



**Sorensen**

**SLH Series DC High  
Power Electronic Load**

**Operating Manual**



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# Important Safety Instructions

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

	<p><b>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.</b></p>
	<p><b>The equipment used contains ESD sensitive ports. When installing equipment, follow ESD Safety Procedures. Electrostatic discharges might cause damage to the equipment.</b></p>

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.

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## SAFETY SYMBOLS

	<p><b>WARNING</b> Risk of Electrical Shock</p>		<p><b>CAUTION</b> Refer to Accompanying Documents</p>
	<p>Off (Supply)</p>		<p>Direct Current (DC)</p>
	<p>Standby (Supply)</p>		<p>Alternating Current (AC)</p>
	<p>On (Supply)</p>		<p>Three-Phase Alternating Current</p>
	<p>Protective Conductor Terminal</p>		<p>Earth (Ground) Terminal</p>
	<p>Fuse</p>		<p>Chassis Ground</p>

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## Product Family: SLH Series DC High Power Electronic Load

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:

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- 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.

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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](http://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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## ABOUT THIS MANUAL

This manual has been written expressly for the Sorensen brand SL series of electronic loads, which have been designed and certified to meet the Low Voltage and Electromagnetic Compatibility Directive Requirements of the European Community.

Since the goal of the Low Voltage Directive is to ensure the safety of the equipment operator, universal graphic symbols have been used both on the unit itself and in this manual to warn the operator of potentially hazardous situations (see Safety Notice, this manual).



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# SECTION 1 INTRODUCTION

## 1.1 GENERAL DESCRIPTION

### 1.1.1 Power Contours

The SLH-Series High Power DC Electronic Load is designed to test, evaluate and burn in DC power supplies and batteries. The power contour of the six models are shown in Figure 1-1 through Figure 1-6. The Sorensen SLH-Series High Power DC Electronic Load can be controlled locally at the front panel or remotely via computer over the GPIB.

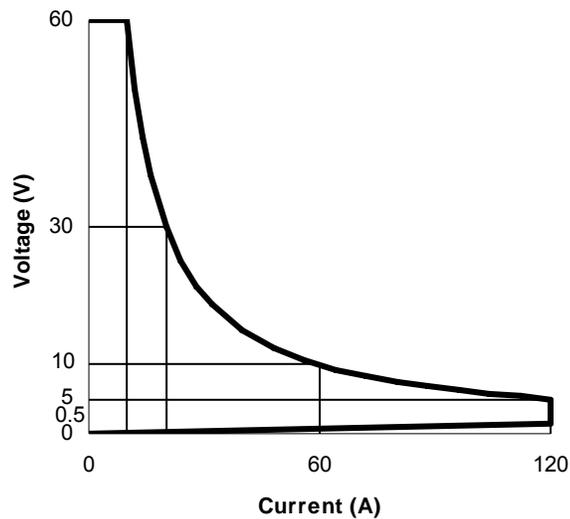


Figure 1-1 SLH-60-120-600 Power Contour

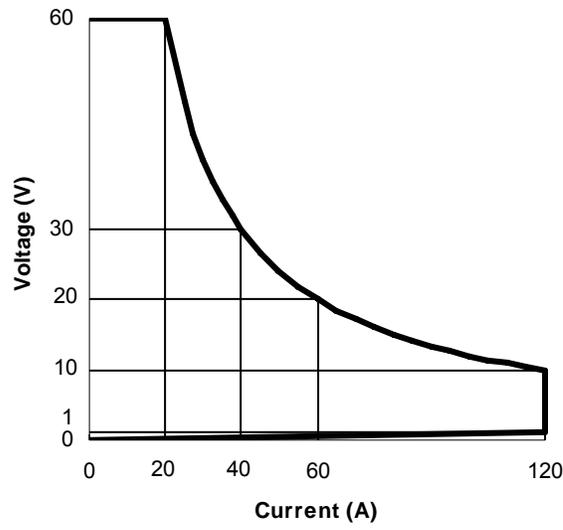


Figure 1-2 SLH-60-120-1200 Power Contour

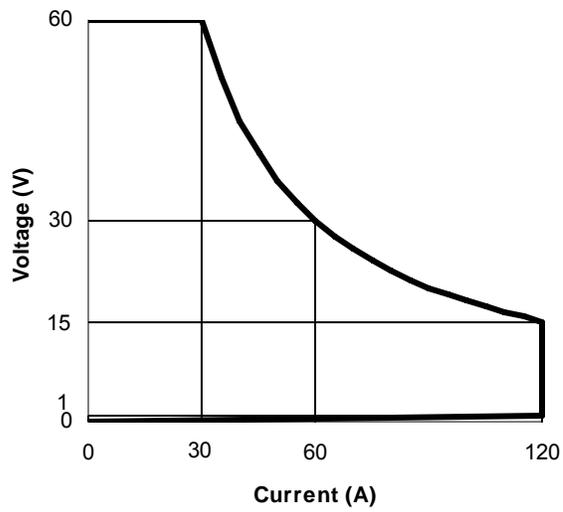


Figure 1-3 SLH-60-120-1800 Power Contour

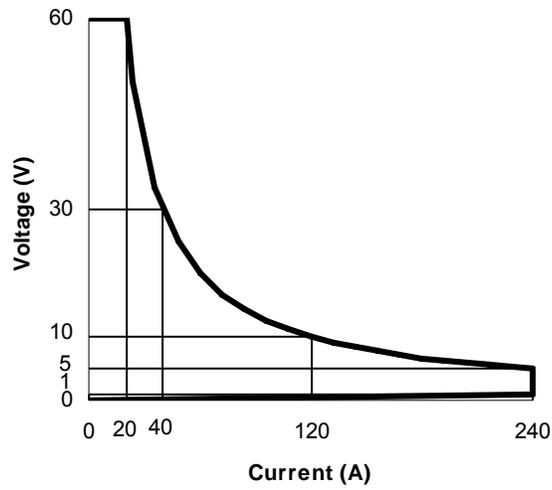


Figure 1-4 SLH-60-240-1200 Power Contour

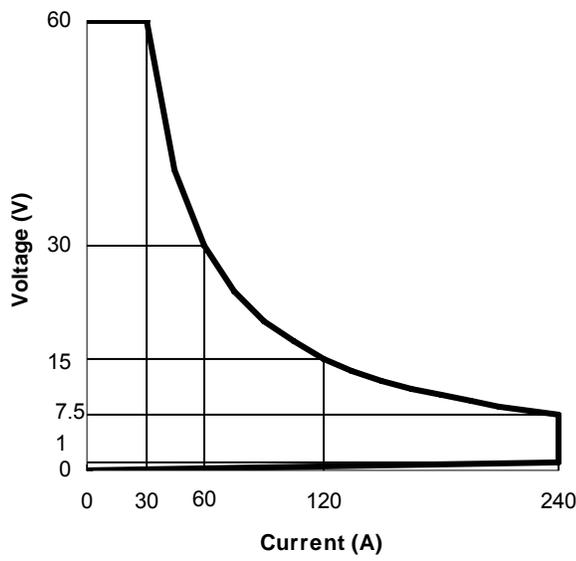


Figure 1-5 SLH-60-240-1800 Power Contour

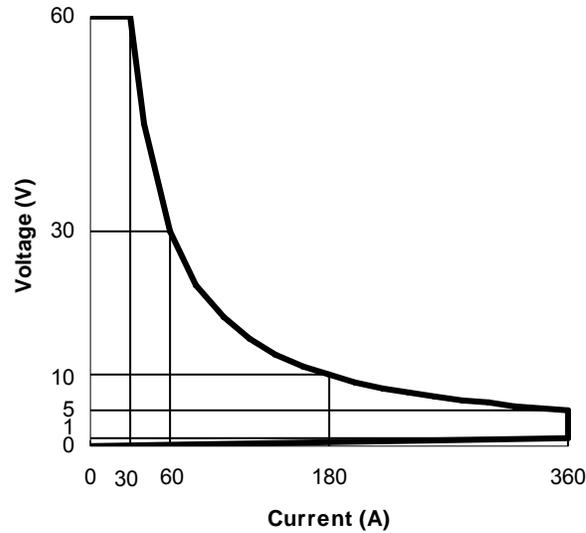


Figure 1-6 SLH-60-360-1800 Power Contour

### 1.1.2 Operating Modes

The operating modes of SLH-series Electronic Load include: Constant Current (CC) mode, Constant Resistance (CR) mode, and Constant Voltage (CV) mode. The wide-range dynamic load with independent rise/fall current slew rate and analog programming input with arbitrary waveform input, is available in Constant Current mode.

#### CC Mode:

In Constant Current mode, the load will sink a current in accordance with the programmed current setting regardless of the input voltage (see Figure 1-7).

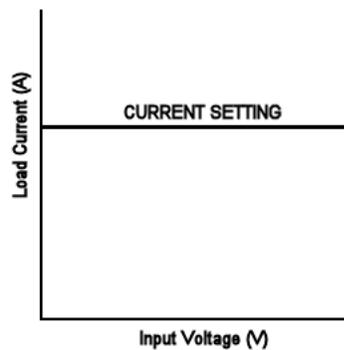


Figure 1-7 Constant Current (CC) Mode

**CR Mode:**

In Constant Resistance mode, the load will sink a current linearly proportional to the load input voltage in accordance with the programmed resistance setting (see Figure 1-8).

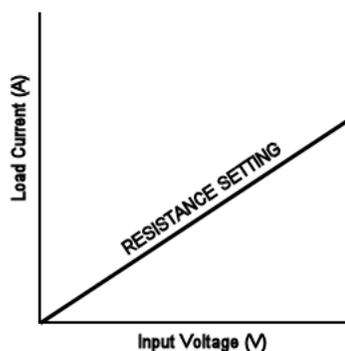


Figure 1-8 Constant Resistance (CR) Mode

**CV Mode:**

In Constant Voltage mode, the load will attempt to sink enough current until the load input voltage is equal to the programmed voltage setting (see Figure 1-9).

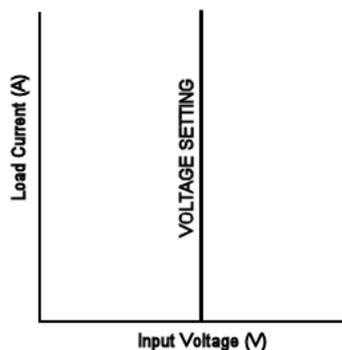


Figure 1-9 Constant Voltage (CV) Mode

**Dynamic Waveform Definition**

There are six parameters to generate dynamic wave form or pulse wave form: High/Low load levels, Rise/Fall slew rates, and THIGH/TLOW durations. The SLH-series Electronic Load will sink current from the power source proportional to the dynamic waveform. The dynamic waveform definition is shown in Figure 1-10. The period of dynamic wave form is, dynamic frequency =  $1 / (T_{HIGH} + T_{LOW})$ , the Duty cycle =  $T_{HIGH} / (T_{HIGH} + T_{LOW})$

The formula to define the period of dynamic waveform ( $T_{HIGH} + T_{LOW}$ ) is:

$$\text{Dynamic frequency} = 1 / (\text{THIGH} + \text{TLOW})$$

$$\text{Duty cycle} = \text{THIGH} / (\text{THIGH} + \text{TLOW})$$

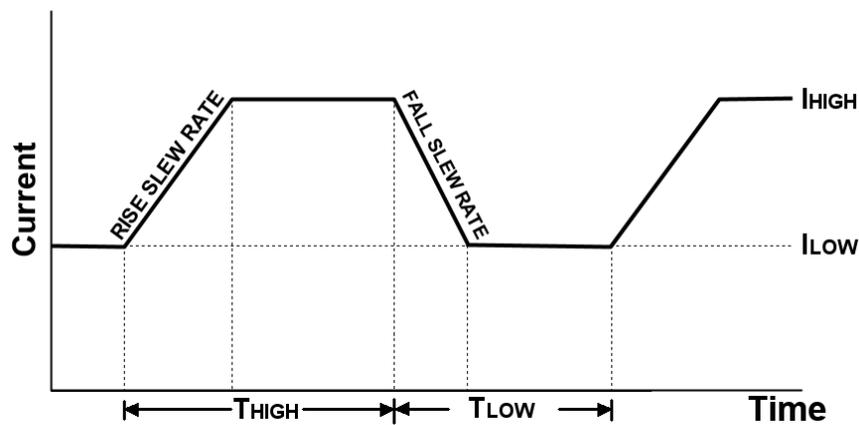


Figure 1-10 Dynamic Waveform

The load current level and load status can be set by either of two ways: manually, through the front panel, or with GPIB command. The load input voltage and load current can be read back to the computer through GPIB. (GPIB operation is described in Section 4).

## 1.2 FEATURES

- Full GPIB control of Load condition setting and meter read back
- Dual high accuracy & resolution 4-1/2 digit voltage and current meter
- Built-in pulse generator includes wide THIGH/TLOW dynamic load range, independent Rise/Fall load current slew rate control, and High/Low Load Level
- Controllable load current Slew Rate of load Level change, load ON/OFF switch change, and power supply turn-on
- Short circuit test and current measure capability, low short resistance and reliable short circuitry is implemented by turn ON Power MOSFET and heavy duty relay
- Automatic voltage sense capability
- Full protection from over power, over temperature, over voltage, and reverse polarity
- Analog programming input capability at rear panel
- Isolated I-monitor BNC output, 10V full scale

## 1.3 ACCESSORIES

- |   |       |
|---|-------|
| • V-sense cable: BNC-CLIP (1M)                              | 1 ea. |
| • Binding Post Plug (Black)                                 | 1 ea. |
| • Binding Post Plug (Red)                                   | 1 ea. |
| • Hook terminal   | 2 ea. |
| • SLH-Series High Power DC Electronic Load operation manual | 1 ea. |
| • Screws, M8x25   | 2 ea. |

## 1.4 SPECIFICATIONS

The next two tables provide specifications for the SLH DC High Power Electronic Load:

AC INPUT	LINE	100V/115V±10%	200V/230V±10%
	FREQUENCY	50/60 HZ	
	FUSE	2A/250V (5x20mm)	1A/250V (5x20mm)
	MAX. POWER CONSUMPTION	100 W	
DIMENSIONS (W*H*D)		17.3x7.0x17.5 in. (440 x177 x445 mm)	
WEIGHT		NET : 51.9 lbs. (23.6 kg)	

**Table 1-1 AC Line Input**

The following specifications apply 25°C ± 5°C:

Model	SLH-60-120-600	SLH-60-120-1200	SLH-60-120-1800	SLH-60-240-1200	SLH-60-240-1800	SLH-60-360-1800
<b>INPUT RATINGS</b>						
VOLTAGE	60 V					
CURRENT	120 A			240 A		360 A
POWER	600	1200	1800	1200	1800	1800
<b>CC MODE</b>						
Range	0-12 / 0-120 A			0-24 / 0-240 A		0 - 36/360 A
Resolution	3/30 mA			6/60 mA		9/90 mA
Accuracy	±0.2% OF (SETTING + RANGE)					
<b>CR MODE (1)</b>						
Range 1 (I>0.05% of rating)	0.5 - 2000Ω			0.25 - 1,000Ω		0.167 - 667Ω
Range 2 (I>0.5% of rating)	0.025 - 0.5 Ω			0.0125 - 0.25Ω		8.3 - 167 mΩ
<b>CV MODE</b>						
Range	2 - 60V					
Resolution	0.015V					
Accuracy	±0.1% OF (SETTING + RANGE)					
<b>CP Mode</b>						
Range	0-600W	0-1200W	0-1800W	0-1200W	0-1800W	0-1800W
Resolution	0.16W	0.32W	0.48W	0.32W	0.48W	0.48W
Accuracy	±0.5% OF (SETTING + RANGE)					
<b>SHORT MODE</b>						
Max. Resistance	4mΩ			0.02Ω		0.01Ω
Current	120 A			240 A		360 A
<b>DYNAMIC MODE</b>						
Thigh/Tlow	50uS to 9.999 Sec					
Slew Rate Low	2mA - 500mA/uS			4mA - 1A/uS		6mA - 1.5A/uS
Slew Rate High	20mA - 5A/uS			40mA - 10A/uS		60mA - 15A/uS
Accuracy	±10% OF SETTING + 10μs					
<b>4 1/2 DVM</b>						
Range	0 - 20.00/60.00V					
Resolution	0.001/0.01V					
Accuracy	±0.05% OF (READING + RANGE)					
<b>4 1/2 DAM</b>						
Range	0 - 120 A			0 - 200/240 A		0 - 200/360 A
Resolution	0.01A			0.01/0.1A		0.01/0.1A
Accuracy	±0.5% OF (READING + RANGE)					
<b>Imonitor</b>						
	12 A/V			24 A/V		36 A/V
<b>PROTECTION</b>						
OPP	~630 W	~1260 W	~1890 W	~1260 W	~1890 W	~1890 W
OCP	~126 A			~252 A		~378 A
OVP	~ 63 V					
OTP	C85					
<b>Load ON Volt.</b>						
Range	0.1 - 25V					
Resolution	0.1V					
Accuracy	1% of Setting + 0.25V					
<b>Load OFF Volt.</b>						
Range	0 - 25V					
Resolution	0.002V					
Accuracy	0.05% of Setting + 0.0125V					
<b>ENVIRONMENTAL</b>						
Operating Temp.	0-40 °C					

Table 1-2. SLH-Series Specifications

## 1.5 REGULATORY COMPLIANCE

- Certified to UL 61010-1, CSA C22.2 No. 61010.1 and IEC/EN 61010-1
- CE Compliant:
  - Low Voltage Directive (73/23/EEC) using EN 61010-1, and
  - EMC Directive (89/336/EEC) using EN 61326
- FCC Compliant to 21 CFR, Subpart J.

## 1.6 BLOCK DIAGRAM

The functional block diagram of SLH-series DC electronic Load module is illustrated in Figure 1-11. Please refer to the SLH Mainframe Operation Manual for the functional Block diagram of the mainframe.

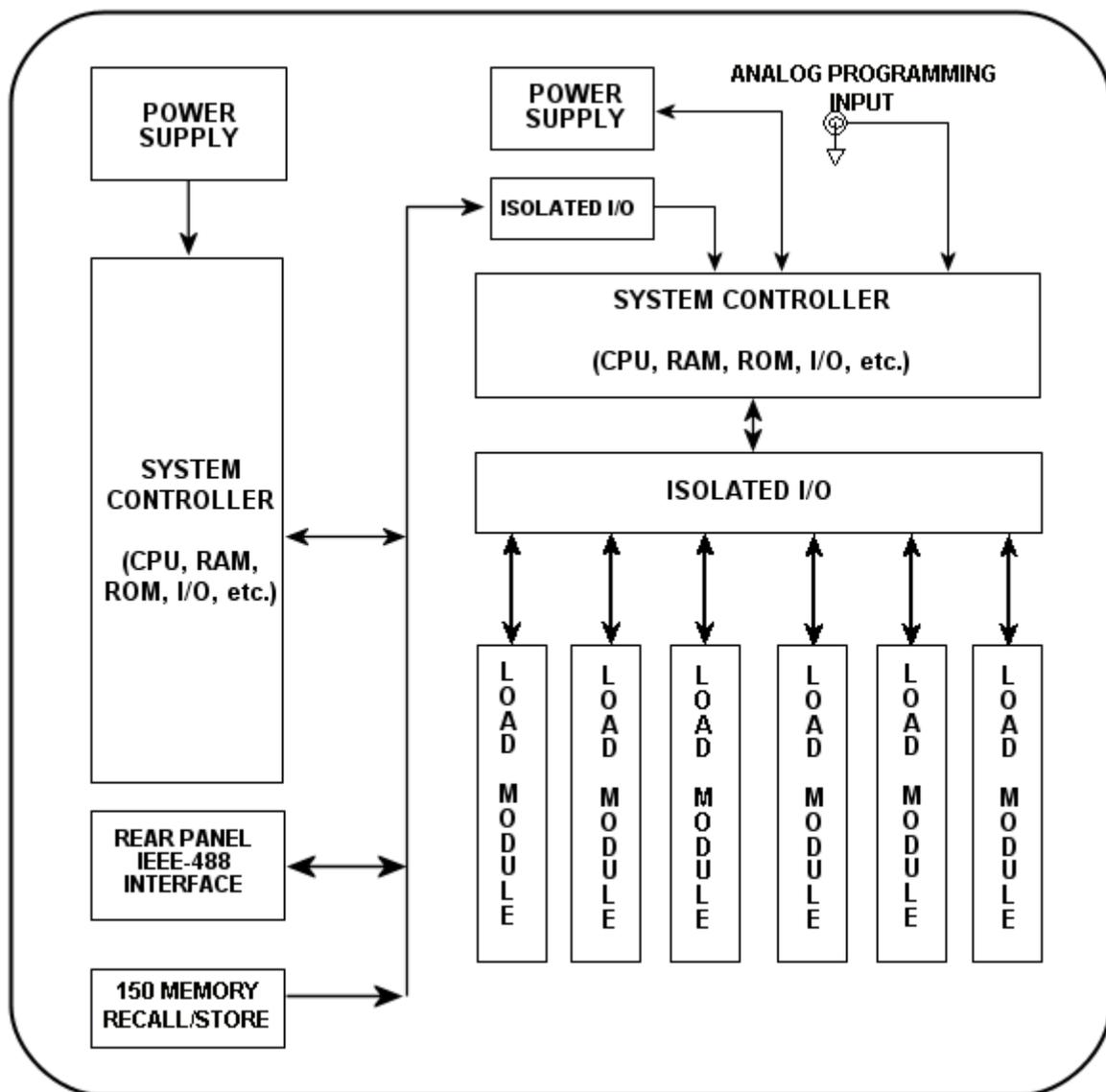


Figure 1-11 Block Diagram of SLH-Series Electronic Load

- The front panel of the SLH-Series provides the load current level and the load status.
- The following three pairs of parameters constitute the wide range pulse generator, and can be used to test the power supply (Device Under Test - DUT):
  - Two 12-bit D/A converters receive digital data of load current, and transfer as an analog signal.
  - Two 8-bit D/A converters control the load current slew rate.
  - Two 16-bit trimmers set the THIGH and TLOW durations
- The Constant Current ( CC ), Constant Resistance ( CR ), and Constant Voltage ( CV ) control circuitry. Range circuitry is selected by existing operating mode and range.
- The drive circuit controls the load current flow through power MOSFET, proportional to the analog control signal. The Short ON/OFF signal through short drive circuit turns the Power MOSFET fully ON.
- The current sense Amplifier feeds the load current signal including the short circuit current signal, to the digital meter (DM) and isolated amplifier to Imonitor BNC output.
- The voltage Auto-sensing circuit selects the Load input terminal or Vsense BNC input depending on whether the Vsense cable is connected or not. The Auto-ranged, high accuracy 4 1/2 digit (five-character) voltage meter indicates the input voltage.
- The 4 1/2-digit (five-character) voltage meter and 4 1/2-digit (five-character) current meter digital bus is connected to CPU circuitry.

