AMETEK®
PROGRAMMABLE POWER

E-LOAD SERIES

SCPI Programming Manual

Programmable DC Electronic Load

This manual covers model:

LPL, PLA, & PLW

AMREL

About AMETEK

AMETEK Programmable Power, Inc., a Division of AMETEK, Inc., is a global leader in the design and manufacture of precision, programmable power supplies for R&D, test and measurement, process control, power bus simulation and power conditioning applications across diverse industrial segments. From bench top supplies to rack-mounted industrial power subsystems, AMETEK Programmable Power is the proud manufacturer of Elgar, Sorensen, California Instruments and Power Ten brand power supplies.

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Important Safety Instructions

Before applying power to the system, verify that your product is configured properly for your particular application.

warning	**Hazardous voltages may be present when covers are removed. Qualified personnel must use extreme caution when servicing this equipment. Circuit boards, test points, and output voltages also may be floating above (below) chassis ground.**
warning	***The equipment used contains ESD sensitive ports. When installing equipment, follow ESD Safety Procedures. Electrostatic discharges might cause damage to the equipment.***

Only *qualified personnel* who deal with attendant hazards in power supplies, are allowed to perform installation and servicing.

Ensure that the AC power line ground is connected properly to the Power Rack input connector or chassis. Similarly, other power ground lines including those to application and maintenance equipment *must* be grounded properly for both personnel and equipment safety.

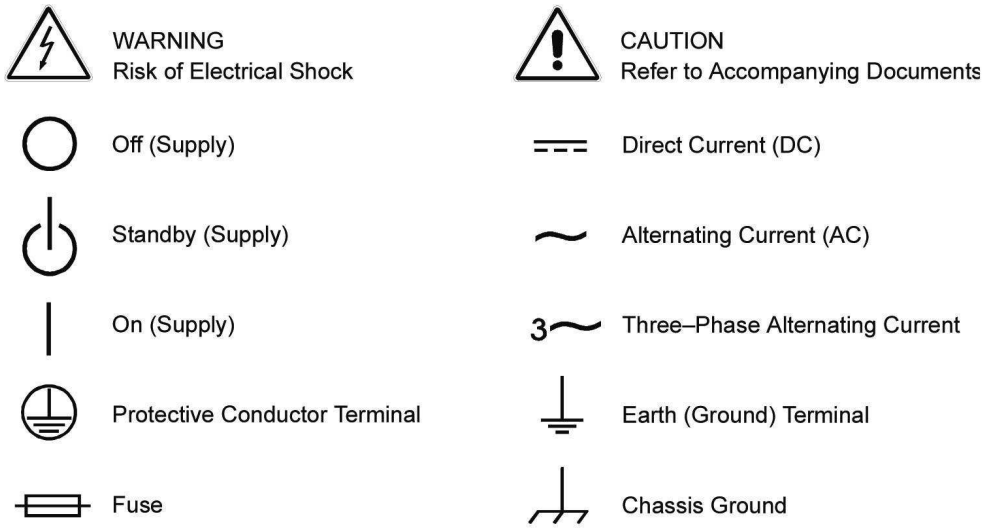
Always ensure that facility AC input power is de-energized prior to connecting or disconnecting any cable.

In normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, **HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY** may be normally generated on the output terminals. The customer/user must ensure that the output power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is eliminated.

Guard against risks of electrical shock during open cover checks by not touching any portion of the electrical circuits. Even when power is off, capacitors may retain an electrical charge. Use safety glasses during open cover checks to avoid personal injury by any sudden component failure.

Neither AMETEK Programmable Power Inc., San Diego, California, USA, nor any of the subsidiary sales organizations can accept any responsibility for personnel, material or inconsequential injury, loss or damage that results from improper use of the equipment and accessories.

SAFETY SYMBOLS



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Product Family: SAS Calibrator

Warranty Period: One Year

WARRANTY TERMS

AMETEK Programmable Power, Inc. ("AMETEK"), provides this written warranty covering the Product stated above, and if the Buyer discovers and notifies AMETEK in writing of any defect in material or workmanship within the applicable warranty period stated above, then AMETEK may, at its option: repair or replace the Product; or issue a credit note for the defective Product; or provide the Buyer with replacement parts for the Product.

The Buyer will, at its expense, return the defective Product or parts thereof to AMETEK in accordance with the return procedure specified below. AMETEK will, at its expense, deliver the repaired or replaced Product or parts to the Buyer. Any warranty of AMETEK will not apply if the Buyer is in default under the Purchase Order Agreement or where the Product or any part thereof:

- is damaged by misuse, accident, negligence or failure to maintain the same as specified or required by AMETEK;
- is damaged by modifications, alterations or attachments thereto which are not authorized by AMETEK;
- is installed or operated contrary to the instructions of AMETEK;
- is opened, modified or disassembled in any way without AMETEK's consent; or
- is used in combination with items, articles or materials not authorized by AMETEK.

The Buyer may not assert any claim that the Products are not in conformity with any warranty until the Buyer has made all payments to AMETEK provided for in the Purchase Order Agreement.

PRODUCT RETURN PROCEDURE

1. Request a Return Material Authorization (RMA) number from the repair facility (**must be done in the country in which it was purchased**):
   - **In the USA**, contact the AMETEK Repair Department prior to the return of the product to AMETEK for repair:

     Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America)
     858-450-0085, ext. 2295 or ext. 2463 (direct)
   - **Outside the United States**, contact the nearest Authorized Service Center (ASC). A full listing can be found either through your local distributor or our website, www.programmablepower.com, by clicking Support and going to the Service Centers tab.
2. When requesting an RMA, have the following information ready:
   - Model number
   - Serial number
   - Description of the problem

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.

NOTE: A returned product found upon inspection by AMETEK, to be in specification is subject to an evaluation fee and applicable freight charges.

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Contents

COMMON COMMANDS

Common commands begin with an * and consist of three letters (command) IEEE 488.2 standard to perform some common interface functions.

Common commands and queries are STEPed alphabetically. If a command has a corresponding query that simply returns the data or status specified by the command, then both command and query are included under the explanation for the command. If a query does not have a corresponding command or is functionally different from the command, then the query is STEPed separately. The description for each common command or query specifies any status registers affected.

*CLS

Clear Status Command. This command causes the following actions:

- **Clears the following registers without affecting any corresponding Enable registers or Transition Filters:**
  - **Questionable Status Event register.**
  - **Operation Status Event register.**
  - **Standard Event Status Event register.**
- **Clears the Error Queue.**
- **Forces a previously executed *OPC command to appear as if it had been completed. It does not do this with the *OPC? command. (See *OPC? for more details).**

Command Syntax *CLS
Parameters None

*ESE

Standard Event Status Enable Command/Query. This command sets the condition of the Standard Event Status Enable register, which determines which events of the Standard Event Status Event register (see *ESR?) are allowed to set the ESB (Event Summary Bit) of the Status Byte register. A "1" in the bit position enables the corresponding event. All of the enabled events of the Standard Event Status Event register are logically ORed to cause the ESB (bit 5) of the Status Byte register to be set.

Command Syntax *ESE <NRf>
Parameters 0 to 255
Suffix None
Query Syntax *ESE?
Returned Parameters <NR1> Value: 0 to 255

*ESR?

Standard Event Status Register Query. This query reads the Standard Event Status Event register.

Bit.		DESCRIPTION
Position	Name	

0	**OPC**	Operation Complete. The electronic load has completed all pending operations. Programming *OPC causes this bit to be set when the electronic load completes all pending operations
1	**N.A.**	
2	**QYE**	Query Error. The output queue was read when no data was present or the data in the queue was lost.
3	**DDE**	Device Dependent Error. Memory was lost, or self-test failed.
4	**EXE**	Execution Error. A command parameter was outside the legal range or inconsistent with the electronic load's operation, or the command could not be executed due to some operating condition.
5	**CME**	Command Error. A syntax or semantic error has occurred or the electronic load received a < GET > within a program message.
6	**N.A.**	
7	**PON**	Power On. The electronic load has been turned on or off since the last time this register was read. This bit is always set when the electronic load is turned on.

Query Syntax *ESR?
Returned Parameters <NR1> Value: 0 to 255
Suffix None

*IDN?

System Identification. This command queries the electronic load to identify itself.

Query Syntax *IDN?
Returned Parameters <aard> form consisting of five fields separated by commas. The content of each string is:

Field	Information
AMETEK	Manufacturer
EL	Model name
x	0
xxxx.xxx	CF92.1CT
FVxx.xx	Revision level of primary interface firmware

*OPC

Operation Complete Event Bit Command. This command causes Bit 0 of the Standard Event Status Event register to be set when the electronic load has completed all pending operations. (See *ESR? for the bit configuration of this register.) Pending operations are complete when:

- **All previous commands have been executed.**
- **Any change in the input level caused by previous commands has been completed. (Effects of slew time have been accounted for.)**
- **No pending trigger level operations are set for the single electronic load or for any channel of the multiple electronic load.**

*OPC does not prevent processing of subsequent commands but Bit 0 will not be set until all pending operations are complete

Command Syntax *OPC
Parameters None

*OPC?

Operation Complete Output Query. This query causes the electronic load to place an ASCII "1" in

the Output Queue when all pending operations are completed. Pending operations are complete when:

- **All commands that were issued before an *OPC command have been executed.**
- **Any change in the input level caused by these previous commands has been completed. (Effects of slew time have been accounted for.)**
- **No pending trigger level operations are set for the single electronic load or for any channel of the multiple electronic load.**

Unlike *OPC, *OPC? prevents processing of all subsequent commands. When all pending operations are completed, an ASCII "1" is placed in the Output Queue. *OPC? is intended to be used at the end of a command line so that the program can then monitor the bus for data until it receives the "1" from the Output Queue.

Command Syntax	*OPC?
Returned Parameters	<NR1> , ASCII 1 is placed in the Output Queue when the electronic load has completed all pending operations.

*PSC

Power-on Status Clear Command/Query. Type Device Initialization Description This command controls the automatic clearing at power turn-on of:

- **The Service Request Enable register.**
- **The Standard Event Status Enable register.**

If the command parameter = 0, then the electronic load can be programmed to request service at turn on. Any non-zero parameter causes both registers to be cleared at turn on, preventing the electronic load from being capable of requesting service at this time.

Command Syntax	*PSC <NRf>	
Parameters	0 or not zero	
Suffix	None	
Query Syntax	*PSC?	
Returned Parameters	<NR1>	0 = power-on clear flag is false; affected registers not cleared at turn on. 1 = power-on clear flag is true; affected registers cleared at turn on.
Suffix	None	

*RCL

Recall Instrument State Command. This command restores the electronic load to a state that was previously stored in memory with a *SAV command to the specified location (see *SAV). *RCL also does the following:

At power turn-on, the equivalent of an *RCL 0 is executed to restore the electronic load to the state stored in location 0. The same state is also set if the *RCL command is directed to a location where no state was stored since the last time power was cycled.

Note *RCL does not affect any Status Enable registers or Transition Filters.

Command Syntax	*RCL <NRf>
Parameters	0 through 3

*RST

Reset Command. This command resets the electronic load to a pre-defined state stored in profile 0. It is similar to "*RCL 0" command except the following:

*RST also does the following:

- **Forces an ABORt command before resetting any parameters.**
- **After all parameters have been reset, executes an INP:PROT:CLE to clear the electronic load's protection circuits.**

Note *RST does not affect any Status Enable registers or Transition Filters.

Command Syntax *RST
Parameters None

*SAV

Save Command. This command stores the present state of the electronic load in a specified location in memory. Location 0, 1, 2 , and 3 are in nonvolatile memory and retains its state throughout power cycling. The electronic load will be set to the state in location 0 at power turn-on.

Command Syntax *SAV <NRf>
Parameters 0 to 3
Suffix None

*SRE

Service Request Enable Command/Query. This command sets the condition of the Service Request Enable register, which determines which events of the Status Byte register (see *STB) are allowed to set the MSS (Master Status Summary) bit. A "1" in the bit position enables the corresponding Status Byte bit to set the MSS bit. All the enabled bits are logically ORed to cause Bit 6 (the Master Summary Status Bit) of the Status Byte register to be set.

Command Syntax *SRE <NRf>
Parameters 0 to 255
Suffix None
Query Syntax *SRE?
Returned Parameters <NR1>, Value: 0 to 255
Suffix None

*STB?

Read Status Byte Query. This query reads the Status Byte register. Note that the MSS (Master Summary Status) bit and not the RQS bit is returned in Bit 6. This bit indicates whether or not the electronic load has at least one reason for requesting service. *STB? does not clear the Status Byte register, which is cleared only when subsequent action has cleared all its set bits.

Status Byte Register

Bit Position	7	6	5	4	3	2	1	0
Condition	OPER	MSS	ESB	MAV	QUES	SUM	0	0

Query Syntax *STB?
Parameters None
Returned Parameters <NR1>, Value: 0 to 255
Suffix None

*TRG

Immediate Trigger Command. This command which is essentially the same as the Group Execute Trigger (<GET>), generates a trigger to the electronic load only if TRIG:SOUR is set to BUS.

Command Syntax *TRG
Parameters None

*TST?

Self Test Query. This query causes the electronic load to go through a limited self-test.

Query Syntax *TST?
Returned Parameters <NR1> 0 = test passed
Nonzero indicates a self-test failure.
Suffix None

*WAI

This command instructs the electronic load not to process any further commands until all pending operations are completed. Pending operations are complete when:

- **All commands sent before *WAI have been executed. This includes overlapped commands. Most commands are sequential and are completed before the next command is executed. Overlapped commands are executed in parallel with other commands. Commands that affect input voltage or state, relays, and trigger actions are overlapped with subsequent commands sent to the electronic load. The *WAI command prevents subsequent commands from being executed before any overlapped commands have been completed.**
- **All triggered actions are completed and the trigger system returns to the Idle state.**

Command Syntax *WAI
Parameters **None**

ROOT-LEVEL COMMANDS

INTRODUCTION

Root-level commands are those that are specific to the family of electronic loads. The commands are grouped as either channel-specific or channel-independent commands

CALIBRATION COMMANDS

Calibration commands let you:

- **Enable and disable the calibration mode**
- **Change the calibration password**
- **Calibrate the input functions, current monitor offset, and store new calibration constants in nonvolatile memory.**

CALibrate:MEASure:HIGH

This command can only be used in calibration mode. It is used to set the count of 2nd calibration point.

