SLH-Series AC High Power Electronic Load

Operating and Programming 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.

	Hazardous voltages may be present when covers are removed. Qualified personnel must use extreme caution when servicing this equipment. Circuit boards, test points, and output voltages also may be floating above (below) chassis ground.
⚠ WARNING	

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

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

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

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

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

SAFETY SYMBOLS

Symbol	Description	Symbol	Description
⚠	WARNING Risk of Electrical Shock	⚠	CAUTION Refer to Accompanying Documents
○	Off (Supply)	===	Direct Current (DC)
⏻	Standby (Supply)	∼	Alternating Current (AC)
|	On (Supply)	3∼	Three–Phase Alternating Current
⏚	Protective Conductor Terminal	⏛	Earth (Ground) Terminal
⏛	Fuse		Chassis Ground

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Important Safety Instructions

This manual has been written expressly for the Sorensen SLH 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 Information page).

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SECTION 1
FEATURES, FUNCTIONS, AND SPECIFICATIONS

1.1   GENERAL DESCRIPTION

SLH-Series High Power, AC/DC Electronic Load is used to test the specification characteristics of AC/DC high power suppliers and the service life characteristics of batteries.
The load works with GPIB interface and front panel manual operation.

1.2   POWER CONTOURS

The power contours of the SLH-Series AC/DC Electronic Loads are shown in the following figures.
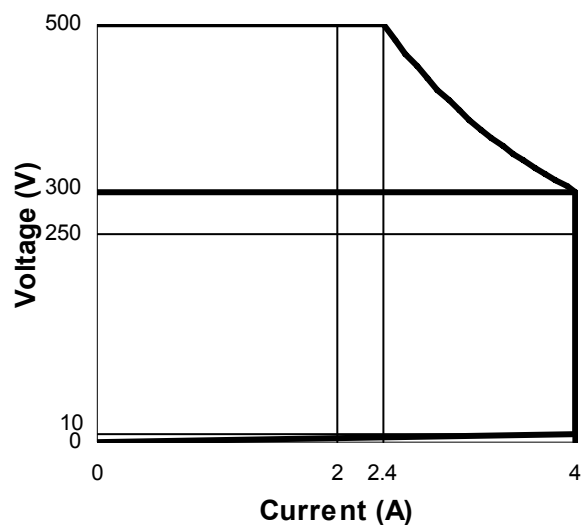
Figure 1-1 SLH-500-4-1200 Electronic Load Power Curve
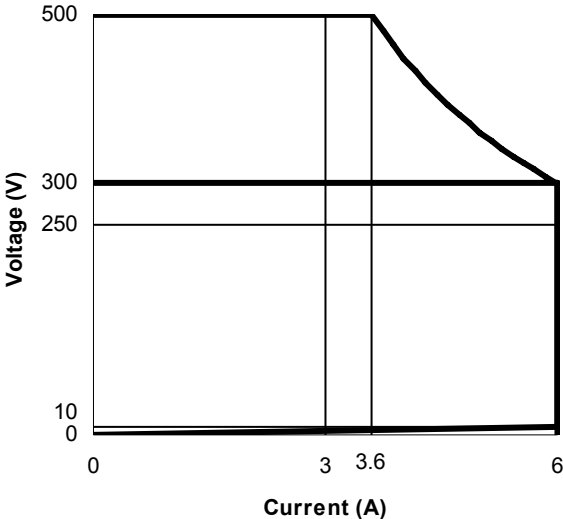
Figure 1-2 SLH-500-6-1800 Electronic Load Power Curve
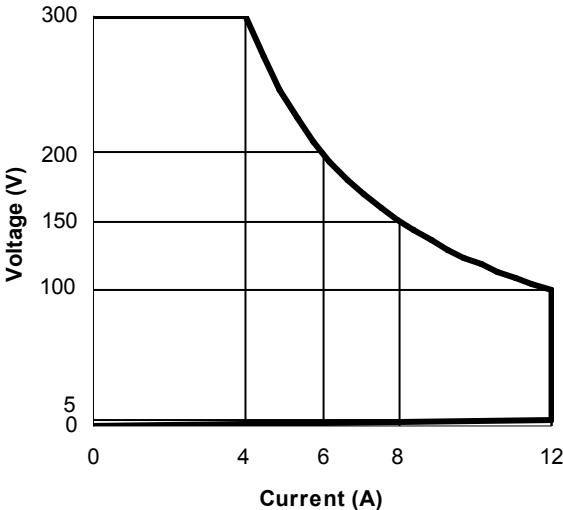
Figure 1-3 SLH-300-12-1200 Electronic Load Power Curve
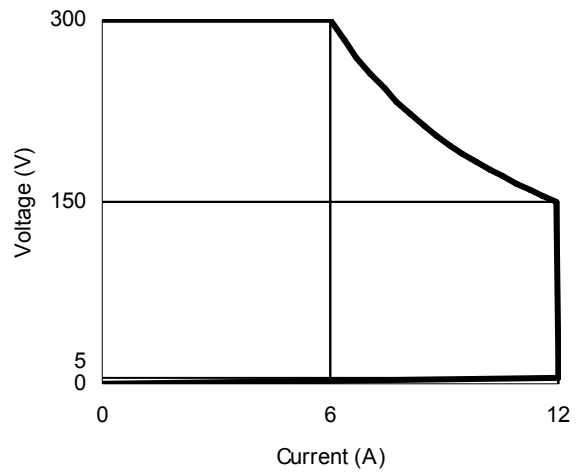
Figure 1-4 SLH-300-12-1800 Electronic Load Power Curve
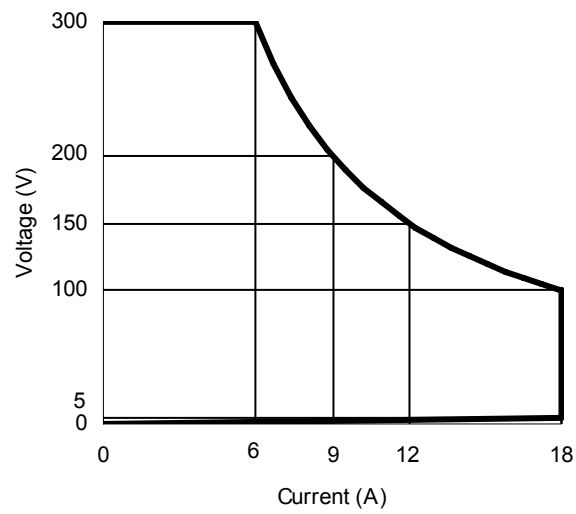
Figure 1-5 SLH-300-18-1800 Electronic Load Power Curve

1.3   OPERATING MODES

The work mode of SLH-series High Power AC Electronic Load includes Constant Current (CC) and Constant Resistance (CR).

CC Mode:

During CC mode, the load current input into SLH-series High Power, AC Electronic Load depends on the current setting regardless of the input voltage, i.e., the current setting remains unchanged.
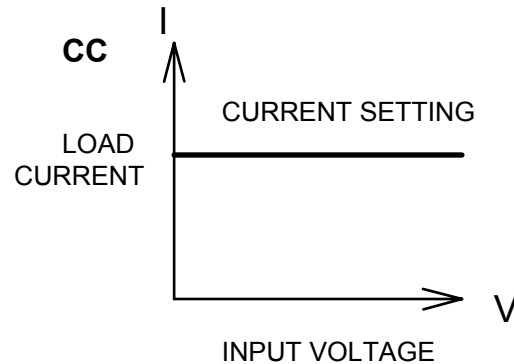
Figure 1-6 Characteristics of CC Mode

CR Mode:

During C.R. mode, the load current input into SLH-series High Power AC/DC Electronic Load depends on the resistance setting. At this time, the load current is in direct proportion to input voltage, e.g. the resistance setting remains unchanged. Please refer to Fig. 1.7 below
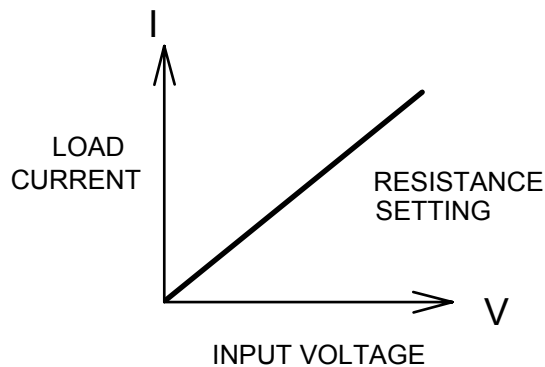
Figure 1-7 Characteristics of CR Mode

The load setting of SLH-series High Power AC/DC Electronic Load and the load condition setting of the front panel can be made through front panel manual operation or through GPIB commands. The load voltage and current can be transmitted to the computer through GPIB bus. For operation of GPIB, please refer to Section 4 GPIB Operation

1.4   FEATURES AND FUNCTIONS

- Interface function of full GPIB control, including setting of load condition and read-back of Vmeter and Ameter
- Dual High Accuracy/High Resolution 4 ½ digit Vmeter and Ameter
- In CC mode, frequency width can reach to 400Hz with the set table range of 1KHz
- In CC mode, the settable Crest Factor can be set to Maximum 3.5
- Automatic judging ability for GO/NG
- Switch-able automatic voltage sensing ability.
- Protection functions include Over-Voltage, Over-Current, Over-Power and Over-Temperature
- Cooling fan control device with revolution change function

1.5   ACCESSORIES

- Vsense Input BNC Connector   1 PC
- Banana Terminal (Black)   1 PC
- Banana Terminal (Red)   1 PC
- Hook-Type Terminal   2 PC
- SLH-series High Power AC/DC Electronic Load Operation Manual   1 PC

1.6   SPECIFICATIONS

AC INPUT	LINE	100V/115V±10%	200V/230V±10%
	FREQUENCY	50/60 HZ	
	FUSE	T2A/250V (5 x 20mm)	T1A/250V (5 x 20mm)
MAX. POWER CONSUMPTION		100 W	
DIMENSIONS (W*H*D)		440mm x 177mm x 445mm	
WEIGHT		13 Kg	

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

MODEL	SLH-500-4-1200	SLH-500-6-1800	SLH-300-12-1200/1800		SLH-300-18-1800
INPUT RATINGS					
Power (VA)	1200 VA	1800 VA	1200/1800 VA		1800 VA
Current (Ampere)	4 Arms	6 Arms	12 Arms		18 Arms
Voltage (Volt)	300 Vrms/500 Vdc	300 Vrms/500 Vdc	300Vrms		300Vrms
Frequency	DC, 40 - 70Hz (CC Mode) ; DC - 70Hz (CR Mode)				
CC MODE					
Range	0-2 / 2-4 A	0-3 / 3-6 A	0-6 / 6-12 A		0-9 / 9-18 A
Resolution	0.5 / 1 mA	0.75 / 1.5 mA	1.5 / 3 mA		2.25 / 4.5 mA
Accuracy	±0.5% of (setting + range)				
Low Current Range	0 - 0.2 A	0 - 0.3 A	0 - 0.6 A		0 - 0.9 A
Accuracy	± 2% of (setting + range)				
Crest Factor	$\sqrt{2}$ - 3.5 (Maximum current = 2 x Rated Current)				
Maximum Peak Current	8A	12A	24A		18A
CR MODE					
Range 1 (I>0.5% of rating)	50 - 200,000 Ω	33.33 - 133,000 Ω	20 - 80,000 Ω		13.3 - 53,333 Ω
Range 2 (I>50% of rating)	12.5 - 50 Ω	8.33 - 33.33 Ω	5 - 20 Ω		3.33 - 13.33 Ω
4-1/2 DVM					
Range	0-500V	0-500V	300 V	300 V	300 V
Resolution	0.1 V	0.1 V	0.1 V	0.1 V	0.1 V
Accuracy	±(0.5% of reading + 0.2% of range)				
4-1/2 DAM					
Range	0-4 A	0-6 A	0-12 A	0-12 A	0-18 A
Resolution	1 mA	1 mA	1 mA	1 mA	1 mA
Accuracy	±(0.5% of reading + 2% of range) ; ±0.5% of (reading + range) @ 50/60Hz				
4-1/2 WATT METER					
Range	0-1200W	0-1800 W	0-1200W	0-1800 W	0-1800 W
Resolution	0.1 W				
Accuracy	± (0.5% of reading)± 3W				
VA METER	Vrms×Arms				

Table 1-1 SLH-series AC/DC Specifications

1.7   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.