## SECTION 2

# INSTALLATION AND MAINTENANCE

### 2.1 INSPECTION

The SLH-series high power load was carefully inspected before shipment. If instrument damage has occurred during transport, please inform the Xantrex sales and service office or representative (see Warranty).

Your SLH-series high power load was shipped with a power cord for the type of outlet used at your location. If the appropriate cord was not included, please contact your nearest Xantrex sales office to obtain the correct cord. Refer to "check line voltage" for voltage selection and fuse type.

#### 2.1.1 Check Line Voltage

The SLH-series high power load can operate with 115, 230VAC input as indicated on the rear panel label. Make sure that the factory check mark corresponds to your nominal line voltage. If not correctly marked, perform the following procedures:

1. With the load power OFF, disconnect the power cord.
2. Refer to the drawing of the SLH-series load rear in Figure 2-1; set the switches to the proper voltage as described in the following steps:

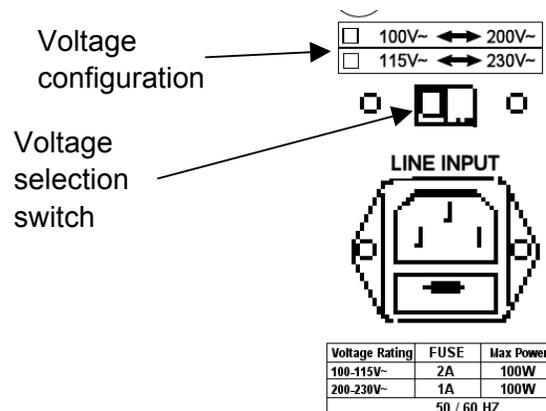
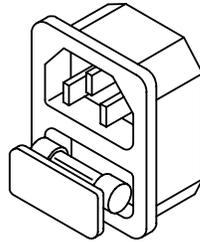


Figure 2-1 Setting Switch

- a. Mark the correct voltage on the rear panel of SLH-series high power load.
- b. Check the rating of the line fuse and replace it with the correct fuse if necessary. (The line fuse is located below the AC line receptacle see Figure 2-2).
- c. With the power cord removed, use a small screwdriver to extract the fuse holder from under the AC socket.
- d. Replace the fuse with the appropriate type as indicated in Figure 2-1. These fuses are slow-blow fuses.
- e. Reinstall fuse holder and connect the power cord.



**Figure 2-2 AC Line Receptacle**

### 2.1.2 Grounding Requirements

The SLH-series high power load is equipped with a three-conductor cable that plugs into an appropriate receptacle to ground the instrument's cover.

### 2.1.3 Environmental Requirements

- For indoor use only
- Installation Category II (overvoltage)
- Pollution Degree 2
- Altitude up to 2000 meters (with power derating)
- Relative Humidity 80% RH Max
- Ambient Operating Temperature 0-40°C, with ideal being 25°C ± 5°C

### 2.1.4 Tilt Adjustment

The SLH-Series high power load is equipped with adjustable tilt stands for use as a bench-top instrument to provide a user-friendly viewing angle.

### 2.1.5 Rack Mount

The SLH-Series high power load is designed to permit mounting in a standard 19-inch rack for system application.

### 2.1.6 Repair

If the instrument is damaged, please attach a tag to the instrument to identify the owner and indicate the required service or repairing. Follow the procedures in the Warranty page.

## 2.2 CONNECTIONS



**CAUTION: PREVENT DAMAGE TO THE LOAD.** Do NOT apply voltage or current with power switched OFF. Turn ON the power switch to the load PRIOR to applying voltage or current to the input terminals (i.e., before turning on the power supply under test).

### 2.2.1 GPIB Connection

The GPIB connector on the rear panel connects the SLH-series high power load to the controller and to other GPIB devices. A GPIB system can be connected in any configuration (star, linear, or both), with the following two provisions:

1. There are no more than 15 devices, including the controller.
2. The maximum length of all cables combined is 20 meters, calculated at 2 meters times the number of devices connected.

Please ensure that the lock screws are firmly hand-tightened; use a screwdriver only for the removal of screws.

Figure 2-3 shows the rear panel of SLH-series high power load, the GPIB connector and GPIB address setting switch is located on the rear panel of SLH-series high power load. The initial GPIB address of the SLH-series high power load is factory set to address 05.

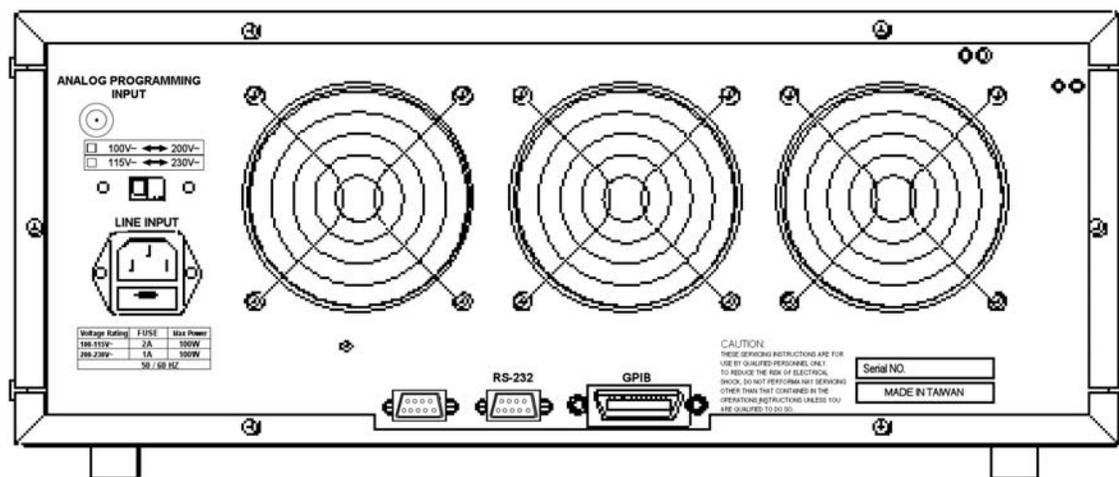
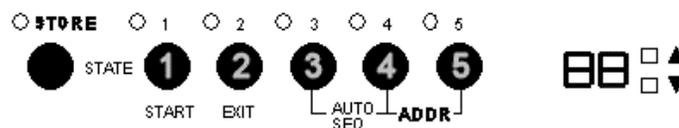


Figure 2-3 SLH-Series High Power Load Rear Panel

### GPIB Address Setting:

To set the GPIB address, simultaneously press the STATE 4+STATE 5 keys on the front panel. Press UP or DOWN on the BANK keys to select the address number (0-31), press STATE 2 to exit GPIB address setting mode.



## 2.2.2 Input Binding Post and Wire Considerations

The output of the device under test (DUT) is connected to the load by **bus bars** located at the rear of the load. A major consideration in making input connection is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires be large enough to limit the voltage drop to less than 0.5V per lead.

**Note:** When using Constant Resistance mode, Vsense inputs should be used to avoid affecting measurements and regulation by cable resistance.

### **Low Current Testing, below 60A input.**

The positive (+) and negative (-) binding posts can be connected to the wires/cables according to the following guidelines:

#### **Bus Bars**

The connection is through the bus bars at the rear of the SLH series load. This is the same connection as high current testing.

#### **Plug Connectors**

This is the most popular way to connect the input of electronic load to the device under test. It is recommended the load current be less than 20A in this connection since the current rating of the plug is rated to 20A. The maximum wire gauge should be limited to AWG14.

#### **Hook Terminals**

The hook terminal provides a good contact to the binding post and can be used anytime. The maximum wire gauge should be limited to AWG10.

#### **Direct Insertion into Binding Posts**

This is the most convenient way to connect the load input to the DUT. The maximum wire gauge AWG14 can be used in this application.

#### **Plug Connectors and Hook Terminals**

This method is recommended when input current is greater than 20A.

#### **Plug Connectors and Direct Insertion**

This method is also recommended when input current is greater than 20A.

## 2.2.3 The Power Line Frequency 50/60 Hz Setting

The high accuracy 4-1/2 digit voltage and current meters use dual slope integrated theory to measure the analog voltage and current signal. The accuracy of the meter is the best when the integration cycle is synchronized with the power line frequency. (The input line voltage and line frequency of SLH-series high power load.) There are two power line frequencies that can be selected, 50Hz or 60Hz.

The 50/60 Hz power line frequency setting switches located at the right hand side of second layer PCB (P/N: 65200271) when open the right hand side Alumina plate of the SLH-series high power load.

The factory setting of power line frequency depends on the purchasing area of your country, and the power line frequency is indicated on the top cover of the load.

In the case of changing power line frequency, from 50Hz to 60Hz, or from 60Hz to 50Hz, please follow the following procedures:

1. Please follow the removal procedure (SECTION 2) to remove the right hand side Alumina plate of SLH-series high power load .
2. On the upper and lower of the right hand side of the Electronic Load, there are three screws respectively. Please remove those screws and remove the Alumina plate as well. (see Fig 2-4)
3. 50Hz power line frequency setting: set switch 1 to "OFF" position and switch 2 to "ON" position. 60HZ power line frequency setting: set switch 1 to "ON" position and switch 2 to "OFF" position.
4. After setting the power line frequency, please follow the reverse procedure to re-install the SLH-series high power load.

## 2.3 MAINTENANCE

### 2.3.1 Cleaning



**WARNING:**

To avoid electrical shock or damage to the meter, do not get water inside the case.

Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents.

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# SECTION 3 OPERATION

This section describes the front panel function and operation of each SLH-series load; GPIB remote programming is described in Section 4, GPIB Operation.

## 3.1 FRONT PANEL CONTROLS AND INDICATORS

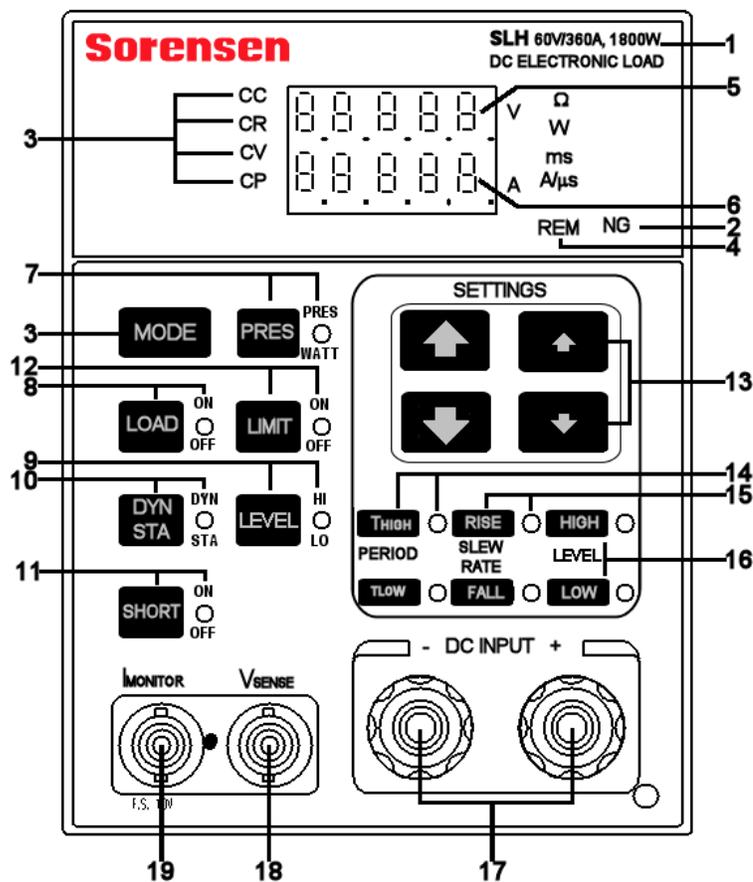


Figure 3-1 SLH-Series High Power Load Front Panel

### 1 Model Identification

Shows the load model name, number and specifications.

## 2 NG LED

Lights to indicate "No Go" (fail) when Vmeter, Ameter, or Wattmeter exceeds the upper or lower limit set. Off, not lit, indicates "Go" (no fail).

## 3 CC, CR, CV, CP LEDs and MODE Key

- LEDs indicate which mode is operating:
  - CC = Constant Current
  - CR = Constant Resistance
  - CV = Constant Voltage
  - CP = Constant Power
- The MODE key switches from one mode to the next.

## 4 REM LED

Indicates remote operation:

- When lit, the unit is under remote control and cannot be operated through the front panel keys.
- When off, the unit is under local control and can be manually operated using the front panel keys.

## 5 Upper 5-Character Digital Meter (DM) and Associated LEDs

The DM is for multi-purpose display, depending on selected mode:

- In PRESet OFF mode, displays voltage of DC input terminal or VSENSE BNC input.
- In PRESet ON mode, displays values being programmed for CV, CR, or CP.
- In WATT On mode, displays load Watt meter.
- In LIMIT ON mode:
  - displays GO/NG upper limit values for voltage, current, and power
  - displays SENSE to indicate VSENSE control
  - displays voltage settings for LOAD ON or for LOAD OFF

Associated LEDs indicate the displayed value's unit:

- V = Value displayed is in Volts
- A = Value displayed is in Amps
- $\Omega$  = Value displayed is in Ohms
- W = Value displayed is in Watts
- ms = Value displayed is in milliseconds
- $A/\mu s$  (or  $mA/\mu s$ ) = Value displayed is in Amps per microsecond (or milliamps per microsecond)

## 6 Lower 5-Character Digital Meter (DM) and Associated LEDs

Multi-purpose display, depending on selected mode:

- In PRESet OFF mode:
  - displays actual load current when SHORT status is OFF
  - displays short circuit current when SHORT status is ON
- In PRESet ON mode, the lower DM displays:
  - value being programmed for CC
  - values being programmed for THIGH/TLOW when in Dynamic mode
  - values being programmed for RISE/FALL slew rates when in Dynamic mode
- In LIMIT ON mode:
  - displays oVP (over voltage), oCP (over current), oPP (over power), or oTP (over temperature) when in protection mode
  - displays GO/NG low limit values for voltage, current, and power
  - displays Auto or On setting for VSENSE control
  - displays either Ld-on or Ld-off to indicate whether Load voltage setting mode is On or Off

Associated LEDs indicate the displayed value's unit:

- V = Value displayed is in Volts
- A = Value displayed is in Amps
- $\Omega$  = Value displayed is in Ohms
- W = Value displayed is in Watts
- ms = Value displayed is in milliseconds
- A/ $\mu$ s (or mA/ $\mu$ s) = Value displayed is in Amps per microsecond (or milliamps per microsecond)

## 7 PRES Key and ON/WATT LED

- PRES key sequentially selects Preset ON, Watt ON and Preset OFF
- LEDs indicate which is selected at any given time:
  - Preset On = LED is lit amber
  - Watt On = LED is lit green
  - Preset Off = LED is not lit

## 8 LOAD Key and ON/OFF LED

- LOAD key toggles ON/OFF the DC load input function. (Does not affect the programmed settings).
- LED indicates the status of the Load function:
  - LED is lit to indicate the Load function is ON and ready to sink current from the DC input.
  - LED is not lit, indicating the Load function is OFF.

## 9 LEVEL Key and Hi/Lo LED

- LEVEL key toggles between the High or Low levels for programming the high and low level load values for CC, CR, CV, CP when in those modes. (These High/Low level load values can be programmed while in Static mode but not in Dynamic mode. See Key **10**, DYN/STA, next).
- LED indicates whether the Load value being programmed is High level or Low level:
  - LED lit = high (HI) level
  - LED not lit = low (Lo) level

Section provides conformation guidelines for programming the values properly.

## 10 DYN / STA Key and LED

- DYN/STA key toggles between Dynamic and Static modes only when in Constant Current mode or Constant Power mode. (When in Constant Resistance and Constant Voltage modes, the SLH-series DC load module automatically adjusts to Static mode because Dynamic mode is not available for either).
- LED indicates whether the SLH-series DC load module is in Dynamic or Static mode:
  - LED lit = Dynamic
  - LED not lit = Static

## 11 SHORT Key and ON/OFF LED

- The SHORT key toggles the short circuit of DC input terminal On and Off.
- LED indicates the ON/OFF status of the short circuit
  - LED lit = ON
  - LED not lit = OFF

## 12 LIMIT Key and LED

- The Limit key sequentially selects the following parameters to program their settings:
  - OFF
  - GO/NG Upper/Lower Voltage limit
  - GO/NG Upper/Lower Current limit
  - GO/NG Upper/Lower Power limit
  - Vsense Auto/ON
  - Load ON voltage
  - Load OFF voltage
  - Range: Auto/Range2
  - iStart
  - iStop
  - iStep
  - Pstart
  - Pstop
  - Pstep
  - V threshold

- Test Mode: Normal, OCP, OPP
- returns to OFF and the loop repeats
- The LED indicates whether limits are being programmed or not:
  - LED lit = ON
  - LED not lit = OFF

### 13 Coarse/Fine Adjust, Increment/Decrement Keys

These keys are used in two different ways, depending on the value(s) being displayed:

- When only one value is displayed, such as for setting Load On voltage, these keys are for coarse and fine adjustments:
  - The coarse-adjust keys (larger arrows,  $\uparrow$   $\downarrow$ ) increase or decrease the setting values by larger increments.
  - The fine-adjust keys (smaller arrows,  $\uparrow\downarrow$ ) increase or decrease the setting values by smaller increments.
- When two values are displayed (one in upper 5-character display and one in lower 5-character display), such as for setting upper and lower limits, these keys are for increment/decrement changes:
  - The larger arrows,  $\uparrow$   $\downarrow$ , increase or decrease the setting value in the upper 5-character display.
  - The smaller arrows,  $\uparrow\downarrow$ , increase or decrease the setting value in the lower 5-character display.

Table 3-1 contains the detailed step resolution of each range for each SLH-series DC series load module.

### 14 THIGH / TLOW PERIOD Keys and LEDs

- The THIGH and TLOW keys are used to program the duration of high and low load current levels, respectively.
- The LEDs indicate which time period (THIGH or TLOW) is being programmed.

### 15 RISE / FALL SLEW RATE Keys and LEDs

- The Rise and Fall keys are used to program the speed of load current changes from low level to high level (Rise) and from high level to low level (Fall).
- The LEDs indicate which slew rate (Rise or Fall) is being programmed.

### 16 HI / Lo LEVEL Keys and LEDs

- These two keys are used to program the High and Low loads for current, resistance, voltage, or power, depending on which mode is set (CC, CR, CV, or CP). (Follow guidelines in the Operation-Setup section that follows).
- The LEDs indicate which level (HI or Lo) is being programmed.

### 17 -/+ DC INPUT Binding Posts

The negative (left) and positive (right) terminal of load input connector

- **+**: Connect to the positive and ground output for a positive output power supply
- **-**: Connect to the negative and ground output for a negative output power supply.

**NOTE:** Before testing, ensure that the voltage and current do not to exceed the maximum rating (see Table 1-2) of each SLH-series DC load and the connection method utilized (see Section 2.2).

Also check the polarity (Section 3.10.5) of DC input connection before testing.

### 18 VSENSE

Used to measure the specific voltage points through the V-sense BNC - CLIP cable.