Command Syntax	CALibrate:MEASure:HIGH <NR1>
Parameters	<NR1> count of calibration point
Query Syntax	CALibrate:MEASure:HIGH?
Returned Parameters	<NR1>

CALibrate:MEASure:LOW

This command can only be used in calibration mode. It is used to set the count of 1st calibration point.

Command Syntax	CALibrate:MEASure:LOW <NR1>
Parameters	<NR1> count of calibration point
Query Syntax	CALibrate:MEASure:LOW?
Returned Parameters	<NR1>

CALibrate:MODe

This command can only be used in calibration mode. It is used to set the calibration mode.

Command Syntax CALibrate:MODe <NR1>

Parameters <NR1> calibration mode

0 = range 0 of immediate voltage calibration
1 = range 1 of immediate voltage calibration
2 = range 2 of immediate voltage calibration
3 = range 3 of immediate voltage calibration
4 = range 0 of immediate current calibration
5 = range 1 of immediate current calibration
6 = range 2 of immediate current calibration
7 = range 3 of immediate current calibration
8 = range 0 of immediate resistance calibration
9 = range 1 of immediate resistance calibration

10 = range 2 of immediate resistance calibration
11 = range 3 of immediate resistance calibration
12 = range 0 of immediate power calibration
13 = range 1 of immediate power calibration
14 = range 2 of immediate power calibration
15 = range 3 of immediate power calibration
16 = range 0 of transient voltage calibration
17 = range 1 of transient voltage calibration
18 = range 2 of transient voltage calibration
19 = range 3 of transient voltage calibration
20 = range 0 of transient current calibration
21 = range 1 of transient current calibration
22 = range 2 of transient current calibration
23 = range 3 of transient current calibration
24 = range 0 of transient resistance calibration
25 = range 1 of transient resistance calibration
26 = range 2 of transient resistance calibration
27 = range 3 of transient resistance calibration
28 = range 0 of transient power calibration
29 = range 1 of transient power calibration
30 = range 2 of transient power calibration
31 = range 3 of transient power calibration
32 = range 0 of readback voltage calibration
33 = range 1 of readback voltage calibration
34 = range 2 of readback voltage calibration
35 = range 3 of readback voltage calibration
36 = range 0 of readback current calibration
37 = range 1 of readback current calibration
38 = range 2 of readback current calibration
39 = range 3 of readback current calibration

Query Syntax CALibrate:MODe?
Returned Parameters <NR1>

CALibrate:POINt

This command can only be used in calibration mode. It is used to set the two calibration points of the analog current monitor signal.

Command Syntax CALibrate:POINt <NR1>
Parameters <NR1> 0=1st calibration points
1=2nd calibration points

CALibrate:SAVe

This command can only be used in calibration mode. It saves any new calibration constants (after a current or voltage calibration procedure has been completed) in nonvolatile memory.

Command Syntax CALibrate:SAVe
Parameters None

CALibrate:STATe

This command enables and disables calibration mode. The calibration mode must be enabled before the load will accept any other calibration commands. The query statement returns only the state, not the password. Whenever the calibration state is changed from enabled to disabled, any new calibration

constants are lost unless they have been stored with CALibrate:SAVE.

Command Syntax CALibrate:STATe <bool>
Parameters 0 | 1 | OFF | ON
***RST Value** OFF
Query Syntax CALibrate:STATe?
Returned Parameters <NR1>

CALibrate:TRANsient:OFFSet

This command can only be used in calibration mode. It is used to set the DAC count of immediate level when enter transient calibration mode.

Command Syntax CALibrate:TRANsient:OFFSet <NR1>
Parameters <NR1> DAC count of immediate level
Query Syntax CALibrate:TRANsient:OFFSet?
Returned Parameters <NR1>

CALibrate:VALue:CURRent

This command is only used in calibration mode. It enters a calibration current that you obtain by reading an external meter. You must first select a calibration level (with CALibrate:LEVel) for the value being entered. These constants are not stored in nonvolatile memory until they are saved with CALibrate:SAVE. If CALibrate:STATE OFF is programmed without a CALibrate:SAVE, the previous calibration constants are restored.

Command Syntax CALibrate:VALue:CURRent <NRf>
Parameters <NRf> current value

CALibrate:VALue:VOLTage

This command is only used in calibration mode. It enters a calibration voltage that you obtain by reading an external meter. You must first select a calibration level (with CALibrate:LEVel) for the value being entered. These constants are not stored in nonvolatile memory until they are saved with CALibrate:SAVE. If CALibrate:STATE OFF is programmed without a CALibrate:SAVE, the previous calibration constants are restored.

Command Syntax CALibrate:VALue:VOLTage <NRf>
Parameters <NRf> voltage value

CURRENT SUBSYSTEM

This subsystem programs the CC (constant-current mode) function of a single electronic load.

[SOURce:]CURRent[:LEVel][:IMMediate], ISET
[SOURce:]CURRent[:LEVel]:TRIGgered

Channel-Specific Current Command/Query. This is an implied keyword that specifies the value of the programmed current level and whether that level is to be applied immediately or on occurrence of a trigger. If the specified channel is in the CC (Constant-Current) Mode, an IMMediate current level is transferred to the input as soon as the command is executed. A TRIGgered level is stored and then transferred to the electronic load input when a trigger occurs. At that time, the change to the input level occurs at the slew time presently in effect. Following the trigger event, subsequent triggers will not affect the input level unless the electronic load has been sent another TRIGgered level command.

If the electronic load is not in the CC (Constant-Current) Mode when an IMMediate or TRIGgered level command is sent, the programmed levels are saved for the time the electronic load is placed in the CC mode. Triggered levels are processed by the Current Subsystem even when the electronic load is not in the CC Mode. In this case, the TRIGgered level becomes a stored IMMediate level that takes effect when the electronic load is again in the CC Mode.

Until they are explicitly programmed, triggered levels will assume their corresponding immediate levels. For example, if a electronic load is powered up and CURR is programmed to 5, then CURR:TRIG will also be 5 until you program it to another value. Once you program CURR:TRIG to a value, it will remain at that regardless of how you subsequently reprogram CURR. Then, when the trigger occurs, the CURR is set to the CURR:TRIG value.

Note: Setting an IMM current level to the same value as the most recent TRIG current level will not deactivate a pending TRIG level. You must use ABORt to deactivate it.

Specify the input current level for the CURRent mode.

- **On a TRIG[:IMM] command (always)**
- **On receipt of an external trigger signal (if TRIG:SOUR is set to EXTernet)**
- **On receipt of a GPIB <GET> (if TRIG:SOUR is set to BUS)**
- **On receipt of an Ethernet trigger signal (if TRIG:SOUR is set to ETHernet)**
- **On receipt of *TRG (unless TRIG:SOUR is set to HOLD)**

Command Syntax	CURRent <NRf+> CURRent:TRIGgered <NRf+> ISET <NRf+>
Parameters	<NRf+>: Current level. Refer to model specifications for range.
Status and Errors	TRIGgered level commands affect the WTG bit in the Operation Condition register and the OPC bit of the Standard Event Status Event register.
Query Syntax	CURRent? CURRent? MIN CURRent? MAX CURRent:TRIGgered? CURRent:TRIGgered? MIN CURRent:TRIGgered? MAX ISET? ISET? MIN ISET? MAX

Returned Parameters	<NRf+>: “CURR?” and “CURR:TRIG?” return the presently programmed current levels. After a trigger signal or “ABORt”, “CURR:TRIG?” returns the same value as “CURR?”. “CURR? MAX”, “CURR? MIN”, “CURR:TRIG? MAX” and “CURR:TRIG?” MIN return the maximum and minimum programmable LEVel values.

[SOURce:]CURRent:[TRANsient:]DUTY

This command sets the duty cycle of each of the transients when the generator is in CONTinuous mode.

Command Syntax	CURRent:[TRANient:]DUTY <NR1>
Parameters	<NR1>: Duty cycle value. 1 – 100.
Unit	Percentage (%)
Query Syntax	CURRent:DUTY? CURRent:DUTY? MIN CURRent:DUTY? MAX CURRent:TRANsient:DUTY? CURRent:TRANsient:DUTY? MIN CURRent:TRANsient:DUTY? MAX
Returned Parameters	<NR1>, duty cycle value in percentage

[SOURce:]CURRent:[TRANsient:]FREQuency

This command sets the frequency of the transients when the generator is in CONTinuous mode.

Command Syntax	CURRent:[TRANsient:]FREQuency <NRf+>
Parameters	<NRf+>: Frequency value, refer to model specifications for range.
Unit	Hertz
Query Syntax	CURRent:FREQuency? CURRent:FREQuency? MIN CURRent:FREQuency? MAX CURRent:TRANsient:FREQuency? CURRent:TRANsient:FREQuency? MIN CURRent:TRANsient:FREQuency? MAX
Returned Parameters	<NRf+>

[SOURce:]CURRent:PROTection[:LEVel]
[SOURce:]CURRent:PROTection:DELay
[SOURce:]CURRent:PROTection:OVER[:LEVel]
[SOURce:]CURRent:PROTection:OVER:DELay
[SOURce:]CURRent:PROTection:STATe
[SOURce:]CURRent:PROTection:UNDer[:LEVel]
[SOURce:]CURRent:PROTection:UNDer:DELay
[SOURce:]CURRent:PROTection:UNDer:STATe

Channel-Specific Current Limiting Command/Query. This command sets the over-current protection limit or the under-current protection limit to the input current that the electronic load will sink. When the input current reaches the over-current protection limit or falls below the under-current protection limit for the specified delay period, the input of the electronic load is shut off and draws no current.

The INPut:PROTection:CLEar command (or front panel key) re-enables the input current. The trigger activated current functions (CURR[:LEV]:TRIG and CURR:TLEV) automatically keep track of incoming

triggers while the input is shut down and will respond to the trigger as soon as the protection fault is cleared.

The :PROTection:DELay command specifies the time that the input current may equal or exceed CURRent:PROTection[:LEVel] or equal or fall below the CURRent:PROTection:UNDer[:LEVel] before the soft circuit breaker is actuated. The PROTection:STATe command enables or disables the soft circuit breaker function.

Note : If the soft circuit breaker function causes the input to shut down, it will not affect INP[STATe]. If INP:STAT is programmed ON, it will remain so even after the CURR:PROT has turned the electronic load off.

Command Syntax

CURRent:PROTection <NRf+>	Set immediate over-current protection limit.
CURRent:PROTection:OVER <NRf+>	Set immediate over-current protection limit.
CURRent:PROTection:DELay <NRf+>	Set time that current may be at or above limit before input is turned off.
CURRent:PROTection:OVER:DELay <NRf+>	Set time that current may be at or above limit before input is turned off.
CURRent:PROTection:UNDer:DELay <NRf+>	Set time that current may be at or below limit before input is turned off.
CURRent:PROTection:STATe OFF|0	Disable over protection function.
CURRent:PROTection:STATe ON|1	Enable over protection function.
CURRent:PROTection:UNDer <NRf+>	Set immediate under-current protection limit.
CURRent:PROTection:UNDer:STATe OFF|0	Disable under current protection function.
CURRent:PROTection:UNDer:STATe ON|1	Enable under current protection function.

Parameters Refer individual model specification for MIN | MAX value.

Query Syntax
CURRent:PROTection?
CURRent:PROTection? MIN CURRent:PROTection? MAX
CURRent:PROTection:OVER?
CURRent:PROTection:OVER? MIN
CURRent:PROTection:OVER? MAX
CURRent:PROTection:DELay?
CURRent:PROTection:DELay? MIN
CURRent:PROTection:DELay? MAX
CURRent:PROTection:OVER:DELay?
CURRent:PROTection:OVER:DELay? MIN
CURRent:PROTection:OVER:DELay?MAX
CURRent:PROTection:UNDer:DELay?
CURRent:PROTection:UNDer:DELay? MIN
CURRent:PROTection:UNDer:DELay?MAX
CURRent:PROTection:STATe?
CURRent:PROTection:UNDer?
CURRent:PROTection:UNDer? MIN
CURRent:PROTection:UNDer? MAX
CURRent:PROTection:UNDer:STATe?

Returned Parameters Depending on the actual query.

[SOURce:]CURRent:SLEW:BOTH

This command sets the slew time for all programmed changes in the input current level of the electronic load. This command programs both positive and negative going slew time. Although any

slew time value may be entered, the electronic load selects a slew time that is closest to the programmed value. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Note: Slew time greater than the maximum value is set to MAXimum. Slew time less than the minimum value are set to MINimum.

Command Syntax	CURRent:SLEW:BOTH <NRf+>
Parameters	Slew time. Refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	None

[SOURce:]CURRent:SLEW:NEGative

This command sets the slew time of the current for negative going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Note: Slew time greater than the maximum value is set to MAXimum. Slew time less than the minimum value are set to MINimum.

Command Syntax	CURRent:SLEW:NEGative <NRf+>
Parameters	Slew time. Refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	CURRent:SLEW:NEGative? CURRent:SLEW:NEGative? MIN CURRent:SLEW:NEGative? MAX
Returned Parameters	<NRf+>, slew time.

[SOURce:]CURRent:SLEW[:POSitive]

This command sets the slew time of the current for positive going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Note: Slew time greater than the maximum value is set to MAXimum. Slew time less than the minimum value are set to MINimum.

Command Syntax	CURRent:SLEW <NRf+> CURRent:SLEW:POSitive <NRf+>
Parameters	<NRf+>: slew time. Refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	CURRent:SLEW? CURRent:SLEW? MIN CURRent:SLEW? MAX CURRent:SLEW:POSitive? CURRent:SLEW:POSitive? MIN CURRent:SLEW:POSitive? MAX
Returned Parameters	<NRf+>, slew time

[SOURce:]CURRent:TLEVel, ITR

Channel-Specific Current Command/Query. This command specifies the value of the programmed current level for the TRANsient input when the electronic load is in the CC Mode. When the Transient Subsystem is on, the electronic load input current will switch (under control of the Transient Subsystem) between the main level and TLEVel at a rate determined by the present value of SLEW.

In order for the input current level to switch, TLEVel must be set to a value greater than the main level. If TLEVel is set to a value below the main level, no error is generated but switching will not occur until the main level is subsequently below the value of TLEVel.

Command Syntax	CURRent:TLEVel <NRf+> ITR <NRf+>
Parameters	<NRf+>: Current transient level value. Refer to model specifications for range | MIN | MAX
Query Syntax	CURRent:TLEVel? CURRent:TLEVel? MIN CURRent:TLEVel? MAX ITR ITR? MIN ITR? MAX
Returned Parameters	<NRf+> returns the transient current level. If the electronic load is not in CC Mode, the level will still be set, even if it is less than the presently programmed input level.