1.8   SYSTEM BLOCK DIAGRAM
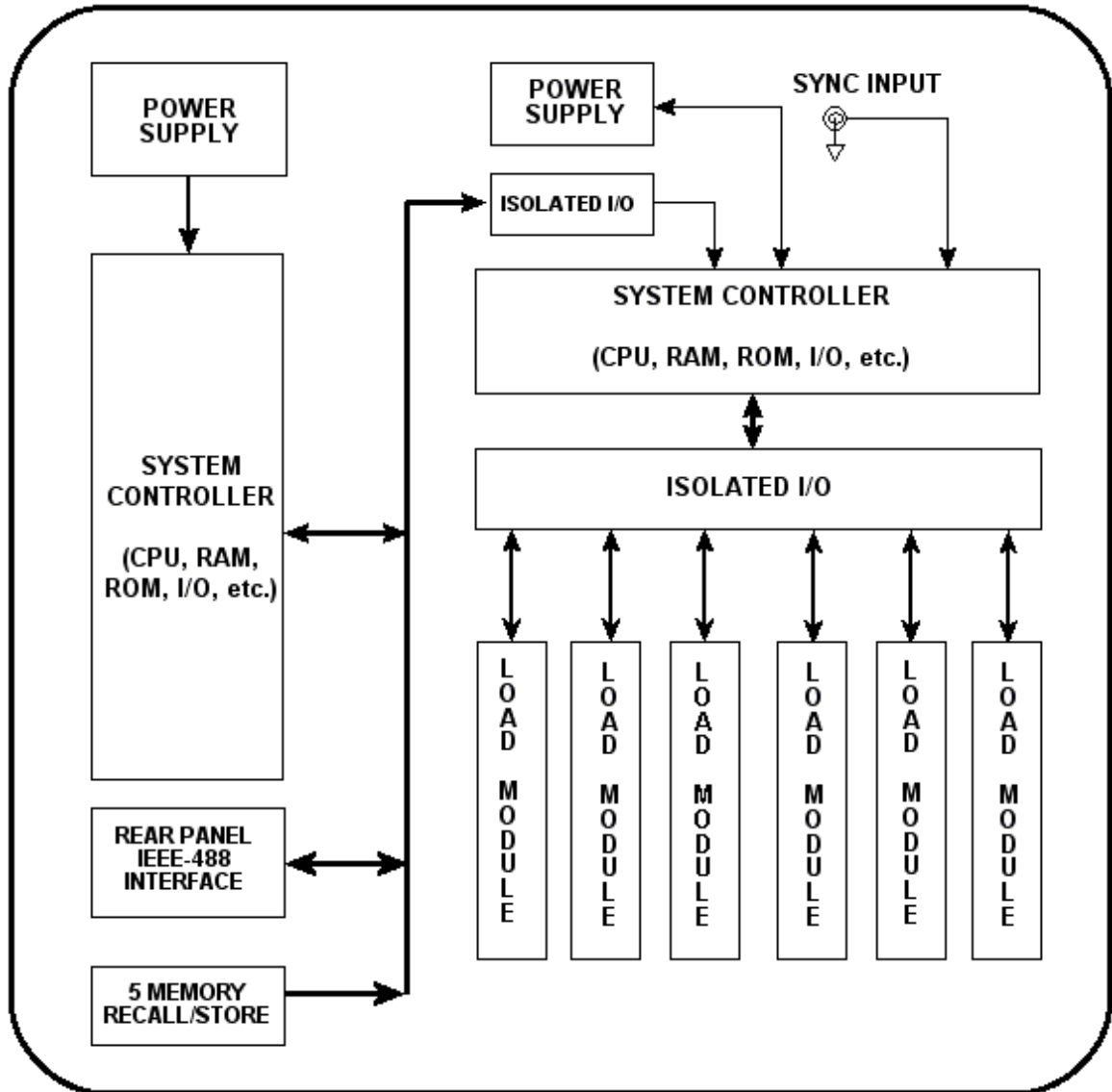
Figure 1-8 System Block Diagram

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SECTION 2
INSTALLATION AND MAINTENANCE

2.1   INSPECTION

The SLH-series High Power, AC/DC Electronic Load was carefully inspected before shipment. If instrument damage has occurred during transport, please inform Sorensen's sales and service office or representative.

Your SLH-series High Power AC/DC Electronic 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 Sorensen sales office to obtain the correct cord. Refer to " check line voltage " to check the line voltage selection and fuse type.

2.1.1   Line Voltage

The SLH-series High Power AC/DC Electronic Load can operate with 115/230VAC input as indicated on the rear panel label (or 100/200VAC for Japan units). Make sure that the factory check mark corresponds to your nominal line voltage. If not correctly marked, perform the following procedures:

1. With the mainframe power OFF, disconnect the power cord.

2. Refer the drawing on the rear panel in Fig 2-1, set the switches to the proper voltage as described in the following:
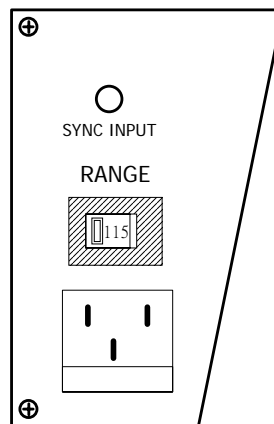
Figure 2-1 Setting Switch

3. Mark the correct voltage on the rear panel of SLH-series High Power AC/DC Electronic Load.

4. Check the rating of the line fuse and replace it with the correct fuse if necessary.

5. The line fuse is located below the AC line receptacle see Fig 2-2. With the power cord removed, use a small screwdriver to extract the fuse holder from under the AC socket. Replace the fuse with the appropriate type as indicated in Table 1-1. These fuses are slow-blow fuses.

6. Reinstall fuse holder and connect the power cord.
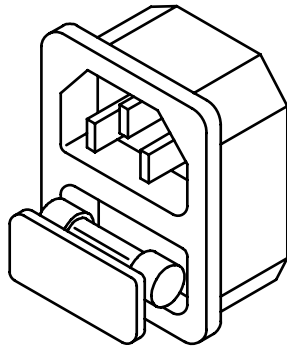
Figure 2-2 Fuse Holder in AC Line Input Connector

2.1.2   Grounding Requirements

The SLH-series High Power AC/DC Electronic Load is equipped with a three-conductor cable which plugs in an appropriate receptacle to ground the instrument's cover.

2.1.3   Environmental Requirements

- For indoor use only

- Installation Category II (over voltage)

- 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   Rack Mount

The SLH-series High Power AC/DC Electronic Load is designed to permit mounting in a standard 19 inches rack for system application.

2.1.5   Tilt Adjustment

The SLH-series High Power AC/DC Electronic Load is equipped with tilt stands on its two front feet, which can be flipped forward to provide an inclined viewing angle of the front panel for bench-top use.

2.1.6   Service or Repair

If the instrument is damaged, please attach a tag to the instrument, identifying the owner and indicating the required service. Follow the procedures detailed on Page iii of this manual.

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   Voltage Sensing Input (Vsense) BNC Connector.

To solve the conductor voltage drop under a big load current, Vsense-CLIP cable can be used to connect with the specific point to be measured thus obtaining the specific voltage value. See Figure 2-3 and Figure 2-4.
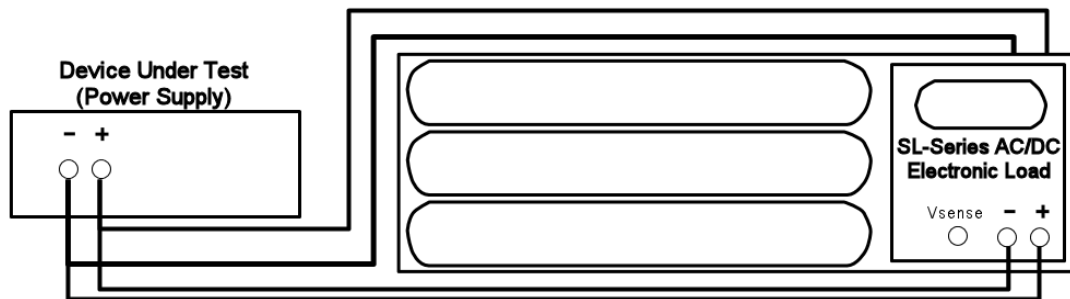
***Figure 2-3 Connection Method for Small Load Current Condition.
Either front or rear connection may be used.***
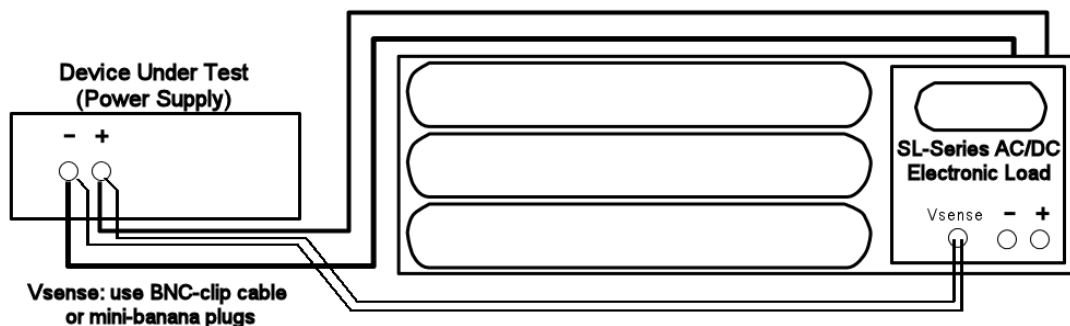
Figure 2-4 Typical Connection for SLH-series High Power AC/DC Electronic Load

2.2.2   RS-232C Connection
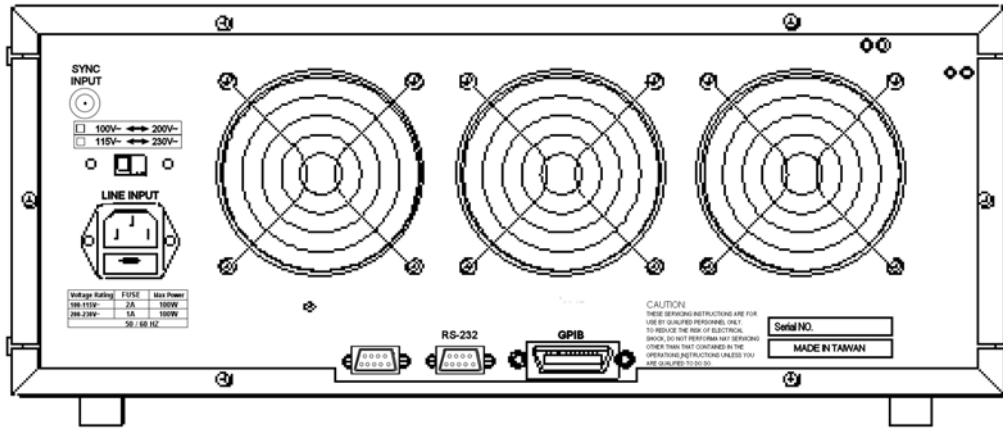
Figure 2-5 SLH-series Rear Panel

2.2.3   GPIB Connection

The GPIB connector on the rear panel (Figure 2-5) connects the SLH-series High Power AC/DC Electronic Load to the controller and to other GPIB devices. An GPIB system can be connected in any configuration (star, linear, or both) with the following provisions:

- The maximum number of devices including the controller is no more than 15.

- The maximum length of all cables is no more than 2 meters times the number of devices connected together, up to 20 meters maximum.

Ensure that the lock screws are firmly hand-tightened; use a screwdriver only for the removal of screws. The GPIB address of the Load is factory set to 05.