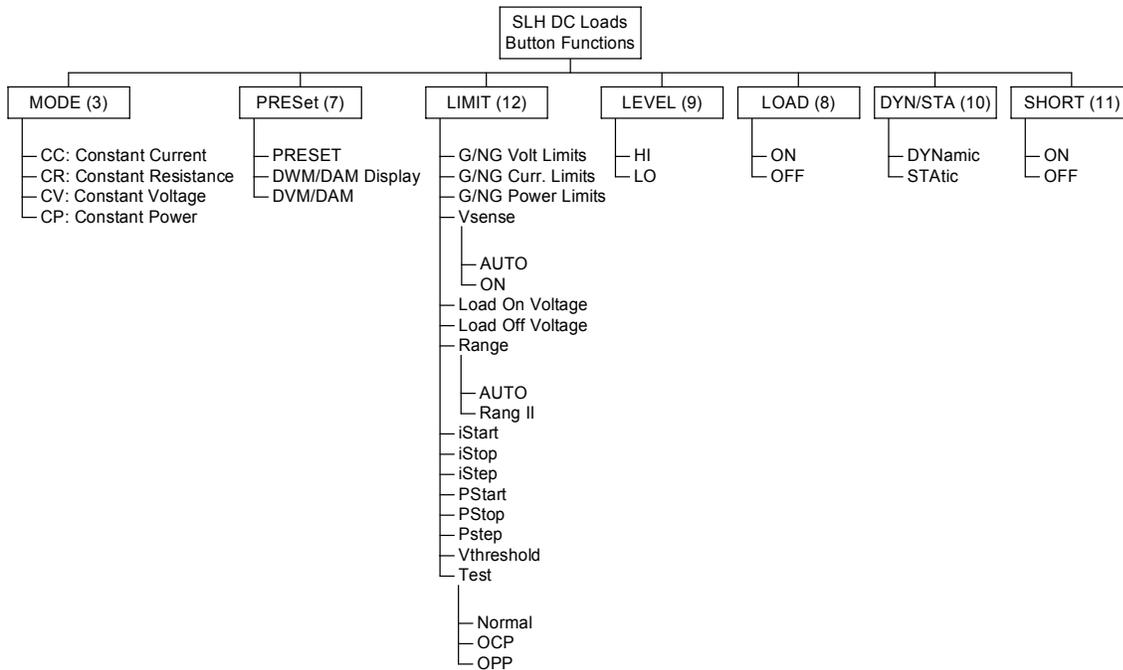
### 19 IMONITOR

Provides the load current waveform output to an oscilloscope to evaluate the current waveform of a power supply under test.

See Table 1-2 for voltage/current relationship of I-monitor outputs in SLH-series DC series modules.

## 3.1.1 Summary Chart

The front panel controls are summarized in Figure 3-2.



**Figure 3-2 Organization of Front Panel Controls of SLH-Series DC Plug-in Module**

## 3.2 OPERATION – SETUP AND OCP/OPP TESTS

The SLH series DC loads can operate in 6 modes: Constant Current (CC), Constant Voltage (CV), Constant Power (CP), Constant Resistance (CR), all selected with the MODE key, Shorts mode, selected with the SHORT key, and Dynamic mode, selected with the DYN/STA key. (Dynamic mode allows controlled current transitions between two states in CC or CP modes only).

**Note:** For the remainder of this Section, the number within parentheses following a front panel key name, refers to the labels in Figure 3-1.

### 3.2.1 Overview of Front Panel Operation

Limits must be set up before selecting a mode in which to operate. The LIMIT key (**12**) is used to set the Go/No Go upper and lower limits for voltage, for current and for power. It is also used to set the system configuration for V-sense control, for Load ON voltage and for Load OFF voltage.

After setting up the initial LIMIT parameters (see Section 3.2.2), use the MODE key (**3**) to enter CC, CR, CV, or CP mode and set up the applicable parameters in each mode. Use the HIGH and LOW keys (**16**) to set the load level values for each mode. If programming values in Dynamic (**10**) mode (again, for CC and CP modes only), the THIGH, TLOW (**14**), and RISE, FALL (**15**) values must also be set.

Then, select the high or low programmed Load level by pressing the LEVEL key (**9**), and last, press the LOAD key (**8**) to apply load to the input terminals.

### 3.2.2 Initial Setup (LIMIT Key)

#### Pass / Fail Limits, Go/No GO Limits

If pass/fail limits are not desired, skip this step. This step is to set the upper and lower limit values within which the inputs must fall in order to pass (the NG register is set to 0 and the NG LED (**2**) remains not lit). If the inputs fall outside those values, i.e., they are less than the lower limit value or higher than the upper limit value, the test is a fail or No Go (the NG register is set to 1 and the NG LED is lit).

#### Voltage:

Press the LIMIT key until its corresponding ON LED (**8**) is lit and the “V” LED (**5**) is lit. The upper 5-character display shows the upper voltage limit; the lower 5-character display shows the lower voltage limit. Use the larger  $\uparrow$   $\downarrow$  increment/decrement arrows to set the upper limit and the smaller  $\uparrow\downarrow$  increment/decrement arrows to set the lower limit.

#### Current:

Press the LIMIT key until its corresponding ON LED is lit and the “A” LED (**5**) is lit. The upper 5-character display shows the upper current limit; the lower 5-character display shows the lower current limit. Use the larger  $\uparrow$   $\downarrow$  increment/decrement arrows to set the upper limit and the smaller  $\uparrow\downarrow$  increment/decrement arrows to set the lower limit.

**Power:**

Press the LIMIT key until the LIMIT LED is on and the “W” LED (5) is lit. The upper 5-character display shows the upper power limit; the lower 5-character display shows the lower power limit. Use the larger  $\uparrow$   $\downarrow$  increment/decrement arrows to set the upper limit and the smaller  $\uparrow$   $\downarrow$  increment/decrement arrows to set the lower limit

**VSENSE:**

Press the LIMIT key until SENSE appears on the display. Use the increment/decrement keys to set AUTO or ON.

- In AUTO, if the external Vsense voltage (through the BNC connection) is greater than 1V (SLH-series DC 60V modules) or 3V (250, 500V modules), the voltage displayed on the 5-character DVM is from the Vsense input. Otherwise, when the voltage on the BNC is not above the minimum voltage, the 5-character DVM measures the DC input terminals of the load module.
- In Vsense ON mode, the 5-character voltage meter displays the voltage of V-sense BNC input.

**LOAD ON:**

Press the LIMIT key until Ld-on appears on the lower 5-character DM display. Use the coarse/fine adjust keys to set the LOAD ON voltage, which is displayed on the upper 5-character DM. The LOAD ON voltage must be higher than the LOAD OFF voltage. The load will set the load current to zero automatically if the LOAD ON voltage is set equal to or lower than the LOAD OFF voltage setting.

**LOAD OFF:**

Press the LIMIT key until LdoFF appears on the lower 5-character DM display. Use the coarse/fine adjust keys to set the LOAD OFF voltage, which is displayed on the upper 5-character DM. The LOAD OFF voltage must be lower than the LOAD ON voltage. The load will set the load current to zero automatically if the LOAD OFF voltage is set equal to or higher than the LOAD ON voltage setting.

**Range Auto/Fixed Range 2:**

There are two programming ranges in Constant Current and Constant Resistance modes. Range selection can be automatic or fixed in Range 2, as set by the LIMIT key. Press the LIMIT key until rAnGE appears on the upper 5-character display. Use the inc/dec arrows to set AUTO or rAn2. rAn2 forces the load to Range 2 for CC and CR mode, as defined in Table 3-6. Ranges are described in the following examples:

**Example, SLH-60-60-300:****Constant Current Mode:**

Range 1 (6A) indicates low load current operating range, Range 2 (60A) indicates high load current operating range. The detailed specification of load current range is listed on the Table 1-1. The current range changes automatically in accordance to the programmed load current. Range 1 is selected automatically if the programmed load current is less than the maximum current of Range 1 (6A), and will set to Range 2 automatically when the programmed current is higher than the maximum current of Range 1 (6A).

**Constant Resistance Mode:**

Range 1 indicates low load resistance operating range (high resistance, low current), Range 2 indicates high load resistance operating range (low resistance, high current). The detailed resistance range specifications are shown in Table 1-1. The resistance range changes automatically in accordance to the programmed load resistance.

The SLH-series electronic load will set Range 1 automatically if the programmed load resistance is higher than the minimum load resistance of Range 1, and will set to Range 2 when the programmed load resistance is lower than the minimum load resistance of Range 1.

The normal operating mode for programming values is for the load to automatically select low or high range (CC or CR modes only). However, in the use of the analog input, the load can be programmed in Range 2 at all times.

**Over Current Test (OCP Test):**

An OCP test automatically steps the current from a start current (iStAr) to a stop current (iStOP) in equal increments (iStEP). When the voltage falls below a threshold voltage (Uth), the test stops and the current setting is saved.

Each press of the LIMIT key steps through settings for the three setup parameters. The threshold voltage setting appears after the OPP test parameters.

After setting the four parameters, set the OCP test mode, store and run the test.

**Over Power Test (OPP Test):**

An OPP test automatically steps the current from a start power (PStAr) to stop power (PStOP) in equal increments (PStEP). When the voltage falls below a threshold voltage (Vth), the test stops and the power setting is saved.

Each press of the LIMIT key steps through settings for the four setup parameters.

After setting the four parameters, set the OPP test mode, store and run the test.

**Test Mode:**

Test modes are Normal, OCP and OPP. All modes except OCP and OPP are “normal” mode.

Press the LIMIT key until tEst appears on the display. Use the inc/dec arrows to set Normal, OCP or OPP modes.

If OCP or OPP mode is selected, store the setting in the chassis memory as described in the SLH-4 or SLH-1 programming manual.

To run an OCP or OPP test, recall the memory location where the test was saved.

To return to Normal mode, press the LIMIT key until tEst appears on the display. Use the down arrows until “nor” appears on the display.

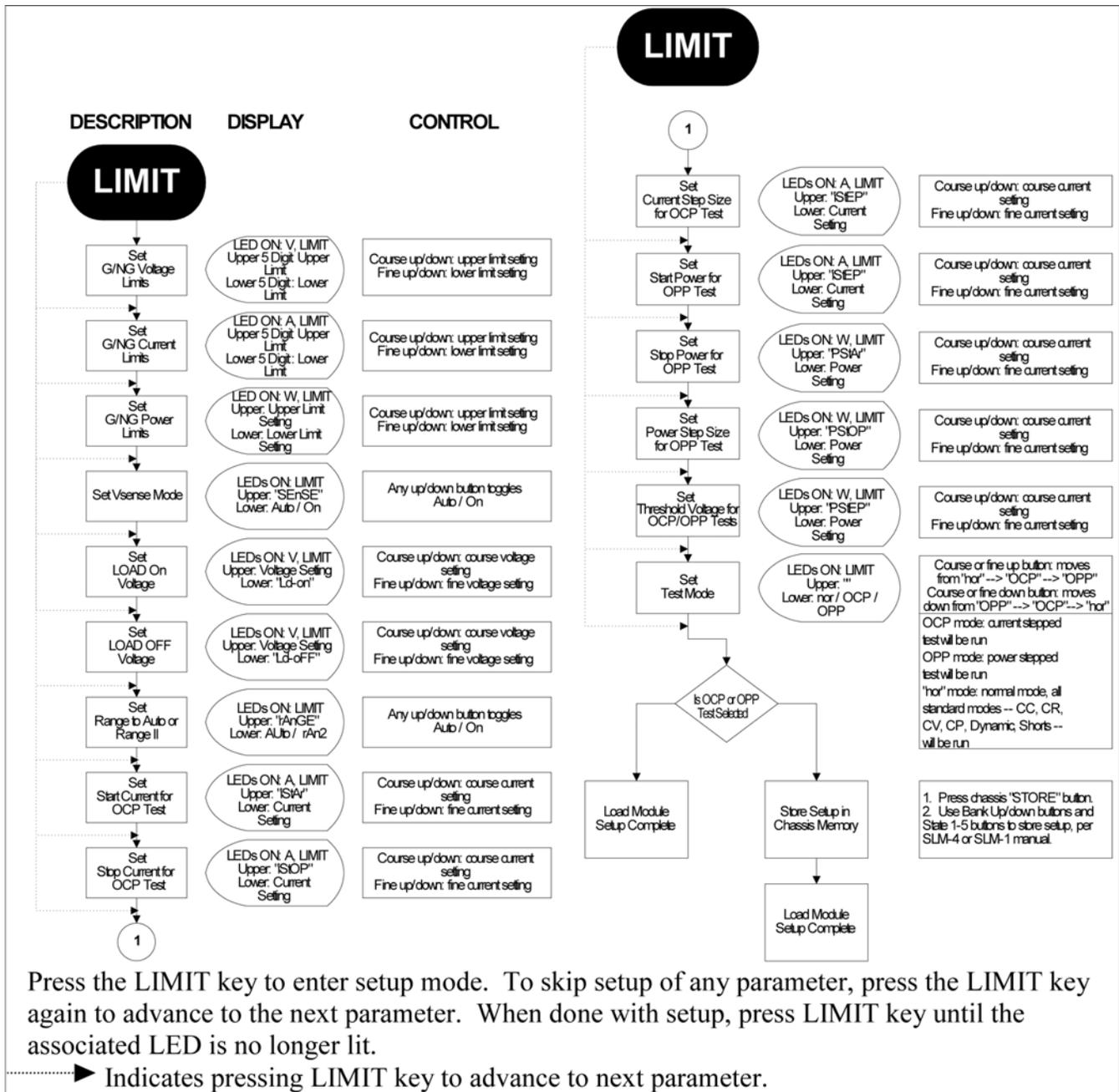


Figure 3-3 Flow Chart for Load Module General Setup Parameters and OCP and OPP Tests

### 3.3 NORMAL OPERATING MODES

In the following instructions, the numbers within parentheses refer to the front panel components of the SLH-series DC plug-in-module, as labeled in Figure 3-1.

#### CC Mode

CC mode can be either static (fixed DC level) or dynamic (two levels with timing and slew rates programmed). Dynamic mode is described later in this Section. In static mode, two levels can be set to allow for quick switching between two current levels.

1. Press the MODE key (3), until the CC LED (3) is lit.
2. Press the PRES key (7) to view the programmed values. The load has a high and low setting to allow for quick changes in load setting. The high level must be higher than the low level; in setting the values below, the load will not allow the HIGH level to be lower than the LOW level.
  - a. To set the high level, press the HIGH key (16) in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
  - b. To set the low level, press the LOW key (16) on the bottom row of the settings area. Use the inc/dec arrows to set the desired level.
3. To exit the preset mode, press the PRES key until the LED is green (power/watts displayed) or not lit.
4. Select the desired level CC mode by pressing the LEVEL key. When the LED is lit, the HIGH level is selected and when unlit, the LOW level is selected.
5. Press the LOAD key (8) to toggle the load off or on. The LEVEL key can be pressed at any time to switch between the settings. The current can be changed at any time using the inc/dec arrows. The values set can be viewed by pressing the PRES key.

#### CR Mode

CR mode static (fixed DC level) can be set in two levels to allow for quick switching between two resistance levels. High and low levels are referenced to the resulting current level, thus the  $\uparrow$   $\uparrow$  keys will decrease the resistance setting and the  $\Downarrow$   $\Downarrow$  keys will increase the resistance setting.

1. Press the MODE key, until the CR LED is lit (3).
2. Press the PRES key (7) to view the programmed values. The load has a high and low setting to allow for quick changes in load setting.
3. The HIGH level must be set to a lower resistance than the LOW level; in setting the values below, the load will not allow the HIGH level to be higher than the LOW level.
  - a. To set the high level, press the HIGH key (16) in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
  - b. To set the low level, press the LOW key (16) at the bottom of the settings area. Use the inc/dec arrows to set the desired level.
4. To exit the preset mode, press the PRES key until the LED is green (power/watts displayed) or not lit.

5. Select the desired CR level by pressing the LEVEL key (9). When the LED is lit, the HIGH level (lower resistance) is selected and when unlit, the LOW level is selected (higher resistance).
6. Press the LOAD key (8) to toggle the load off or on. The LEVEL key can be pressed at any time to switch between the settings. The current can be changed at any time using the inc/dec arrows. The value set can be viewed by pressing the PRES key.

### CV Mode

CV mode operates in static mode only. Two levels can be set to allow for quick switching between two current levels.

1. Press the MODE key (3) until the CV LED (3) is lit.
2. Press the PRES key (7) to view the programmed values. The high level must be higher than the low level; in setting the values, the load will not allow the HIGH level to be lower than the LOW level.
  - a. To set the high level, press the HIGH key (16) in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
  - b. To set the low level, press the LOW key (16) at the bottom of the settings area. Use the inc/dec arrows to set the desired level.
3. To exit the preset mode, press the PRES key until the LED is green (power/watts displayed) or not lit.
4. Select the desired level CV mode by pressing the LEVEL key where LED lit is high level and unlit is the low level setting.
5. Press the LOAD key to toggle the load off or on. The LEVEL key can be pressed at any time to switch between the settings. The current can be changed at any time using the inc/dec arrows. The value set can be viewed by pressing the PRES key.

### CP Mode

CP mode can be either static (fixed DC level) or dynamic (two levels with timing and current slew rates programmed). Dynamic mode is described in Section 0. In static mode, two levels can be set to allow for quick switching between two current levels.

1. Press the MODE key (3), until the CP LED (3) is lit.
2. Press the PRES key (7) to view the programmed values. The high level must be higher than the low level; in setting the values below, the load will not allow the HIGH level to be lower than the LOW level.
  - a. To set the high level, press the HIGH key in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
  - b. To set the low level, press the LOW key in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
3. To exit the preset mode, press the PRES key until the LED is green (power/watts displayed) or not lit.
4. Select the desired level CP mode by pressing the LEVEL key. When the LED is lit, the high level is selected; when the LED is not lit, low level is selected.

5. Press the LOAD key to toggle the load off or on. The LEVEL key can be pressed at any time to switch between the high and low settings. The power can be changed using the inc/dec arrows. The value set can be viewed by pressing the PRES key until the amber LED is lit.

### Dynamic Mode

Dynamic mode allows fast state switching in either current or power mode. The dwell time and current slew rate are controlled along with the high and low values.