[SOURce:]CURRent:[TRANsient:]TWIDth

This command sets the pulse width of the transients when the generator is in PULSe mode.

Note: This command will also change the CURR:FREQ value.

Command Syntax	CURRent:[TRANsient:]TWIDth <NRf+>
Parameters	Refer to model's specification | MAX | MIN
Unit	ms
Query Syntax	CURRent:TRANsient:TWIDth? CURRent:TWIDth?
Returned Parameters	<NRf+>, pulse width time in ms.

INPUT COMMANDS

These commands control the input of the electronic load. The INPut and OUTput commands are equivalent. The CURRent, POWer, RESistance and VOLTage commands program the actual input current, power, resistance, and voltage.

[SOURce:]INPut
[SOURce:]OUTPut

These commands enable or disable the electronic load inputs. The state of a disabled input is a high impedance condition.

Command Syntax	INPut <bool> OUTPut <bool>
Parameters	0 | 1 | OFF | ON
***RST Value**	OFF
Query Syntax	INPut? OUTPut?
Returned Parameters	0 | 1

[SOURce:]INPut:PROTection:CLEar
[SOURce:]OUTPut:PROTection:CLEar

These commands clear the latch that disables the input when a protection condition such as over-current (OC), under-current (UV), over-power (OP), under-power (UP), over-voltage (OV) under-voltage (UV) or over-temperature (OT) is detected. All conditions that generated the fault must be removed before the latch can be cleared. The input is then restored to the state it was in before the fault condition occurred.

Command Syntax	INPut:PROTection:CLEar OUTPut:PROTection:CLEar
Parameters	None

[SOURce:]INPut:SHORt,
[SOURce:]OUTPut:SHORt, SHORt

This command programs the specified electronic load module to the maximum current that it can sink.

Note: When "SYST:SHOR:STAT" command is set to OFF, "INP:SHOR ON" will cause an execution error.

Command Syntax	INPut:SHORt <bool> OUTPut:SHORt <bool> SHORt <bool>
Parameters	0 | 1 | OFF | ON
***RST Value**	OFF
Query Syntax	INPut:SHORt? OUTPut:SHORt? SHORt?
Returned Parameters	0 | 1

STEP COMMANDS

STEP commands let you program complex sequences of input changes with rapid, precise timing, and synchronized with trigger signals. Each function for which STEPs can be generated has a STEP of values that specify the input at each STEP step. STEP:COUNt determines how many times the unit sequences through a STEP before that STEP is completed. STEP:{mode}:TIMe specifies the time interval that each value (step) of a STEP is to remain in effect.

NOTE: The STEP:{mode}:TIMe command is active whenever any function is set to STEP mode. Therefore, a STEP:{mode}:TIMe time must always be specified whenever any STEP function is programmed.

All STEP point data can be stored in nonvolatile memory.

[SOURce:]STEP:COUNt

This command sets the number of times that the STEP is executed before it is completed. The command accepts parameters in the range 1 through 65535, or infinity(0). Use 0(infinity) to execute a STEP indefinitely.

Command Syntax	STEP:COUNt <NR1> | INFinity
Parameters	0 | INF(0) | 1 to 65535 | MIN | MAX
Query Syntax	STEP:COUNt?
Returned Parameters	<NR1>

[SOURce:]STEP:CURRent[:LEVel]

This command specifies the current setting for each step.

Command Syntax	STEP:CURRent <NR1>,<NRf+>
Parameters	<NR1> point index, 1 through 256 <NRf+> current level for specified point. Refer to model specifications for range | MIN | MAX
Query Syntax	STEP:CURRent? <NR1>
Parameters	<NR1> point index, 1 through 256
Returned Parameters	<NRf+> current level for specified point

[SOURce:]STEP:CURRent:TIMe?

This command specifies the dwell time for each STEP step. Each value of point represents the time in milli-seconds that the input will remain at the particular STEP step point before completing the step. At the end of the dwell time, the input of the electronic load depends upon the following conditions:

- **If STEP:CURRent:STATe ON has been programmed, the input automatically changes to the next point in the STEP.**
- **If STEP:CURRent:STATe AUTO has been programmed, the input awaits for a trigger command to change to the next point in the STEP.**
- **If STEP:CURRent:STATe ONCE has been programmed, the input remains at the present level until a trigger sequences the next point in the STEP.**

Command Syntax	STEP:CURRent:TIMe <NR1>,<NR1>
Parameters	1st <NR1>, point index 2nd <NR1>, 0 to 65535 | MIN | MAX

Unit	ms
Query Syntax	STEP:CURRent:TIMe? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NR1> dwelling time value in ms

[SOURce:]STEP:CURRent:STATe

This command specifies how to process the STEP sequencing. The following parameters may be specified.

- **ON** Causes the entire STEP to be executed immediately, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.
- **ONCE** Causes the STEP to advance only one point after each trigger. Triggers that arrive during a dwell delay are ignored
- **AUTO** Causes the entire STEP to be executed sequentially after the starting trigger, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.

Command Syntax	STEP:CURRent:STATe <NR1>
Parameters	0 | OFF(0) | 1 | ON(1) | 2 | AUTO(2) | 3 | ONCE(3)
Query Syntax	STEP:CURRent:STATe?
Returned Parameters	<NR1> 0=OFF 1=ON 2=AUTO 3=ONCE

[SOURce:]STEP:POWer[:LEVel]

This command specifies the power setting for each STEP step.

Command Syntax	STEP:POWer <NR1>,<NRf+>
Parameters	<NR1>: point index, 1 through 256 <NRf+>: power level value for the specified point. Refer to individual model specification for range | MIN | MAX
Query Syntax	STEP:POWer? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NRf+>: power level value for the specified point

[SOURce:]STEP:POWer:TIMe?

This command specifies the dwell time for each STEP step. Each value of point represents the time in milli-seconds that the input will remain at the particular STEP step point before completing the step. At the end of the dwell time, the input of the electronic load depends upon the following conditions:

- **If STEP:POWer:STATe ON or STEP:POWer:STATe AUTO has been programmed, the input automatically changes to the next point in the STEP.**
- **If STEP:POWer:STATe ONCE has been programmed, the input remains at the present level until a trigger sequences the next point in the STEP.**

Command Syntax	STEP:POWer:TIMe <NR1>,<NR1>
Parameters	1st <NR1> point index, 1 to 256 2nd <NR1> 0 to 65535 | MINimum | MAXimum
Unit	ms
Query Syntax	STEP:POWer:TIMe? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NR1> dwelling time for the specified point

[SOURce:]STEP:POWer:STATe

This command specifies how to process the STEP sequencing. The following parameters may be specified.

- **ON** Causes the entire STEP to be executed immediately, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.
- **ONCE** Causes the STEP to advance only one point after each trigger. Triggers that arrive during a dwell delay are ignored
- **AUTO** Causes the entire STEP to be executed sequentially after the starting trigger, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.

Command Syntax	STEP:POWer:STATe <NR1>
Parameters	0 | OFF(0) | 1 | ON(1) | 2 | AUTO(2) | 3 | ONCE(3)
***RST Value**	0
Query Syntax	STEP:POWer:STATe?
Returned Parameters	<NR1> 0=OFF 1=ON 2=AUTO 3=ONCE

[SOURce:]STEP:RESistance[:LEVel]

This command specifies the resistance setting for each STEP step.

Command Syntax	STEP:RESistance <NR1>,<NRf+>
Parameters	<NR1> point index, 1 through 256 <NRf+> resistance level value, refer individual model specification for range. | MIN | MAX
Query Syntax	STEP:RESistance? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NRf+> resistance value

[SOURce:]STEP:RESistance:TIMe?

This command specifies the dwell time for each STEP step. Each value of point represents the time in milli-seconds that the input will remain at the particular STEP step point before completing the step. At the end of the dwell time, the input of the electronic load depends upon the following conditions:

- **If STEP:RESistance:STATe AUTO has been programmed, the input automatically changes to the next point in the STEP.**
- **If STEP:RESistance:STATe ONCE has been programmed, the input remains at the present level until a trigger sequences the next point in the STEP.**

Command Syntax	STEP:RESistance:TIMe <NR1>,<NR1>
Parameters	1st <NR1> point index 2nd <NR1> 0 to 65535 | MIN | MAX
Unit	ms
Query Syntax	STEP:RESistance:TIMe? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NR1> Resistance level for the specified point.

[SOURce:]STEP:RESistance:STATe

This command specifies how to process the STEP sequencing. The following parameters may be

specified.

- **ON** Causes the entire STEP to be executed immediately, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.
- **ONCE** Causes the STEP to advance only one point after each trigger. Triggers that arrive during a dwell delay are ignored
- **AUTO** Causes the entire STEP to be executed sequentially after the starting trigger, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.

Command Syntax	STEP:RESistance:STATe <NR1>
Parameters	0 | OFF(0) | 1 | ON(1) | 2 | AUTO(2) | 3 | ONCE(3)
***RST Value**	0
Query Syntax	STEP:RESistance:STATe?
Returned Parameters	<NR1> 0=OFF 1=ON 2=AUTO 3=ONCE

[SOURce:]STEP:VOLTage[:LEVel]

This command specifies the voltage setting for each STEP step.

Command Syntax	STEP:VOLTage <NR1>,<NRf+>
Parameters	<NR1> point index, 1 through 256 <NRf+> Voltage level, refer individual mode specification for range. | MIN | MAX
Query Syntax	STEP:VOLTage? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NRf+> voltage level

[SOURce:]STEP:VOLTage:TIMe?

This command specifies the dwell time for each STEP step. Each value of point represents the time in milli-seconds that the input will remain at the particular STEP step point before completing the step. At the end of the dwell time, the input of the electronic load depends upon the following conditions:

- **If STEP:VOLTage:STATe On or STEP:VOLT:STATe AUTO has been programmed, the input automatically changes to the next point in the STEP.**
- **If STEP:VOLTage:STATe ONCE has been programmed, the input remains at the present level until a trigger sequences the next point in the STEP.**

Command Syntax	STEP:VOLTage:TIMe <NR1>,<NR1>
Parameters	1st <NR1>, point index 2nd <NR1>, 1 to 65535 | MIN | MAX
Unit	ms
Query Syntax	STEP:VOLTage:TIMe? <NR1>
Parameters	<NR1> point index
Returned Parameters	<NR1> dwelling time in ms

[SOURce:]STEP:VOLTage:STATe

This command specifies how to process the STEP sequencing. The following parameters may be specified.

- **ON** Causes the entire STEP to be executed immediately, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.

- **ONCE** Causes the STEP to advance only one point after each trigger. Triggers that arrive during a dwell delay are ignored
- **AUTO** Causes the entire STEP to be executed sequentially after the starting trigger, paced by its dwell delays. As each dwell delay elapses, the next point is immediately executed.

Command Syntax	STEP:VOLTage:STATe <NR1>
Parameters	0 | OFF(0) | 1 | ON(1) | 2 | AUTO(2) | 3 | ONCE(3)
***RST Value**	0
Query Syntax	STEP:VOLTage:STATe?
Returned Parameters	<NR1> 0=OFF 1=ON 2=AUTO 3=ONCE

[SOURce:]STEP:TIMe:UNIT

This command is to set or to query the time unit for step function. The default unit for step dwell time is in millisecond. This command allows user to switch the time unit between millisecond and second.

Command Syntax	STEP:TIMe:UNIT <NR1>
Parameters	0 | OFF | 1 | ON
***RST Value**	0
Query Syntax	STEP:VOLTage:STATe?
Returned Parameters	<NR1> 0=millisecond 1=second

MEASUREMENT COMMANDS

MEASure:CURRent[:DC]?
MEASure:POWer[:DC]?
MEASure:RESistance[:DC]?
MEASure:VOLTage[:DC]?
MEASure:VOLTage:INPut?

This function consists of queries that return the current, power, resistance ,and voltage at the input of the electronic load.

Query Syntax

MEASure:CURRent?	electronic load input current
MEASure:POWer?	Computed electronic load input power
MEASure:RESistance?	Computed electronic load input resiatance
MEASure:VOLTage?	electronic load input voltage
MEASure:VOLT:INPut?	electronic load input voltage at input end
Returned parameters	<NRf+> Value representing amperes, watts, ohm, or volts

MEASure:DELay

This command is to sets or queries the delay time to obtain read back value for “MEAS:CURR?”, “MEAS:POW?”, “MEAS:RES?” and “MEAS:VOLT?” queries.

Command Syntax	MEASure:DELay <NR1>	
Parameters	0 t0 2000 | MIN | MAX	
Unit	milli-second	
Query Syntax	MEASure:DELay?	
	MEASure:DELay? MIN	MEASure:DELay? MAX
Returned Parameters	<NR1> delay time in ms	

MEASure:SENSe

This command sets or queries the measurement sense (Local / Remote).

Note: When input voltage is greater than 30 V, this command will cause an execution error.

Command Syntax	MEASure:SENSe <bool>	
Parameters	0 | 1 | LOCal(0) | REMote(1)	
Query Syntax	MEASure:SENSe?	
Returned Parameters	<bool>	0=LOCal
		1=REMote

MODE COMMANDS

[SOURce:]MODe

The commands sets and query the input regulation mode of the electronic load.

CURRent	**constant current mode**
POWer	**constant power mode**
RESistance	**constant resistance mode**
VOLTage	**constant voltage mode**

Command Syntax	MODe <CRD>	
Parameters	CURR | POW | RES | VOLT	
***RST Value**	CURR	
Query Syntax	MODe?	
Returned Parameters	<CRD>	CURR= constant current mode POW= constant power mode RES= constant resistance mode VOLT= constant voltage mode

[SOURce:]MODe:RANGe

The commands sets and query the operating range at the current operating mode.

Note: When Range control ("UTIL:RANG") is set to AUTO (1), this command will cause execution error.

Command Syntax	MODe:RANGe <NR1>	
Parameters	range index	0 – Low Range 1 – Middle Range 2 – High Range 3 – Ultra High/Ultra Low Range
Query Syntax	MODe:RANGe?	
Returned Parameters	<NR1>, range index number	

PORT COMMANDS

These commands control the general purpose digital port on the electronic load modules.

PORT

This command sets the state of the general purpose digital port on the specified electronic load module. A value of 1 sets the state high, a 0 sets the state low.