GPIB Address Setting:

Set the GPIB address on the front panel (see Figure 2-6) by pressing STATE 4+STATE 5 keys simultaneously. Press UP or DOWN on the BANK keys (white buttons to right) to select the address number (0-31). Press STATE 2 to exit GPIB address setting mode.
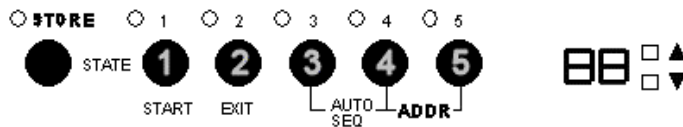
Figure 2-6 Close-up, Front Panel State Keys

2.3   MAINTENANCE

2.3.1   Cleaning

WARNING!

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

3.1 FRONT PANEL CONTROLS AND INDICATORS

This section describes the front panel and its manual operation of the SLH-series High Power AC/DC Electronic Load. For calibration procedures, please refer to the SLH-series High Power Load Calibration Manual. For GPIB control, please refer to Section 4, GPIB Remote Operation, of this manual.
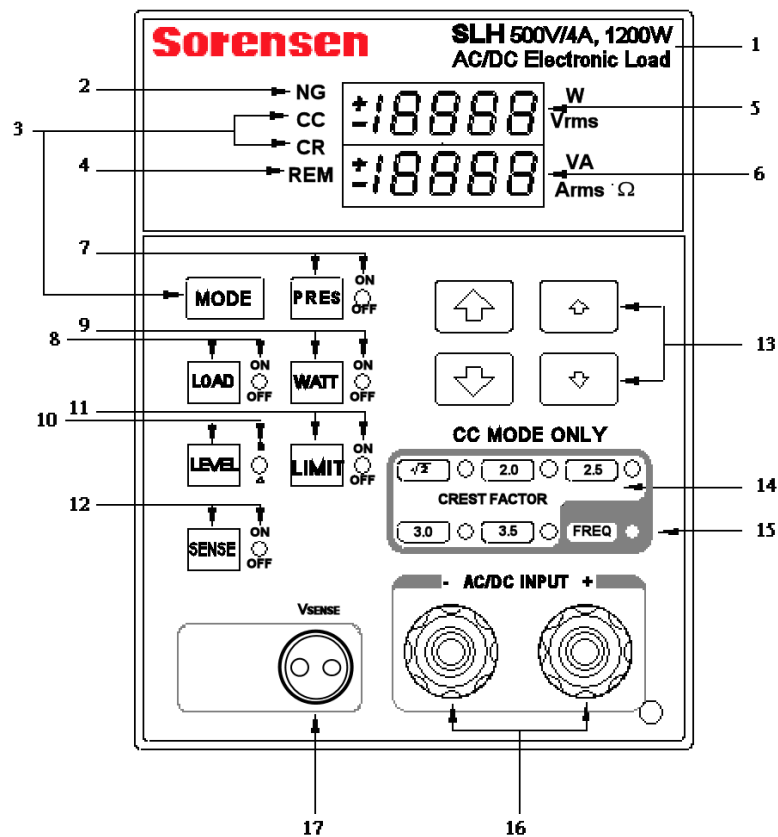
Figure 3-1 Front Panel of SLH-series High Power AC/DC Electronic Load

1 Model Label

Shows load model series and its voltage, current and power specifications.

2 NG LED

- When lit, indicates "No Go" (fail) when Vmeter, Ameter, Wattmeter or VA meter exceeds the upper or lower limit set.
- When not lit, indicates "Go" (no fail).

3 MODE key and CC, CR LEDs

The MODE key toggles between Constant Current (CC LED on) or Constant Resistance (CR LED on) operating modes.

4 REM LED

Indicates remote operation:

- When lit, the unit is under remote control and cannot be operated through the front panel keys. (Remote controller releases control by GPIB command).
- When not lit, the unit is under local control and can be manually operated using the front panel keys.

5 Upper Digital Meter (DM)

Multi-purpose display, depending on selected mode:

- Under general conditions, functions as a 4 ½ digital voltmeter to display the voltage at the load input end or Vsense BNC input end.
- During WATT ON condition, functions as a wattmeter to display the power of the load.
- Under LIMIT ON condition, displays the upper limit of:
    ο Voltmeter with the unit as "Vrms".
    ο Ammeter with the unit as "Arms".
    ο Wattmeter with the unit as "W".
    ο VA meter with the unit as "VA".
- During protection condition, displays "oVP" for over-voltage.
- During FREQ ON (see **15**) condition, displays:
    ο "FrEq" (frequency),
    ο "bAn" (bank), or
    ο "Sync" (Sync)

6 Lower Digital Meter (DM)

- Under general conditions, functions as a 4 ½ digital ammeter to display the load current actually flowing into the electronic load.
- In Preset ON (see **7**) mode, displays the set value whether by front panel manual operation or by remote control.
- In CC Mode (see **3**), displays the set value of CC Level A and B in "Arms".
- In CR Mode (see **3**), displays the set value of CR Level A and B in "Ω".
- During protection condition, displays:
    ο "oCP" for over-current,
    ο "oPP" for over-power, or
    ο "oTP" for over-temperature
- During LIMIT ON condition (see **11**), displays the lower limit of:
    ο Voltmeter with the unit as "Vrms".
    ο Ammeter with the unit as "Arms".
    ο Wattmeter with the unit as "W".
    ο VA meter with the unit as "VA".

- During FREQ ON condition (see **15**):
  - ο For frequency ("FrEq") setting, displays DC, 0.1 - 70.0, Auto.
  - ο For bank ("bAn") selection, displays 0 - 10.
  - ο For sync ("Sync") selection, displays "ON", OFF".

7 PRES key and ON/OFF LED
   Key toggles Preset mode and its LED on and off.
- During Preset OFF, PRES ON/OFF LED not lit:
  - ο upper DM displays the voltage input to electronic load as "Vrms" (Vrms LED lit)
  - ο lower DM displays the current flowing into electronic load as "Arms" (Arms LED lit)
- During Preset ON, PRES ON/OFF LED lit,
  - ο both upper and lower DMs will have different displays depending on which mode is active:
    - ▪ Constant Current mode (CC LED on), lower DM displays the setting value of Level A/B load current as "Arms", (Arms LED lit).
    - ▪ Constant Resistance mode (CR LED on), lower DM displays the setting value of Level A/B load resistance as "Ω", (Ω LED lit).

8 LOAD key and ON/OFF LED
   Key toggles Load and its LED on and off.
- Load OFF (LED not lit), electronic load returns to the condition set originally.
- Load ON (LED lit), electronic load is at the condition set originally and is ready to be loaded with the load current of the AC/DC input power source.

9 WATT key and ON/OFF LED
   Key toggles Watt mode and its LED on and off.
- Watt ON (LED lit) indicates the Watt VA condition of actual loading.
- Watt OFF (LED not lit) means Watt OFF, e.g., to indicate the voltage and current condition of actual loading.
- During Preset OFF (see **7**) condition:
  - ο upper DM displays the value in Watts consumed for electronic loading ("W" LED is lit);
  - ο lower DM displays the value in VA flowing into electronic load ("VA" LED lit).
- During Preset ON (see **7**) condition, both upper and lower 4-½ digit monitors will have different displays with the change of working mode as follows:
  - ο CC Mode, the setting value of Level A/B load current displayed on the lower DM with the unit as "Arms" and corresponding LED lit.
  - ο CR Mode, the setting value of Level A/B load resistance displayed on the lower DM with the unit as "Ω" and corresponding LED lit.

10 LEVEL key and A/B LED
   Key toggles between A (Level A), LED off, and B (Level B), LED ON to set the values of groups A/B for rapid switching load current or resistance.

11 LIMIT key and ON/OFF LED
   Key toggles between Limit ON (LED lit) and Limit OFF (LED not lit) condition:
- Upper DM displays upper limit of:
  - ο Voltmeter with the unit as "Vrms".
  - ο Ammeter with the unit as "Arms".
  - ο Wattmeter with the unit as "W".

ο   VA meter with the unit as "VA"..
- Lower DM displays the lower limit of:
    - ο   Voltmeter with the unit as "Vrms".
    - ο   Ammeter with the unit as "Arms".
    - ο   Wattmeter with the unit as "W".
    - ο   VA meter with the unit as "VA".

(See **13** for upper and lower limit adjustment).

12 SENSE key and ON/OFF LED
Controls whether or not the input to the voltmeter is made from the AC input end (Sense LED OFF) or from the Vsense end (Sense LED ON). The DM displays the voltage from either.

13 Load Current Coarse Tuning/Fine Tuning, Increase/Decrease Keys
- During PRESET ON (see **7**):
    - ο   The larger arrows (⇧ ⇩) coarse tune the value by larger increments/decrements.
    - ο   The smaller arrows (↑ ↓) fine tune the value by smaller increments/decrements.
- During LIMIT ON (see **11**):
    - ο   3.1.13.2.1 ⇧ ⇩ :Upper limit value Up/Down Key.
    - ο   3.1.13.2.2 ↑ ↓ :Lower limit value Up/Down Key.
- When FREQ (see **15**) LED lit:
    - ο   "FrEq" displayed in upper DM, ⇧ ⇩ keys adjust the frequency value by coarse (larger) increments/decrements, and the ↑ ↓ keys adjust the frequency value by fine (smaller) increments/decrements.
    - ο   "bAn" displayed in upper DM,:⇧ ↑ is Fine Tuning Up Key ⇩ ↓ is Fine Tuning Down Key.
    - ο   "Sync" displayed in upper DM, ⇧ ↑ is ON Key ⇩ ↓ is OFF Key.

14 √2, 2.0, 2.5, 3.0, 3.5 keys and their respective LEDs:
Each key only functions in CC mode and has no effect in CR mode.
These keys are selected to change the current C.F. (Peak Factor) of CC mode. When changing BANK (see **15**) settings, these keys will define different C.F. values.

15 FREQ key and LED
Key scrolls from FREQ to BANK to SYNC (displayed in DM) to off (LED not lit).
- Frequency and Bank can only be set in CC MODE
    - ο   FREQ (For Frequency Setting) : Setting Range: DC, 0.1 - 70.0 Hz, Auto.
    - ο   BANK (For Bank Setting) : 0 - 10 totaling 11 banks (Not valid for DC).
- SYNC (Current Bank Sync Signal Selection):
    - ο   ON is external Sync
    - ο   OFF is internal Sync.

16 AC/DC Load Input Connector
Must not exceed the rated specification of the voltage and current of the SLH-series High Power AC/DC Electronic Load.

⚠ **CAUTION**   **Avoid damage to internal circuit and connector:** Upon wiring, please refer to Section 3.2.

17 Vsense BNC, Voltage Sensing Input BNC Connector.
To solve the conductor voltage drop under a big load current, Vsense-CLIP cable can be used to connect with the specific point to be measured thus obtaining the specific voltage value.

