commands

The CONDition register is a read-only register that monitors the current state of the instrument. The CONDition register updates in real time and the inputs are not latched or buffered. When a condition monitored by the CONDition register becomes true, the bit for that condition also becomes true (1). When the condition is false, the bit is 0.

The read-only EVENt register latches any false-to-true change in condition. Once the bit in the EVENt register is set, it is no longer affected by changes in the corresponding bit of the CONDition register. The bit remains set until the controller reads it. The command *CLS (Clear Status) clears the EVENt registers.

ENABle registers control the reporting of events latched in the EVENt registers. The QUEStionable Enable Register, for example, sets the summary bit (3) of the Status Byte Register true only if one or more of the bits in the QUEStionable Event Register are true. The programmable power supply can assert SRQ (Service Request) on the GPIB only after the ENABle register sets the summary bit true.

OPERation Status Register. To comply with SCPI, the PS2510G and PS2511G Programmable Power Supplies have both the OPERation and QUEStionable registers. However, the PS2510G and PS2511G Programmable Power Supplies do not use the OPERation status registers to report any status information.

QUEStionable Status Register. The Table 6 shows the bit designations of the 16 bit QUEStionable Status Register.

Table 6: QUEStionable Status Register

Bit Number	Name	Condition (Bit is True)
15	—	Not used.
14	—	Not used.
13	—	Not used.
12	—	Not used.
11	—	Not used.
10	OC	Overcurrent protection tripped.
9	OV	Overvoltage protection tripped.
8	—	Not used.
7	—	Not used.
6	—	Not used.
5	—	Not used.
4	—	Not used.
3	—	Not used.
2	—	Not used.
1	Current	Constant Voltage (CV), current unregulated.
0	Voltage	Constant Current (CC), voltage unregulated.

The command `STATus:QUEStionable:CONDition?` reads the QUEStionable CONDition register but does not clear it.

The command `STATus:QUEStionable[:EVENt]?` reads and clears the QUEStionable EVENt Status Register.

IEEE-488.1 and IEEE-488.2 Status Registers

To conform with the IEEE-488.1 and IEEE-488.2 standards, an instrument must have both the Status Byte Register and Standard Event Status Register.

Status Byte Register (SBR). The SBR (Figure 9) summarizes the status of all other registers and queues.

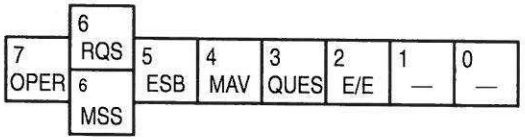

Figure 9: Status Byte Register (SBR)

Use a serial poll or the *STB? query to read the contents of the SBR. The bits in the SBR are set and cleared depending on the contents of the Standard Event Status Register (SESR), the Event Status Enable Register (ESER), and the Output Queue. When you use a serial poll to obtain the SBR, bit 6 is the MSS bit. Reading the SBR does not clear the bits.

Table 7 explains the function of each bit in the SBR.

Table 7: SBR Bit Functions

Bit	Function
7 (MSB)	**OPER** (OPERation) is the summary bit for the OESR (OPERation EVENt Status Register). This bit is never set in the PS2510G and PS2511G Programmable Power Supplies
6	**RQS** (Request Service) is obtained from a serial poll. This bit shows that the power supply requests service from the GPIB controller. **MSS** (Master Status Summary) is obtained from *STB? query. This bit indicates another bit in the SBR has been enabled and is set.
5	**ESB** (Event Status Bit) is the summary bit for the Standard Event Status Register (SESR). When this bit is high it indicates that status is enabled and present in the SESR.
4	**MAV** (Message Available) indicates that output is available in the output queue.
3	**QUES** (QUEStionable) is the summary bit for the QESR (QUEStionable Event Status Register). When this bit is high it indicates that status is enabled and present in the QESR.
2	**E/E** (Error and Event) indicates an error code is waiting to be read in the Error Event Queue
1	Not used. This bit always reads back as zero.
0 (LSB)	Not used. This bit always reads back as zero.

Standard Event Status Register (SESR). Figure 10 shows the SESR which records five types of events that can occur within the power supply.

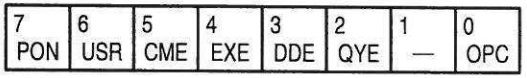

Figure 10: The Standard Event Status Register (SESR)

Use the *ESR? query to read the SESR. Reading the SESR clears the bits of the register so that the register can accumulate information about new events.

Table 8 explains the function of each bit in the SESR.

Table 8: SESR Bit Functions

Bit	Function
7 (MSB)	**PON** (Power On) shows that the power supply was powered on.
6	**USR** (User Request) indicates the LOCAL button was pushed.
5	**CME** (Command Error) shows that an error occurred while the power supply was parsing a command or query. Table 9 on page 42 lists the error messages ("–1XX" errors).
4	**EXE** (Execution Error) shows that and error occurred while the power supply was executing a command or query. Table 9 lists the error messages ("–2XX" errors).
3	**DDE** (Device Error) shows that a device error occurred. Error messages are listed in Table 9 ("–3XX" errors).
2	**QYE** (Query Error) indicates a command or query protocol error. Error messages are listed in Table 9 ("–4XX" errors).
1	Not used. This bit always reads back as zero.
0 (LSB)	**OPC** (Operation Complete) shows that the operation is complete. This bit is set when all pending operations complete following a *OPC command.