Command Syntax	PORT <bool>
Parameters	0 | 1 | OFF | ON
***RST Value**	OFF
Query Syntax	PORT?
Returned Parameters	<bool>, 0 | 1

INPUT CONTACTOR COMMANDS

These commands control the INPUT CONTACTOR function providing Mode Selection and Delay Time Setting.

[SOURce:]INPut:CONtactor

This command configures the INPUT CONTACTOR Mode

Command Syntax	INPut:CONtactor <mode>
Parameters	1: DISABLE | 2: PORT0+ @ ON | 3: PORT0+ @ ON
Query Syntax	INPut:CONtactor?
Returned Parameters	1 | 2 | 3

[SOURce:]INPut:CONtactor:DELay

This command configures the INPUT CONTACTOR Mode

Command Syntax	INPut:CONtactor:DELay <delay-time>
Parameters	50 ~ 500ms
Query Syntax	INPut:CONtactor:DELay?
Returned Parameters	50 ~ 500ms

POWER SUBSYSTEM

This subsystem programs the CP (constant-power mode) function of a single electronic load.

[SOURce:]POWer[:LEVel][:IMMediate], PSET
[SOURce:]POWer[:LEVel]:TRIGgered

Channel-Specific Power Command/Query. This is an implied keyword that specifies the value of the programmed power level and whether that level is to be applied immediately or on occurrence of a trigger. If the specified channel is in the CP (Constant-Power) Mode, an IMMediate power level is transferred to the input as soon as the command is executed. A TRIGgered level is stored and then transferred to the electronic load input when a trigger occurs. At that time, the change to the input level occurs at the slew time presently in effect. Following the trigger event, subsequent triggers will not affect the input level unless the electronic load has been sent another TRIGgered level command.

If the electronic load is not in the CP (Constant-ower) Mode when an IMMediate or TRIGgered level command is sent, the programmed levels are saved for the time the electronic load is placed in the CP mode. Triggered levels are processed by the Power Subsystem even when the electronic load is not in the CP Mode. In this case, the TRIGgered level becomes a stored IMMediate level that takes effect when the electronic load is again in the CP Mode.

Until they are explicitly programmed, triggered levels will assume their corresponding immediate levels. For example, if a electronic load is powered up and POW is programmed to 10, then POW:TRIG will also be 10 until you program it to another value. Once you program POW:TRIG to a value, it will remain at that regardless of how you subsequently reprogram POW. Then, when the trigger occurs, the POW is set to the POW:TRIG value.

Note : Setting an IMM power level to the same value as the most recent TRIG power level will not deactivate a pending TRIG level. You must use ABORt to deactivate it.

Specify the input power level for the Power mode.

- **On a TRIG[:IMM] command (always)**
- **On receipt of an external trigger signal (if TRIG:SOUR is set to EXTernal)**
- **On receipt of a GPIB <GET> (if TRIG:SOUR is set to BUS)**
- **On receipt of an Ethernet trigger signal (if TRIG:SOUR is set to ETHernet)**
- **On receipt of *TRG (unless TRIG:SOUR is set to HOLD)**

Command Syntax	POWer <NRf+> POWer:TRIGgered <NRf+> PSET <NRf+>	
Parameters	Power level, refer to model specifications for range | MIN | MAX	
Status and Errors	TRIGgered level commands affect the WTG bit in the Operation Condition register and the OPC bit of the Standard Event Status Event register.	
Query Syntax	POWer? POWer? MIN POWer:TRIGgered? POWer:TRIGgered? MIN PSET? PSET? MIN	 POWer? MAX POWer:TRIGgered? MAX PSET? MAX

Returned Parameters <NRf+> POW? and POW:TRIG? return the presently programmed power levels. After a trigger or ABORt, POWer:TRIG? returns the same value as POWer? .

POWer? MAX, POWer? MIN, POWer:TRIG? MAX and POWer:TRIG? MIN return the maximum and minimum programmable LEVel and TLEVel values.

[SOURce:]POWer:[TRANsient:]DUTY

This command sets the duty cycle of each of the transients when the generator is in CONTinuous mode.

Command Syntax POWer:[TRANsient:]DUTY <NR1>
Parameters Duty cycle value. 1 – 100
Unit Percentage (%)
Query Syntax POWer: DUTY?
POWer: DUTY? MIN POWer: DUTY? MAX
POWer:TRANsient:DUTY?
POWer:TRANsient:DUTY? MIN POWer:TRANsient:DUTY? MAX
Returned Parameters <NR1> Duty cycle value in percentage.

[SOURce:]POWer:[TRANsient:]FREQuency

This command sets the frequency of the transients when the generator is in CONTinuous mode.

Command Syntax POWer:[TRANsient:]FREQuency <NRf+>
Parameters Frequency value, refer to model specifications for range | MIN | MAX
Unit Hertz
***RST Value** 1.0 Hz
Query Syntax POWer:FREQuency?
POWer:FREQuency? MIN POWer:FREQuency? MAX
POWer:TRANsient:FREQuency?
POWer:TRANsient:FREQuency? MIN
POWer:TRANsient:FREQuency? MAX
Returned Parameters <NRf+>, frequency value.

[SOURce:]POWer:PROTection[:LEVel]
[SOURce:]POWer:PROTection:OVER[:LEVel]
[SOURce:]POWer:PROTection:DELay
[SOURce:]POWer:PROTection:OVER:DELay
[SOURce:]POWer:PROTection:UNDer:DELay
[SOURce:]POWer:PROTection:STATe
[SOURce:]POWer:PROTection:UNDer[:LEVel]
[SOURce:]POWer:PROTection:UNDer:STATe

Channel-Specific Power Limiting Command/Query. This command sets the over-power protection limit or the under-power protection limit to the input power that the electronic load will sink. When the input power reaches the over-power protection limit or falls below the under-power protection limit for the specified delay period, the input of the electronic load is shut off and draws no power.

The INPut:PROTection:CLEar command (or front panel key) re-enables the input power. The trigger activated power functions (POWer[:LEV]:TRIG and POWer:TLEV) automatically keep track of

incoming triggers while the input is shut down and will respond to the trigger as soon as the protection fault is cleared.

The :PROTection:DELay command specifies the time that the input power may equal or exceed POWer:PROTection[:LEVel] or equal or fall below the POWer:PROTection:UNDer[:LEVel] before the soft circuit breaker is actuated. The PROTection:STATe command enables or disables the soft circuit breaker function.

Note : If the soft circuit breaker function causes the input to shut down, it will not affect INP[STATe]. If INP:STAT is programmed ON, it will remain so even after the POWer:PROT has turned the electronic load off.

Command Syntax

POWer:PROTection <NRf+>	Set immediate overpower protection limit.
POWer:PROTection:OVER <NRf+>	Set immediate overpower protection limit.
POWer:PROTection:DELay <NRf+>	Set time that power may be at or above :LEVel before input is turned off.
POWer:PROTection:OVER:DELay <NRf+>	Set time that power may be at or above :LEVel before input is turned off.
POWer:PROTection:UND:DELay <NRf+>	Set time that power may be at or above :LEVel before input is turned off.
POWer:PROTection:STATe OFF|0	Disable over protection function.
POWer:PROTection:STATe ON|1	Enable over protection function.
POWer:PROTection:UNDer <NRf+>	Set immediate under-power protection limit.
POWer:PROTection:UND:STAT OF|0	Disable under protection function.
POWer:PROTection:UND:STAT ON|1	Enable under protection function.

Parameters Refer individual model specification for | MIN | MAX

Query Syntax

POWer:PROTection?
POWer:PROTection? MIN POWer:PROTection? MAX
POWer:PROTection:OVER?
POWer:PROTection:OVER? MIN
POWer:PROTection:OVER? MAX
POWer:PROTection:DELay?
POWer:PROTection:DELay? MIN
POWer:PROTectionDELay? MAX
POWer:PROTection:DELay?
POWer:PROTection:OVER:DELay? MIN
POWer:PROTection:OVER:DELay?MAX
POWer:PROTection:UNDer:DELay?
POWer:PROTection:UNDer:DELay? MIN
POWer:PROTection:UNDer:DELay? MAX
POWer:PROTection:STATe?
POWer:PROTection:UNDer?
POWer:PROTection:UNDer? MIN
POWer:PROTection:UNDer? MAX
POWer:PROTection:UNDer:STATe?

[SOURce:]POWer:SLEW:BOTH

This command sets the slew time for all programmed changes in the input power level of the electronic load. This command programs both positive and negative going slew time. Although any slew time value may be entered, the electronic load selects a slew time that is closest to the programmed value.

MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time. Slew times less than the minimum value are set to MINimum. Slew time greater than the maximum value are set to MAXimum.

Command Syntax	POW:SLEW:BOTH <NRf+>
Parameters	Slew time, refer to model specifications | MIN | MAX
Unit	ms

[SOURce:]POWer:SLEW:NEGative

This command sets the slew time of the power for negative going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	POWer:SLEW:NEGative <NRf+>
Parameters	Slew time, refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	POWer:SLEW:NEGative?
	POWer:SLEW:NEGative? MIN POWer:SLEW:NEGative? MAX
Returned Parameters	<NRf+> slew time in ms

[SOURce:]POWer:SLEW[:POSitive]

This command sets the slew time of the power for positive going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	POWer:SLEW <NRf+>
	POWer:SLEW:POSitive <NRf+>
Parameters	slew time, refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	POWer:SLEW?
	POWer:SLEW? MIN POWer:SLEW? MAX
	POWer:SLEW:POSitive?
	POWer:SLEW:POSitive? MIN POWer:SLEW:POSitive? MAX
Returned Parameters	<NRf+> slew time in ms

[SOURce:]POWer:TLEVel, PTR

Channel-Specific Power Command/Query. This command specifies the value of the programmed power level for the TRANsient input when the electronic load is in the CP Mode. When the Transient Subsystem is on, the electronic load input power will switch (under control of the Transient Subsystem) between the main level and TLEVel at a rate determined by the present value of SLEW.

In order for the input power level to switch, TLEVel must be set to a value greater than the main level. If TLEVel is set to a value below the main level, no error is generated but switching will not occur until the main level is subsequently below the value of TLEVel.

Command Syntax	POWer:TLEVel <NRf+>
	PTR <NRf+>
Parameters	Power transient level value, refer to model specifications for range.
Query Syntax	POWer:TLEVel?
	POWer:TLEVel? MIN POWer:TLEVel? MAX
	PTR?
	PTR? MIN PTR? MAX
Returned Parameters	<NRf+> “POW:TLEV?” returns the transient power level.

If the electronic load is not in CP Mode, the level will still be set, even if it is less than the presently programmed input level.

[SOURce:]POWer:[TRANsient:]TWIDth

This command sets the pulse width of the transients when the generator is in PULSe mode.

Note: This command will also change the POW:FREQ value.

Command Syntax	POWer:[TRANsient:]TWIDth <NRf+>
Parameters	Refer to model's specification | MAX | MIN
Unit	ms
Query Syntax	POWer:TRANsient:TWIDth? POWer:TWIDth?
Returned Parameters	<NRf+> the pulse width in ms

RESISTANCE SUBSYSTEM

This subsystem programs the CR (constant-resistance mode) function of a single electronic load.

[SOURce:]RESistance[:LEVel][:IMMediate], RSET
[SOURce:]RESistance[:LEVel]:TRIGgered

Channel-Specific Resistance Command/Query. This is an implied keyword that specifies the value of the programmed resistance level and whether that level is to be applied immediately or on occurrence of a trigger. If the specified channel is in the CR (Constant-Resistance) Mode, an IMMediate resistance level is transferred to the input as soon as the command is executed. A TRIGgered level is stored and then transferred to the electronic load input when a trigger occurs. At that time, the change to the input level occurs at the slew time presently in effect. Following the trigger event, subsequent triggers will not affect the input level unless the electronic load has been sent another TRIGgered level command.

If the electronic load is not in the CR (Constant-resistance) Mode when an IMMediate or TRIGgered level command is sent, the programmed levels are saved for the time the electronic load is placed in the CR mode. Triggered levels are processed by the Resistance Subsystem even when the electronic load is not in the CR Mode. In this case, the TRIGgered level becomes a stored IMMediate level that takes effect when the electronic load is again in the CR Mode.

Until they are explicitly programmed, triggered levels will assume their corresponding immediate levels. For example, if a electronic load is powered up and RES is programmed to 10, then RES:TRIG will also be 6 until you program it to another value. Once you program RES:TRIG to a value, it will remain at that regardless of how you subsequently reprogram RES. Then, when the trigger occurs, the RES is set to the RES:TRIG value.

Note : Setting an IMM resistance level to the same value as the most recent TRIG resistance level will not deactivate a pending TRIG level. You must use ABORt to deactivate it.

Specify the input resistance level for the RESistance mode.

- **On a TRIG[:IMM] command (always)**
- **On receipt of an external trigger signal (if TRIG:SOUR is set to EXT)**
- **On receipt of a GPIB <GET> (if TRIG:SOUR is set to BUS)**
- **On receipt of an Ethernet trigger signal (if TRIG:SOUR is set to ETHernet)**
- **On receipt of *TRG (unless TRIG:SOUR is set to HOLD)**

Command Syntax	RESistance <NRf+> RESistance:TRIGgered <NRf+> RSET <NRf+>	
Parameters	Refer to model specifications | MIN | MAX	
Status and Errors	TRIGgered level commands affect the WTG bit in the Operation Condition register and the OPC bit of the Standard Event Status Event register.	
Query Syntax	RESistance?	
	RESistance? MIN	RESistance? MAX
	RESistance:TRIGgered?	RESistance:TRIG? MIN
	RESistance:TRIGgered? MAX	
	RSET?	
	RSET? MIN	RSET? MAX

Returned Parameters	<NR3> RES? and RES:TRIG? return the presently programmed resistance levels. After a trigger or ABORt, RESistance:TRIG? returns the same value as RESistance? . RESistance? MAX, RESistance? MIN, RESistance:TRIG? MAX and RESistance:TRIG? MIN return the maximum and minimum programmable LEVel and TLEVel values.

[SOURce:]RESistance:[TRANsient:]DUTY

This command sets the duty cycle of each of the transients when the generator is in CONTinuous mode.

Command Syntax	RESistance:DUTY <NR1> RES:TRAN:DUTY <NR1>
Parameters	Duty cycle value, 1 - 100
Unit	Percentage
Query Syntax	RESistance:DUTY? RESistance:DUTY? MIN RESistance:DUTY? MAX RESistance:TRANsient:DUTY? RESistance:TRANsient:DUTY? MIN RESistance:TRANsient:DUTY? MAX
Returned Parameters	<NR1> duty cycle in percentage

[SOURce:]RESistance:[TRANsient:]FREQuency

This command sets the frequency of the transients when the generator is in CONTinuous mode.