The control keys are summarized in Figure 3-2.
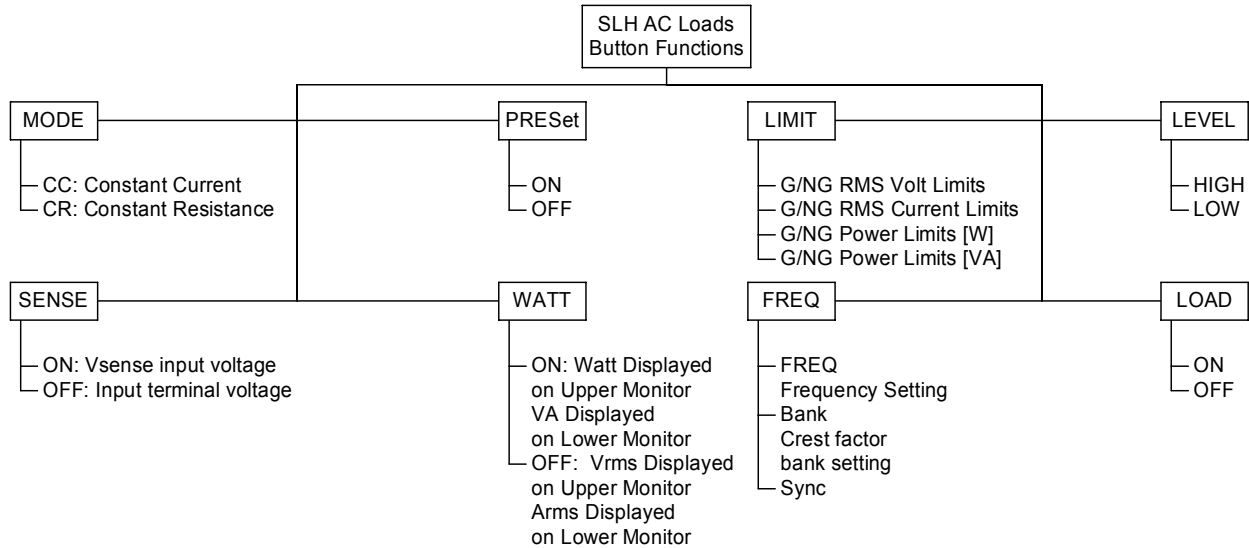
Figure 3-2 Front Panel Button Functions for SLH-series AC Unit

3.2   SET-UP PROCEDURES

The following set up procedures are summarized in Figure 3-4.

Pass / Fail Limits, Go/No GO Limits
> (If pass/fail limits are not desired, skip to Frequency Setting below).
> The limits set the value range within which the inputs must fall for the NG LED to remain off and sets the NG register to 0 (pass) or 1 (fail).

Voltage:
> Press the LIMIT key until the LIMIT LED is on and the "Vrms" LED (5) is lit. The upper digital meter (DM) displays the upper voltage limit; the lower DM displays the lower voltage limit. Use the coarse ⇧ ⇩ keys to set the upper limit and the fine ↑↓ keys to set the lower limit.

Current:
> Press the LIMIT key until the LIMIT LED is on and the "Arms" LED (5) is lit. The upper DM displays the upper current limit; the lower 5-digit display shows the lower current limit. Use the coarse ⇧ ⇩ keys to set the upper limit and the fine ↑↓ keys 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 DM displays the upper power limit; the lower DM displays the lower power limit. Use the coarse ⇧ ⇩ keys to set the upper limit and the fine ↑↓ keys to set the lower limit.

VA:

Press the LIMIT key until the LIMIT LED is on and the "VA" LED (5) is lit. The upper DM displays the upper VA limit; the lower DM displays the lower VA limit. Use the coarse ⇧ ⇩ to set the upper limit and the fine ↑↓ keys to set the lower limit.

Vsense Input: The "SENSE" key toggles external Vsense on (LED lit) and off (LED not lit).

Frequency Setting:

The range for setting the frequency of SLH-Series AC electronic Load AC/DC module is from DC-70Hz. Specifications apply 40-70Hz.

Press the FREQ key (15) until its LED lights and "FrEq" appears on the upper DM.
Use the coarse/fine ⇧ ⇩/↑↓ keys to set the frequency to the desired value, to DC or to Auto.
- If the frequency setting is less than 0.1 Hz, the frequency setting value will set automatically to DC.
- In Auto, the load automatically synchronizes to the zero crossing of the voltage input at the terminals.
- After setting the frequency, set the SYNC trigger to OFF to make the frequency valid.

Current Synchronization (Figure 3-3)

External SYNC Signal (SYNC ON)
> The user can input a SYNC signal to the Analog Programming Input BNC connector on the back plate.
> Based on this external SYNC signal, the SLH-Series AC Electronic Load, the phase of load current will synchronize to the zero crossing of the external signal.
> The external SYNC signal must have be a 50% duty cycle.

> Press the "FREQ" key until "Sync" appears on the upper DM.
> Press any ⇧ ⇩↑↓ key to toggle the external sync on and off.

Internal SYNC signal (SYNC OFF)
> The internal SYNC signal source of SLH-Series AC electronic load is taken from the voltage signal at the terminal inputs.
> The load current signal will synchronize to the voltage zero crossing of the input terminals.
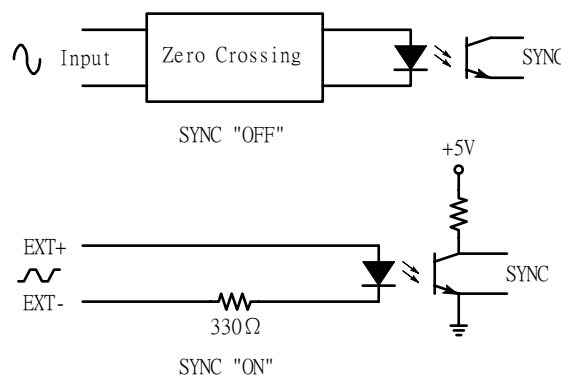
Figure 3-3 Illustration of Sync

Crest Factor

The SLH-Series AC electronic load module provides 11 built-in sets totaling 55 waveforms. The waveforms are stored in memory banks (0-10) with 5 selections per bank as shown in Table 3-1. (See Appendix for waveform details). Selection of crest factor is through the $\sqrt{2}$, 2.0, 2.5, 3.0 and 3.5 keys in addition to the bank selection.

	BANK	√2	2.0	2.5	3.0	3.5
Sine Wave	0	√2	2.0	2.5	3.0	3.5
	1	1.5	1.6	1.7	1.8	1.9
	2	2.0	2.1	2.2	2.3	2.4
	3	2.5	2.6	2.7	2.8	2.9
	4	3.0	3.1	3.2	3.3	3.4
Square Wave	5	1.0	1.1	1.2	1.3	1.4
	6	1.5	1.6	1.7	1.8	1.9
	7	2.0	2.1	2.2	2.3	2.4
	8	2.5	2.6	2.7	2.8	2.9
	9	3.0	3.1	3.2	3.3	3.4
DC	10	√2dc	2dc	2.5dc	3.0dc	3.5dc

Table 3-1 Built in Crest Factor Settings by Bank andKkey Selection

When Frequency is set to DC (see Frequency Setting above), the waveform information shall be fixed at DC level and the "bAn" bank selection will not appear in the FREQ key menu.

- Press FREQ key (15). The associated LED will light. The first selection is for frequency, as described in the section, "Frequency Setting" above.
- Verify that the frequency does not read "dc". If it does, use the ⇧⇩↑↓ keys to adjust the frequency from "dc".
- Press the "FREQ" key until "bAn" appears on the upper DM.
- Use the ⇧ ⇩↑↓ keys to select the desired bank.
- Press the "FREQ" key two times to exit setting mode.
- Press the appropriate $\sqrt{2}$, 2.0, 2.5, 3.0 and 3.5 keys to select the desired crest factor. The associated LED will light.

Display Setting

In normal operation, the DMs display RMS voltage and RMS current. To display power in Watts (upper DM) and VA (lower DM), press the "WATT" key until the associated LED (W or VA) is lit.

Press the "WATT" key again to return to normal display mode.

DESCRIPTION   DISPLAY   CONTROL

LIMIT

| Set G/NG Voltage Limits | LED ON: VRMS, LIMIT
Upper 4½-digit: Upper Limit Setting
Lower 4½-digit: Lower Limit Setting | ⇧ ⇩ Sets upper limit
↑↓ Sets lower limit |

| Set G/NG Current Limits | LED ON: ARMS, LIMIT
Upper 4½-digit: Upper Limit Setting
Lower 4½-digit: Lower Limit Setting | ⇧ ⇩ Sets upper limit
↑↓ Sets lower limit |

| Set G/NG Power Limits | LED ON: W, LIMIT
Upper 4½-digit: Upper Limit Setting
Lower 4½-digit: Lower Limit Setting | ⇧ ⇩ Sets upper limit
↑↓ Sets lower limit |

| Set G/NG VA Limits | LED ON: VA, LIMIT
Upper 4½-digit: Upper Limit Setting
Lower 4½-digit: Lower Limit Setting | ⇧ ⇩ Sets upper limit
↑↓ Sets lower limit |

SENSE

LEDs ON: SENSE

⇧ ⇩ ↑↓
Any setting button toggles sense on/off

FREQ

| Set frequency.
MIN=dc,
Max.=Auto | LED ON: FREQ
Upper 4½-digit: "FrEq"
Lower 4½-digit: dc, frequency setting, auto | ⇧ ⇩ ↑↓
Course/fine setting |

| Set BANK Number for Crest Factor Waveform | LED ON: FREQ
Upper 4½-digit: "bAn"
Lower 4½-digit: Bank number setting 0-10 | ⇧↑ ⇩↓
High Bank# / Lower Bank# |

| Set SYNC source
ON=External
OFF=Input Terminal or Vsense | LED ON: FREQ
Upper 4½-digit: "Sync"
Lower 4½-digit: On/off | ⇧ ⇩ ↑↓
Any button toggles on/off |

WATT

LED ON: WATT
Upper 4½-digit: "W"
Lower 4½-digit: "VA"

⇧ ⇩ ↑↓
Any button toggles on/off

Setup Complete

Figure 3-4 SLH-series AC Electronic Load Operation Flow Chart

3.3   NORMAL OPERATION

3.3.1   CC Mode:

Two levels can be set to allow for quick switching between two current levels. One crest factor setting (see Crest Factor Selection next) applies to both levels. Although the levels are referenced "high" and "low," the setting level does not require one to be higher than the other.

1. Press the MODE button (3), until the CC LED (3) is lit.

2. Press the PRES button (7) to view the programmed values. The load has a high and low setting to allow for quick changes in load setting.

    a. To set the low level, press the LEVEL button (10) until the associated LED is not lit (or do not press the button if the load is already in low state). Use the ⇧⇩↑↓ buttons (13) to adjust to the desired level.

    b. To set the high level, press the LEVEL button until the associated LED is lit (or do not press the button if the load is already in high state). Use the ⇧⇩↑↓ buttons to set the desired level.

3. To exit the preset mode, press the PRES button until the associated LED turns

3.3.2   Crest Factor Selection:

The SLM Series AC/DC electronic load module provides 11 built-in sets totaling 55 waveforms. The waveforms are stored in memory banks (0-10) with 5 selections per bank as shown in Table 3-1. Please refer to Appendix for details of waveforms.

When Frequency is set to DC (see Frequency section above), the waveform information shall be fixed at DC level and the "bAn" bank selection will not appear in the FREQ button menu.

1. Press FREQ button (15). The associated LED will light. Verify that the frequency does not read "dc". If it does, use the ⇧⇩↑↓ buttons to adjust the frequency from "dc".

2. Press the "FREQ" button until "bAn" appears on the upper display.

3. Use the ⇧ ⇩↑↓ buttons to select the desired bank, as defined in Table 3-1.

4. Press the "FREQ" button two times to exit setting mode.

5. Press the appropriate √2, 2.0, 2.5, 3.0 and 3.5 key to select the desired crest factor. The associated LED will light.

6. Press the LEVEL key to select the desired level CC mode. When the LED is lit, the HIGH level is selected and when unlit, the LOW level is selected.

7. Press the LOAD button (8) to toggle the load off or on.

    • Press the LEVEL button at any time to switch between the settings.

    • Use the ⇧ ⇩↑↓ keys any time to change the current.

    • Press the PRES key to view the set values.

3.3.3   CR Mode

Two levels can be set to allow for quick switching between two current levels. One crest factor setting (see section 3-2) applies to both levels. Although the levels are referenced "high" and "low," the setting level does not require one to be higher than the other.

In CR mode, the value setting is inverse to the increment/decrement arrows; i.e., the ⇧↑ keys *decrease* the resistance setting, and the ⇩↓ keys *increase* the resistance setting.

1. Press the MODE button, until the CR LED is lit (3).

2. Press the PRES button (7) to view the programmed values.

    a. To set the low level, press the LEVEL button (10) until the associated LED is not lit (or do not press the button if the load is already in low state). Use the ⇧⇩↑↓ buttons (13) to adjust to the desired level.

    b. To set the high level, press the LEVEL button until the associated LED is lit (or do not press the button if the load is already in high state). Use the ⇧⇩↑↓ buttons to set the desired level.

    c. To exit the preset mode, press the PRES button until the LED is no longer lit.