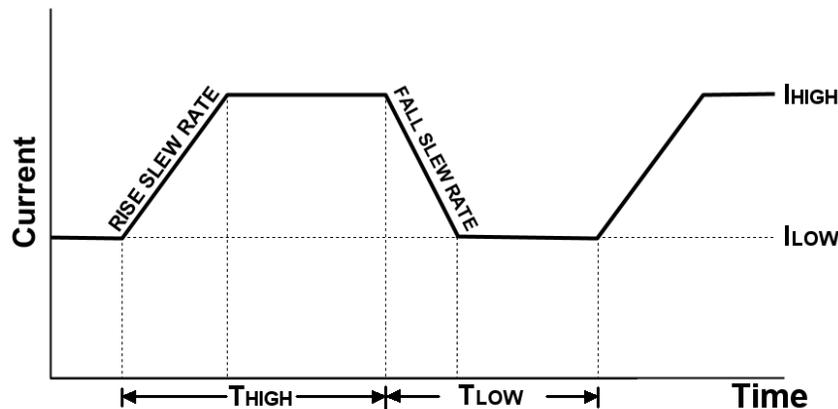


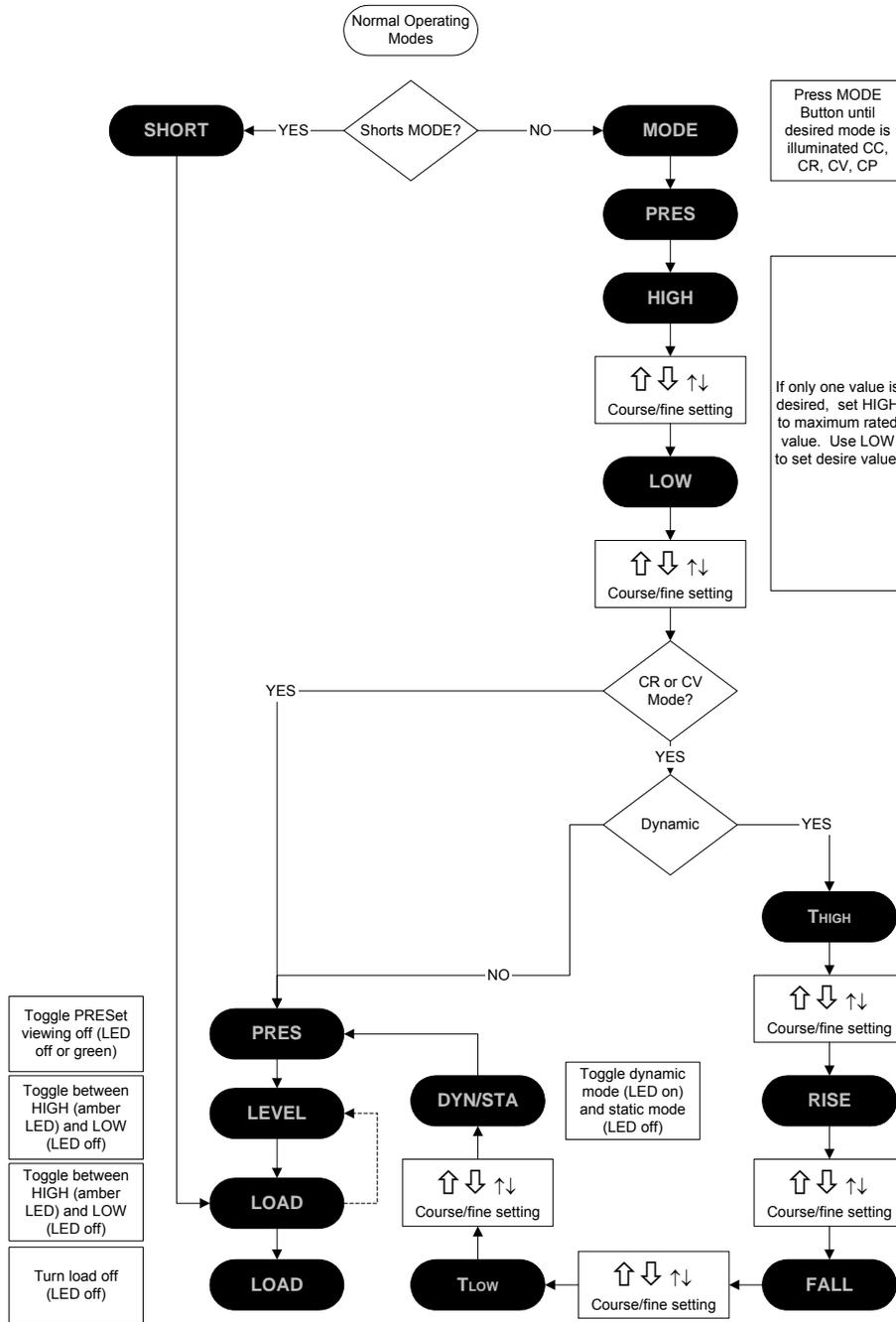
Figure 3-4 Dynamic Mode Waveform and Definition Parameters

1. Press the MODE key (3), until the desire mode LED (3) is lit, CP or CC only.
2. Set high and low values
  - a. Press the PRES key (7) until the amber LED is lit to view the programmed values. The high level must be higher than the low level; in setting the values below, the load will not allow the HIGH level to be lower than the LOW level.
  - b. To set the high level, press the HIGH key (16) in the lower part of the settings area. Use the inc/dec arrows to set the desired level.
  - c. To set the low level, press the LOW key (16) at the bottom of the settings area. Use the inc/dec arrows to set the desired level.
3. Set the current RISE and FALL rates
  - a. Press the RISE key. Use the inc/dec arrows to set the desired RISE rate. Note: In CP mode, the rise rate is limited to Range 1.
  - b. Press the FALL key. Use the inc/dec arrows to set the desired FALL rate. Note: In CP mode, the rise rate is limited to Range 1.
4. Set the dwell time
  - a. Press the Thigh key. Use the inc/dec arrows to set the desired high state time.
  - b. Press the Tlow key. Use the inc/dec arrows to set the desired low state time rate.
5. Operating in Dynamic Mode
  - a. Press the MODE key (3), until the desire mode LED (3) is lit, CP or CC only.
  - b. Press the DYN/STA key (10) until the amber LED is lit.
  - c. Press the LOAD key (8) to turn the load on (amber LED is lit).

**Shorts Mode**

1. Shorts mode puts the load in minimum resistance/maximum current state.
2. To turn on shorts mode, press the SHORT key (11) until the LED turns on. This overrides any selection using the MODE key. When the LOAD key is toggled to ON, the load simulates a short by sinking maximum rated current at minimum resistance.
3. To exit shorts mode, press the SHORT key until the LED turns off.

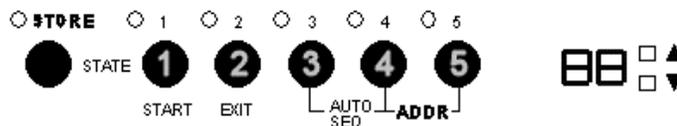
**Normal Operating Mode Flow Chart:**



**Figure 3-5 Normal Operating Mode Flowchart**

## 3.4 STORE / RECALL FUNCTION

The eight function keys along the bottom of the front panel (Figure 3-6) are designed for high throughput testing. There are 30 banks of 5 operation states for a total of 150 testing setups that can be stored in memory.



**Figure 3-6 Store/Recall/Sequence control buttons**

### 3.4.1 STORE Procedure:

1. Set the load status and load level for each load module within the mainframe (Sections 3.2 and 3.3).
2. Select the Memory Bank (01-30) for storing the setup. Use the white buttons at the right side of the LED display.
3. Press the STORE key. The STORE LED begins flashing to indicate that the load is ready to store the setup. If an error was made, to exist store mode, press the Store key again or wait 20 seconds, at which time the STORE LED will turn off to prevent accidentally overwriting a memory state.
4. Press one of the State 1-5 keys. The appropriate State key's LED will light immediately; the load level and status of SL-series load module is now stored in memory. The STORE procedure is completed when the STORE LED turns OFF.

**Notes:**

If more than one state is stored in the same State key, the last one entered will be treated as an update and will overwrite the previously input state.

After pressing the STORE key, the front panel keys on the SLH-series electronic load are still active. However, the STATE LED will turn off if any key on any load is pressed. This indicates that the front panel state of the load module is not the same as stored state.

### 3.4.2 RECALL Procedure:

1. Use UP and Down keys to select the Memory Bank,
2. Press one of the Memory State 1 through 5 keys; the appropriate LED will be lit, and the stored state will be recalled. If any key is pressed on a load module, the state LED indicator turns off immediately, to indicate that the module state no longer matches the recalled state.

### 3.5 SEQUENCE FUNCTION

There are two modes in the SEQUENCE function: EDIT MODE and TEST MODE, The AUTO SEQ function can be initiated by pressing State 3 + State 4 keys simultaneously. To enter EDIT MODE, press STORE; to enter the TEST MODE, press START key. Please refer to the flow chart in Figure 3-7. A brief description of each mode follows the flow chart.

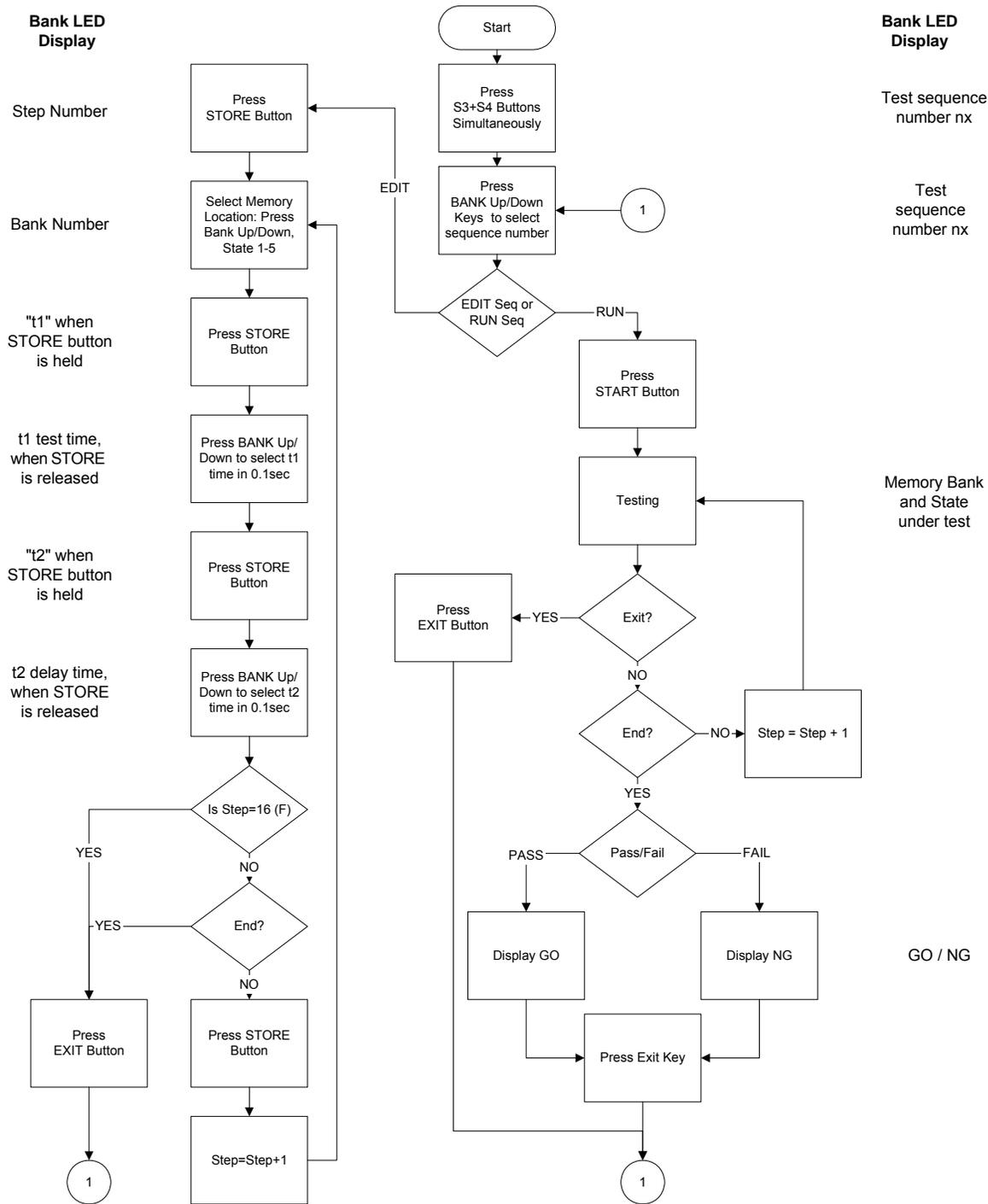


Figure 3-7 Auto Sequence Function Set-Up and Operation Flowchart

### 3.5.1 EDIT Mode

To enter the EDIT mode of the Sequence function, press State3 + State4 keys simultaneously (State 3 and State 4 LEDs are On, indicating Auto Sequence function is now active). Use the BANK Up/Down keys to select the sequence to be edited, then press the STORE key to begin the editing process.

The EDIT MODE flow chart is described below:

- Nine Auto Sequences (n1-n9) can be edited within the SLH mainframe.
- Each Auto Sequence has up to 16 test steps, where each step is pulled from any one of 150 Stored memory sets (30 Bank memory locations in each of 5 State locations).
- Each test step has t1 (test time, or duration of test step) and t2 (delay time), the unit of time is 100mS, the range is 0.1S - 9.9S in 100mS resolution. SLH mainframe will check each module GO/NG at the end of t1 (test time), the next step will be started after t2 (delay time).
- The test step sequence can include up to 16 steps, and can be terminated by pressing the EXIT key (State 2) if fewer than 16 steps are required.

### 3.5.2 TEST Mode

To enter the TEST Mode of Sequence function, press State 3 + State 4 keys simultaneously; (State 3 and State 4 LEDs are On, indicating Auto Sequence function is now active). Use the BANK Up/Down keys to select the sequence test to be run, then press the START key to run the test sequence.

- After pressing the START key, the SLH mainframe controls all the installed modules to recall the memory correspond to the memory stored in Auto-sequence (n1~n9).
- Each test sequence starts from (Step 0 - t1 - t2), then (step 1 - t1 - t2), and so on until either it completes the last step or is stopped by pressing the EXIT (State 2) key.
- The two-digit BANK LED will display "GO" (flash) if all test steps in all modules pass, and will show "NG" (flash) if there is at least one failure during the test.
- At that point, the user can either press the Start key to continue with another test, or press EXIT (State 2) key to quit the Auto-Sequence function.

### 3.6 INITIAL SETTING OF SLH-SERIES DC LOADS

Table 3-1 lists the factory, or initial, load value settings when the SLH-series DC electronic load is initially powered ON when it first arrives from the factory.

Item	SLH-60-120-600	SLH-60-120-1200	SLH-60-120-1800	SLH-60-240-1200	SLH-60—240-1800	SLH-60-360-1800
<b>Basic Settings</b>						
CC LOW [amps]	0.0000	0.0000	0.000	0.0000	0.0000	0.0000
CC HIGH [amps]	0.0000	0.0000	0.000	0.0000	0.0000	0.0000
CR HIGH [ $\Omega$ ]	1875.	1875.	1875.	937.5	937.5	625.0
CR LOW [ $\Omega$ ]	1875.	1875.	1875.	937.5	937.5	625.0
CV HIGH [volts]	60.00	60.00	60.00	60.00	60.00	60.00
CV LOW [volts]	60.00	60.00	60.00	60.00	60.00	60.00
CP LOW [watts]	0.000	0.000	0.000	0.000	0.000	0.000
CP HIGH [watts]	0.000	0.000	0.000	0.000	0.000	0.000
<b>Dynamic Settings</b>						
FALL [A/ $\mu$ s]	0.5000	0.5000	0.5000	1.0000	1.0000	1.5000
RISE [A/ $\mu$ s]	0.5000	0.5000	0.5000	1.0000	1.0000	1.5000
THIGH [ms]	0.050	0.050	0.050	0.050	0.050	0.050
TLOW [ms]	0.050	0.050	0.050	0.050	0.050	0.050
<b>Go/No Go Limits</b>						
V HIGH	60.00	60.00	60.00	60.00	60.00	60.00
V LOW	0.000	0.000	0.000	0.000	0.000	0.000
CURR. HIGH	120.00	120.00	120.00	240.00	240.00	360.00
CURRENT LOW	0.000	0.000	0.000	0.000	0.000	0.000
POWER HIGH	600.00	1200.0	1800.0	1200.0	1800.0	1800.0
POWER LOW	0.000	0.000	0.000	0.000	0.000	0.000
<b>System Settings</b>						
V SENSE	Auto	Auto	Auto	Auto	Auto	Auto
LD-ON [volts]	1.0	1.0	1.0	1.0	1.0	1.0
LD-OFF [volts]	0.500	0.500	0.500	0.500	0.500	0.500

Table 3-1 SLH-Series DC Electronic Load Factory Settings for Power On

### 3.7 ANALOG PROGRAMMING INPUT

The Electronic Load has an analog programming BNC input on the rear panel. CC and CP modes can be programmed with a 0 to 10V analog signal controlling 0 to full scale current or power. The input may be an arbitrary waveform or arbitrary waveform + dc up to 20kHz bandwidth. The analog programming signal can act alone or it can be summed with the programmed value via GPIB, RS-232, or the front panel. Figure 3-8 shows the analog programming signal (4 Vac, 500Hz) is summed with the 24A programmed setting in CC mode.

**Example:** SLH-60-120-1800. The 0 to 10V Analog signal can program the 0 to full-scale input range in the CC mode (0 to 6A range when load current setting is less than 6A, or 0 to 60A range when load current setting is higher than 6A) or in the CP mode (0 to 300W). To operate only in the high range (Range 2).

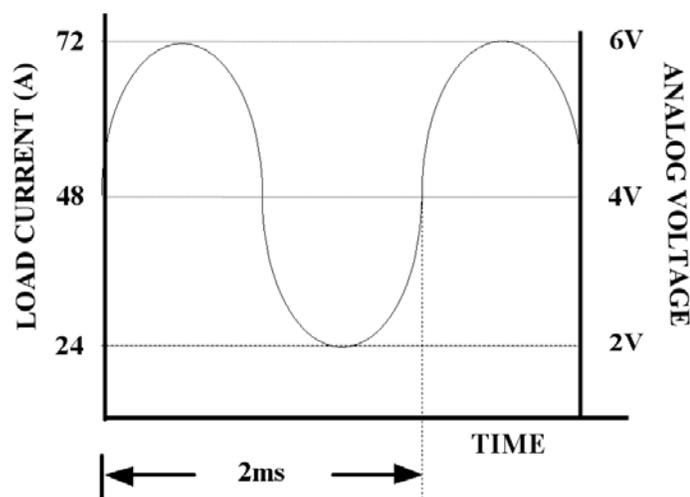


Figure 3-8 Analog Programming Load Current in CC Mode Operation

### 3.8 LOAD COARSE/FINE INCREASE/DECREASE ADJUSTMENT KEY

The load current step change or resolution is shown in Table 3-2 for each load module. After press the one of four load current adjustment keys for more than 1 second, the operating mode of the key become increase or decrease the load current resolution repeat automatically, and the load current will stop the load current change until releasing the press key or the load current setting is reaching the minimum or maximum setting.

<b>SLH-60-120-600</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	032.0 mA	3.2 mA	0.32 A	32.0 mA
CR Mode	53.33mS	0.533mS	13.3mΩ	0.133mΩ
CV Mode	0.16V	16mV	0.16V	16mV
CP Mode	1.6W	0.16W	1.6W	0.16W
<b>SLH-60-120-1200</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	32.0 mA	3.2 mA	0.32 A	32.0 mA
CR Mode	53.33mS	0.533mS	13.33mΩ	0.133mΩ
CV Mode	0.16V	16 mV	0.16V	16 mV
CP Mode	3.2W	0.32W	3.2W	0.32W
<b>SLH-60-120-1800</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	32.0 mA	3.2 mA	0.32 A	32 mA
CR Mode	53.33mS	0.533mS	13.33mΩ	0.133mΩ
CV Mode	0.16V	16 mV	0.16V	16 mV
CP Mode	4.8W	0.48W	4.8W	0.48W
<b>SLH-60-240-1200</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	64.0 mA	6.4 mA	0.64 A	64.0 mA
CR Mode	0.1067 S	1.066 mS	6.67mΩ	0.066mΩ
CV Mode	0.16 V	16 mV	0.16 V	16 mV
CP Mode	3.2W	0.32W	3.2W	0.32W
<b>SLH-60-240-1800</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	64.0 mA	6.4 mA	0.64 A	64.0 mA
CR Mode	0.1067 S	1.066 mS	6.67 mΩ	0.066 mΩ
CV Mode	0.16 V	16 mV	0.16 V	16 mV
CP Mode	4.8W	0.48W	4.8W	0.48W
<b>SLH-60-360-1800</b>	<b>RANGE I</b>		<b>RANGE 2</b>	
COARSE/FINE LOAD CURRENT ADJUSTMENT KEY	↑ ↓	↓ ↑	↑ ↓	↓ ↑
CC Mode	96.0 mA	9.6 mA	0.96 A	96.0 mA
CR Mode	0.166 S	1.66 mS	4.44 mΩ	0.044 mΩ
CV Mode	0.16 V	116 mV	0.16 V	16 mV
CP Mode	4.8W	0.48W	4.8W	0.48W

Table 3-2 Resolution of Range 1/2 vs Coarse/Fine Load Current Setting Keys

### 3.9 I-MONITOR

The I-monitor BNC is designed to monitor the Electronic load's input current or short current. An isolated amplifier output 0V to 10V full-scale signal indicates the zero to full-scale current for each Electronic load module.

The isolated voltage is 250V between load module and I-monitor BNC output, and it has the same ground potential with mainframe (i.e., GPIB ground potential).

The isolated I-monitor feature provides an ideal solution for power supply testing, it is designed to eliminate the ground problem while connecting I-monitor BNC and measure power supply output voltage to oscilloscope simultaneously, because the two or more input BNC terminals in the oscilloscope are not isolated.

This feature is also very useful while testing a dual or more outputs power supply which has positive and negative polarity output simultaneously, because the I-monitor output is isolated from each load module or each power supply output. It is convenient and free of ground problem while monitoring the current signal from the I-monitor BNC connector.

### 3.10 PROTECTION FEATURES



**CAUTION:** Never apply the AC line voltage or input voltage exceeding the rated voltage to the input terminals. It may cause damage of the electronic load module.

There are five protection functions for the SLH-Series DC electronic load: over-voltage, over-current, over-power, over-temperature and reverse polarity. When an electronic load exceeds the normal work area range, one of the above 4 functions will come to effect. When any one protection comes to effect, the load will be automatically be switch OFF to protect electronic load. Also, protection status is indicated by flickering to allow the user understand present condition.

- If the any of the five protection circuits is tripped, the electronic load input turns OFF immediately to protect the abnormal condition.
- The SLH-series DC electronic load will reset the Over voltage, Over current, Overpower and Over temperature protection if the protection condition is removed and the "LOAD" key is pressed to the "ON" state.

#### 3.10.1 Over Voltage

- The protection point of over voltage protection (OVP) is preset in the load. The activation values are shown in Table 3-3.
- When an over-voltage condition occurs, the OVP circuit is activated, and the upper 5-character monitor on the front panel of the electronic load flashes "oVP". The load will automatically go to a LOAD OFF state.
- Once the over voltage condition is reset, the upper 5-character monitor will resume normal operation.



**CAUTION:** The OVP circuit does not protect against severe over voltage conditions. Voltages above 60V, 400V and 900V applied across the input terminals of 60V-rated, 250V-rated and 500V-rated loads, respectively, will permanently damage the electronic load. This damage will require factory repair.