Command Syntax	RESistance: FREQuency <NRf+> RESistance:TRANsient:FREQuency <NRf+>
Parameters	Frequency value, refer to model specifications | MAX | MIN
Unit	Hertz
Query Syntax	RESistance:FREQuency? RESistance:FREQuency? MIN RESistance:FREQuency? MAX RESistance:TRANsient:FREQuency? RESistance:TRANsient:FREQuency? MIN RESistance:TRANsient:FREQuency? MAX
Returned Parameters	<NRf+> frequency value.

[SOURce:]RESistance:SLEW:BOTH

This command sets the slew time for all programmed changes in the input resistance level of the electronic load. This command programs both positive and negative going slew time. Although any slew time value may be entered, the electronic load selects a slew time that is closest to the programmed value. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time. Slew times less than the minimum value are set to MINimum. Slew times greater than the maximum value are set to MAXimum.

Command Syntax	RESistance:SLEW:BOTH <NRf+>
Parameters	Slew time value, refer to model specifications | MIN | MAX
Unit	ms

[SOURce:]RESistance:SLEW:NEGative

This command sets the slew time of the resistance for negative going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	RESistance:SLEW:NEGative <NRf+>
Parameters	slew time value, refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	RESistance:SLEW:NEG?
	RESistance:SLEW:NEG? MIN RES:SLEW:NEG? MAX
Returned Parameters	<NRf+>

[SOURce:]RESistance:SLEW:POSitive

This command sets the slew time of the resistance for positive going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	RESistance:SLEW <NRf+>
	RESistance:SLEW:POSitive <NRf+>
Parameters	Refer to model specifications | MIN | MAX
Unit	ms (milli-second)
Query Syntax	RESistance:SLEW?
	RESistance:SLEW? MIN RESistance:SLEW? MAX
	RESistance:SLEW:POSitive?
	RESistance:SLEW:POSitive? MIN
	RESistance:SLEW:POSitive? MAX
Returned Parameters	<NRf+>

[SOURce:]RESistance:TLEVel, RTR

Channel-Specific Resistance Command/Query. This command specifies the value of the programmed resistance level for the TRANsient input when the electronic load is in the CR Mode. When the Transient Subsystem is on, the electronic load input resistance will switch (under control of the Transient Subsystem) between the main level and TLEVel at a rate determined by the present value of SLEW.

In order for the input resistance level to switch, TLEVel must be set to a value greater than the main level. If TLEVel is set to a value below the main level, no error is generated but switching will not occur until the main level is subsequently below the value of TLEVel.

Command Syntax	RESistance:TLEVel <NRf+>
	RTR <NRf+>
Parameters	resistance transient level setting, refer to individual model specification | MIN | MAX
Query Syntax	RESistance:TLEVel?
	RESistance:TLEVel? MIN RESistance:TLEV? MAX
	RTR?
	RTR? MIN RTR? MAX
Returned Parameters	<NRf+> RES:TLEV? returns the transient resistance level.
	If the electronic load is not in CR Mode, the level will still be set, even if it is less than the presently programmed input level.

[SOURce:]RESistance:[TRANsient:]TWIDth

This command sets the pulse width of the transients when the generator is in PULSe mode.

Note: This command will also change the RES:FREQ value.

Command Syntax	RESistance:TRANsient:TWIDth <NRf+>
	RESistance:TWIDth <NRf+>

Parameters	pulse width value, refer to model's specification | MAX | MIN
Unit	ms
Query Syntax	RESistance:TRANsient:TWIDth? RESistance:TWIDth?
Returned Parameters	<NRf+>, pulse width value in ms

STATUS COMMANDS

These commands program the electronic load status registers. The electronic load has three groups of status registers; Questionable Status, Standard Event Status, and Operation Status.

Bit Configuration of Operation Status Registers

Bit Position	15	14	13	12	11	10	8	7	9,6~ 4	3	2 ~ 1	0
Bit Name	Not used	VPP	VNP	INF	UTP	INT	ACF	OP	Not used	WTG	Not used	CAL
Bit Weight	**0**	**16384**	**8192**	**4096**	**2048**	**1024**	**256**	**128**	**0**	**8**	**0**	**1**

CAL = Interface is computing new calibration constants
WTG = Interface is waiting for a trigger
INT = Interlocked – eLOAD Interlock function enabled and input is locked.
UTP = Warning Message - The eLOAD is operating continuously under low temperatures (below 15 degrees Celsius), which will cause condensation if persisted
INF = In-fault Protection – Power Stage failure condition (Critical Failure)
VNP = Voltage Negative Protection – Internal Negative Bias Voltages Failure (Critical Failure)
VPP = Voltage Positive Protection – Internal Positive Bias Voltages Failure (Critical Failure)
ACF = Communication Fail – Micro controller and Analog controller failure condition (Critical Failure)
OP = Warning Message – The eLOAD is operating over 105% of rated power, which may cause Over Temperature Protection (OTP) if persisted.

STATus:OPERation?

This query returns the value of the Operation Event register. The Event register is a read-only register that holds (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Operation Event register clears it. This command is not channel specific, it applies to the entire mainframe.

Query Syntax STATus:OPERation?
Parameters None
Returned Parameters <NR1> (register value)

STATus:OPERation:CONDition?

This query returns the value of the Operation Condition register. That is a read-only register that holds the real-time (unlatched) operational status of the electronic load. This command is not channel specific, it applies to the entire mainframe.

Query Syntax STATus:OPERation:CONDition?
Parameters None
Returned Parameters <NR1> (register value)

STATus:OPERation:ENABle

This command and its query set and read the value of the Operation Enable register. This register is a mask for enabling specific bits from the Operation Event register to set the operation summary bit (OPER) of the Status Byte register. The operation summary bit is the logical OR of all enabled Operation Event register bits. This command is not channel specific, it applies to the entire mainframe.

Command Syntax STATus:OPERation:ENABle <NR1>
Parameters 0 to 32767 | MIN | MAX
Default Value 0

Query Syntax STATus:OPERation:ENABle?
Returned Parameters <NR1> (register value)

STATus:OPERation:NTRansition
STATus:OPERation:PTRansition

These commands set or read the value of the Operation NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as polarity filters between the Operation Enable and Operation Event registers to cause the following actions. This command is not channel specific, it applies to the entire mainframe.

- **When a bit in the Operation NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.**
- **When a bit of the Operation PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.**
- **If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Condition register sets the corresponding bit in the Operation Event register.**
- **If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Operation Condition register can set the corresponding bit in the Operation Event register.**

NOTE : Setting a bit in the PTR or NTR filter can of itself generate positive or negative events in the corresponding Operation Event register.

Command Syntax STATus:OPERation:NTR <NR1>
STATus:OPERation:PTR <NR1>
Parameters 0 to 32767 | MIN | MAX
Default Value 0
Query Syntax STATus:OPERation:NTR?
STATus:OPERation:PTR?
Returned Parameters <NR1> (register value)

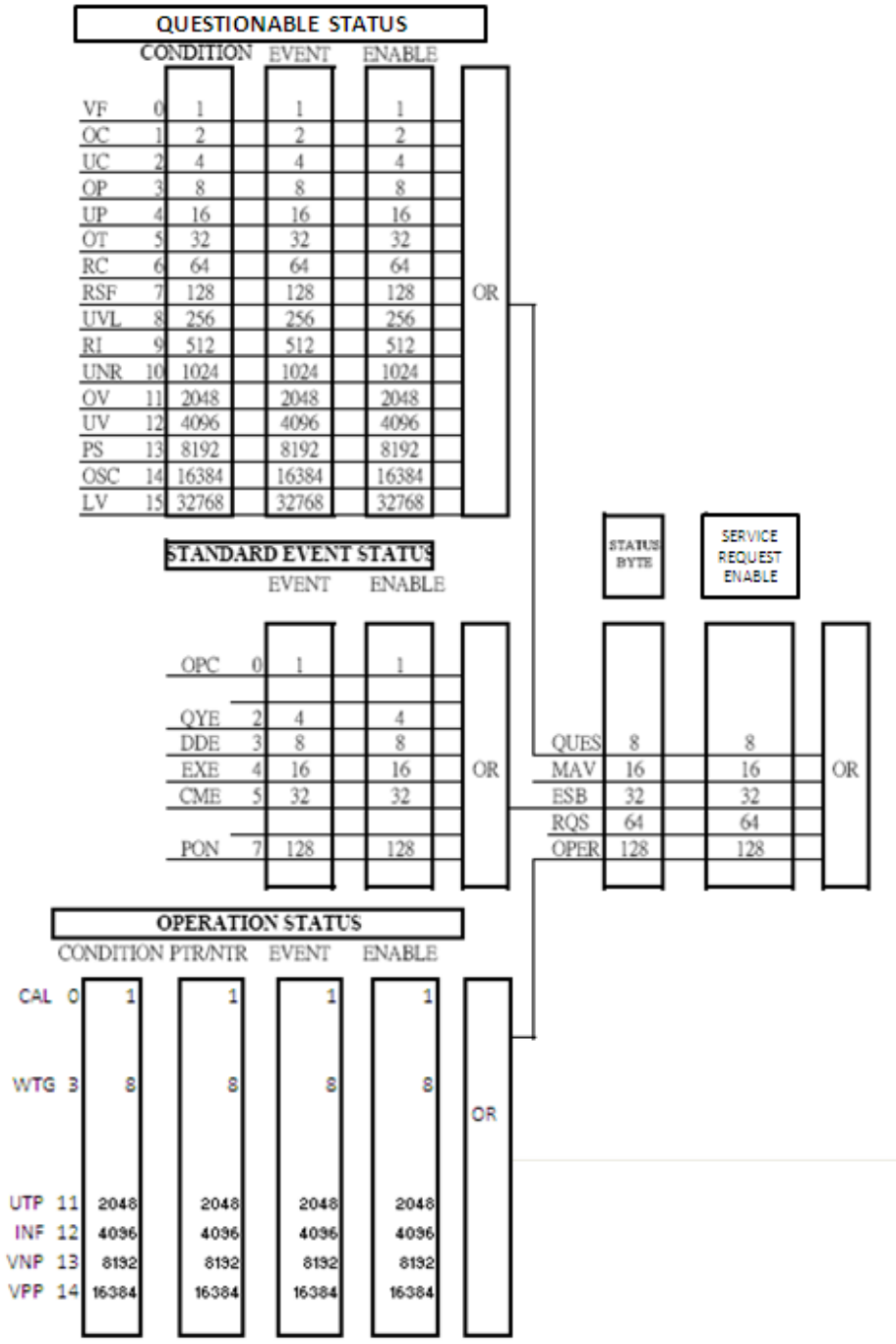
Bit Configuration of Questionable Status Registers

Bit Position	7	6	5	4	3	2	1	0
Bit Name	RSF	RC	OT	UP	OP	UC	OC	VF
Bit Weight	218	64	32	16	8	4	2	1
Bit Position	15	14	13	12	11	10	9	8
Bit Name	LVP	OSC	PS	UV	OV	UNR	RI	UVL
Bit Weight	32768	16384	8192	4096	2048	1024	512	256

VF Voltage fault has occurred
OC Over-current has occurred
UC Under-current has occurred
OP Over-power has occurred
UP Under-power has occurred
OT Over-temperature has occurred
RC Reverse-current has occurred
RSF Remote sense fault has occurred

UVL Under-voltage lock out has occurred
RI Remote Inhibition has occurred
UNR Input is unregulated
OV Over-voltage has occurred
UV Under-voltage has occurred
PS Protection shutdown circuit has tripped
OSC Oscillation protection has occurred
LV Low-voltage has occurred

Important Note: *Please refer to the eLOAD Operation Manual for Protection or Fault Condition Descriptions*



STATus:QUEStionable?

This query returns the value of the Questionable Event register. The Event register is a read-only register that holds (latches) all events that pass into it. Reading the Questionable Event register clears it. This command is not channel specific, it applies to the entire mainframe.

Query Syntax STATus:QUEStionable?
Parameters None
Returned Parameters <NR1> (register value)

STATus:QUEStionable:CONDition?

This query returns the value of the Questionable Condition register. That is a read-only register that holds the real-time (unlatched) questionable status of the electronic load. This command is not channel specific, it applies to the entire mainframe.

Query Syntax STATus:QUEStionable:CONDition?
Parameters None
Returned Parameters <NR1> (register value)

STATus:QUEStionable:ENABle

This command sets or reads the value of the Questionable Enable register. This register is a mask for enabling specific bits from the Questionable Event register to set the questionable summary (QUES) bit of the Status Byte register. This bit (bit 3) is the logical OR of all the Questionable Event register bits that are enabled by the Questionable Status Enable register. This command is not channel specific, it applies to the entire mainframe.

Command Syntax STATus:QUEStionable:ENABle <NRf+>
Parameters 0 to 32767 | MAXimum | MINimum
Default Value 0
Query Syntax STATus:QUEStionable:ENABle?
Returned Parameters <NR1> (register value)

SYSTEM COMMANDS

System commands control the system-level functions of the electronic load that are not directly related to input control or measurement functions.

SYSTem:CHANnel:VERSion?

This query returns the firmware version of analog control

Query Syntax SYSTem:CHANnel:VERSion?
Parameters None
Returned Parameters <CRD> MOVYYMMDD
YY = year
MM = month
DD = day

SYSTem:COMMand:SYNTax

This command sets or queries the syntax mode state

Command Syntax SYSTem:COMMand:SYNTax <NR1>
Parameters <NR1> Syntax Mode
0 = PEL Syntax Mode
1 = PLA/PLW Syntax Mode
Query Syntax SYSTem:COMMand:SYNTax?
Parameters None
Returned Parameters <NR1> integer value representing syntax mode state

SYSTem:CONSole:BAUD

This command sets or queries the value of baud rate for RS-232 interface.

Command Syntax SYSTem:CONSole:BAUD <NR1>
Parameters <NR1> baud rate. 9600, 19200, 38400 and 115200 are valid baud rate.
Query Syntax SYSTem:CONSole:BAUD?
Parameters None
Returned Parameters <NR1> baud rate value

Note: Default baud rate is set to 115200.

SYSTem:CONSole:EOS

This command sets or queries the value of the end-of-string (EOS) code for RS-232 interface.