3. Select the desired CR level by pressing the LEVEL button (10). When the LED is lit, the HIGH level is selected and when unlit, the LOW level is selected.

4. Press the LOAD button (8) to toggle the load off or on

    • Press the LEVEL button at any time to switch between the settings.

    • Use the ⇧ ⇩↑↓ keys any time to change the resistance.

    • Press the PRES key to view the set values.

```
                              ┌─────────────────┐
                              │ Normal Operating │
                              │     Modes        │
                              └────────┬─────────┘
                                       │
┌─────────────────┐          ┌─────────▼─────────┐
│ Press MODE      │          │      MODE         │
│ Button until    │          └─────────┬─────────┘
│ desired mode is │                    │
│ illuminated     │          ┌─────────▼─────────┐
│ CC, CR          │          │      PRES         │
└─────────────────┘          └─────────┬─────────┘
┌─────────────────┐                    │
│ Preset desired  │          ┌─────────▼─────────┐
│ values          │          │  ⇧ ⇩ ↑↓           │
└─────────────────┘          │ Course/fine       │          ┌───────────────────┐
                             │ setting           │          │      FREQ         │
┌─────────────────┐          └─────────┬─────────┘          └─────────┬─────────┘
│ Set LO level    │                    │              YES             │
└─────────────────┘          ┌─────────▼─────────┐          ┌─────────▼─────────┐   ┌──────────────┐
                             │      LEVEL        │          │ Set FREQ          │   │ ⇧ ⇩ ↑↓       │
                             └─────────┬─────────┘          │ DC, AC 0.1-70,    │   │ Course/fine  │
┌─────────────────┐                    │                   │ Auto              │   │ setting      │
│ Activate and    │          ┌─────────▼─────────┐          └─────────┬─────────┘   └──────────────┘
│ Set HI level    │          │  ⇧ ⇩ ↑↓           │                    │
│                 │          │ Course/fine       │          ┌─────────▼─────────┐
└─────────────────┘          │ setting           │          │      FREQ         │
                             └─────────┬─────────┘          └─────────┬─────────┘
                                       │                              │
                              ┌────────▼────────┐           ┌─────────▼─────────┐   ┌──────────────┐
                   NO         │   CC Mode?      │  YES       │ Set BANK Number   │   │ ⇧↑ ⇩↓        │
                ◄─────────────┤                 ├──────────► │ for Crest Factor  │   │ High Bank# / │
                              └─────────────────┘           │ Waveform          │   │ Lower Bank#  │
                                                            └─────────┬─────────┘   └──────────────┘
┌─────────────────┐                                                   │
│ Toggle PRESet   │          ┌─────────────────┐           ┌─────────▼─────────┐
│ viewing off     │          │      PRES        │◄──────    │      FREQ         │
│ (LED off )      │          └─────────┬─────────┘          └─────────┬─────────┘
└─────────────────┘                    │                              │
┌─────────────────┐          ┌─────────▼─────────┐          ┌─────────▼─────────┐   ┌──────────────┐
│ Toggle between  │          │      LEVEL        │◄─ ─ ─     │ Set SYNC source   │   │ ⇧ ⇩ ↑↓       │
│ HIGH (amber LED)│          └─────────┬─────────┘          │ ON=External       │   │ Any button   │
│ and LOW (LED off)│                   │                   │ OFF=Input Terminal│   │ toggles      │
└─────────────────┘                    │                   │ or Vsense         │   │ sense on/off │
                                       │                   └─────────┬─────────┘   └──────────────┘
                                       │                              │
┌─────────────────┐                    │                   ┌─────────▼─────────┐   ┌──────────────┐
│ Turn load ON    │          ┌─────────▼─────────┐          │      FREQ         │   │ Exit FREQ/   │
│ (LED ON/amber)  │          │      LOAD         │─ ─ ─      └─────────┬─────────┘   │ BANK/        │
└─────────────────┘          └─────────┬─────────┘                    │             │ SYNC Setup   │
┌─────────────────┐                    │                              │             └──────────────┘
│ Turn load off   │          ┌─────────▼─────────┐                    │
│ (LED off)       │          │      LOAD         │                    │
└─────────────────┘          └─────────────────┘◄──────────────────────
```
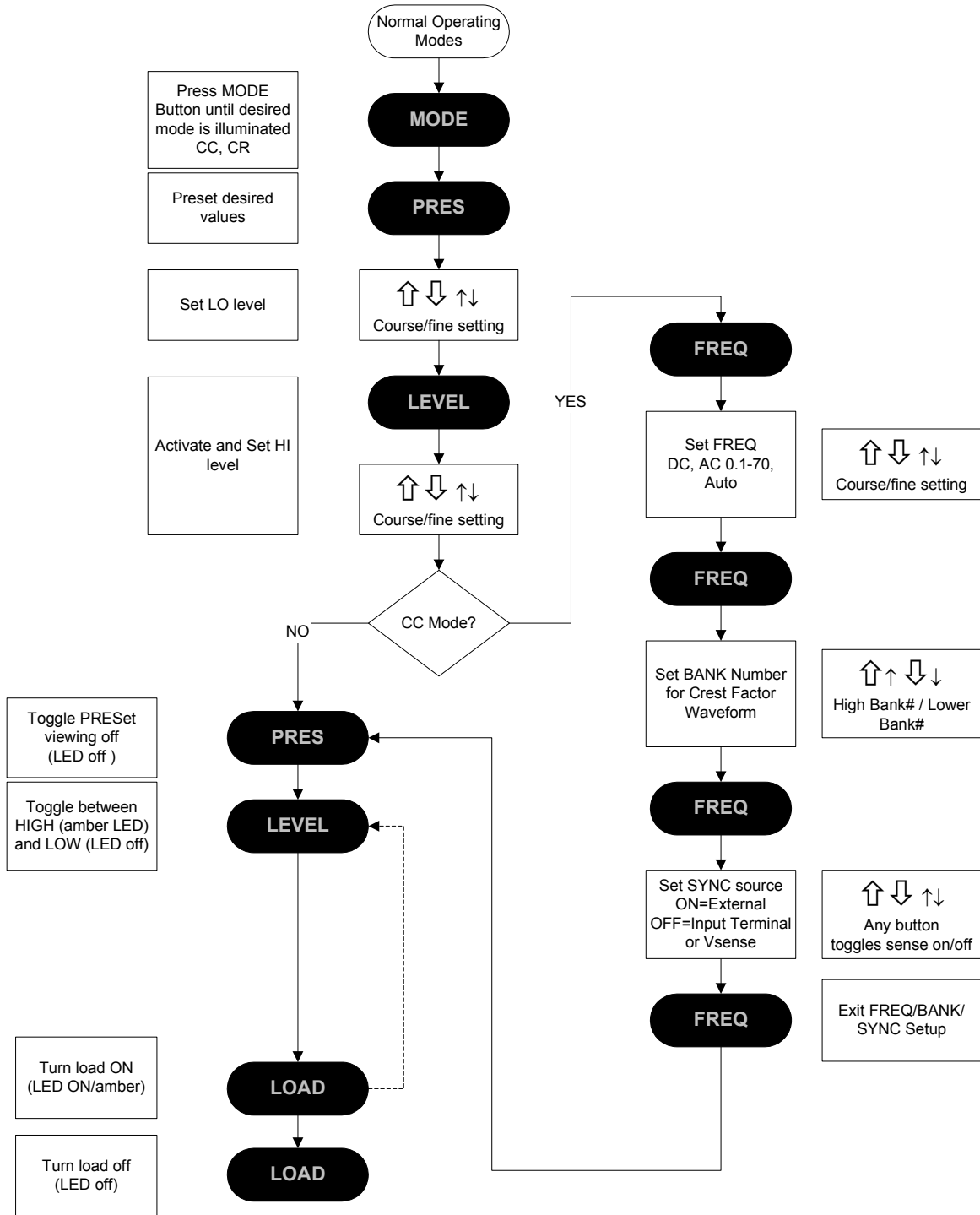
Figure 3-5. AC Electronic Load Operation Flow Char

3.4   STORE / RECALL FUNCTION AND SEQUENCE OPERATION

The six front panel function keys of the SLH-series High Power Load are designed for high testing throughput. Five operation states (keys 1 through 5 in Figure 3-6) can be stored in the non-volatile memory of SLH-series electronic load. Each state saves or recalls the load setup, the status and the electronic load level.
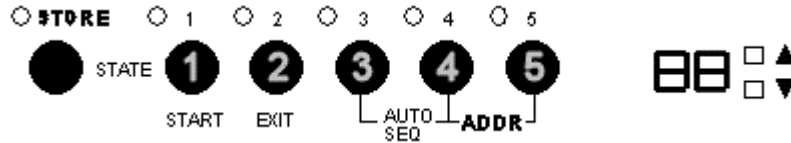

Figure 3-6 STORE/RECALL and Sequencing Keypad

3.4.1   STORE Procedure:

The STORE function stores up to five states of SLH-series load settings. If you store 2 different states in the same state key, the most recent input will replace the previous state.

    a.   Set the load status and the load level from load module.
    b.   Press the STORE key to start the store process; its LED begins flashing. You have ten seconds to select and press a STATE key (next) in which to store the status and level that you've set.
    c.   Press one of the STATE 1-5 keys; the corresponding LED will light, the load status and level of the load are stored into the non-volatile memory. Once the STORE procedure is complete, the STORE LED is no longer lit.

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 SL-series electronic load module are still active. However, the STATE LED will turn off if any key on any load module 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

Press one of the STATE 1 through 5 keys to recall the stored state; its corresponding LED will be lit.

3.4.3   AUTO SEQUENCE Procedures

There are two modes that can be activated while in AUTO SEQUENCE: EDIT MODE and TEST MODE. To enter AUTO SEQUENCE, simultaneously press STATE KEYS 3 and 4 (S3 and S4). To activate EDIT MODE, press the STORE key. To enter TEST MODE, press the START key. Please refer to the flow chart in Figure 3-7. A brief description of each mode follows the flow chart.

Bank LED Display

Bank LED Display

Step Number

Test sequence number nx

Bank Number

Test sequence number nx

"t1" when STORE button is held

t1 test time, when STORE is released

Memory Bank and State under test

"t2" when STORE button is held

t2 delay time, when STORE is released

GO / NG

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

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 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.

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 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.

3.5   INITIAL SETTINGS OF SLH-SERIES AC/DC ELECTRONIC LOAD

The initial setting parameters of SLH-series High Power AC/DC Electronic Load are described in Table 3-2.

Last Setting

All SLH-series High Power AC/DC Electronic Loads have the function for simplifying the setting procedures. This function is called "Last Setting" e.g., All SLH-series High Power AC/DC Electronic Load, undergone the initial inspection program procedure (Power on), can be immediately changed back to the setting

condition prior to Machine OFF thus simplifying the procedures for re-setting after machine being turned off.

Reset

If the Load's memory data have been damaged in some way, for example, due to unstable power source or noises, there may be an error, such as the display screen showing something different from the actual condition.   The Reset function corrects the errors.

To reset the SLH-series High Power AC/DC Electronic Load, simultaneously press the SENSE and the PRES keys.   The front panel monitor will display firmware version and initialize the setting parameters of SLH-series High Power AC/DC Electronic Load as shown in Table 3-2 until the key is released.