### 3.10.2 Over Current

- The protection point of over current protection (OCP) is preset in the load. The activation values of the OCP circuit are shown in Table 3-3.
- When an over-current condition occurs, the OCP circuit is activated, and the lower 5-character monitor on the front panel of the electronic load flashes “oCP”. The load will automatically go to a LOAD OFF state.
- Once the over current condition is reset, the lower 5-character monitor will resume normal operation.

### 3.10.3 Over Power

- The protection point of over power protection (OPP) is preset in the load. The activation values of the OPP circuit are shown in Table 3-3.
- When an over-power condition occurs, the OPP circuit is activated, and the upper 5-character monitor on the front panel of the electronic load flashes “oPP”. The load will automatically go to a LOAD OFF state.
- Once the over power condition is reset, the upper 5-character monitor will resume normal operation.

### 3.10.4 Over Temperature

- SLH-Series DC electronic loads also are designed with a temperature sensor(s) for over temperature protection (OTP). The activation values are shown in Table 3-3.
- When an over-temperature condition occurs, the OTP circuit is activated, and the lower 5-character monitor on the front panel of the electronic load flashes “otP”. The load will automatically go to a LOAD OFF state.
- When OTP occurs, please check the environment condition such as the ambient temperature and distance between the rear panel of Electronic load mainframe and wall is greater than 6in. / 15cm.
- Once the over temperature condition is reset, the lower 5-character monitor will resume normal operation.

<b>Model</b>	<b>OVP</b>	<b>OCP</b>	<b>OPP</b>	<b>OTP</b>
SLH-60--120-600	63V	126A	630W	85°C
SLH-60-120-1200	63V	126A	1260W	85°C
SLH-60-120-1800	63V	126A	1890W	85°C
SLH-60-240-1200	63V	252A	1260W	85°C
SLH-60-240-1800	63V	252A	1890W	85°C
SLH-60-360-1800	63V	378A	1890W	85°C

**Table 3-3 Summary of Over Protection Values**

### 3.10.5 Reverse Polarity

- The SLH-series DC electronic load conducts reverse current when the polarity of the DC source connection is incorrect. The maximum reverse current is the same as the maximum forward current.



**CAUTION:** If the reverse current exceeds the current rating, it may cause damage to the SLH-Series DC electronic Load.

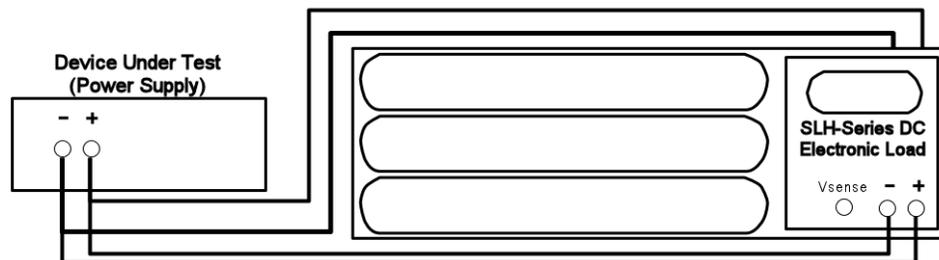
- When in the reverse condition, the reverse current is displayed on the 5-character Current Meter on the front panel, and the 5-character DAM indicates negative current reading, whenever the reverse current is displayed on the current meter, turn OFF power to the DC source and make the correct connections.

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## SECTION 4 CONNECTIONS AND APPLICATIONS

### 4.1 LOCAL SENSE CONNECTIONS

Figure 4-1 illustrates a typical set up with the electronic load connected to the DC power supply. Local sensing is used in application where lead lengths are relatively short, or where load regulation is not critical. The 4½-digit volt Meter of SLH-series DC electronic load measures the voltage of DC INPUT Terminal automatically; load leads should be bundled or tie-wrapped together to minimize inductance.



**Figure 4-1 Local Voltage Sense Connections**

## 4.2 REMOTE SENSE CONNECTIONS

Figure 4-2 illustrates a typical set up with the electronic load connected for remote sense operation. The remote V-sense BNC cable of the electronic load are connected to the output of the power supply. Remote sensing compensates for the voltage drop in applications that require long lead lengths.

The 4½-digit volt Meter of SLH-series DC electronic load measures the voltage of V-sense BNC input Terminal automatically, so the high accuracy 5-character voltage Meter can measure the specific points voltage of the power supply's output voltage.

Load leads should be bundled or tie wrapped together to minimize inductance.

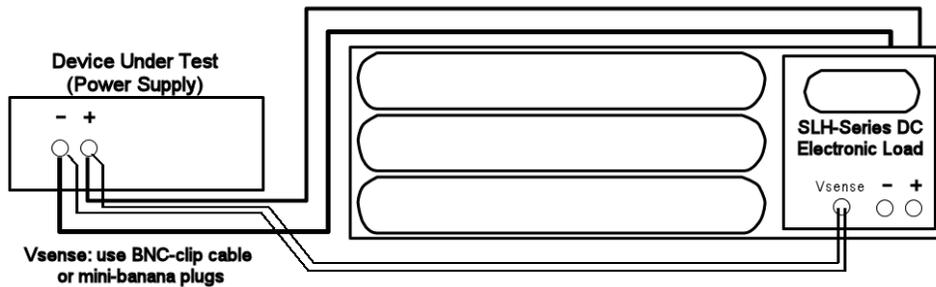


Figure 4-2 Remote Voltage Sense Connections

## 4.3 CONSTANT CURRENT (CC) MODE APPLICATION

The Constant Current mode is very suitable for testing the Load Regulation, Cross Regulation, Output Voltage and Dynamic Regulation of the power supply testing, and for testing the discharge characteristic and the life cycle of the Battery.

### 4.3.1 Static Mode:

Major application (see Figure 4-3):

- Voltage source testing.
- Power supply load regulation testing
- Battery discharge testing

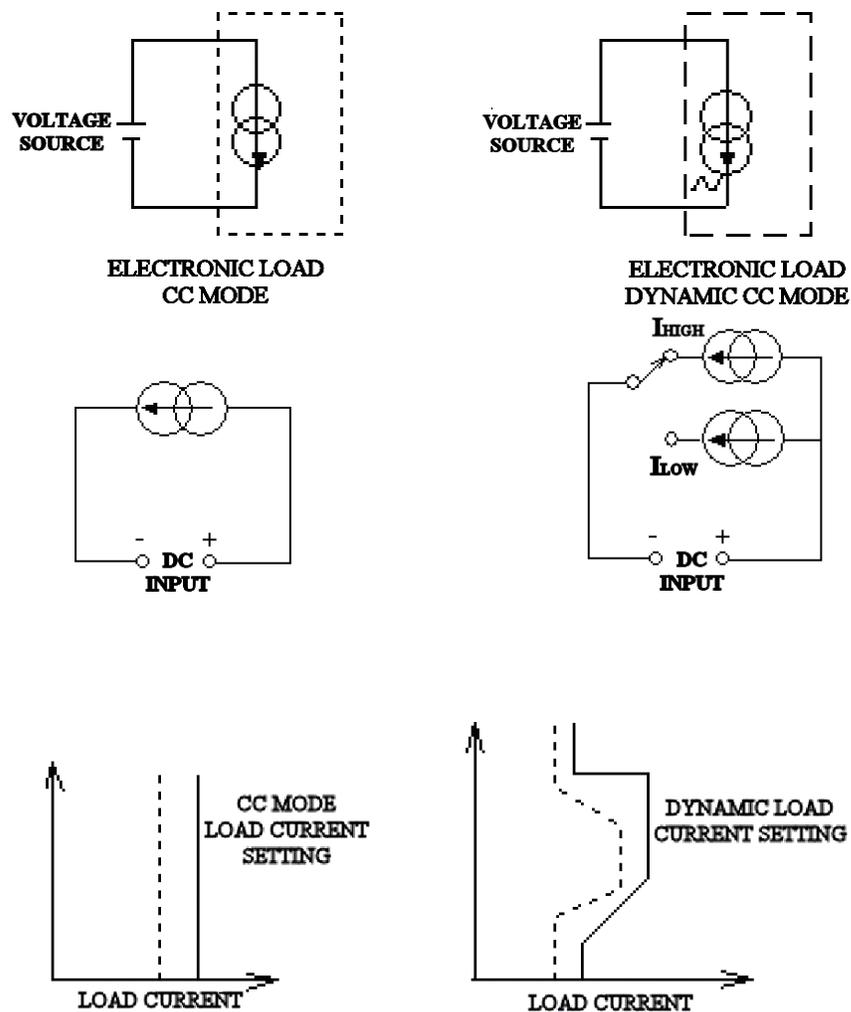


Figure 4-3 Constant Current Mode Application

## 4.3.2 Dynamic Mode:

**Built-in Pulse Generator:** (Fig 4-4)

**Major application:**

Power supply load transient response testing, power recovery time testing, pulse load simulation, power component testing

**Description:**

The maximum Rise/Fall current slew rate or minimum Rise/fall time is the time required for the load input to change from 10% to 90% or from 90% to 10% of the programmed High to Low load level.

- Rise slew rate =  $|I_{low} - I_{high}| / T_a$  (A/us)
- Fall slew rate =  $(I_{high} - I_{low}) / T_b$  (A/us)
- Rise time =  $T_a = |I_{low} - I_{high}| / \text{Rise slew rate}$
- Fall time =  $T_b = (I_{high} - I_{low}) / \text{Fall slew rate}$

**Major application:**

Simulate real load condition, Battery discharge testing

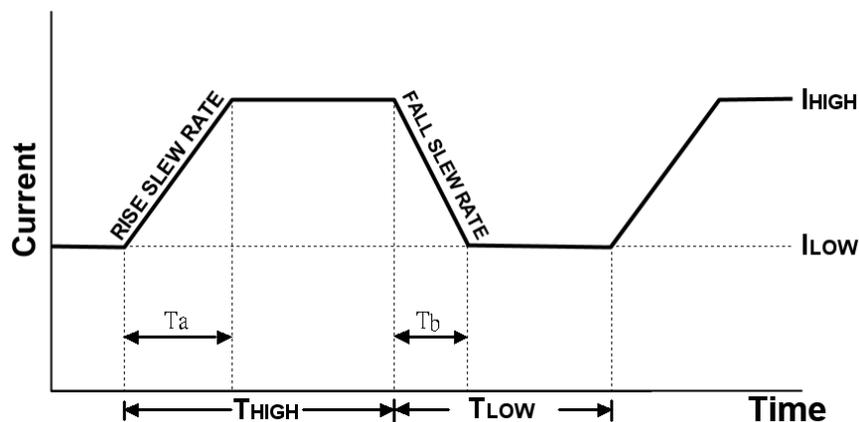


Figure 4-4 Dynamic Load Current with Independent Programmed Rise/Fall Slew Rate

## 4.4 CONSTANT VOLTAGE (CV) MODE APPLICATION

**Major applications:** Current source testing, power supply current limit characteristic testing

### Current Source Testing

Battery chargers are among the most common current sources; they are used to inputs current to a re-chargeable battery. The CV mode of electronic load can be used to simulate the terminal voltage of re-chargeable battery, to test the current being generated by the battery charger.

For example, CV mode can be used to first set voltage and read the charge current from the current meter on the load; then set CV voltage to 5V (example), then read the charge current again, this method is used to test the load regulation of a current source.

### Current Limit Testing

A lab power supply could use the fold-back current limit test for a switching power supply, to find the constant current limit curve. CV mode is effective for such testing.

For example, the user can set CV voltage, record the output current, then run a series of voltage and current to get an output current limit curve (Figure 4-5) of a power supply.

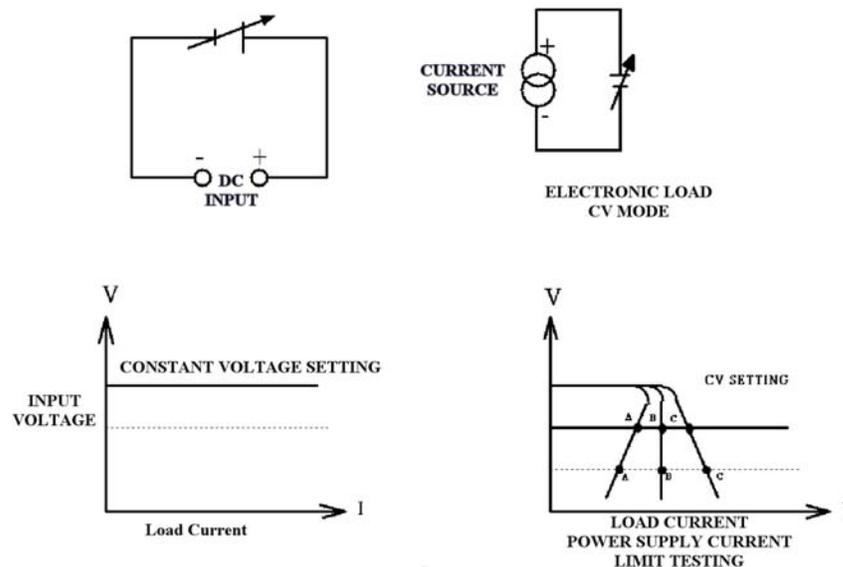


Figure 4-5 Constant Voltage Mode Application

## 4.5 CONSTANT RESISTANCE (CR) MODE APPLICATION

**Major applications:** Voltage source testing, current source testing, power supply power-up sequence

CR mode can be used in conjunction with CC mode when testing switching power supplies, to avoid shutdown.

For example, if CC mode alone were used in test set up, a 5V/50A output power supply cannot deliver 50A over its start-up range of 0-5 volts. In many cases, the power supply short circuit or over current protection circuit will shut the power supply down because it can't deliver enough current at low voltage. This is due to the power supply trying to deliver 50A at 2V because the load is in CC mode.

Therefore, when testing a power supply, the CR mode can be used to allow the power supply voltage and current to ramp up together. After ramp-up the CC mode should be used to complete testing. The need for manually switching from the CR to the CC mode is eliminated with SLH-series DC electronic loads. They can be programmed with proper current and slew rate in the CC mode, which allows a power supply to reach its specified output condition in the CC load mode.

**Note:** Vsense input should be connected when running in CR mode to avoid resistance variation due to the cable resistance.

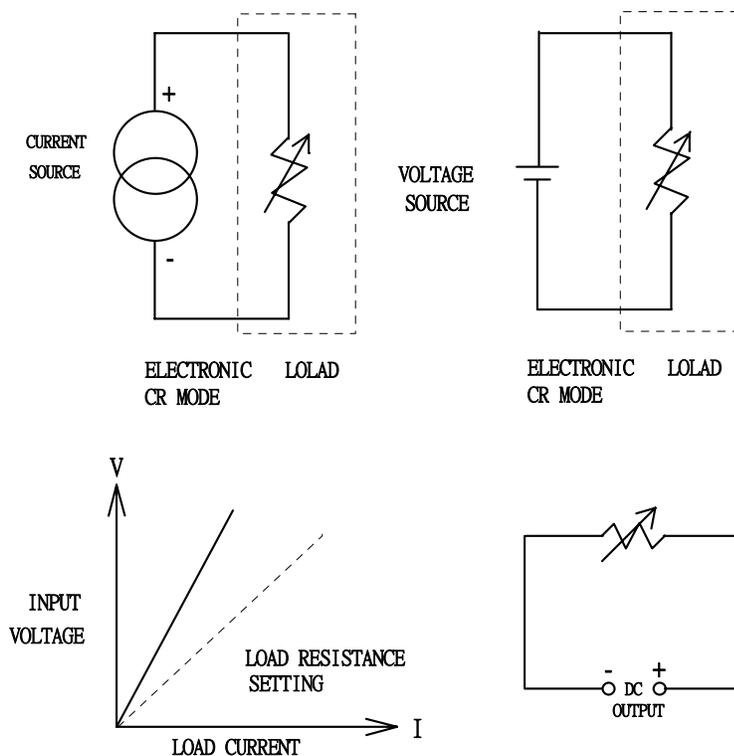


Figure 4-6 Constant Resistance Mode Application

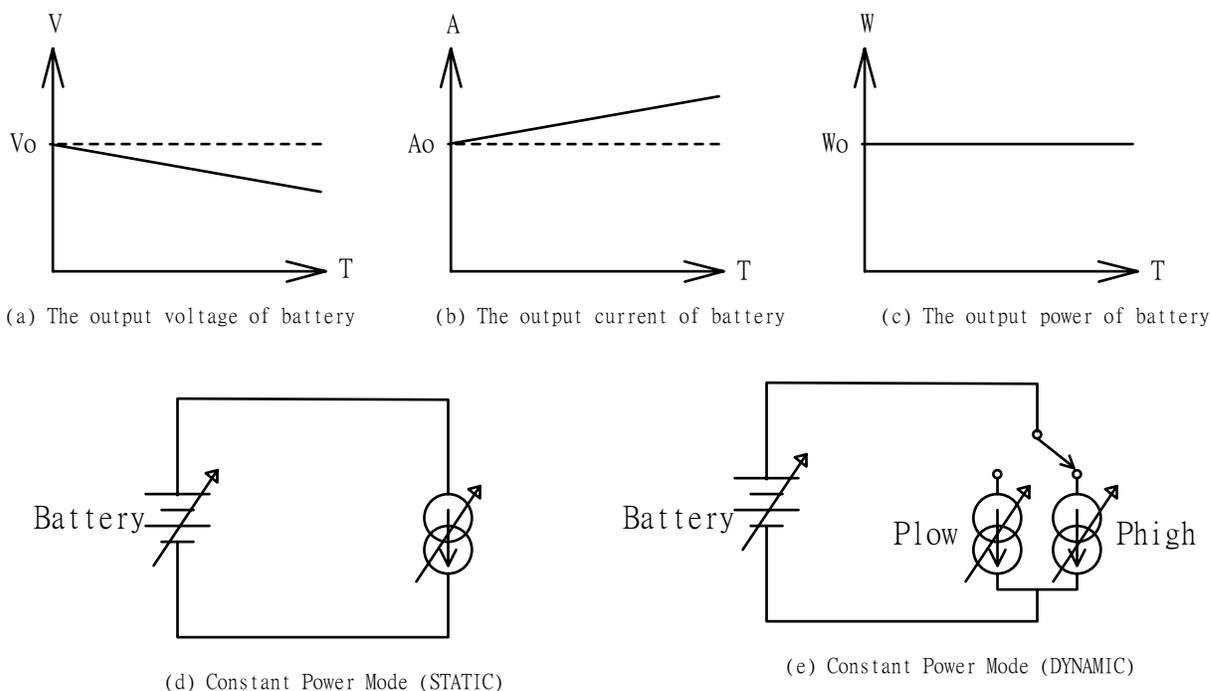
## 4.6 CONSTANT POWER (CP) MODE APPLICATION

**Major Application:** Test and evaluate a battery's energy capacity.

Primary or secondary battery is the power source for every portable electronics product, such as notebook computer, video camera, etc. A typical sequence of battery output is where the output voltage of battery begins to drop (Figure 4-7a) according to the output current and usage duration. (Figure 4-7b); however, it should provide a stable power output regardless of output voltage (Figure 4-7c), therefore, the energy capacity (output power x time) is one of the most important factors in evaluating a battery.

In CP mode, the SLH-series DC electronic load can sink constant power load for a battery; the load current increases as the battery's output voltage drops; the load power will remain equal to the load power setting of CP mode (Figure 4-7d), the SLH-series DC electronic load in CP mode with time record can be used to evaluate the energy capacity or discharge life time of a battery.

Moreover, the real power could be a dynamic loading condition. The SLH-series DC CP mode can be operated in Dynamic power load as well, setting the STA/DYN to DYN on the front panel or remote programming, SLH-series DC load can sink dynamic power waveform to test the dynamic characteristics of battery (Figure 4-7e).



**Figure 4-7 Constant Power Mode Application**

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# SECTION 5 REMOTE PROGRAMMING

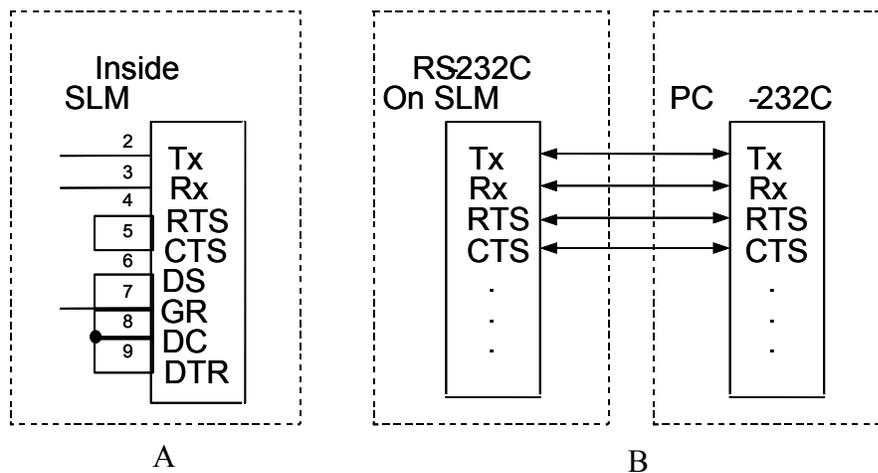
The rear panel of the SLH mainframe is designed to connect with a PC (Personal Computer) or NOTEBOOK PC through GPIB or RS-232C interfaces.