Command Syntax SYSTem:CONSole:EOS <NR1>
Parameters <NR1> end-of-string(EOS) code
0 = NULL(no EOS)
1 = CR
2 = LF
3 = CR/LF
Query Syntax SYSTem:CONSol:EOS?
Parameters None

Returned Parameters <NR1> integer value representing EOS code

SYSTem:CROSs:MODe:STATe

This command sets or queries the cross mode state.

Command Syntax SYSTem:CROSs:MODe:STATe <NR1>
Parameters <NR1> cross mode state
0 = Input Off
1 = Input Remain
Query Syntax SYSTem:CROSs:MODe:STATe?
Parameters None
Returned Parameters <NR1> integer value representing cross mode state

SYSTem:CROSs:RANGe:STATe

This command sets or queries the cross range state.

Command Syntax SYSTem:CROSs:RANGe:STATe <NR1>
Parameters <NR1> cross range state
0 = Input Off
1 = Input Remain
Query Syntax SYSTem:CROSs:RANGe:STATe?
Parameters None
Returned Parameters <NR1> integer value representing cross range state

SYSTem:EOS

This command sets or queries the value of the end-of-string(EOS) code for all interface (RS-232 interface, GPIB interface and Ethernet interface).

Command Syntax SYSTem:EOS <NR1>
Parameters <NR1> end-of-string(EOS) code
0 = NULL(no EOS)
1 = CR
2 = LF
3 = CR/LF
Query Syntax SYSTem:EOS?
Parameters None
Returned Parameters <NR1> integer value representing EOS code

SYSTem:ERRor?

This query returns the next error message response string from the remote programming error queue. The queue is a FIFO (first-in, first-out) buffer that stores maximum 9 errors as they occur. As it is read, each error is removed from the queue. When all errors have been read, the query returns **"0,No error"**. Please refer to the following table for detailed error code, and error message.

Query Syntax SYSTem:ERRor?
Parameters None
Returned Parameters <CRD> Error code with actual error message

"SYSTem:ERRor?" returned code and error message table:

0	No error
-100	Command error[generic]
-101	Invalid character
-102	Syntax error[unrecognized command or data type]
-103	Invalid Separator
-104	Data type error[numeric or string expected]
-105	GET not allowed
-108	Parameter not allowed[too many parameters]
-109	Missing parameter[too few parameters]
-112	Program mnemonic too long[maximum 12 characters]
-113	Undefined header[operation not allowed]
-121	Invalid character in number[include '9' in octal data, etc]
-123	Numeric overflow[exponent too large]
-124	Too many digits[numbers too long]
-128	Numeric data not allowed
-131	Invalid suffix[unrecognized units]
-138	Suffix not allowed
-141	Invalid character data[bad character]
-148	Character data not allowed
-150	string data error
-151	Invalid string data
-158	String data not allowed
-161	Invalid block data
-168	Block data not allowed
-200	Execution error[generic]
-220	Parameter error
-221	Parameter error[invalid channel number]
-222	Data out of range
-223	Too many data
-230	Data buffer exhausted
-241	Hardware missing[device-specific]
-310	Device dependent syntax error
-311	Addressing not allowed in a line with multiple command
-312	Execution error [measurement sense]
-330	Self-test error
-350	Too many errors
-400	Query error[generic]
-410	Query Interrupted
-420	Query unterminated[incomplete programming message received]
-430	Query deadlocked
-440	Query unterminated[after indefinited response]
-500	command error during parallel operation
-510	try to send a command to a channel already in parallel group

SYSTem:EXTernal:CONTrol

This command sets or queries the syntax mode state

Command Syntax	SYSTem:EXTernal:CONTrol <NR1>
Parameters	<NR1> Toggles External Control State On/Off 0 = External Control Off 1 = External Control On
Query Syntax	SYSTem:EXTernal:CONTrol?
Parameters	None
Returned Parameters	<NR1> integer value representing external control state

SYSTem:GPIB:ADDRess

This command sets or queries the value of the GPIB address.

Note: The new GPIB address will only take effect after power cycle.

Command Syntax	SYSTem:GPIB:ADDRess <NR1>
Parameters	<NR1> GPIB address, 1 to 30
Query Syntax	SYSTem:GPIB:ADDRess?
Parameters	None
Returned Parameters	<NR1> integer value representing GPIB address

SYSTem:GPIB:EOS

This command sets or queries the value of the end-of-string (EOS) code for GPIB interface.

Command Syntax	SYSTem:GPIB:EOS <NR1>
Parameters	<NR1> end-of-string(EOS) code 0 = NULL(no EOS) 1 = CR 2 = LF 3 = CR/LF
Query Syntax	SYSTem:GPIB:EOS?
Parameters	None
Returned Parameters	<NR1> integer value representing EOS code

SYSTem:INPut:BOOT

The command sets and queries the state of input when syst boot/init.

Command Syntax	SYSTem:INPut:BOOT <NR1>
Parameters	<NR1> 0 = input is OFF 1 = input is ON
Query Syntax	SYSTem:INPue:BOOT?
Parameters	None
Returned Parameters	<NR1> integer value representing system boot state.

SYSTem:MODel

The command queries the model specification.

Query Syntax	SYSTem:MODel?
Parameters	None
Returned Parameters	<AARD> aaaW-bbbV-cccA-dddKOHM

aaa = maximum power
bbb = maximum voltage
ccc = maximum current
ddd = maximum resistance

Example 300W-60V-60A-10KOHM

SYSTem:NET:ADDRess

This command sets or queries the IP address.

Command Syntax SYSTem:NET:ADDRess <AARD>
Parameters <AARD> IP address, in decimal dot notation.
Query Syntax SYSTem:NET:ADDRress?
Parameters None
Returned Parameters <AARD> string representing IP address

SYSTem:NET:DHCP

This command queries the configuration state of the DHCP.

Query Syntax SYSTem:NET:DHCP?
Parameters None
Returned Parameters <NR1>
0 = config from setup
1 = config from DHCP

SYSTem:NET:EOS

This command sets or queries the value of the end-of-string (EOS) code for Ethernet interface.

Command Syntax SYSTem:NET:EOS <NR1>
Parameters <NR1> end-of-string(EOS) code
0 = NULL(no EOS)
1 = CR
2 = LF
3 = CR/LF
Query Syntax SYSTem:NET:EOS?
Parameters None
Returned Parameters <NR1> integer value representing EOS code

SYSTem:NET:GATeway

This command sets or queries the IP address of the gateway.

Command Syntax SYSTem:NET:GATeway <AARD>
Parameters <AARD> IP address in decimal dot notation.
Query Syntax SYSTem:NET:GATeway?
Parameters None
Returned Parameters <AARD> string representing Gateway IP address

SYSTem:NET:STATe

The command queries the net configuration state.

Query Syntax SYSTem:NET:STATe?
Parameters None

Returned Parameters <AARD>
Four fields: <serial> <dhcp> <ip address> <idn string>
<serial> serial number, same as SYST:SERial?
<dhcp> assigned flag of DHCP, same as SYST:NET:DHCP?
<ip address> IP address, same as SYST:NET:ADDR?
<idn string> identification string, same as *IDN?

SYSTem:NET:SUBNet

The command sets or queries the device subnet mask.

Command Syntax SYSTem:NET:SUBNet <AARD>
Parameters <AARD> decimal dot notation.
Query Syntax SYSTem:NET:SUBNet?
Returned Parameters <AARD> string representing subnet mask.

SYSTem:OSC:PROTect

This command sets or queries the eLOAD system bandwidth and Oscillation Protection Settings.

Command Syntax SYSTem:OSC:PROT <NR1>
Parameters <NR1> System OSC Settings
0 = Default
1 = OSC1
2 = OSC2
3 = OSC3
4 = DEFAULT + disabled
5 = OSC1 + disabled
6 = OSC2 + disabled
7 = OSC3 + disabled

Query Syntax SYSTem:OSC:PROT?
Parameters None
Returned Parameters <NR1> integer value representing EOS code

SYSTem:RANGe

This command queries the range number for all four operational modes.

Query Syntax SYSTem:RANGe?
Returned Parameters <AARD> nn1/nn2/nn3/nn4
nn1 = range number of constant voltage
nn2 = range number of constant current
nn3 = range number of constant resistance
nn4 = range number of constant power

SYSTem:SERial?

This command queries the serial number of the main control board.

Query Syntax SYSTem:SERial?
Parameters None
Returned Parameters <CRD> SN:000B87XXXXXX
SN:000B87 = Fixed string
XXXXXX = serial number of main control board

SYSTem:SHORT:STATus?

This command queries or enables the control of the eLOAD's SHORT function. Once enabled, the SHORT function can be activated/deactivated via the command INP:SHOR ON/OFF

Query Syntax SYSTem:SHORt:STATus?
Parameters <NR1> Toggle on/off
0 = OFF
1 = ON

Returned Parameters <NR1> integer value representing short status state

SYSTem:VERSion?

This query returns the firmware version. The value is in the form FVX.XX, where X.XX is the revision number.

Query Syntax SYSTem:VERSion?
Parameters None
Returned Parameters <CRD> string representing version number

SYSTem:INH:STATus?

This command queries or sets the control of the eLOAD's Remote Inhibit (RI) function. RI can be connecting to a switch or an open collector device that shorts the RI pin to common (EGND) whenever it is necessary to disable input of the unit. RI function is controlled via two modes –
1) Latch Mode: The eLOAD requires a protection clear signal (CLEAR key or SCPI Command), before the input can be activated again.
2) Live Mode: The eLOAD input is controlled via the RI port, Low (0Vdc) will shut off the input and High (5Vdc) will activate the input.

Query Syntax SYSTem:INH:STATus?
Parameters <NR1> RI Function Settings
0 = Latch
1 = Live

Returned Parameters <NR1> integer value representing short status state

TRANSIENT COMMANDS

These commands program the transient generator of the electronic load. The transient generator programs a second (transient) level at which the electronic load can operate without changing the original programmed settings.

See also [SOURce:]CURRent:TLEVel, [SOURce:]RESistance:TLEVel, and [SOURce:]VOLTage:TLEVel in the Input Commands section.

[SOURce:]TRANsient

This command turns the transient generator on or off.

Command Syntax TRANsient <bool>
Parameters 0 | 1 | OFF | ON
***RST Value** OFF
Query Syntax TRANsient?
Returned Parameters <NR3>

[SOURce:]TR:MODe
[SOURce:]TRANsient:MODe

This command selects the operating mode of the transient generator as follows.

TRIGger **The transient switch to trigger levels upon receipt of a trigger.**
CONTinuous **The transient generator puts out a continuous pulse stream.**
TOGGle **The transient generator toggles between two levels upon receipt of a trigger.**
PULSe **The transient generator puts out a single pulse upon receipt of a trigger.**

Command Syntax TR:MODe <NR1>
TRANsient:MODe <NR1>
Parameters <NR1> transient mode
0:TRIGger
1:CONTinuous
2:TOGGle
3:PULSe
4:STEP
5:AUTO
6:ONCE
Query Syntax TR:MODe?
TRANsient:MODe?
Returned Parameters <NR1> integer value representing transient mode

TRIGGER COMMANDS

Trigger commands controls the triggering of the electronic load. See also CURRent:TRIGgered, POWer:TRIGgered, RESistance:TRIGgered, and VOLTage:TRIGgered in the Input Commands section.

ABORt

This command applies only to trigger functions. It cancels all pending [:LEVel]:TRIG operations (such as CURR:TRIG) in all operating modes and on all channels. As a result, subsequent triggers have no effect on the input level. This command resets the WTG bit of the Operation Condition register and has the same effect on status as the receipt of a trigger. ABORt has no affect on the Transient Subsystem.

Command Syntax ABORt
Parameters None

TRIGger[:IMMediate]

When the trigger system has been initiated, this command generates a trigger signal regardless of the selected trigger source.

Command Syntax TRIGger
TRIGger:IMMediate
Parameters None

TRIGger:DELay

This command sets the time delay between the detection of a trigger signal and the start of any corresponding trigger action. After the time delay has elapsed, the trigger is implemented.

Command Syntax TRIG:DEL <NRf+>
Parameters 0 - 65535 | MIN | MAX
Unit ms
***RST Value** 0
Query Syntax TRIG:DEL?
Returned Parameters <NR3> integer representing trigger delay time

TRIGger:SOURce

This command selects the trigger source.

EXTernal **Selects the electronic load's trigger input as the trigger source. This trigger is processed as soon as it is received.**
BUS **Accepts a GPIB <GET> signal or a *TRG command as the trigger source. This selection guarantees that all previous commands are complete before the trigger occurs.**
ETHERNET **Selects the Ethernet's trigger input as the trigger source. This trigger is processed as soon as it is received.**
HOLD **Only the TRIG:IMM command will generate a trigger in HOLD mode. All other trigger commands are ignored.**

Command Syntax TRIGger:SOURce <CRD>
Parameters EXTernal | BUS | ETHernet | HOLD
Query Syntax TRIGger:SOURce?
Returned Parameters <CRD> A string representing trigger source.

UTILITY COMMANDS

UTILity:RANGe

This command selects and queries the range control mode.

Command Syntax UTILity:RANGe <bool>
Parameters <bool> range control mode.
0 : manual mode,
1 : auto mode,
Query Syntax UTILity:RANGe?
Returned Parameters <NR1> integer representing range control mode

UTILity:MEASure:SENSe

This command sets or queries the measurement sense (Local / Remote).

Note: When input voltage is greater than 30 V, this command will cause an execution error.

Command Syntax UTILity:MEASure:SENSe <bool>
Parameters 0 | 1 | LOCal(0) | REMote(1)
Query Syntax UTILity:MEASure:SENSe?
Returned Parameters <bool> 0=LOCal
1=REMote

UTILity:TR:MODE
UTILity:TRANsient:MODE

This command selects the operating mode of the transient generator as follows.

TRIGger **The transient switch to trigger levels upon receipt of a trigger.**
CONTinuous **The transient generator puts out a continuous pulse stream.**
TOGGle **The transient generator toggles between two levels upon receipt of a trigger.**
PULSe **The transient generator puts out a single pulse upon receipt of a trigger.**

Command Syntax TR:MODe <NR1>
TRANsient:MODe <NR1>
Parameters <NR1> transient mode
0:TRIGger
1:CONTinuous
2:TOGGle
3:PULSe
4:STEP
5:AUTO
6:ONCE
Query Syntax TR:MODe?
TRANsient:MODe?
Returned Parameters <NR1> integer value representing transient mode

VOLTAGE SUBSYSTEM

This subsystem programs the CV (constant-voltage mode) function of a single electronic load.