Parameter	SLH-500-4-1200	SLH-500-6-1800	SLH-300-12-1200	SLH-300-12-1800	SLH-300-18-1800
MODE	CC	CC	CC	CC	CC
LOAD	OFF	OFF	OFF	OFF	OFF
LEVEL	LOW	LOW	LOW	LOW	LOW
SENSE	OFF	OFF	OFF	OFF	OFF
PRES	OFF	OFF	OFF	OFF	OFF
WATT	OFF	OFF	OFF	OFF	OFF
Upper Pass / Fail Limits					
V LIMIT	600.0 V	600.0 V	400.0 V	400.0 V	400.0 V
A LIMIT	5.000 A	8.000 A	15.00 A	15.00 A	20.00 A
WLIMIT	1250.0 W	2000.0 W	1250.0 W	2000 W	2000 W
VALIMIT	1250.0 VA	2000.0 VA	1250.0 VA	2000 VA	2000 VA
Lower Pass/Fail Limits					
V, A, W, VA	0.0	0.0	0.0	0.0	0.0
C.F	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$
FREQ	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
BANK	0	0	0	0	0
SYNC	OFF	OFF	OFF	OFF	OFF
CC LEVEL LOW	0.0000 A	0.0000 A	0.0000 A	0.0000 A	0.0000 A
CC LEVEL HIGH	0.0000 A	0.0000 A	0.0000 A	0.0000 A	0.0000 A
CR LEVEL LOW	20E4 Ω	133E3 Ω	80E3 Ω	80E3 Ω	53E3 Ω
CR LEVEL HIGH	20E4 Ω	133E3 Ω	80E3 Ω	80E3 Ω	53E3 Ω

Table 3-2 SLH-series AC Electronic Load Factory Settings

3.6   PROTECTION FEATURES

There are four protection functions for the SLH-series High Power Electronic Load: Over-Voltage, Over-Current, Over-Power and Over-Temperature. When the electronic load exceeds the normal work area range, one of these four functions will activate. This feature turns OFF the load to protect it from damage. The lower digital meter

flashes the protection status, indicating which protection function is active. These functions are described below:

3.6.1   Over Voltage

The over voltage protection (OVP) point is preset in the SLH-series High Power AC/DC Electronic load. Table 3- shows the OVP trip values for the various models in the series. When OVP occurs, the lower digital meter (DM) flashes "oVP". Once the over voltage condition is reset, the lower DM resumes normal display.

Model	OVP	OCP	OPP
SLH-500-4-1200	525.0 V	4.20 A	1260 VA
SLH-500-6-1800	525.0 V	6.30 A	1890 VA
SLH-300-12-1200	315.0 V	12.60 A	1260 VA
SLH-300-12-1800	315.0 V	12.60 A	1890 VA
SLH-300-18-1800	315.0 V	18.90 A	1890 VA

Table 3-3 SLH AC-series Protection Setting Values

3.6.2   Over Current

The over current protection (OCP) point is preset in the SLH-series High Power AC/DC Electronic load. Table 3- shows the OCP trip values for the various models in the series. When OCP occurs, the lower digital meter (DM) flashes "oCP". Once the over current condition is reset, the lower DM resumes normal display.

3.6.3   Over Power

The over power protection (OPP) point is preset in the SLH-series High Power AC/DC Electronic load. Table 3- shows the OPP trip values for the various models in the series. When OPP occurs, the lower digital meter (DM) flashes "oPP". Once the over power condition is reset, the lower DM resumes normal display.

3.6.4   Over Temperature

SLH-series High Power AC/DC Electronic load is provided with a temperature sensor. Over temperature protection (OTP) is tripped when the heat dissipater temperature exceeds about 85 ±5 , and the lower DM flashes "oTP". Once the over temperature condition is reset, the lower DM resumes normal display.

When OTP occurs, check the ambient working temperature and ventilation. The air outlet on requires a distance of greater than 6 in / 15 cm from any obstruction, for proper ventilation.

SECTION 4
GPIB/RS-232 PROGRAMMING OPERATION

4.1   INTRODUCTION

The rear panel of SLH-series is designed for automated and/or remote testing from a computer through a GPIB or RS-232 interface. This feature can be used as an automatic load/cross load regulation and centering voltage testing for a switching power supply or a rechargeable battery charge/discharge characteristic testing.

4.2   SLH-SERIES GPIB COMMAND LIST

4.2.1   Setting Commands

Function	Command	Format
SET AUTO FREQUENCY DETECT ON/OFF	AFREQ{SP}{0|1|OFF|ON}{;|NL}	
SET SYNC ON/OFF	SYNC{SP}{0|1|OFF|ON}{;|NL}	
SET SENC ON/OFF	SENS{SP}{0|1|OFF|ON}{;|NL}	
SET WATT ON/OFF	WATT{SP}{0|1|OFF|ON}{;|NL}	
SET BANK	BANK{SP}{d}{;|NL}	d:0 ~ 10
SET WAVE	WAVE{SP}{m}{;|NL}}	m:1 ~ 5
SET FREQUENCY	PREQ{SP}{NR2}{;|NL}	NR2:###.#####
SET VOLTAGE LOW LIMIT	VL{SP}{NR2}{;|NL}	
SET VOLTAGE HIGH LIMIT	VH{SP}{NR2}{;|NL}	
SET CURRENT LOW LIMIT	IL{SP}{NR2}{;|NL}	
SET CURRENT HIGH LIMIT	IH{SP}{NR2}{;|NL}	
SET WATT LOW LIMIT	WL{SP}{NR2}{;|NL}	
SET WATT HIGH LIMIT	WH{SP}{NR2}{;|NL}	
SET VA LOW LIMIT	VAL{SP}{NR2}{;|NL}	
SET VA HIGH LIMIT	VAH{SP}{NR2}{;|NL}	
SET CURRENT	CURR:{LOW|HIGH|A|B}{SP}{NR2}{;|NL}	NR2:###.#####
SET RESISTANCE	RES:{LOW|HIGH|A|B}{SP}{NR2}{;|NL}	
SET LOAD ON/OFF	LOAD{SP}{0|1|OFF|ON}{;|NL}	
SET LEVEL LOW/HIGH	LEV{SP}{0|1|LOW|HIGH}{;|NL}	
SET PRESENT ON/OFF	PRES{SP}{0|1|OFF|ON}{;|NL}	
SET MODE	MODE{SP}{0|1|2|CC|CR|CV}{;|NL}	
SET CLEAR STATE	CLER{;|NL}	
SET STORE STATE	STORE{SP}{m}{;|NL}	m:1 ~ 5
SET RECALL STATE	RECALL{SP}{m}{;|NL}	m:1 ~ 5

Table 4-1 GPIB Setting Command Summary

REMARK :
 1. CURRENT ENGINEERING UNIT : A
 2. VOLTAGE ENGINEERING UNIT : V
 3. RESISTANCE ENGINEERING UNIT : Ω

4.2.2   Query Commands

Function	Command Syntax	ECHO
AUTO FREQUENCY DETECT ON/OFF	AFREQ?{;|NL}	1:ON, 0:OFF
SYNC	SYNC?{;|NL}	1:ON, 0:OFF
SENS ON/OFF	SENS?{;|NL}	1:ON, 0:OFF
WATT ON/OFF	WATT?{;|NL}	1:ON, 0:OFF
BANK	BANK?{;|NL}	0 ~ 10
WAVE	WAVE?{;|NL}	1 ~ 5
FREQUENCY	FREQ?{;|NL}	###.####
VOLTAGE LOW LIMIT	VL?{;|NL}	###.####
VOLTAGE HIGH LIMIT	VH?{;|NL}	###.####
CURRENT LOW LIMIT	IL?{;|NL}	###.####
CURRENT HIGH LIMIT	IH?{;|NL}	###.####
WATT LOW LIMIT	WL?{;|NL}	###.####
WATT HIGH LIMIT	WH?{;|NL}	###.####
VA LOW LIMIT	VAL?{;|NL}	###.####
VA HIGH LIMIT	VAH?{;|NL}	###.####
MEASURE POWER	MEAS:POW?{;|NL}	###.####
MEASURE VA	MEAS:VA?{;|NL}	###.####
No Good INDICATER	NG?{;|NL}	0:OFF, 1:ON
CURRENT	CURR:{LOW|HIGH|A|B}?{;|NL}	###.####
RESISTANCE	RES:{LOW|HIGH|A|B}?{;|NL}	###.####
LOAD ON/OFF	LOAD?{;|NL}	1:ON, 0:OFF
LEVEL LOW/HIGH	LEV?{;|NL}	0:LOW/A, 1:HIGH/B
PRESET ON/OFF	PRES?{;|NL}	1:ON, 0:OFF
MODE CC/CR	MODE?{;|NL}	0:CC, 1:CR
NAME	NAME?{;|NL}	325x
PROTECT STATE	PROT?{;|NL}	0 ~ F(hex)
ERROR STATE	ERR?{;|NL}	0 ~ F(hex)
CURRENT METER	MEAS:CURR?{;|NL}	±###.####
VOLTAGE METER	MEAS:VOLT?{;|NL}	±##.####
GLOB. CURRENT METER	GLOB:MEAS:CURR?{;|NL}	##.###, ##.###, ##.###, ##.###
GLOB. VOLTAGE METER	GLOB:MEAS:VOLT?{;|NL}	##.###, ##.###, ##.###, ##.###

Table 4-2 GPIB Query Command Summary

REMARK :
 1. CURRENT ENGINEERING UNIT:A
 2. VOLTAGE ENGINEERING UNIT:V
 3. RESISTANCE ENGINEERING UNIT:Ω

4.3   COMMAND SYNTAX ABBREVIATIONS

SP   :Space, the ASCII code is 20 Hexadecimal.
;   :Semicolon, Program line terminator, the ASCII code is OA Hexadecimal.
NL   :New line, Program line terminator, the ASCII code is OA 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 are listed in Table 4-3.

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

Table 4-3 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 OA 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 4-4 presents a summary of the GPIB/RS-232 Setting commands, and Table 4-5 summarizes the GPIB/RS-232 preset Query commands with applicable module types. Table 4-6 is a summary of State commands, the System commands are in Table 4-7, Measure and Limit commands are in Table 4-8, and the Global commands are in Table 4-9.

Setting Preset Numeric Command	Remark
[PRESet:] BANK{SP}{d}{;|NL}	d=0~30
[PRESet:] WAVE{SP}{m}{;|NL }	M=0~5
[PRESet:] FREQ{SP}{NR2}{;|NL}	40.0~70.0Hz
[PRESet:] CC:{HIGH|LOW}{SP}{NR2}{;|NL}	
[PRESet:] CR:{HIGH|LOW}{SP}{NR2}{;|NL}	

Table 4-4 GPIB/RS-232 Setting Command Summary

Query Preset Numeric Command	RETURN
[PRESet:] BANK{SP}{?}{;|NL}	0~10
[PRESet:] WAVE{SP}{?}{;|NL}	1~5
[PRESet:] FREQuency{?}{;|NL}	40.0~70.0
(PRESet:] CC:{HIGH|LOW}{?}{;|NL}	###.####
[PRESet:] CR:{HIGH|LOW}{?}{;|NL}	###.####

Table 4-5 GPIB/RS-232 Preset Query Command Summary

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:] PRESet{SP}{ON|OFF}{;|NL}	
[STATe:] PRESe{?}{;|NL}	0=OFF, 1=ON::
[STATe:] SENSe{SP}{ON|OFF}{;|NL}	
[STATe:] LEVEl{SP}{HIG|LOW}{;|NL}	
[STATe:] LEVEl{?}{;|NL}	0:=LOW, 1:=HIGH
[STATe:] SYNCronize{SP}{ON|OFF}{;|NL}	
[STATe:] SYNCronize{?}{;|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 4-6 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}		"XXXXX"

Table 4-7 System Commands

COMMAND	RETURN
MEASure:CURRent {?}{;| NL}	###.####
MEASure:VOLTage {?}{;| NL}	###.####
MEASure:PWR {?}{;| NL}	###.####
MEASure:VA {?}{;| 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:VA:{HIGH|LOW}{SP}{NR2}{;|NL}	
LIM:VA:{HIGH|LOW}{?}{;|NL}	###.####
LIM:VOLTage:{HIGH|LOW}{SP}{NR2}{;|NL}	
LIM:VOLTage:{HIGH|LOW}{?}{;|NL}	###.####

Table 4-8 Measure and Limit Commands

COMMAND	RETURN
GLOBal:[STATe:] PRESet{SP}{ON|OFF}{;|NL}	
GLOBal:[STATe:] LOAD{SP}{ON|OFF}{;|NL}	
GLOBal:[STATe:] MODE{SP}{ON|OFF}{;|NL}	
GLOBal:[STATe:] LEVEL{SP}{A|B}{;|NL}	
GLOBal:MEASure:CURRent{?}{;|NL}	###.##
GLOBal:MEASure:VOLtage{?}{;|NL}	###.##

Table 4-9 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 : Ω
6. PERIOD ENGINEERING UNIT : mS
7. SLEW-RATE ENGINEERING UNIT : A/μS

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

4.4   GPIB/RS-232 COMMAND DESCRIPTION

4.4.1   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}
Sets the current level of Electronic Load modules.