## 5.1 RS-232C INTERFACE AND COMMANDS

The following RS-232C commands are the same as GPIB commands. The RS-232C protocol in SLH mainframe is listed as follows:

Baud Rate	9600
Parity	none
Data bit	8 bits
Stop bit	1 bit
Command delay time	20 msec.

The connections for the rear panel RS-232C interface are shown below; Figure 5-1-A depicts the connector wire diagram, and Figure 5-1-B depicts the connections using a standard RS-232C cable.



**Figure 5-1 RS-232C Interface Diagram**

## 5.2 GPIB/RS-232C COMMAND LIST

### 5.2.1 Command Syntax Abbreviations

- SP** :Space, the ASCII code is 20 Hexadecimal.  
**;** :Semicolon, Program line terminator, the ASCII code is 0A Hexadecimal.  
**NL** :New line, Program line terminator, the ASCII code is 0A Hexadecimal.  
**N** :Integer from 1 to 8.  
**NR2** :Digits with decimal point. It can be accepted in the range and format of **##.#####**.

**Example:** 30.12345, 5.0

#### Description of GPIB Programming Command Syntax.

- { }** :The contents of the { } symbol must be used as a part or data of the GPIB command, it can not be omitted.  
**[ ]** :The contents of the [ ] symbol indicates that the command is optional, depending on the testing application.  
**|** :This symbol means to make a choice between one or the other. For example “HIGH|LOW” means it can only use HIGH or LOW as the command, but one of the choices must be used.  
**Terminator** The program line terminator character must be sent after the GPIB command; the available command terminator characters that can be accepted in the SLH mainframe are listed in Table 5-1.

LF
LF WITH EOI
CR, LF
CR, LF WITH EOI

**Table 5-1 GPIB Command Terminator**

A terminator informs GPIB that it has reached the end of statement. Normally, this is sent automatically by your GPIB programming statements. In this manual, the terminator is assumed at the end of each example line of code. If it needs to be indicated, it is shown by symbol (nl); which stand for “new line” and represents ASCII code byte the 0A Hexadecimal or 10 decimal.

Semicolon “;”: “ The semicolon “;” is a back-up command, the semicolon allows you to combine command statements on one line to create command message.

Table 5-2 presents a summary of the GPIB/RS-232 Setting commands, and Table 5-3 summarizes the GPIB/RS-232 preset Query commands with applicable module types. Table 5-4 is a summary of State commands, the System commands are in Table 5-5, Measure and Limit commands are in Table 5-6, and the Global commands are in Table 5-7.

Setting Preset Numeric Command	Model			Remark
	SLH DC	SLD	SLH AC	
[PRESet:] RISE{SP}{NR2}{; NL}	•			
[PRESet:] FALL{SP}{NR2}{; NL}	•			
[PRESet:] SLEWrate{SP}{NR2}{; NL}		•		
[PRESet:] PERIod:{HIGH LOW}{SP}{NR2}{; NL}	•	•		
[PRESet:] LDONv{SP}{NR2}{; NL}	•	•		
[PRESet:] LDOFfv{SP}{NR2}{; NL}	•	•		
[PRESet:] CC{SP}{NR2}{; NL}		•		
[PRESet:] CC:{A B}{SP}{NR2}{; NL}			•	
[PRESet:] CC:{HIGH LOW}{SP}{NR2}{; NL}	•	•		
[PRESet:] CP:{HIGH LOW}{SP}{NR2}{; NL}	•			
[PRESet:] CR{SP}{NR2}{; NL}		•		
[PRESet:] CR:{A B}{SP}{NR2}{; NL}			•	
[PRESet:] CR:{HIGH LOW}{SP}{NR2}{; NL}	•			
[PRESet:] CV:{HIGH LOW}{SP}{NR2}{; NL}	•			
[PRESet:] CV{SP}{NR2}{; NL}		•		

Table 5-2 GPIB/RS-232 Setting Command Summary

Query Preset Numeric Command	RETURN
[PRESet:] RISE{?}{; NL}	###.####
[PRESet:] FALL{?}{NR2}{; NL}	###.####
[PRESet:] SLEWrate{?}{; NL}	###.####
[PRESet:] PeRIod:{HIGH LOW}{?}{; NL}	###.####
[PRESet:] LDONv{?}{; NL}	###.####
(PRESet:] LDOFfv{?}{; NL}	###.####
(PRESet:] CC{?}{; NL}	###.####
(PRESet:] CC:{HIGH LOW}{?}{; NL}	###.####
(PRESet:] CP:{HIGH LOW}{?}{; NL}	###.####
[PRESet:] CR{?}{; NL}	###.####
[PRESet:] CR:{HIGH LOW}{?}{; NL}	###.####
[PRESet:] CV:{HIGH LOW}{?}{; NL}	###.####
[PRESet:] CV{?}{; NL}	###.####

Table 5-3 GPIB/RS-232 Preset Query Command Summary with Applicable Module Types

STATE Command	RETURN
[STATe:] LOAD{SP}{ON OFF}; NL}	
[STATe:] LOAD{?}; NL}	0=OFF, 1=ON
[STATe:] MODE{SP}{CC CR CV CP}; NL}	
[STATe:] MODE{?}; NL}	0=CC, 1=CR 2=CV, 3=CP
[STATe:] SHORt{SP}{ON OFF}; NL}	
[STATe:] SHORt{?}; NL}	0=OFF, 1=ON
[STATe:] PRESet{SP}{ON OFF}; NL}	
[STATe:] PRESe{?}; NL}	0=OFF, 1=ON
[STATe:] SENSE{SP}{ON OFF}; NL}	
[STATe:] SENSE{?}; NL}	0=OFF, 1=ON
[STATe:] LEVEl{SP}{HIG LOW AIB}; NL}	
[STATe:] LEVEl{?}; NL}	0=LOW, 1=HIGH
[STATe:] RANG{?}; NL}	1=AUTO, 2=RANGE II
[STATe:] DYNAmic{SP}{ON OFF}; NL}	
[STATe:] DYNAmic{?}; NL}	0=OFF, 1=ON
[STATe:] WATT{SP}{ON OFF}; NL}	
[STATe:] WATT{?}; NL}	0=OFF, 1=ON
[STATe:] CLear; NL}	
[STATe:] ERRor{?}; NL}	Dddddddd
[STATe:] NG{?}; NL}	0=OK, 1=NG
[STATe:] PROTEct{?}; NL}	Dddddddd

Table 5-4 State Command Summary

COMMAND	NOTE	RETURN
[SYStem:] RECall{SP}{m[,n]}; NL}	M=1~5 n=1~30	
[SYStem:] STORe{SP}{m[,n]}; NL}	M=1~5 n=1~30	
[SYStem:] REMOTE; NL}	Only RS232 cmd	
[SYStem:] LOCAL; NL}	Only RS232 cmd	0=:OFF, 1=:ON
[SYStem:] NAME{?}; NL}		"XXXXXX"

Table 5-5 System Commands - All Modules

COMMAND	SLH DC	RETURN
MEASure:CURRent {?}; NL}	•	###.####
MEASure:VOLTagE {?}; NL}	•	###.####
LIM:CURRent:{HIGH LOW}{SP}{NR2}; NL}	•	
LIM:CURRent:{HIGH LOW}{?}; NL}	•	###.####
LIM:POWer:{HIGH LOW}{SP}{NR2}; NL}	•	
LIM:POWer:{HIGH LOW}{?}; NL}	•	###.####
LIM:VOLTagE:{HIGH LOW}{SP}{NR2}; NL}	•	
LIM:VOLTagE:{HIGH LOW}{?}; NL}	•	###.####

Table 5-6 Measure and Limit Commands

COMMAND	SLH DC	RETURN
GLOBAL:[STATe:] PRESet{SP}{ON OFF}; NL}	•	
GLOBAL:[STATe:] LOAD{SP}{ON OFF}; NL}	•	
GLOBAL:[STATe:] MODE{SP}{ON OFF}; NL}	•	
GLOBAL:[STATe:] SHORt{SP}{ON OFF}; NL}	•	
GLOBAL:[STATe:] DYNamic{SP}{ON OFF}; NL}	•	
GLOBAL:[STATe:] LEVEL{SP}{HIGH LOW}; NL}	•	
GLOBAL:[STATe:] CC{SP}R2; NL}	•	
GLOBAL:MEASure:CURRent{?}; NL}	•	###.##
GLOBAL:MEASure:VOLtagE{?}; NL}	•	###.##

Table 5-7 Global Commands

**REMARKS:**

1. d : 0 - 9
2. GLOB : GLOBAL (ALL CHANNELS ACTIVE AT SAME TIME)
3. CURRENT ENGINEERING UNIT : A
4. VOLTAGE ENGINEERING UNIT : V
5. RESISTANCE ENGINEERING UNIT :  $\Omega$
6. PERIOD ENGINEERING UNIT : mS
7. SLEW-RATE ENGINEERING UNIT : A/ $\mu$ S

**Note:** The RS-232 command set is the same as the GPIB command set.

## 5.3 GPIB/RS-232 COMMAND DESCRIPTION

### 5.3.1 Setting Commands

#### **CURRENT Level**

**Purpose:**

The load current setting in Constant Current mode.

**Command Syntax:**

CC:{LOW|HIGH}{SP}{NR2}{;|NL}

**Description:**

CC:{LOW|HIGH}{SP}{NR2}{;|NL}

**Note:**

- a. The load current data must include the decimal point; otherwise, this command will not execute. The load current level can be programmed up to the sixth place after the decimal point.
- b. The HIGH level load current **MUST** be higher than the LOW level load current (and vice versa) for proper dynamic waveform definition; if not, the SLH-series Electronic Load will adjust and limit the programmed values to be equal. The adjustment matches the second input value to the first input value.  
This means that if the value for the LOW level is input first, and then the HIGH level value is input as less than the programmed LOW level, the SLH-series load module will adjust the HIGH level to be equal to the LOW level. If the value for the HIGH level is input first and the LOW level value is input as higher than the programmed HIGH level, the SLH-series load module will adjust the LOW level to be equal to the HIGH level.
- c. If the programmed load current level is over the maximum rated specification, the full scale current will be sent to the load module.
- d. Engineering unit for load current is Amps.
- e. Please refer to Appendices proper programming procedure of SLH-series electronic load.

**Example:**

CC:LOW 1.8 set LOW level load current to 1.8 A.

CC:HIGH 25.123456 set HIGH level load current to 25.123456 A.

#### **RESISTANCE Level**

**Purpose:**

The load resistance setting in Constant Resistance mode.

**Command Syntax:**

CR:{HIGH|LOW}{SP}{NR2}{;|NL}

**Description:**

CR:{HIGH|LOW}{SP}{NR2}{;|NL}

**Note:**

- a. The load resistance data must include the decimal point; otherwise, this command will not execute. The load resistance level can be programmed up to the sixth place after the decimal point.
- b. The HIGH level load resistance **MUST** be higher than the LOW level load resistance

(and vice versa) for proper dynamic waveform definition; if not, the SLH-series Electronic Load will adjust and limit the programmed values to be equal. The adjustment matches the second input value to the first input value.

This means that if the value for the LOW level is input first, and then the HIGH level value is input as less than the programmed LOW level, the SLH-series load module will adjust the HIGH level to be equal to the LOW level. If the value for the HIGH level is input first and the LOW level value is input as higher than the programmed HIGH level, the SLH-series load module will adjust the LOW level to be equal to the HIGH level.

- c. If the programmed load resistance level is over the maximum rated specification, the full scale resistance will be sent to the load module.
- d. Engineering unit for load resistance is Ohms.
- e. Please refer to the Appendix for the programming flow chart for the SLH-series electronic load.

**Example:**

CR:LOW 0.123 set LOW level load resistance to 0.123 OHM.

CR:HIGH 3.456789 set HIGH level load resistance to 3.456789 OHM.

**VOLTAGE Level****Purpose:**

The load voltage setting in Constant Voltage mode.

**Command Syntax :**

CV:{HIGH|LOW}{SP}{NR2}{;|NL}

**Description:**

CV:{HIGH|LOW}{SP}{NR2}{;|NL}

**Notes:**

- a. The load voltage data must include the decimal point; otherwise, this command will not execute. The load voltage level can be programmed up to the sixth place after the decimal point.
- b. The HIGH level load voltage MUST be higher than the LOW level load voltage (and vice versa) for proper dynamic waveform definition; if not, the SLH-series Electronic Load will adjust and limit the programmed values to be equal. The adjustment matches the second input value to the first input value.  
This means that if the value for the LOW level is input first, and then the HIGH level value is input as less than the programmed LOW level, the SLH-series load module will adjust the HIGH level to be equal to the LOW level. If the value for the HIGH level is input first and the LOW level value is input as higher than the programmed HIGH level, the SLH-series load module will adjust the LOW level to be equal to the HIGH level.
- c. If the programmed load voltage level is over the maximum rated specification, the full scale voltage will be sent to the load module.
- d. Engineering unit for load current is Volts.
- e. Please refer to Appendix for proper programming procedure of SLH-series electronic load modules.

**Example:**

CV:LOW 3.0 set LOW level load voltage to 3.0 V.

CV:HIGH 45.123456 set HIGH level load voltage to 45.123456 V.

**POWER Level****Purpose:**

The load power setting in Constant Power mode.

**Command Syntax:**

CP:{HIGH|LOW}{SP}{NR2}{;|NL}

**Description:**

This command is used to set the load Power level of electronic load modules.

**LOAD ON/OFF****Purpose:**

Turn the Electronic load module input ON or OFF.

**Command Syntax:**

LOAD{SP}{OFF|ON}{NL}

**Description:**

This command sets the Electronic load to sink current from power source.

**For Example :**

LOAD OFF ; load are at input OFF condition.

LOAD ON ; Set load to LOAD ON status, this load is ready to sink current from the power source.

**LOAD ON VOLTAGE Setting****Purpose:**

The Load ON voltage setting (Initial is 1.0V) of DC electronic load.

**Command Syntax:**

LDON{SP}{NR2}{;|NL}

**Description:**

The Load On voltage can be adjusted by the LDON command. The range is 0.1-25.0 V (Resol. = 0.1V). The load will start to sink current if power source output voltage is higher than Load On voltage.

**For Example:**

LDON 2.5; Set the Load On voltage to 2.5V, The load will start to sink current when the power source output voltage is higher than 2.5V.

**LOAD OFF VOLTAGE Setting****Purpose:**

The Load OFF voltage setting (Initial is 0.5V) of DC electronic load.

**Command Syntax:**

LDOF{SP}{NR2}{;|NL}

**Description:**

The Load Off voltage can be adjusted by the LDOF command; the adjust range is 0.1-load on voltage (Resol. = 0.1V). The load will stop to sink current if power source output voltage is lower than Load Off voltage.

**For Example :**

LDOF 2.0 ; Set the Load Off voltage to 2.0V. The load will start to sink current when power source output voltage is lower than 2.0V.

**LEVEL HIGH/LOW****Purpose:**

Select Low or High level in static mode, of DC electronic loads.

**Command Syntax:**

```
LEVE {SP}{HIGH|LOW}{NL}
```

**Description:**

LEVE LOW is Set LOW current level in CC mode, LOW resistance level in CR mode, or LOW voltage level in CV mode at the active load channel.

LEVE 1 is Set HIGH current level in CC mode, HIGH resistance level in CR mode, or HIGH voltage level in CV mode at the active load channel.

**PRESET ON/OFF****Purpose:**

Set the upper or lower digit multi-function meter to display the programmed load level.

**Command Syntax:**

```
PRES{SP}{0|1|OFF|ON}{NL}
```

**Description:**

PRES ON is set the load to preset on status.

**MODE****Purpose:**

Select the operating mode of Electronic load module.

**Command Syntax:**

```
MODE{SP}{0|1|2|3|CC|CR|CV|CP}{NL}
```

**Description:**

MODE CC ; set the presently operating mode to Constant Current mode for all of the load module in the SLH mainframe.

MODE CV ; set the presently operating mode to Constant Voltage mode.

MODE 1 ; set the presently operating mode to Constant Resistance mode.

MODE CP ; set the presently operation mode to Constant Power mode.

**CLEAR status register****Purpose:**

CLear the PROT and ERR status byte registers.

**Command Syntax:**

```
All Modules:          CLER{NL}
```

**Description:**

CLER ; clear the PROT and ERR status byte register, the PROT and ERR status byte register will indicate "0" after executing the CLER command.

## **STORE**

**Purpose:**

STORE the load level and load status into the memory of the SLH-series electronic load.

**Command Syntax:**

STOR{SP}{m[,n]};|NL}

**Description:**

Parameter m is 1~5 for 5 different states with electronic load's status and load current into the non-volatile memory.

Parameter n is 1-30 for 30 memory bank for 150 (m\*n) different state with DC electronic load module's load status and load current into memory in the electronic loads.

**Example:**

STORE 2,30; store the DC electronic load module's load status and load current into the memory 147.

## **RECALL**

**Purpose:**

Recall the state of load level and status, is stored by the GPIB/RS232 STORe command.

**Command Syntax:**

REC{SP}{m[,n]};|NL}

**Description:**

This command is used to recall the memory state, which is stored into memory by the GPIB/RS232 STORe command. Up to 150 states can be recalled for DC electronic load modules.

**Example:**

REC 2,30; Recall the state of load level and status that is stored in memory 147 by GPIB/RS232 STOR command.

REC 147; Recall the state of load level and status that is stored in memory 147 by GPIB/RS232 STOR command.

## **VOLTAGE Limit**

**Purpose:**

To set the upper/lower limit value of threshold voltage.

**Command Syntax:**

LIM:VOLT:{HIGH|LOW}{SP}{NR2};|NL}

**Description:**

This command is to set the upper/lower limit value of threshold voltage. When input voltage is lower than the lower limit value or higher than the upper limit value, NG indicating light will come on to indicate "NO GOOD."

**Example:**

LIM:VOLT:LOW 1.0 ; To set the lower limit value of threshold voltage to 1.0 V.

LIM:VOLT:HIGH 200.0 ; To set the upper Limit vale of threshold voltage to 200.0V.

## **CURRENT Limit**

**Purpose:**

To set the upper/lower limit value of threshold current.

**Command Syntax:**

```
LIM:CURR{HIGH/LOW}{SP}{NR2}{;|NL}
```

**Description:**

This command is to set the lower limit value of threshold current. When load sink current is lower than this lower limit value or higher than the upper limit value, NG indicating light will come on to indicate "NO GOOD."

**Example:**

LIM:CURR:LOW:0.05 ; To set the lower limit value of threshold current to 0.05A.

LIM:CURR:HIGH:10.0 ; To the upper limit value of threshold current to 10.0A.

## **POWER Limit**

**Purpose:**

To set the upper/lower limit value of threshold power (W).

**Command Syntax:**

```
LIM:POW:{HIGH|LOW}{SP}{NR2}{;|NL}
```

**Description:**

This command is to set the upper/lower limit value of threshold power (WATT). When power (WATT) is lower than this lower limit value or higher than the upper limit value, NG indicating light will come on to indicate "NO GOOD."

**Example:**

LIM:POW:LOW 0.05 ; To set the lower limit value of threshold power (W) to 0.05 W.

LIM:POW:HIGH 250.0 ; To set the upper limit value of threshold power(W) to 250.0 W.

## **PERIOD**

**Purpose:**

Set the Tlow/Thigh duration of dynamic load in Constant Current mode.

**Command Syntax:**

```
PERI:{LOW|HIGH}{SP}{NR2}{NL}
```

**Description:**

The PERiod of dynamic waveform is composed by Tlow and Thigh. The PERIOD LOW and HIGH data must include decimal point, otherwise this command will not execute.

The value for PERIOD LOW and HIGH can be programmed up to the sixth place after the decimal point. If the period of Tlow and Thigh setting is over the maximum specification at programmed range of load module, the maximum duration of Tlow and Thigh will be sent to the load module.

Please verify the appropriate timer range before executing the load PERI LOW or HIGH command, otherwise the PERI load module will adjust to fit the Tlow and Thigh ranges after programming the PERI LOW or HIGH command. The engineering unit for PERI LOW and HIGH is "ms."

**Note:**

1. There are four timer ranges in the Tlow / T high generator to produce a wide period

dynamic range, these ranges are adjusted by the load module automatically which depends on the programmed Flow / Thigh range.

**Example:**

PERI:LOW 0.125;PERI:HIG 0.8

Set the LOW dynamic load duration to 0.125 ms, and the HIGH dynamic load duration to 0.8 ms.

**RISE Time****Purpose:**

RISE load current slew rate setting.

**Command Syntax:**

RISE{SP}{NR2}{NL}

**Description:**

The RISE load current slew rate of load level change or dynamic load can be programmed by RISE command. The RISE slew rate of SLH-series DC electronic load modules can be fully independent from the FALL slew rate.