Enable Registers

The enable registers determine whether certain events are reported to the Status Byte Register and SRQ. The programmable power supply has the following enable registers:

- Event Status Enable Register (ESER)
- Service Request Enable Register (SRER)
- OPERation Enable Register
- QUEStionable Enable Register

The enable registers perform a logical OR function; whenever one of the bits of the enable registers is high and the corresponding bit in the status register is high, the output that controls one of the bits of the Status Byte Register is also high.

Various commands set the bits in the enable registers. The following sections describe the enable registers and the commands that set them.

Event Status Enable Register (ESER)

The ESER (Figure 11) controls which types of events are summarized by the Event Status Bit (ESB) in the SBR. Refer to Table 8 on page 38 for an explanation of each bit in the ESER.

Use the *ESE command to set the bits in the ESER. Use the *ESE? query to read it.

7	6	5	4	3	2	1	0
PON	USR	CME	EXE	DDE	QYE	—	OPC

Figure 11: Event Status Enable Register (ESER)

Service Request Enable Register (SRER)

The SRER (Figure 12) controls which bits in the SBR generate a service request. The Master Status Summary (MSS) bit summarizes the enabled bits in the SBR.

Use the *SRE command to set the SRER. Use the *SRE? query to read it. The RQS bit remains set to one until either a serial poll reads the SBR or the MSS bit changes back to a zero.

Refer to Table 7 on page 37 for an explanation of each bit in the SRER.

7	6	5	4	3	2	1	0
OPER	—	ESB	MAV	QUES	E/E	—	—

Figure 12: Service Request Enable Register (SRER)

OPERation Enable Register

Even though the OPERation Enable Register is present in the PS2510G and PS2511G Programmable Power Supplies, the OPERation registers do not report any conditions.

QUEStionable Enable Register

The QUEStionable Enable Register controls which types of events are summarized by the QUES status bit in the SBR. Use the STATus:QUEStionable:ENABle command to set the bits in the QUEStionable Enable register. Use the STATus:QUEStionable:ENABle? query to read it. Refer to Table 6 on page 35 for a description of each of the bits in this register.

Queues

The PS2510G and PS2511G Programmable Power Supplies contain two queues: the Output Queue and the Error/Event queue.

Output Queue

Following IEEE 488.2 protocols, the PS2510G and PS2511G Programmable Power Supplies store query responses in the Output Queue. The power supply clears and resets this queue each time it receives a new command or query message after an <EOM>. The controller must read a query response before it sends the next command (or query) or it loses responses to earlier queries.

Error/Event Queue

When an error or event occurs, the Error/Event Queue stores the message and sets bit 2 of the Status Byte Register high. Enabling this bit by using the *SRE 4 command causes the event to signal the GPIB controller with a Service Request (SRQ) signal.

The Error/Event Queue stores and reports the messages on a first-in-first-out basis. The `SYSTem:ERRor?` or the `STATus:QUEue[:NEXT]?` query reads the next item from the Error/Event Queue. If the Error/Event Queue overflows, the last message is "–350, Queue overflow"; the queue cannot store or report subsequent messages until it is read or cleared.

Error Messages

Table 9 lists the SCPI error messages of the PS2510G and PS2511G Programmable Power Supplies. The listing includes the equivalent front-panel error code along with a description of the error message.

Table 9: Error Messages

SCPI Error Code and Description	Front Panel Error Code	SESR Bit
0, "No error"	—	—
–100, "Command Error"	—	5
–108, "Parameter not allowed"	—	5
–109, "Missing parameter"	—	5
–121, "Invalid character in number"	—	5
–124, "Too many digits"	—	5
–200, "Execution error"	—	4
–200, "Execution error; STEP error"	—	4
–221, "Setting conflict; Timer setting error"	–064	4
–221, "Setting conflict; Overvoltage protection setting error"	–065	4
–221, "Setting conflict; Address setting error"	–066	4
–221, "Setting conflict; Voltage setting error"	–067	4
–221, "Setting conflict; Current setting error"	–068	4
–221, "Setting conflict; Recall setting error"	–069	4
–221, "Setting conflict; Store setting error"	–070	4
–221, "Setting Conflict; STEP voltage or current setting error"	—	4
–222, "Data out of range; Voltage too large"	–016	4
–222, "Data out of range; Current too large"	–017	4
–222, "Data out of range; Voltage too small"	–018	4
–222, "Data out of range; Current too small"	–019	4
–222, "Data out of range"	—	4
–240, "Hardware error"	—	4
–300, "Device-specific error; Overcurrent protection error"	–012	3
–300, "Device-specific error; Overvoltage protection error"	–013	3

Table 9: Error Messages (Cont.)

SCPI Error Code and Description	Front Panel Error Code	SESR Bit
–300, "Device-specific error; Calibration current full-scale error"	–091	3
–300, "Device-specific error; Calibration voltage full-scale error"	–092	3
–300, "Device-specific error; Calibration overvoltage protection full-scale error"	–093	3
–300, "Device-specific error; Calibration overvoltage protection offset error"	–094	3
–310, "System error"	—	3
–313, "Calibration memory lost"	—	3
–330, "Self-test failed"	—	3
–330, "Self-test failed; CPU test error"	–001	3
–330, "Self-test failed; RAM test error"	–002	3
–330, "Self-test failed; ROM test error"	–003	3
–330, "Self-test failed; DAC/ADC test error"	–005	3
–350, "Queue overflow"	—	—
–410, "Query INTERRUPTED"	—	2
–420, "Query UNTERMINATED"	—	2
–430, "Query DEADLOCKED"	—	2
–440, "Query UNTERMINATED after indefinite response"	—	2

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