CC:{SP}{NR2}{;|NL}
This command is used to set the load current level for CC static mode of SLH-series electronic load module.

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. If the programmed load current level is over the maximum rated specification, the full scale current will be sent to the load module.
    c. Engineering units for load current is Amps.

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}
This command is used to set the LOW/HIGH load resistance level of the electronic load.

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. If the programmed load resistance level is over the maximum rated specification, the full scale resistance will be sent to the load module.
    c. Engineering unit for load resistance is Ohms.

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.

LOAD

Purpose:
Turn the Electronic load module input ON or OFF.

Command Syntax:
LOAD{SP}{0FF|ON}{NL}

Description:
This command sets the Electronic load to sink current from power source.
For Example :
LOAD OFF ; All loads are at input OFF condition.

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

LOAD 0; Set the load to LOAD OFF.

LEVEL HIGH/LOW

Purpose:
Select Low or High level in static mode, of DC electronic loads, or LEVEL A/B of AC electronic loads.

Command Syntax:
 [GLOB:] LEVE {SP}{HIGH|LOW}{NL}

Description:
LEVE LOW is Set LOW current level in CC mode or LOW resistance level in CR mode.

LEVE 1 is Set HIGH current level in CC mode or HIGH resistance level in CR mode.

PRESET ON/OFF

Purpose:
Set the upper or lower digit multi-function meter to display the programming load level.

Command Syntax:
PRES{SP}{0|1|OFF|ON}{NL}

Description:
PRES ON is set to preset on status.

MODE

Purpose:
Select the operating mode of Electronic load module.

Command Syntax:
MODE{SP}{0|1|CC|CR}{NL}

Description:
MODE CC ; set the presently operating mode to Constant Current mode.

MODE 1 ; set the presently operating mode to Constant Resistance 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 SL-series electronic LOAD.

Command Syntax:

STOR{SP}{m}{;|ML}

Description:

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

Example:

STORE 1; store the AC electronic load module's load status and load current into the memory 1.

RECALL

Purpose:

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

Command Syntax:

REC{SP}{m}{;|NL}

Description:

This command is used to recall the memory state, is stored into memory by the GPIB/RS232 STORe command, up to 5 states can be recalled for AC electronic load modules, and up to 150 states can be recalled for DC electronic load modules.

Example:

REC 1; Recall the state of load level and status that is stored in memory 1 by GPIB/RS232 STOR command.

SYNCHRONOUS ON/OFF

Purpose:

To set synchronous function ON/OFF of AC electronic loads.

Command Syntax:

SYNC{SP}{0|1|OFF|ON}{;|NL}

Description:

1. External synchronous signal (SYNC ON): Using external synchronous signal as the synchronous triggering signal of the electronic load thus making the load current synchronous with the voltage.
2. Internal synchronous signal (SYNC OFF): Using the signal at the terminal of the input connector thus generating synchronous signal through the internal zero-crossing circuit and isolated circuit.

Example:

SYNC ON ; To set external synchronization.

SYNC OFF ; To set internal synchronization.

WATT Meter ON/OFF

Purpose:
To set display of power meter of AC series electronic load.

Command Syntax:
WATT{SP}{0|1|OFF|ON}{;|NL}

Description:
This command is to set the power meter display. This command must be used in conjunction with PRES:OFF. When setting to ON, the top monitor will change from voltmeter to Watt meter while the monitor at the bottom will change from ammeter to Volt-Ameter (VA) and the unit is "W" and "VA" respectively. When setting to OFF, the Watt meter on the top will change back to voltmeter while the VA meter at the bottom will change back to ammeter and the unit is "Vrms" and "Arms" respectively.

Example:
PRES OFF

WATT ON ; to display WATT, VA meter.

WATT OFF ; to display Voltage, Current meter.

WAVEFORM BANK

Purpose:
To set waveform bank for AC electronic load modules.

Command Syntax:
BANK{SP}{d}{;|NL}   d:0-10

Description:
This command is to set the desired waveform bank.
 1. waveform bank 0-4 are sine wave.
 2. waveform bank 5-9 are square wave.
 3. waveform bank 10 is DC.
 4. There are five (5) waveforms for each of eleven (11) waveform banks for a total of 55 waveforms. Waveform information is shown in Table 4-10.

Example:
BANK 1, to set waveform bank 1.

BANK 10, to set waveform bank 10.

	Waveform Bank	m=1	m=2	m=3	m=4	m=5
Sine Wave	0	√2	2.0	2.5	3.0	3.5
	1	1.5	1.6	1.7	1.8	1.9
	2	2.0	2.1	2.2	2.3	2.4
	3	2.5	2.6	2.7	2.8	2.9
	4	3.0	3.1	3.2	3.3	3.4
Square Wave	5	1.0	1.1	1.2	1.3	1.4
	6	1.5	1.6	1.7	1.8	1.9
	7	2.0	2.1	2.2	2.3	2.4
	8	2.5	2.6	2.7	2.8	2.9
	9	3.0	3.1	3.2	3.3	3.4
DC	10	√2dc	2dc	2.5dc	3.0dc	3.5dc

Table 4-10 Waveform Information

WAVEFORM

Purpose:
To set waveform for AC electronic load modules.

Command Syntax:
WAVE{SP}{m}{;|NL} m:1-5

Description:
This command is to set the Crest Factor (C.F.) at CC MODE (Peak Value Factor).

This command works only at CC MODE. When BANK varies, these 5 sets of C.F. will at the same time define different C.F. as shown in Table 4-10, m=1-5 corresponds to A-E

Example:
WAVE 2 ; To set 2nd set C.F.
WAVE 5 ; To set 5th set C.F.

FREQUENCY

Purpose:
Setting of Frequency Value for AC electronic load modules.

Command Syntax:
FREQ{SP}{NR2}{;|NL}

Description:
This command is for setting the frequency value of electronic load. To use this command, attention must be paid to the following five items:

 1. The frequency value designated must include the decimals, otherwise, the command will become null and void.

 2. The minimum effective digit of the value is the fifth place after the decimal point.

 3. If the value designated exceeds the specification of the electronic load, the mainframe will send out the full scale current value of the electronic load specification.

 4. The frequency range is 40.0~70.0Hz.

  5. The engineering unit for frequency is Hz.

Example:

FREQ 50.0, to set frequency is 50.0Hz.

FREQ 60.0, to set frequency is 60.0Hz.

FREQ 0.1, to set frequency is 0.1Hz, that is to set DC.

VOLTAGE Limit

Purpose:

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

Command Syntax:

All Modules: 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:

All Modules: 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.

VA Limit

Purpose:
To set the upper/lower limit value of threshold power (VA).

Command Syntax:
LIM:VA:{HIGH|LOW}{SP}{NR2}{;|NL}

Description:
This command is to set the upper/lower limit value of threshold power (VA). When power (VA) 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:VA:LOW 0.05 ; To set the lower limit value of threshold power (VA) is 0.05 VA.

LIM:VA:HIGH 250.0 ; To set the upper limit value of threshold power(VA)is 250.0 VA.

SENSE ON/OFF

Purpose:
Set the voltage sense ON/OFF of Electronic load.

Command Syntax:
 [GLOB:]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 or automatically sensed. If Vsense is set to On, voltage is measured at the Vsense input.

Example:
GLOB:SENS ON set all load module V-sense input to sense ON state.

SENS OFF set load module V-sense input to sense OFF state.
DUAL OFF; Disable the dual meter function, the upper 5-digit LED display is voltage meter, the lower 5-digit LED display is current meter.

4.4.2   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 the electronic load.

CURR? return the presently programmed load current level in Constant Current mode.

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 the electronic load.

The engineering unit is "OHM".

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.

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:
All Modules: PRES?{NL}

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

MODE

Purpose:
CC or CR operating mode query command.

Command Syntax:
MODE?{NL}

Description:
MODE? returns the present operating mode status, "0" indicates CC MODE, "1" indicates CR MODE.

NAME

Purpose:

Electronic Load module model number query command.

Command Syntax:

All Modules: NAME?{NL}

Description:

NAME? return the active Electronic Load model number, 325x for SLH AC-series loads.

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.
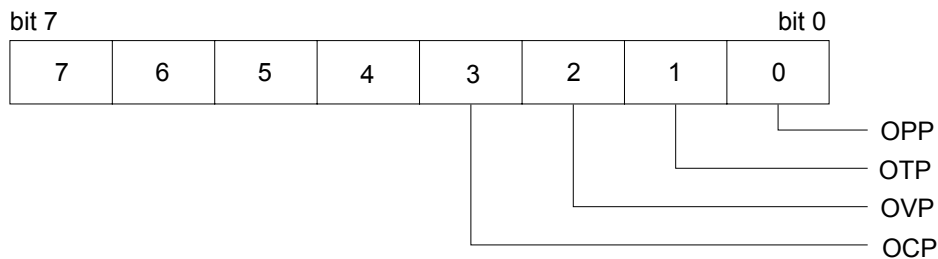
Figure 4-1 Protection Status Register

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.
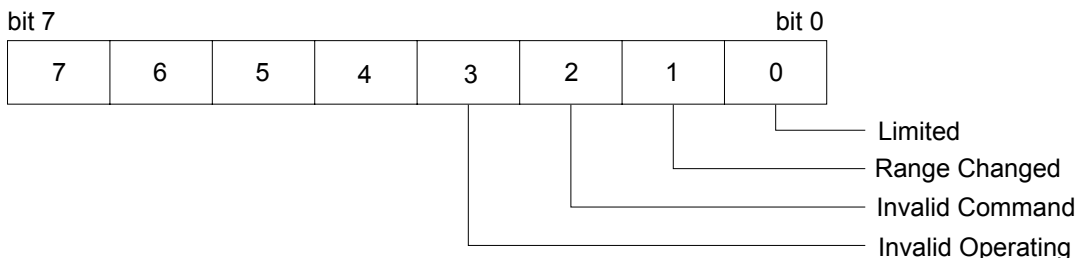
Figure 4-2 Error Status Byte Register

bit 0:Limited
This bit set to high by Electronic Module Load setting command causing over range. Reset by CLER command.

Example:
Module 3310
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:
Module 3310
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:
Module 3310
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 digit of the Watt meter; unit is (W).

VA METER

Purpose:
To read the value of VA meter.

Command Syntax:
MEAS:VA?{;|NL}

Description:
MEAS:VA? Reads back the value of 4 digit of VAmeter, unit is (VA).

SYNCHRONOUS ON/OFF

Purpose:
To read the setting condition of SYNC.

Command Syntax:
SYNC?{;|NL}

Description:
SYNC? Read back the condition of SYNC. "0" denotes OFF, "1" denotes ON.

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 ON.

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.

WAVEFORM BANK

Purpose:
To read the set value of BANK

Command Syntax:
BANK?{;|NL}

Description:
BANK? Reads back the set value of BANK. 0-10 denotes waveform bank of level 0-10.

WAVEFORM

Purpose:
To read the set value of WAVE.

Command Syntax:
Modules: WAVE?{;|NL}

Description:
WAVE? Reads back the set value of WAVE. 1-5 denotes the C.F. setting of level 1-level 5.

FREQUENCY

Purpose:
To read the set frequency of FREQ.

Command Syntax:
    FREQ?{;|NL}

Description:
Reads back the set frequency of FREQ, unit is Hz.

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 voltag;, 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).