The RISE load current slew rate data must include a decimal point, otherwise this command is will not execute.

The value for the RISE load current slew rate can be programmed up to sixth place after the decimal point. If the programming load current level is over the maximum specification at the programmed range of SLH DC series load module, the fastest RISE slew rate will be sent to the load module. Please verify the Range 1/2 command before execute the load RISE slew rate setting command, otherwise the SLH DC load module will adjust to fit the RISE slew rate after programming the RISE command. The engineering unit for RISE slew rate is "A/us."

**Example:**

RISE 1.25 set RISE slew rate to 1.25 A/us.

**FALL Time****Purpose:**

FALL load current slew rate setting.

**Command Syntax:**

FALL{SP}{NR2}{NL}

**Description:**

Programs the FALL load current slew rate of load level change or dynamic load. The FALL slew rate of SLH DC electronic load modules can be fully independent of the RISE slew rate.

The FALL load current slew rate data must include a decimal point, otherwise this command will not execute. The value for FALL load current slew rate can be programmed up to the sixth place after the decimal point. If the programming load FALL slew rate is over the full-scale specification, the fastest FALL slew rate will be sent to the load module. Please verify the Range 1/2 command before executing the load FALL slew rate setting command, otherwise, the load module will adjust to fit the FALL slew rate after programming the FALL command.

The engineering unit for FALL slew rate is "A/μs".

**Example:**

FALL 0.124 set FALL slew rate to 0.124 A/μs.

### **SHORT ON/OFF**

**Purpose:**

Short the DC input of Electronic load module.

**Command Syntax:**

SLH DC, SLD Modules: [GLOB:]SHOR{SP}{0|1|OFF|ON}{NL}

**Description:**

This command applies the short across the input of the Electronic load. Executing SHOR does not affect any programmed settings and the Electronic load will return to those settings when the short is removed.

**Example:**

SHOR ON ; set load input to short state.

SHOR OFF ; set load input short open state.

### **SENSE ON/OFF**

**Purpose:**

Set the voltage sense AUTO/ON or OFF of Electronic load.

**Command Syntax:**

SENS{SP}{0|1|OFF|ON}{NL}

**Description:**

Set the Vsense inputs Off or On. If Vsense is set to Off, voltage measurement is taken at the load input terminals. On SLH-series DC loads, Vsense is auto/off or on. If it is set to auto/off, the module will measure the Vsense input if the voltage is greater than 1V (on 60V models).

**Example:**

SENS ON set all load V-sense input to sense AUTO.

SENS OFF set load V-sense input to sense OFF state.

### **DYNAMIC ON/OFF**

**Purpose:**

Set DYNamic ON or OFF command.

**Command Syntax:**

DYN{SP}{0|1|OFF|ON}{NL}

**Description:**

DYN OFF ; set the load to static load mode.

DYN 1 ; set load to dynamic load mode.

## 5.3.2 Query Commands

### **CURRENT Level**

**Purpose:**

The Constant Current mode's load current level query command.

**Command Syntax:**

CC:{HIGH|LOW}{?}{NL}

**Description:**

CURR:LOW? return the presently programmed low load current level in Constant Current mode of SLH-series electronic load.

### **RESISTANCE Level**

**Purpose:**

The Constant Resistance mode's load resistance level query command.

**Command Syntax:**

CR:{HIGH|LOW}{?}{;|NL}

**Description:**

RES:LOW? returns the presently programmed low load resistance level in Constant Resistance mode of SLH-series DC electronic load.

The engineering unit is "OHM".

### **VOLTAGE Level**

The Constant Voltage mode's load voltage level query command.

**Command Syntax:**

CV:{LOW|HIGH}{?}{NL}

**Description:**

CV:LOW? return the presently programmed low load voltage level in Constant Voltage mode of SLH DC electronic load.

CV:HIGH? return the presently programmed high load voltage level in Constant Voltage mode of SLH DC electronic load.

The engineering unit is "V".

### **POWER Level**

The Constant Power mode's load power level query command.

**Command Syntax:**

CP:{LOW|HIGH}{?}{NL}

**Description:**

CP:LOW? return the presently programmed low load power level in Constant Power mode of SLH DC electronic load.

CP:HIGH? return the presently programmed high load power level in Constant Power mode of SLH DC electronic load.

The engineering unit is "W".

### **LOAD ON/OFF**

**Purpose:**

LOAD ON or LOAD OFF status query command.

**Command Syntax:**

LOAD?{NL}

**Description:**

LOAD? returns the present load status, "0" indicates LOAD OFF, and "1" indicates LOAD ON.

**LOAD ON Voltage****Purpose:**

LOAD ON voltage level query command.

**Command Syntax:**

LDON?{;|NL}

**Description:**

LDON? returns the present load on voltage of SLH-series electronic load module.

**LOAD OFF Voltage****Purpose:**

LOAD OFF voltage level query command.

**Command Syntax:**

LDOF?{;|NL}

**Description:**

LDOF? returns the present load off voltage of SLH-series electronic load module.

**LEVEL HIGH/LOW****Purpose:**

Static mode's LEVEL low or high status query command or active LEVEL of AC electronic load query command.

**Command Syntax:**

LEVE?{NL}

**Description:**

LEVE? returns the present level status, "0" indicates LEVEL LOW, and "1" indicates LEVEL HIGH.

**PRESET ON/OFF****Purpose:**

PRESet ON or OFF status query command.

**Command Syntax:**

PRES?{NL}

**Description:**

PRES? returns the present preset status, "0" indicates PRESet OFF, and "1" indicates PRESet ON.

**MODE****Purpose:**

CC, CR, CV or CP operating mode query command.

**Command Syntax:**

MODE?{NL}

**Description:**

MODE? returns the present operating mode status, "0" indicates CC MODE, "1" indicates CR MODE, and "2" indicates CV MODE, "3" indicates CP MODE.

**NAME****Purpose:**

Electronic Load model number query command.

**Command Syntax:**

All Modules:               NAME?{NL}

**Description:**

NAME? return the electronic load's model number.

**PROTECTION Status Register****Purpose:**

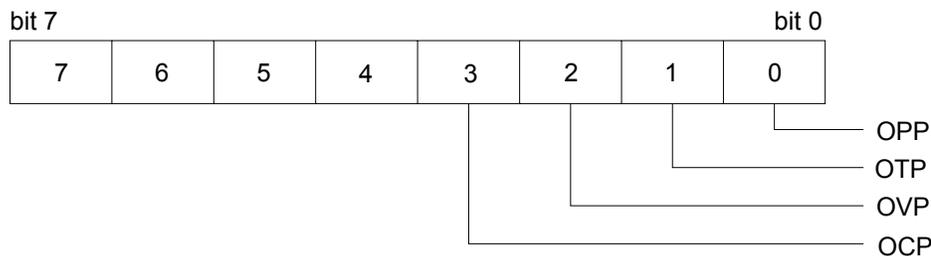
OPP, OTP, OVP, and OCP protection status query command.

**Command Syntax:**

All Modules:               PROT?{NL}

**Description:**

PROT? returns the present protection status; the status byte register summarizes all of the protection status events from all status register. the following figure describes the status byte the happened on the SLH-series Electronic load. The PROT status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.



**Figure 5-2 Protection Status Register**

**ERROR Status Register****Purpose:**

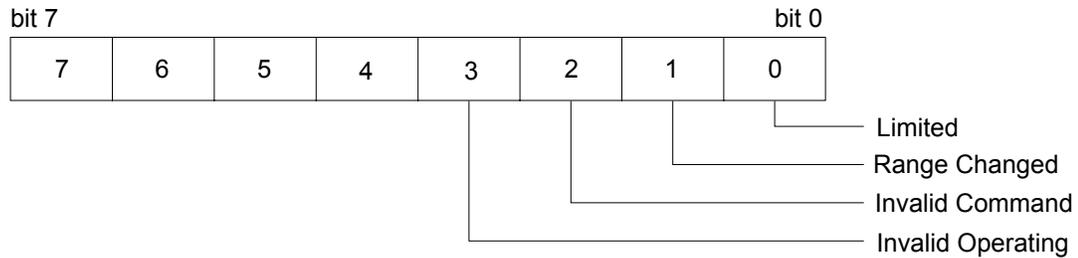
ERRor status register query command.

**Command Syntax:**

All Modules:               ERR?{;|NL}

**Description:**

ERR? returns the present error status; the status byte register summarizes all of the error status events from all status registers. the following figure describes the status byte the happened on the SLH-series electronic load. The ERR status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.



**Figure 5-3 Error Status Byte Register**

**bit 0: Limited**

This bit set to high by Electronic Module Load setting command causing over range. Reset by CLER command.

**Example:**

SLH-60-30-150  
MODE CC  
RANG 1

CURR:HIGH 20.0  
setting current = 20.0 A  
actual setting current = 3.071 A  
bit 0 will set to high

**bit 1: Range Changed**

This bit set to high by Electronic Module Load setting command causing change range. Reset by CLER command.

**Example:**

SLH-60-30-150  
FALL 0.050 MA  
FALL 100.0 MA  
setting fall time to 100.0 MA will change range then bit 1 will set to high.

**bit 2 :invalid command**

This bit set to high by accepted illegal command.

**bit 3 :invalid operating**

This bit set to high by accepted invalid operating command.

**Example:**

SLH-60-120-1200  
MODE CR  
DYN ON  
DYNAMIC function only supports CC MODE.

**VOLTAGE METER**

**Purpose:**

The reading of 4 1/2 digit voltage meter read back query command.

**Command Syntax:**

MEAS:VOLT?{NL}

**Description:**

MEAS:VOLT? returns the present 4 1/2 digital voltage meter reading. The returned data format is shown in Table 4-2, the engineering unit is "V".

**CURRENT METER**

**Purpose:**

The reading of 4 1/2 digit current meter read back query command.

**Command Syntax:**

MEAS:CURR?{NL}

**Description:**

MEAS:CURR? returns the present 4 1/2 digital current meter reading. The engineering unit is "A."

**POWER METER**

**Purpose:**

To read the value of Watt meter.

**Command Syntax:**

MEAS:POW?{;|NL}

**Description:**

MEAS:POW? Reads back the value of 4 1/2 digit of the Watt meter; unit is (W).

**SENSE ON/OFF**

**Purpose:**

To read the setting condition of Sense ON or OFF.

**Command Syntax:**

SENS?{;|NL}

**Description:**

SENS? Reads back the setting condition of SENS. "0" denotes OFF, "1" denotes Auto.

**WATT Meter ON/OFF**

**Purpose:**

To read the setting condition of WATT.

**Command Syntax:**

WATT?{;|NL}

**Description:**

WATT? Reads back the setting condition of WATT. "0" denotes OFF, "1" denotes ON.

**VOLTAGE Limit**

**Purpose:**

To read the set value of upper/lower limit value of threshold voltage.

**Command Syntax:**

LIM:VOLT:{HIGH/LOW}?{;|NL}

**Description:**

LIM:VOLT:LOW? Reads back the lower limit set value of threshold voltage, unit is "volts" (V).

**CURRENT Limit****Purpose:**

To read the set value of upper/lower limit value of threshold current.

**Command Syntax:**

LIM:CURR{HIGH|LOW}?{;|NL}

**Description:**

LIM:CURR:LOW? Reads back the lower limit set value of threshold current; unit is "amps (A)".

**POWER Limit****Purpose:**

To read the set value of upper/lower limit value of threshold power(W).

**Command Syntax:**

LIM:POW{HIGH|LOW}?{;|NL}

**Description:**

LIM:POW:LOW? Reads back the lower limit set value of threshold power; unit is "watts" (W).

**NG****Purpose:**

To read the set value of NG.

**Command Syntax:**

NG?{;|NL}

**Description:**

NG? Reads back the condition indicating light of NG. "0" denotes that NG (NO GOOD) indicating light has been extinguished. "1" denotes that NG indicating light has been lit.

**PERIOD****Purpose:**

The dynamic mode's Tlow or Thigh duration query command

**Command Syntax:**

PERI:{LOW|HIGH}?{NL}

**Description:**

PERI:LOW? returns the presently programmed low duration time in dynamic load mode  
PERI:HIGH? returns the presently programmed high duration time in dynamic load mode  
The engineering unit is "msec".

**RISE Time****Purpose:**

The dynamic load mode's RISE slew rate query command

**Command Syntax:**

RISE?{NL}

**Description:**

RISE? returns the presently programmed low load current level in Constant Current mode  
The engineering unit is "A/us".

**FALL Time****Purpose:**

The dynamic load mode's FALL slew rate query command.

**Command Syntax:**

FALL?{NL}

**Description:**

FALL? returns the presently programmed low load current level in Constant Current mode  
The engineering unit is "A/us".

**SHORT ON/OFF****Purpose:**

SHORT ON or OFF status query command.

**Command Syntax:**

SHOR?{NL}

**Description:**

SHOR? returns the presently SHORT status, "0" indicates SHORT OFF, and "1" indicates SHORT ON.

**DYNAMIC ON/OFF****Purpose:**

DYNAmic ON or OFF status query command

**Command Syntax:**

DYN?{NL}

**Description:**

DYN? returns the presently DYNamic ON or OFF status, "0" indicates static load mode or DYNamic OFF, and "1" indicates DYNamic load mode or DYNamic ON.

# APPENDIX A SLH-SERIES DC LOAD GPIB/RS-232 OPERATING FLOW CHART

The flow chart on the following page shows typical setting procedures for the SLH-series remote control and load current level and status.

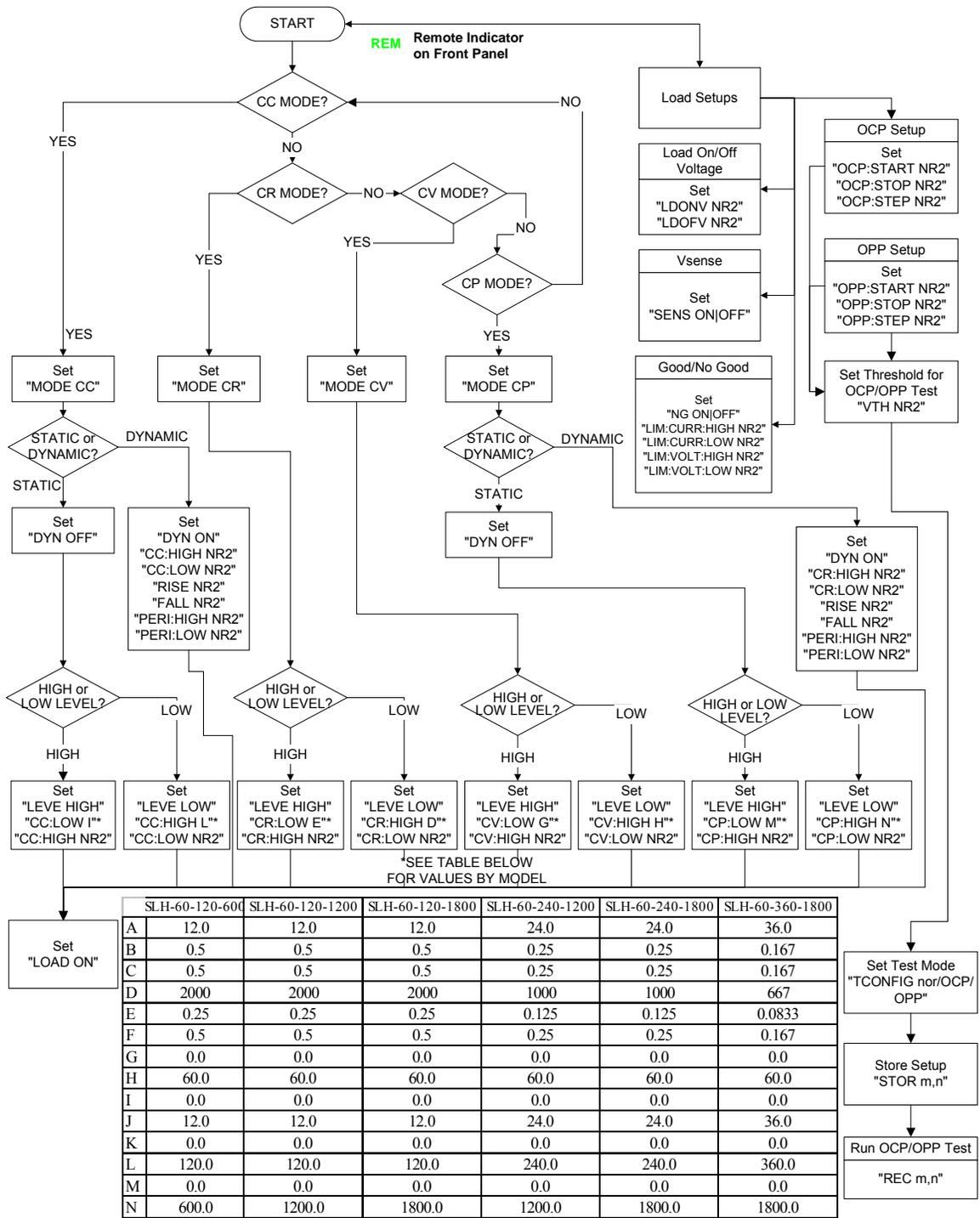


Figure A-1 SLH-series DC Load GPIB/RS-232 Operating Flow Chart

# APPENDIX B

## INSTALLATION GUIDE AND SPECIFICATION ADDENDUM FOR SLH-SERIES ELECTRONIC LOADS: MASTER/SLAVE CONFIGURATIONS

### B.1 Introduction

This guide provides instructions for installing and configuring master/slave systems for SLH-Series high power electronic loads. A system includes 1 master unit and 1 or more slave units, to get higher total current or power capacity, and an installation kit. For installing a master and slave unit into a standard width/depth cabinet, all units are of a standard modular design. Maintain a clearance area of at least 2 ft (0.6 m) at the front and the rear of the cabinet.

### B.2 Installation Kits [n=number of basic load units (master+slaves)]

#### B.2.1 Ship Kit Included with System

- SLH-Series Model Name plate      QTY = 1  
Identifies the model number, voltage, current, and watt rating of the high power load system.
- Parallel Bus-bar:      QTY =  $(n-1) \times 4$   
Wires all “+” and “-“ load inputs in parallel connection.  
The L-type bus bar requires four pieces per interload unit (1 each for up/down and +/-).
- Screws M8X25      QTY =  $(n \times 4) - 2$   
Connect the bus bars for each load input and interload.
- L BNC connector      QTY = 4  
The L type BNC connects the current program and the current sum BNC between the top (master) and bottom slave unit.

- T BNC connector      QTY =  $(n-2) \times 2$   
The T-type BNC connects the current programming and the current summing BNC between the slave units when two or more are configured.
- BNC to BNC cable (14cm)      QTY =  $(n-1) \times 2$   
Connect the interload units for current programming and current summing.
- Power cord for Master and Slave unit      QTY = (n)  
Connects to AC line input, providing the working power to the load unit.

### B.2.2 Recommended Items (not included in system kit)

- AC Power Strip      QTY =  $n / 4$   
To control AC power ON/OFF simultaneously
- External Power Switch      QTY = 1  
To turn ON or OFF the master/slave load system
- System Cabinet      QTY = 1  
19"-wide rack-mount cabinet with horizontal mounting rails, to house all loads  
Recommend 24" (600mm) depth x number of base loads at 7" height each

## B.3 Master and Slave System Connection



**Only qualified personnel are to perform system assembly.**

### B.3.1 System Assembly

#### Handles

1. Place the master on top of the slave unit.
2. Attach the handles to the left and right sides (Figure 1) using the screws provided. The handles should protrude forward from the front of the units.

#### Rear Supports (applies to a two-unit configuration only)

1. From each unit, remove the six (6) screws on the rear panel (3 screws on the left and 3 screws on the right). Figure 1 shows the six screws for each of two units.
2. Align the holes of the rear supports (vertical angle brackets) with the screw taps on the rear panels and screw into place (Figure 1).