[SOURce:]VOLTage[:LEVel][:IMMediate], VSET
[SOURce:]VOLTage[:LEVel]:TRIGgered

Channel-Specific Voltage Command/Query. This is an implied keyword that specifies the value of the programmed voltage level and whether that level is to be applied immediately or on occurrence of a trigger. If the specified channel is in the CV (Constant-Voltage) Mode, an IMMediate voltage level is transferred to the input as soon as the command is executed. A TRIGgered level is stored and then transferred to the electronic load input when a trigger occurs. At that time, the change to the input level occurs at the slew time presently in effect. Following the trigger event, subsequent triggers will not affect the input level unless the electronic load has been sent another TRIGgered level command.

If the electronic load is not in the CV (Constant-ower) Mode when an IMMediate or TRIGgered level command is sent, the programmed levels are saved for the time the electronic load is placed in the CV mode. Triggered levels are processed by the Voltage Subsystem even when the electronic load is not in the CV Mode. In this case, the TRIGgered level becomes a stored IMMediate level that takes effect when the electronic load is again in the CV Mode.

Until they are explicitly programmed, triggered levels will assume their corresponding immediate levels. For example, if a electronic load is powered up and VOLT is programmed to 10, then VOLT:TRIG will also be 10 until you program it to another value. Once you program VOLT:TRIG to a value, it will remain at that regardless of how you subsequently reprogram VOLT. Then, when the trigger occurs, the VOLT is set to the VOLT:TRIG value.

Note : Setting an IMM voltage level to the same value as the most recent TRIG voltage level will not deactivate a pending TRIG level. You must use ABORt to deactivate it.

Specify the input voltage level for the VOLTage mode.

- **On a TRIG[:IMM] command (always)**
- **On receipt of an external trigger signal (if TRIG:SOUR is set to EXTernal)**
- **On receipt of a GPIB <GET> (if TRIG:SOUR is set to BUS)**
- **On receipt of an Ethernet trigger signal (if TRIG:SOUR is set to ETHernet)**
- **On receipt of *TRG (unless TRIG:SOUR is set to HOLD)**

Command Syntax	VOLTage <NRf+> VOLTage:TRIG <NRf+> VSET <NRf+>	
Parameters	Voltage level value, refer individual model specification | MIN | MAX	
Status and Errors	TRIGgered level commands affect the WTG bit in the Operation Condition register and the OPC bit of the Standard Event Status Event register.	
Query Syntax	VOLTage? VOLTage? MIN	VOLTage? MAX
	VOLTage:TRIGgered? VOLTage:TRIGgered? MIN	VOLTage:TRIGgered? MAX
	VSET? VSET? MIN	VSET? MAX
Returned Parameters	<NRf+> VOLT? and VOLT:TRIG?	

return the presently programmed voltage levels. After a trigger or ABORt, VOLTage:TRIG? returns the same value as VOLTage? .

VOLTage? MAX, VOLTage? MIN, VOLTage:TRIG? MAX and VOLTage:TRIG? MIN return the maximum and minimum programmable LEVel and TLEVel values.

[SOURce:]VOLTage:[TRANsient:]DUTY

This command sets the duty cycle of each of the transients when the generator is in CONTinuous mode.

Command Syntax VOLTage:DUTY <NR1>
VOLTage:TRANsient:DUTY <NR1>
Parameters Duty cycle value, 1 - 100
Unit Percentage
Query Syntax VOLTage:DUTY?
VOLTage:DUTY? MIN VOLTage:DUTY? MAX
VOLTage:TRANsient:DUTY?
VOLTage:TRANsient:DUTY? MIN
VOLTage:TRANsient:DUTY? MAX
Returned Parameters <NR1> an integer representing duty cycle value

[SOURce:]VOLTage:[TRANsient:]FREQuency

This command sets the frequency of the transients when the generator is in CONTinuous mode.

Command Syntax VOLTage:FREQuency <NRf+>
VOLTage:TRANsient:FREQuency <NRf+>
Parameters Frequency value, refer to model specifications | MIN | MAX
Unit Hertz
Query Syntax VOLTage:FREQuency?
VOLTage: FREQuency? MIN VOLTage:FREQuency? MAX
VOLTage:TRANsient:FREQuency?
VOLTage:TRANsient:FREQuency? MIN
VOLTage:TRANsient:FREQuency? MAX
Returned Parameters <NRf+> frequency value in Hz

[SOURce:]VOLTage:PROTection[:LEVel]
[SOURce:]VOLTage:PROTection:OVER[:LEVel]
[SOURce:]VOLTage:PROTection:DELay
[SOURce:]VOLTage:PROTection:OVER:DELay
[SOURce:]VOLTage:PROTection:UNDer:DELay
[SOURce:]VOLTage:PROTection:STATe
[SOURce:]VOLTage:PROTection:UNDer[:LEVel]
[SOURce:]VOLTage:PROTection:UNDer:STATe

Channel-Specific Voltage Limiting Command/Query. This command sets the over-voltage protection limit or the under-voltage protect limit to the input voltage that the electronic load will sink. When the input voltage reaches the protection limit for the specified delay period, the input of the electronic load is shut off and draws no voltage.

The INPut:PROTection:CLEar command (or front panel key) re-enables the input voltage. The trigger activated voltage functions (VOLTage[:LEV]:TRIG and VOLTage:TLEV) automatically keep track of

incoming triggers while the input is shut down and will respond to the trigger as soon as the protection fault is cleared.

The :PROTection:DELay command specifies the time that the input voltage may equal or exceed VOLTage:PROTection[:LEVel] or equal or fall below the VOLTage:PROTection:UNDer[:LEVel] before the soft circuit breaker is actuated. The PROTection:STATe command enables or disables the soft circuit breaker function.

Note : If the soft circuit breaker function causes the input to shut down, it will not affect INP[STATe]. If INP:STAT is programmed ON, it will remain so even after the VOLTage:PROT has turned the electronic load off.

Command Syntax

VOLTage:PROTection <NRf+>	Set immediate over-voltage protection limit.
VOLTage:PROTection:DELay <NRf+>	Set time that voltage may be at or above :LEVel before input is turned off.
VOLTage:PROTection:STATe OFF|0	Disable over protection function.
VOLTage:PROTection:STATe ON|1	Enable over protection function.
VOLTage:PROTection:UNDer <NRf+>	Set immediate under-voltage protection limit.
VOLTage:PROTection:UNDer:STATe OFF|0	Disable under protection function.
VOLTage:PROTection:UNDer:STATe ON|1	Enable under protection function.

Parameters Refer individual model specification | MIN | MAX

Query Syntax

VOLTage:PROTection?
VOLTage:PROTection? MIN VOLTage:PROTection? MAX
VOLTage:PROTection:OVER?
VOLTage:PROTection:OVER? MIN
VOLT:PROTection:OVER? MAX
VOLTage:PROTection:DELay?
VOLTage:PROTection:DELay? MIN
VOLTage:PROTection:DELay? MAX
VOLTage:PROTection:OVER:DELay?
VOLTage:PROTection:OVER:DELay? MIN
VOLTage:PROTection:OVER:DELay? MAX
VOLTage:PROTection:UNDer:DELay?
VOLTage:PROTection:UNDer:DELay? MIN
VOLTage:PROTection:UNDer:DELay? MAX
VOLTage:PROTection:STATe?
VOLTage:PROTection:UNDer?
VOLTage:PROTection:UNDer? MIN
VOLTage:PROTection:UNDer? MAX
VOLTage:PROTection:UNDer:STATe?

[SOURce:]VOLTage:SLEW:BOTH

This command sets the slew time for all programmed changes in the input voltage level of the electronic load. This command programs both positive and negative going slew time. Although any slew time value may be entered, the electronic load selects a slew time that is closest to the programmed value. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time. Slew times less than the minimum value are set to MINimum. Slew times greater than the maximum value are set to MAXimum.

Command Syntax VOLTage:SLEW:BOTH <NRf+>

Parameters	slew time, refer to model specifications | MIN | MAX
Unit	ms

[SOURce:]VOLTage:SLEW:NEGative

This command sets the slew time of the voltage for negative going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	VOLTage:SLEW:NEGative <NRf+>
Parameters	Refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	VOLTage:SLEW:NEGative? VOLTage:SLEW:NEGative? MIN VOLTage:SLEW:NEGative? MAX
Returned Parameters	<NRf+> slew time in ms

[SOURce:]VOLTage:SLEW[:POSitive]

This command sets the slew time of the voltage for positive going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	VOLTage:SLEW <NRf+> VOLTage:SLEW:POSitive <NR1>
Parameters	Slew time, refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	VOLTage:SLEW? VOLTage:SLEW? MIN VOLTage:SLEW? MAX VOLTage:SLEW:POSitive? VOLTage:SLEW:POSitive? MIN VOLGage:SLEW:POSitive? MAX
Returned Parameters	<NRf+> slew time in ms

[SOURce:]VOLTage:TLEVel, VTR

Channel-Specific Voltage Command/Query. This command specifies the value of the programmed voltage level for the TRANsient input when the electronic load is in the CV Mode. When the Transient Subsystem is on, the electronic load input voltage will switch (under control of the Transient Subsystem) between the main level and TLEVel at a rate determined by the present value of SLEW.

In order for the input voltage level to switch, TLEVel must be set to a value greater than the main level. If TLEVel is set to a value below the main level, no error is generated but switching will not occur until the main level is subsequently below the value of TLEVel.

Command Syntax	VOLTage:TLEVel <NRf+> VTR <NRf+>
Parameters	Voltage transient level value, refer individual model specification | MIN | MAX.
Query Syntax	VOLTage:TLEVel? VOLTage:TLEVel? MIN VOLTage:TLEVel? MAX VTR? VTR? MIN VTR? MAX
Returned Parameters	<NRf+> returns the transient voltage level. If the electronic load is not in CP Mode, the level will still be set, even if it is less than the presently programmed input level.

[SOURce:]VOLTage[:TRANsient]:TWIDth

This command sets the pulse width of the transients when the generator is in PULSe mode.

Command Syntax	VOLTage:TRANsient:TWIDth <NRf+> VOLTage:TWIDth <NRf+>
Parameters	pulse width value, refer to model's specification | MAX | MIN
Unit	ms
Query Syntax	VOLTage:TRANsient:TWIDth? VOLTage:TWIDth?
Returned Parameters	<NRf+> a integer representing pulse width value

Under Voltage Lockout Protection

The programmable under voltage lockout feature allows the user to set the trip point between zero and full-scale voltage. The input will remain off until the input voltage is greater than the pre-programmed value.

Continuous Mode

When the V-On is set to continuous mode, the UVL message will appear and the input current will be forced off each time the voltage drops below the set threshold voltage.

Input-On Mode

Under "input on" mode, the UVL will detect under voltage only once, and will reset each time the input is turned off. When the voltage is below the UVL threshold, the input current will be forced off and an "UVL" message will display.

By default, the V-On threshold is set to 1 V and the V-On feature can also prevent turn-on current spike from occurring. As a precaution, it is recommended to leave the V-On threshold at 1 V or higher.

Command:

Use " VOLT:VON <value> " to set value.

Use "VOLT:VON:STAT 0 | 1" to set VON mode. 0 - only work when input ON, 1 - continue

PROGRAMMING INTRODUCTION

POWER-ON INITIALIZATION

When the electronic load is first turned power on, it wakes up with the input state set OFF. The following commands are given implicitly at power-on:

***RST**
***CLS**
***SRE 0**
***ESE 0**

*RST is a convenient way to program all parameters to a known state, which is stored in profile location 0.

INPUT CURRENT

All models have a programmable current function. The command to program the current is:

CURRent <n>

where <n> is the input current in amperes.

Maximum Current

The maximum input current that can be programmed can be queried with:

CURRent? MAX

Overcurrent Protection

The electronic load can also be programmed to turn off its input if the current protection level is reached. This protection feature is implemented the following command:

CURRent:PROTection <NRf+>
CURRent:PROTection:STATe ON | OFF

Undercurrent Protection

The electronic load can also be programmed to turn off its input if its input current is lower than the under-current protection level. This protection feature is implemented the following command:

CURRent:PROTection:UNDer <NRf+>
CURRent:PROTection:UNDer:STATe ON | OFF

NOTE: Use CURRent:PROTection:DELay to prevent momentary current limit conditions caused by programmed input changes from tripping the overcurrent protection or undercurrent.

INPUT POWER

All models have a programmable power function. The command to program the current is:

POWer <n>

where <n> is the input power in watts.

Maximum Power

The maximum input power that can be programmed can be queried with:

POWer? MAX

Overpower Protection

The electronic load can also be programmed to turn off its input if the power protection level is reached. This protection feature is implemented the following command:

POWer:PROTection <NRf+>
POWer:PROTection:STATe ON | OFF

Underpower Protection

The electronic load can also be programmed to turn off its input if its input current is lower than the under-power protection level. This protection feature is implemented the following command:

POWer:PROTection:UNDer <NRf+>
POWer:PROTection:UNDer:STATe ON | OFF

INPUT RESISTANCE

The input resistance is controlled with the RESistance command. For example, to set the input resistance to 25 ohms, use:

RESistance 25

Maximum Resistance

The maximum input resistance that can be programmed can be queried with:

RESistance? MAX

INPUT VOLTAGE

The input voltage is controlled with the VOLTage command. For example, to set the input voltage to 25 volts, use:

VOLTage 25

Maximum Voltage

The maximum input voltage that can be programmed can be queried with:

VOLTage? MAX

Overvoltage Protection

The electronic load can also be programmed to turn off its input if the voltage protection level is reached. This protection feature is implemented the following command:

VOLTage:PROTection <NRf+>
VOLTage:PROTection:STATe ON | OFF

Undervoltage Protection

The electronic load can also be programmed to turn off its input if its input voltage is lower than the under-voltage protection level. This protection feature is implemented the following command:

VOLTage:PROTection:UNDer <NRf+>
VOLTage:PROTection:UNDer:STATe ON | OFF

PROGRAMMING TRANSIENTS

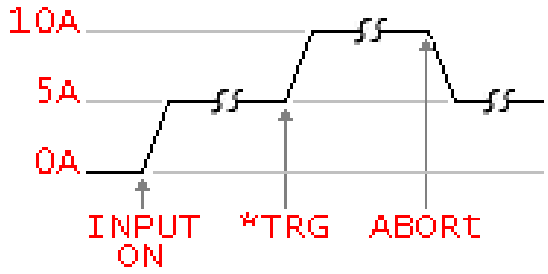
Transient operation is used to synchronize input changes with internal or external trigger signals, and simulate loading conditions with precise control of timing, duration, and slew. The following transient modes can be generated:

Trigger	**Changes to triggered level.**
Continuous	**Generates a repetitive pulse stream that toggles between two load levels.**
Pulse	**Generates an load change that returns to its original state after some time period.**
Toggle	**Generates a repetitive pulse stream that toggles between two load levels. Similar to Continuous mode except that the transient points are controlled by explicit triggers instead of an internal transient generator.**

NOTE : Before turning on transient operation, set the desired mode of operation as well as all of the parameters associated with transient operation. At *RST all transient functions are set to OFF.

TRIGGERED TRANSIENTS

To program voltage or current triggered levels, you must specify the voltage or current level that the input will go to once a trigger signal is received. Use the following commands to set a triggered level:



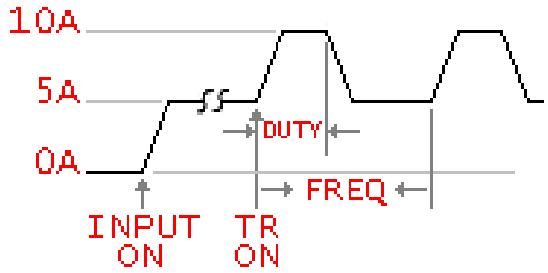

```
MODe:CURRent                    ; selects the CC mode
TRANsient:MODE TRIGgered        ; configures transient mode
CURRent 5                       ; immediate level
CURRent:TRIGgered 10            ; triggered level
TRANsient 1                     ; transient on
INPut ON
*TRG                            ; or TRIGger:IMMediate

(others statements)

ABORt
```

CONTINUOUS TRANSIENTS

In continuous operation, a repetitive pulse train switches between two load levels, a main level (which can be either the immediate or triggered level) and a transient level. The rate at which the level changes is determined by the slew time (see slew time descriptions for CC, CP, CR, or CV mode as applicable). In addition, the frequency and duty cycle of the continuous pulse train are programmable. Use the following commands to program continuous transients:



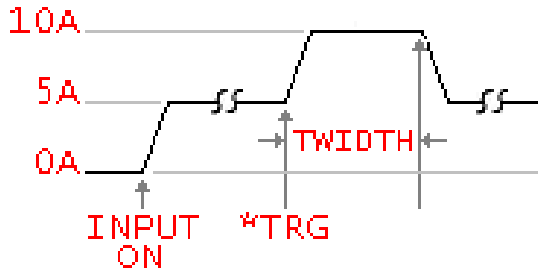

```
MODe:CURRent                            ; the CC mode is active
TRANsient:MODE CONTinuous               ;
CURRent 5
CURRent:TLEVel 10
CURRent:TRANsient:FREQuency 1000
CURRent:TRANsient:DUTy 40               ; remain at 10 amps for 40% of the period
INPut ON
TRANsient ON                            ; transient operation is turned on
```

PULSE TRANSIENTS

Pulsed transient operation generates a load change that returns to its original state after some time period. It is similar to continuous operation with the following exceptions:

a. To get a pulse, an explicit trigger is required. To specify the trigger source, use TRIGger:SOURce. See "Triggering Transients".

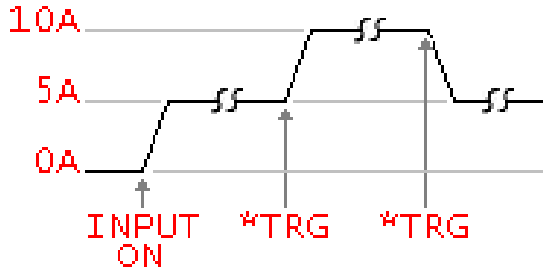
b. One pulse results from each trigger. Therefore, frequency cannot be programmed.




```
MODe:CURRent                    ; the CC mode is active
TRIGger:SOURce BUS              ; a trigger signal is connected to the GPIB's trigger
                                  input
TRANsient:MODE PULSe
CURRent 5
CURRent:TLEVel 10
CURRent:TRANsient:TWIDth .01    ; pulse width
INPut ON
TRANsient ON
*TRG
```

TOGGLED TRANSIENTS

Toggled transient operation causes the module input to alternate between two pre-defined levels as in continuous operation except that the transient transitions are controlled by explicit triggers instead of the internal transient generator. See "Triggering Transients". Use the following commands to program toggled transients:




```
MODE CURRent or MODe:CURRent
TRIGger:SOURce BUS
TRANsient:MODE TOGGle
CURRent 5
CURRent:TLEVel 10
INPut ON
TRANsient ON
```

PROGRAMMING STEPS

STEP mode lets you generate complex sequences of input changes with rapid, precise timing, which may be synchronized with internal or external signals. This is useful when running test sequences with a minimum amount of programming overhead.

You can program up to 256 settings (or points) in the STEP, the time interval (time) that each setting is maintained, the number of times that the STEP will be executed, and how the settings change in response to triggers. All STEP data is can be stored in nonvolatile memory when saved in profile locations 0 to 3 using the *SAV command. This means that the programmed data for any STEP will be retained when the electronic load is turned off. Use the *RCL command to recall the saved state. *RST clears the presently active STEP but will not clear the STEPs saved in profile locations 0 to 3.

STEP steps can be either individually triggered, or paced by a separate STEP of dwell times that define the duration of each step. Therefore, each of the up to 256 steps has an associated dwell time, which specifies the time (in milli-second) that the input remains at that step before moving on to the next step.

STATE ON

```
MODe:CURRent
STEP:CURRent[:LEVel] 1,15        ; Program the STEP of input values for each
                                   function. The STEP commands take a
                                   comma-separated STEP of arguments.
STEP:CURRent[:LEVel] 2,30
STEP:CURRent[:LEVel] 3,45
STEP:CURRent[:LEVel] 4,60
STEP:CURRent:TIMe 1,1000         ; Determine the time interval that the input remains
                                   at each level or point in the STEP before it advances
                                   to the next point. The time is specified in
                                   mill-seconds.
STEP:CURRent:TIMe 2,1500
STEP:CURRent:TIMe 3,2000
STEP:CURRent:TIMe 4,2500
STEP:COUNt 10                    ; Determine the number of times the STEP is
                                   repeated before it completes. Entering 0 or INFinity
                                   makes the STEP repeat indefinitely. At *RST, the
                                   count is set to 1.
INPut ON
STEP:CURRent:STATe ON            ; the entire STEP to be executed immediately, paced
                                   by its dwell delays. As each dwell delay elapses, the
                                   next point is immediately executed.

(other statements)

STEP:CURRent:STATe OFF           ; Stop the STEP sequencing.
```

STATE AUTO

```
MODe:CURRent
STEP:CURRent[:LEVel] 1,15        ; Program the STEP of input values for each
                                 function. The STEP commands take a
                                 comma-separated STEP of arguments.
STEP:CURRent[:LEVel] 2,30
STEP:CURRent[:LEVel] 3,45
STEP:CURRent[:LEVel] 4,60
STEP:CURRent:TIMe 1,1000         ; Determine the time interval that the input remains
                                 at each level or point in the STEP before it advances
                                 to the next point. The time is specified in
                                 mill-seconds.
STEP:CURRent:TIMe 2,1500
STEP:CURRent:TIMe 3,2000
STEP:CURRent:TIMe 4,2500
STEP:COUNt 10                    ; Determine the number of times the STEP is
                                 repeated before it completes. Entering 0 or INFinity
                                 makes the STEP repeat indefinitely. At *RST, the
                                 count is set to 1.
TRIGger:SOURce BUS
INPut ON
STEP:CURRent:STATe AUTO          ; the STEP to advance only one point after each
                                 trigger. Triggers that arrive during a dwell delay are
                                 ignored
*TRG

(other statements)

STEP:CURRent:STATe OFF           ; Stop the STEP sequencing.
```

STATE ONCE

```
MODe:CURRent
STEP:CURRent[:LEVel] 1,15        ; Program the STEP of input values for each
                                 function. The STEP commands take a
                                 comma-separated STEP of arguments.
STEP:CURRent[:LEVel] 2,30
STEP:CURRent[:LEVel] 3,45
STEP:CURRent[:LEVel] 4,60
STEP:CURRent:TIMe 1,1000         ; Determine the time interval that the input remains
                                 at each level or point in the STEP before it advances
                                 to the next point. The time is specified in
                                 mill-seconds.
STEP:CURRent:TIMe 2,1500
STEP:CURRent:TIMe 3,2000
STEP:CURRent:TIMe 4,2500
STEP:COUNt 10                    ; Determine the number of times the STEP is
                                 repeated before it completes. Entering 0 or INFinity
                                 makes the STEP repeat indefinitely. At *RST, the
                                 count is set to 1.
TRIGger:SOURce BUS
```

```
INPut ON
STEP:CURRent:STATe ONCE        ; the entire STEP to be executed sequentially after
                               the starting trigger, paced by its dwell delays. As
                               each dwell delay elapses, the next point is
                               immediately executed.
*TRG
*TRG

  (other statements)

STEP:CURRent:STATe OFF         ; Stop the STEP sequencing.
```

MAKING MEASUREMENTS

The electronic load has the ability to make several types of voltage or current measurements. The measurement capabilities of the electronic load are particularly useful with applications that draw current in pulses.

All measurements are performed by digitizing the instantaneous input voltage or current for a defined number of samples and sample interval, storing the results in a buffer, and then calculating the measured result. Many parameters of the measurement are programmable. These include the number of samples, the time interval between samples, and the method of triggering. Note that there is a tradeoff between these parameters and the speed, accuracy, and stability of the measurement in the presence of noise.

Use the MEASure commands to immediately start acquiring new voltage or current data, and return measurement calculations from this data as soon as the buffer is full. This is the easiest way to make measurements, since it requires no explicit trigger programming.

VOLTAGE AND CURRENT MEASUREMENTS

The SCPI language provides a number of MEASure queries, which return various measurement parameters of voltage and current waveforms.

DC Measurements

To measure the dc input voltage or current, use:

MEASure:VOLTage? or
MEASure:CURRent?

SIMPLICITY COMMANDS

The section introduces some simplicity commands that depend on current operating mode.

DUTY <NR1>
TRAN:DUTY <NR1>

This command sets the duty cycle of each of the transients when the generator is in CONTinuous mode.

Command Syntax DUTY <NR1>
TRAN:DUTY <NR1>
Parameters <NR1> duty cycle value, 1 – 100.
Unit Percentage
Query Syntax DUTY?
DUTY? MIN DUTY? MAX
TRAN:DUTY?
TRAN:DUTY? MIN TRAN:DUTY? MAX
Returned Parameters <NR1> an integer value representing duty cycle value

FREQ <NRf>
TRAN:FREQ <NRf>

This command sets the frequency of the transients when the generator is in CONTinuous mode.

Command Syntax FREQ <NRf+>
TRAN:FREQ <NRf+>
Parameters <NRf+> frequency value, refer to model specifications | MIN | MAX
Unit Hertz
Query Syntax FREQ?
FREQ? MIN FREQ? MAX
TRAN:FREQ?
TRAN:FREQ? MIN TRAN:FREQ? MAX
Returned Parameters <NRf+>

MLEV <NRf+>
MLEV:TRIG <NRf+>

This is an implied keyword that specifies the programmed level and whether that level is to be applied immediately or on occurrence of a trigger.

Command Syntax MLEV <NRf+>
MLEV:TRIG <NRf+>
Parameters <NRf+> main level value, refer individual model specification | MIN | MAX
Query Syntax MLEV?
MLEV? MIN MLEV? MAX
MLEV:TRIG?
MLEV:TRIG? MIN MLEV:TRIG? MAX
Returned Parameters <NRf+> main level value

SLEW[:POS] <NRf+>

This command sets the slew time for positive going transitions. MINimum sets the slew to the fastest

possible time. MAXimum sets the slew to the slowest time.

Command Syntax	SLEW <NRf+> SLEW:POS <NR1>
Parameters	slew time, refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	SLEW? SLEW? MIN SLEW? MAX SLEW:POS? SLEW:POS? MIN SLEW:POS? MAX
Returned Parameters	<NRf+>

SLEW:BOTH <NRf+>

This command sets the slew time for all programmed changes. This command programs both positive and negative going slew time.

Command Syntax	SLEW:BOTH <NRf+>
Parameters	Refer to model specifications | MIN | MAX
Unit	ms

SLEW:NEG <NRf+>

This command sets the slew time for negative going transitions. MINimum sets the slew to the fastest possible time. MAXimum sets the slew to the slowest time.

Command Syntax	SLEW:NEG <NRf+>
Parameters	Refer to model specifications | MIN | MAX
Unit	ms
Query Syntax	SLEW:NEG? SLEW:NEG? MIN SLEW:NEG? MAX
Returned Parameters	<NRf+>

TLEV <NRf+>

This command specifies the value for the TRANsient input.

Command Syntax	TLEV <NRf+>
Parameters	Refer individual model specification | MIN | MAX.
Query Syntax	TLEV? TLEV? MIN TLEV? MAX
Returned Parameters	<NRf+> returns the transient level.

TRAN:TWID <NRf+>

This command sets the pulse width of the transients when the generator is in PULSe mode.

Command Syntax	TRAN:TWID <NRf+>
Parameters	Refer to model's specification | MAX | MIN
Unit	ms
Query Syntax	TRAN:TWID?
Returned Parameters	**<NRf+> pulse width value in ms**

CALIBRATION EXAMPLES

VOLTAGE CALIBRATION

CALibrate:MEASure:HIGH 32000
CALibrate:MEASure:LOW 6400
CALibrate:TRANsient:OFFSet 6400
CALibrate:STATe ON
CALibrate:MODe 0
CALibrate:POINt 0
CALibrate:VALue:VOLTage xx.xxx
CALibrate:POINt 1
CALibrate:VALue:VOLTage xx.xxx
CALibrate:SAVe
CALibrate:STATe OFF

RESISTANCE CALIBRATION

CALibrate:MEASure:HIGH 32000
CALibrate:MEASure:LOW 6400
CALibrate:TRANsient:OFFSet 6400
CALibrate:STATe ON
CALibrate:MODe 8
CALibrate:POINt 0
CALibrate:VALue:VOLTage xx.xxx
CALibrate:VALue:CURRent xx.xxx
CALibrate:POINt 1
CALibrate:VALue:VOLTage xx.xxx
CALibrate:VALue:CURRent xx.xxx
CALibrate:SAVe
CALibrate:STATe OFF

Note: A *SAV command is required to store all newly calibrated slope and offset data to internal back-up flash memory.