**Two people are required to lift the combined unit for a rack/cabinet installation.**

**The rear supports are for a 2-unit configuration only. Any system comprised of three or more units must be installed into a cabinet.**

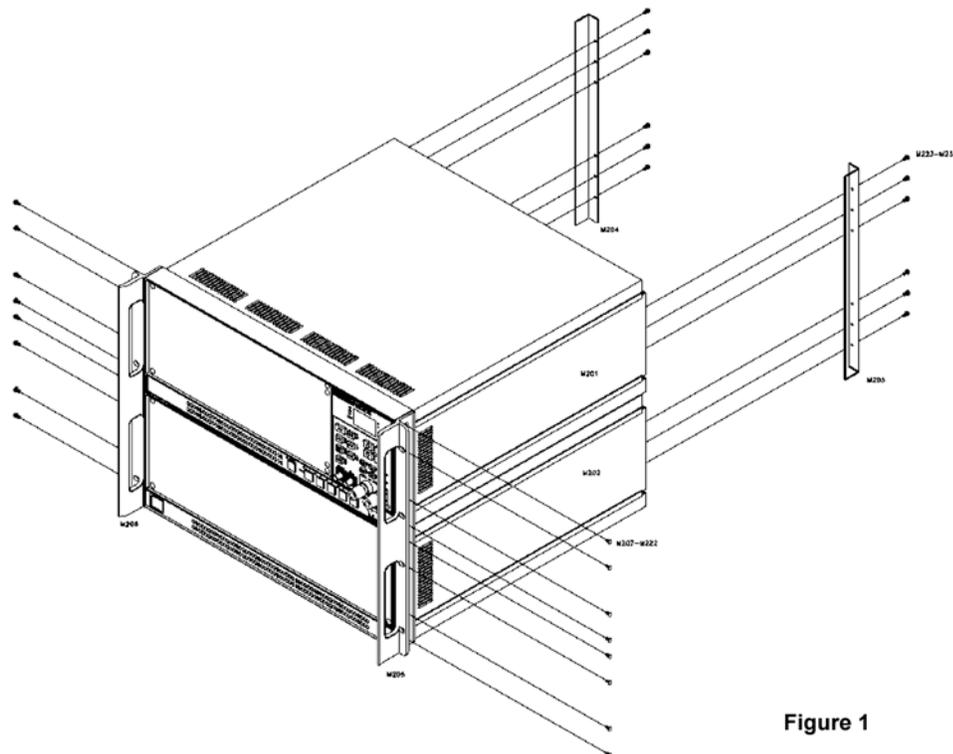


Figure 1



The following connections should be made with power disconnected from the load.

**WARNING**

### Load Input Bus Bar Parallel Connection

Use the L-type bus bars to parallel positive terminals on the rear panel (positive is located on the right as you face the rear panel), and to parallel all negative terminals (negative is located on the left as you face the rear panel). Refer to Figure 2. Wire the system Positive and Negative (+ and -) load input, from any point of the Bus Bar. The unused screw holes on the Bus Bar are designed for your load input wiring connection.

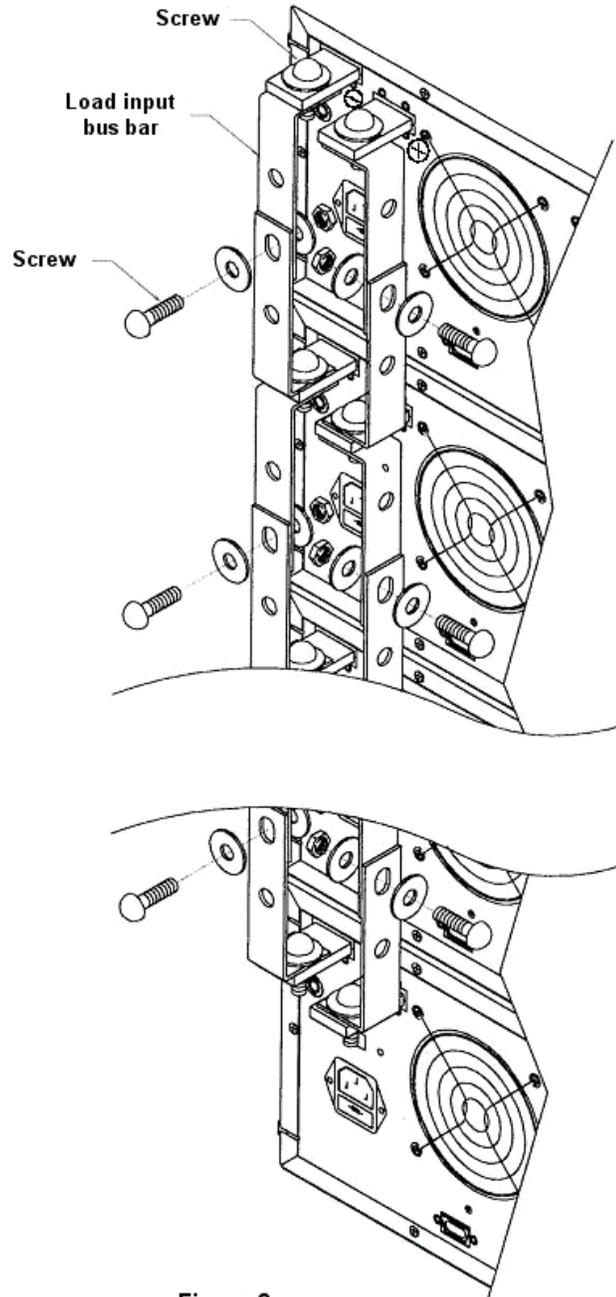


Figure 2

### Iprogram and Isum Parallel Connection

Use the L-type BNC adapter for the Isum and the Iprogram BNC connectors on the rear panel of the Master unit and of the bottom slave unit. Use the T-type BNC adapters for the Isum and the Iprogram BNC connectors on the rear panel of each additional slave unit between.

Figure 3 illustrates these connections.

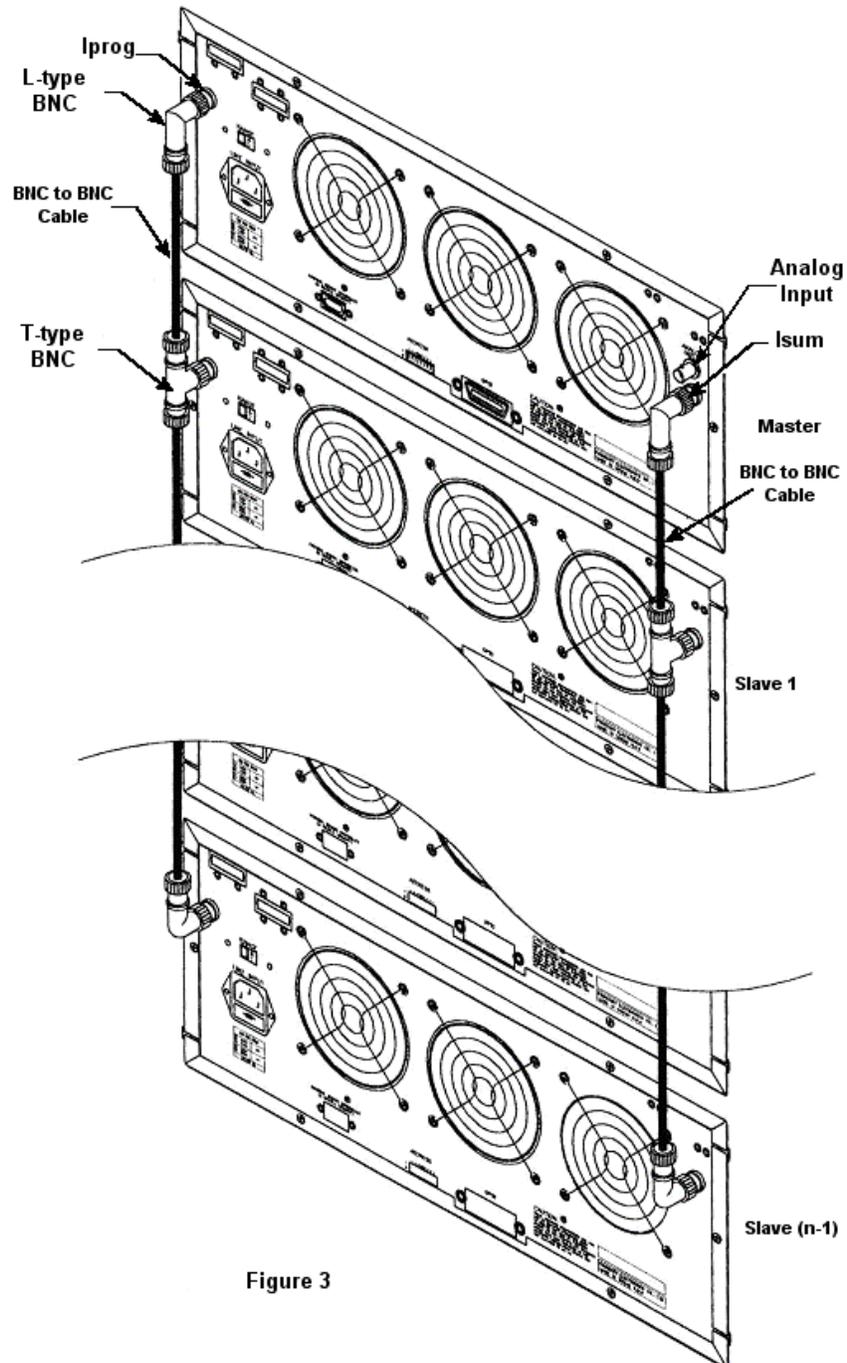


Figure 3

### B.3.2 OPTIONAL INSTALLATION

#### System Cabinet Dimensions

The industrial standard 19" wide system cabinet can be used for the high power electronic load; the minimum recommended width and depth of a cabinet are 21.65 inches by 23.6 inches (Figure 4). Allocate 4U high (7" / 177mm) for each load unit in the system cabinet. No vertical space is required between load units, because the airflow for cooling travels from front to back, exiting through the rear panel of each unit. Allocate 185 CFM per unit for airflow.

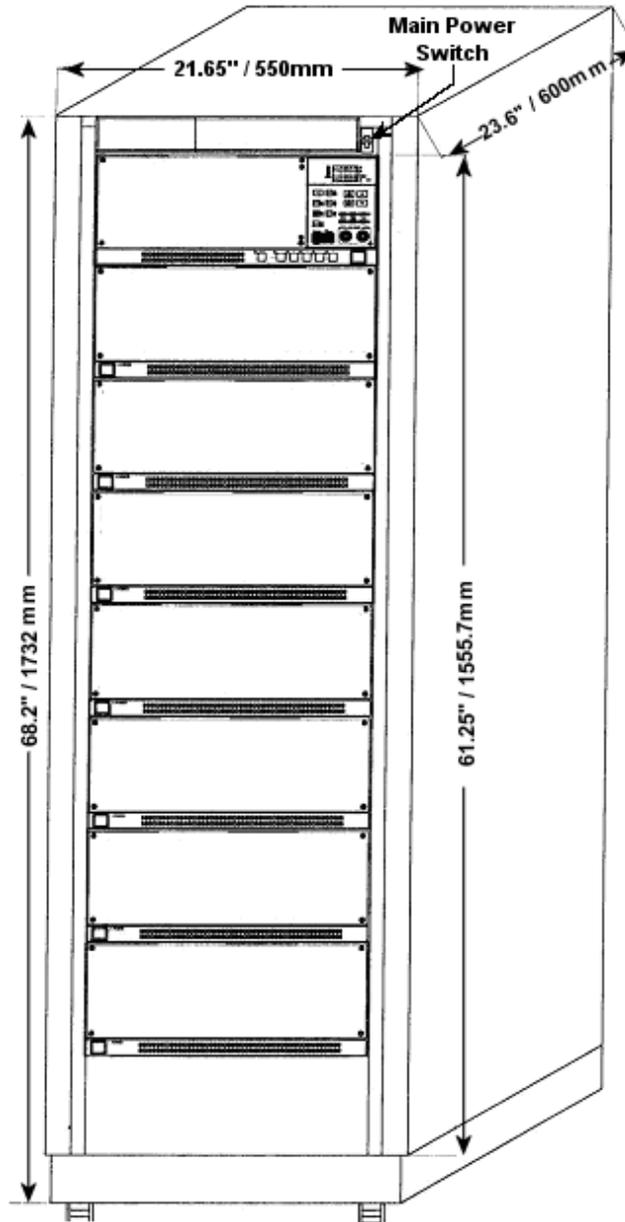


Figure 4

### Installation into Cabinet

Figure 5 shows the Master load unit being mounted into the system cabinet with four (4) screws to secure it (two on each side). The required horizontal mounting rails for bottom support, are not shown.

Figure 6 shows the finished rear panel system connection.

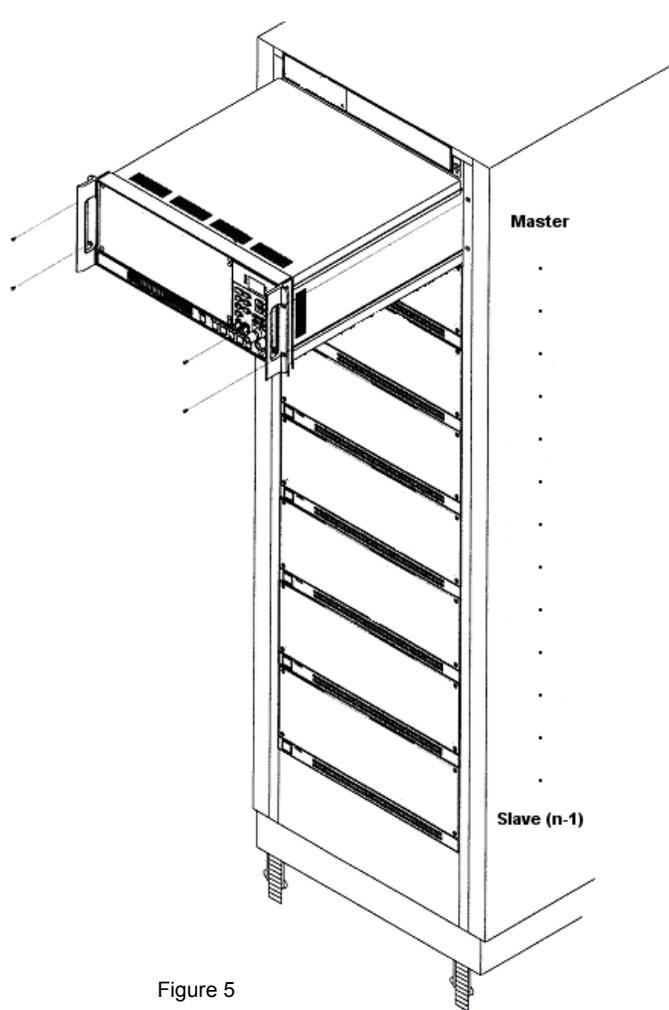


Figure 5

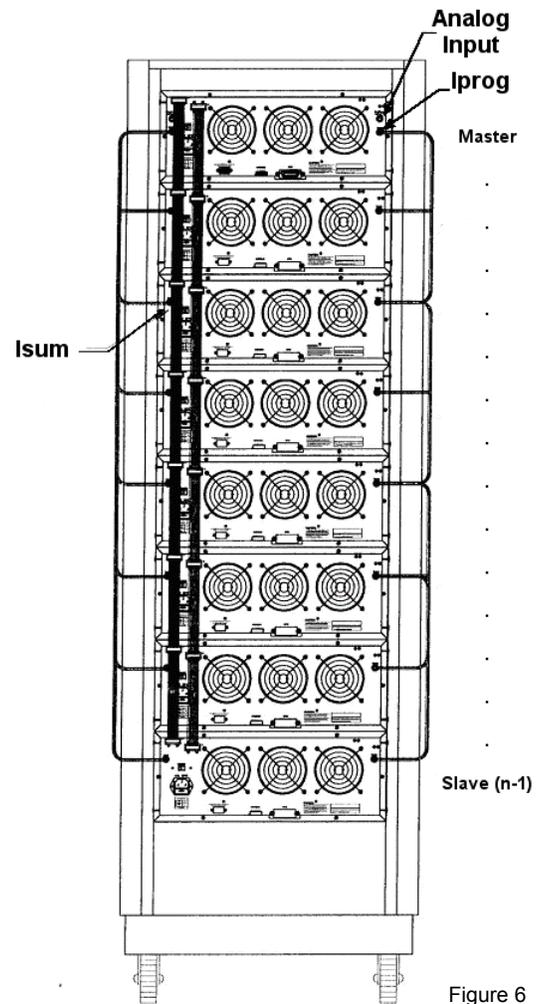


Figure 6

## AC Power

Connect a power cord from each load unit into a power strip connected to a single AC power switch. If there are more load units than there are outlets in the power strip, connect another power strip into the first power strip for a serial connection, so that the single AC power switch controls all load units at the same time. See Figure 7.

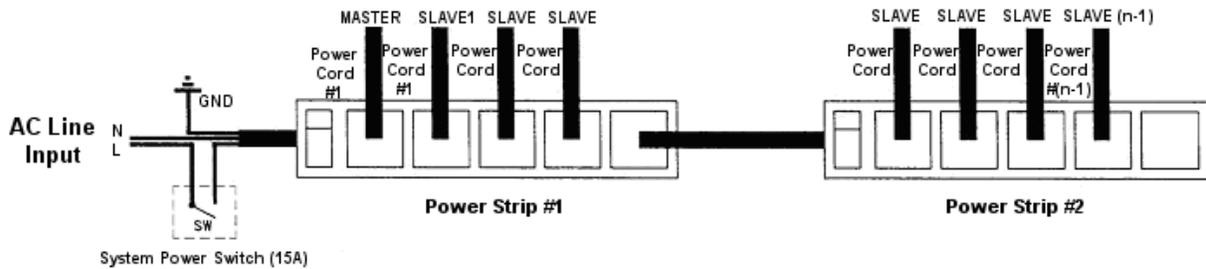


Figure 7

## B.4 Specifications Addendum

All specifications detailed in the SLH-Series High Power Electronic Load, Operation and Programming Manual shall apply with the updates to Section 1.4 as noted below.

The next two tables provide specifications for the SLH High Power Electronic Load. Table B-1 applies per basic load unit, i.e. for each master or slave unit.

AC INPUT	LINE	100V/115V±10%	200V/230V±10%
	FREQUENCY	50/60 HZ	
	FUSE	2A/250V (5x20mm)	1A/250V (5x20mm)
	MAX. POWER CONSUMPTION	100 W	
DIMENSIONS (W*H*D)		17.3x7.0x17.5 in. (440 x177 x445 mm)	
WEIGHT		NET : 51.9 lbs. (23.6 kg)	

Table B-1 AC Line Input per Load Unit

The following specifications apply 25°C ± 5°C:

<b>Model</b>	<b>SLH-60-240-3600</b>	
<b>INPUT RATINGS</b>		
VOLTAGE	60 V	
CURRENT	240 A	
POWER	3600 W	
<b>CC MODE</b>		
Range	0-24 / 0-240 A	
Resolution	6.4/64 mA	
Accuracy	±0.2% OF (SETTING + RANGE)	
<b>CR MODE (I)</b>		
Range 1 (I>0.05% of rating)	0.25 - 937.5Ω	
Range 2 (I>0.5% of rating)	0.0133 - 0.25 Ω	
<b>CV MODE</b>		
Range	2 - 60V	
Resolution	0.015V	
Accuracy	±0.1% OF (SETTING + RANGE)	
<b>CP Mode</b>		
Range	0-3600W	
Resolution	0.96W	
Accuracy	±0.5% OF (SETTING + RANGE)	
<b>SHORT MODE</b>		
Max. Resistance	2mΩ	
Current	240 A	
<b>DYNAMIC MODE</b>		
Thigh/Tlow	50uS to 9.999 Sec	
Slew Rate Low	2mA - 500mA/uS	
Slew Rate High	20mA - 5A/uS	
Accuracy	±10% OF SETTING + 10µs	
<b>4 1/2 DVM</b>		
Range	0 - 20.00/60.00V	
Resolution	0.001/0.01V	
Accuracy	±0.05% OF (READING + RANGE)	
<b>4 1/2 DAM</b>		
Range	0 - 24/240 A	
Resolution	1 / 10 mA	
Accuracy	±0.5% OF (READING + RANGE)	
<b>Imonitor</b>	24 A/V	
<b>PROTECTION</b>		
OPP	~1890 W	
OCP	~252 A	
OVP	~ 63 V	
OTP	~ 85°C	
<b>Load ON Volt.</b>		
Range	0.1 - 25V	
Resolution	0.1V	
Accuracy	1% of Setting + 0.25V	
<b>Load OFF Volt.</b>		
Range	0 - 25V	
Resolution	0.002V	
Accuracy	0.05% of Setting + 0.0125V	
<b>ENVIRONMENTAL</b>		
Operating Temp.	0-40 °C	

Table B-2 SLH-Series Specifications

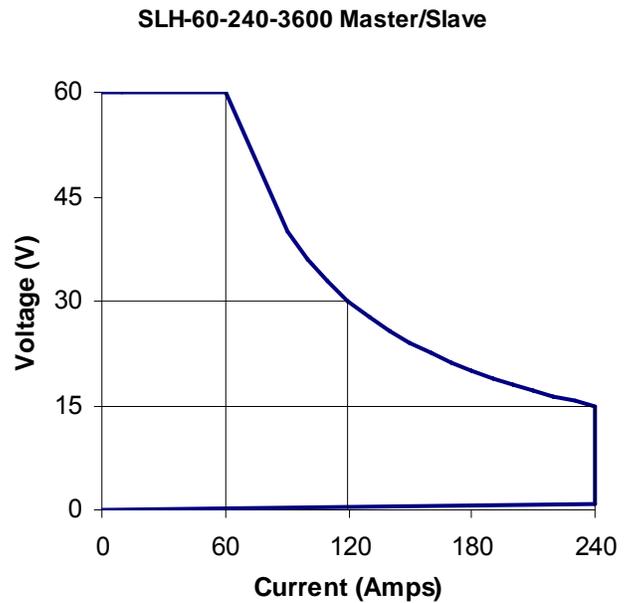


Figure 8 Power Curve