VA Limit

Purpose:

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

Command Syntax:

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

Description:

LIM:VA:LOW? Reads back the lower limit set value of threshold power, unit is (VA).

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.

APPENDIX A
SLH-SERIES AC/DC LOAD WAVE FORM DATA BANK

SLH-series High Power AC/DC Electronic load provides 11 banks with five states each, totaling 55 settings, described as follows:

	BANK	A	B	C	D	E
Sine wave	0	√2	2.0	2.5	3.0	3.5
	1	1.5	1.6	1.7	1.8	1.9
	2	2.0	2.1	2.2	2.3	2.4
	3	2.5	2.6	2.7	2.8	2.9
	4	3.0	3.1	3.2	3.3	3.4
Square Wave	5	1.0	1.1	1.2	1.3	1.4
	6	1.5	1.6	1.7	1.8	1.9
	7	2.0	2.1	2.2	2.3	2.4
	8	2.5	2.6	2.7	2.8	2.9
	9	3.0	3.1	3.2	3.3	3.4
DC	10	√2dc	2dc	2.5dc	3.0dc	3.5dc

C.F. value of sine wave consists of √2 - 3.4 totaling 25 banks of which the definition is described in the following figure:
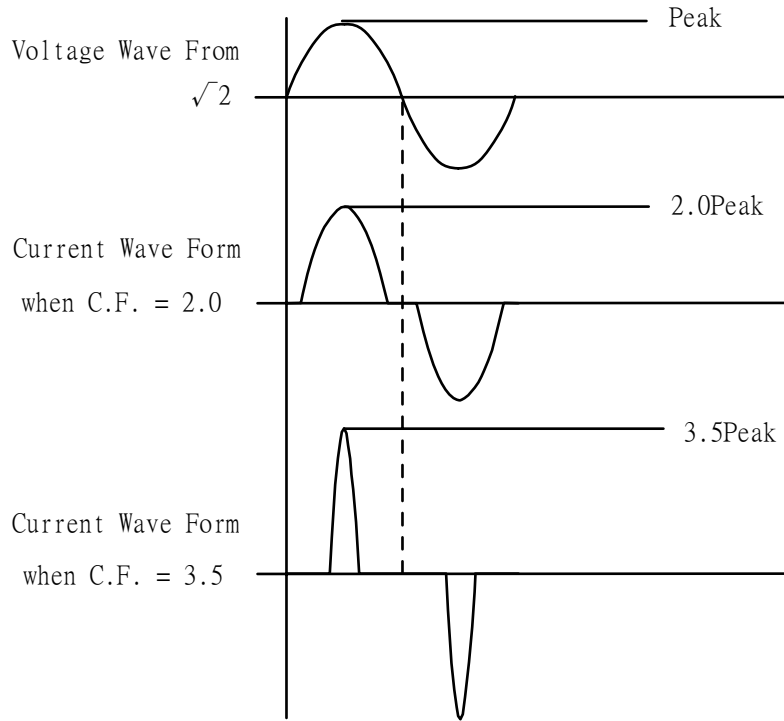
C.F. Value of square wave consists of 1.0-3.4 totaling 25 banks of which the definition described in figure below:
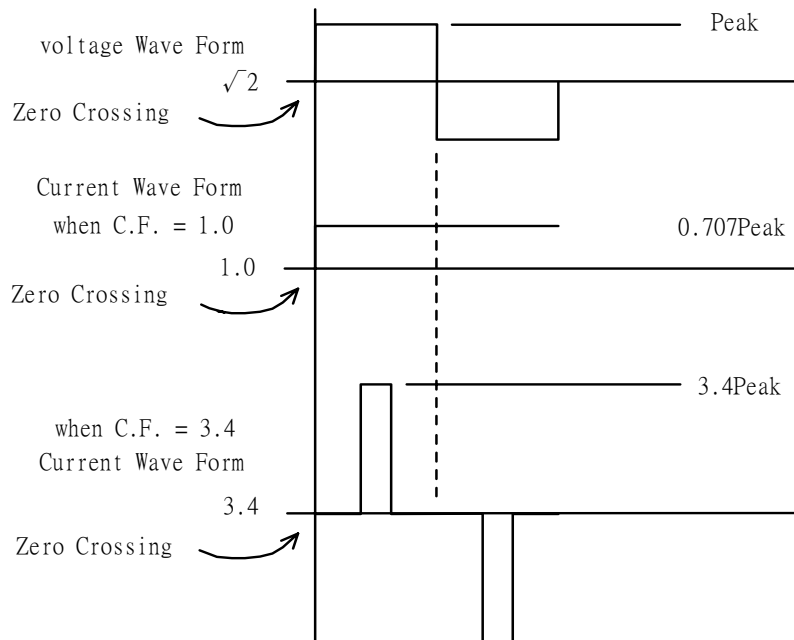
There are five DC waveforms in Bank 10, shown in the figure below:
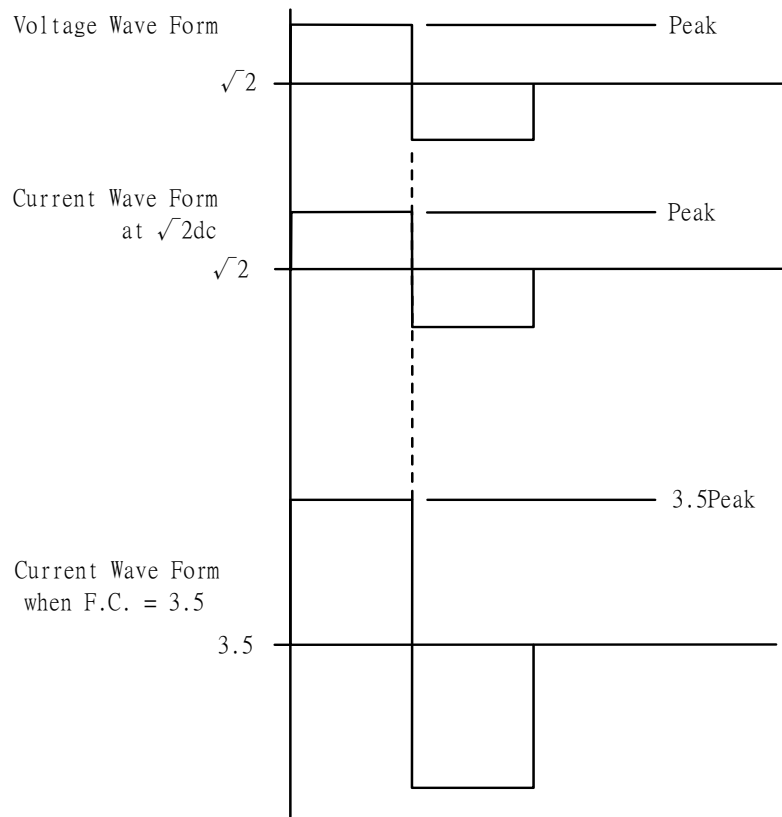
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APPENDIX B
SLH-SERIES AC/DC LOAD R.201 EDITION
WAVE FORM DATA BANK

SLH-series High Power AC/DC Electronic load module provides 11 banks with five states each, totaling 55 settings, which are described as follows:

	BANK	A	B	C	D	E
Sine Wave	0	$\sqrt{2}$	2.0	2.5	3.0	3.5
	1	1.5	1.6	1.7	1.8	1.9
	2	2.0	2.1	2.2	2.3	2.4
	3	2.5	2.6	2.7	2.8	2.9
	4	3.0	3.1	3.2	3.3	3.4
Square Wave	5	1.0	1.2	1.4	1.5	1.6
	6	1.8	2.0	2.2	2.4	2.5
	7	2.6	2.8	3.0	3.2	3.4
	8	$\sqrt{2}$	1.2	1.5	1.8	2.0
	9	2.2	2.5	2.8	3.0	3.4
DC	10	$\sqrt{2}$dc	2dc	2.5dc	3.0dc	3.5dc

C.F. values of sine wave are √2-3.5 totaling 25 settings, described in the following figure:
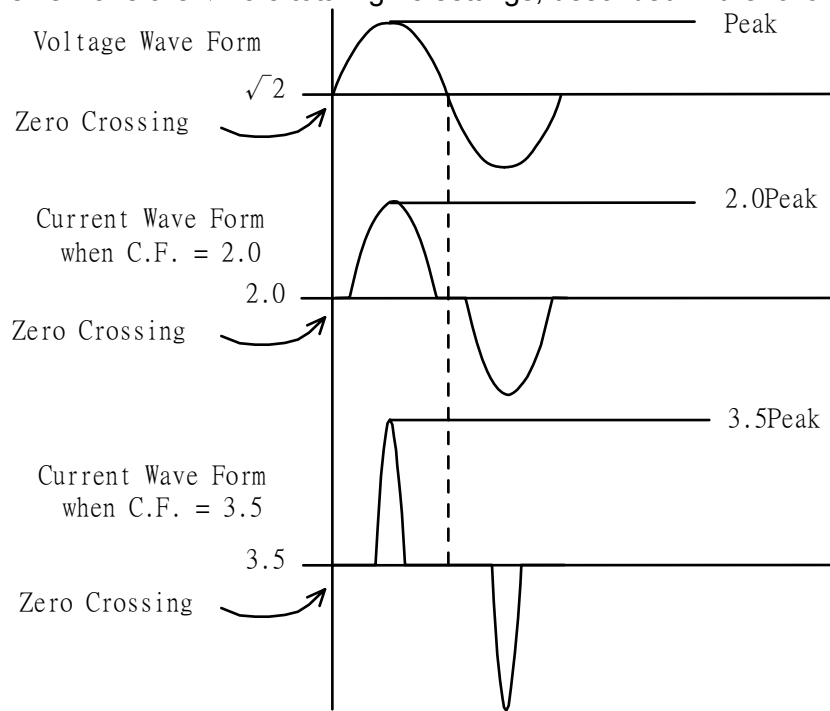
C.F. Values of square wave are 1.0-3.4 totaling 15 settings, described in the following figure:
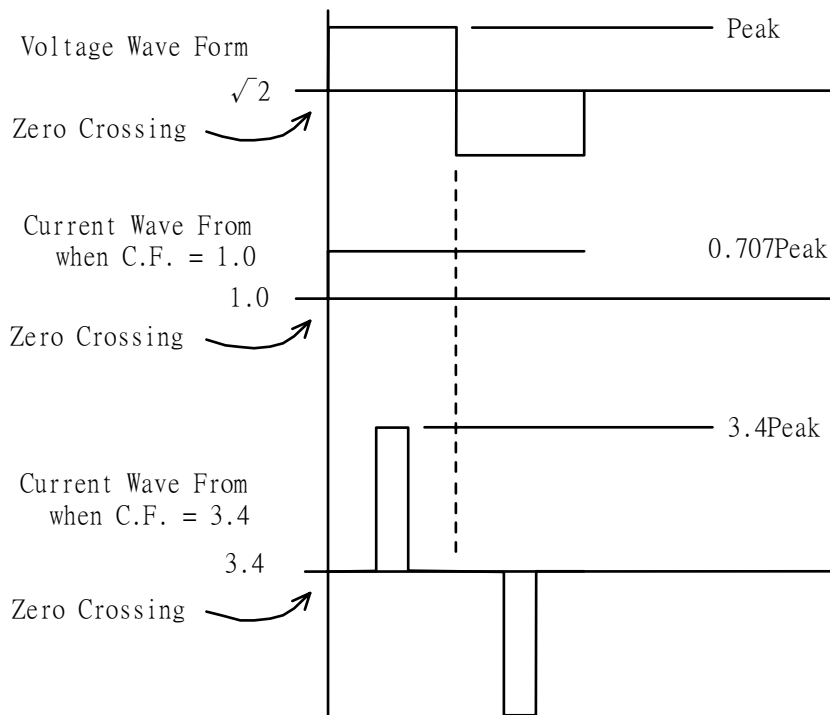
Square wave is a special wave form and is the bank established for DC/AC power supplier, UPS applications, its C.F. values are 1.2-3.4 totaling 10 settings, described in the following figure:
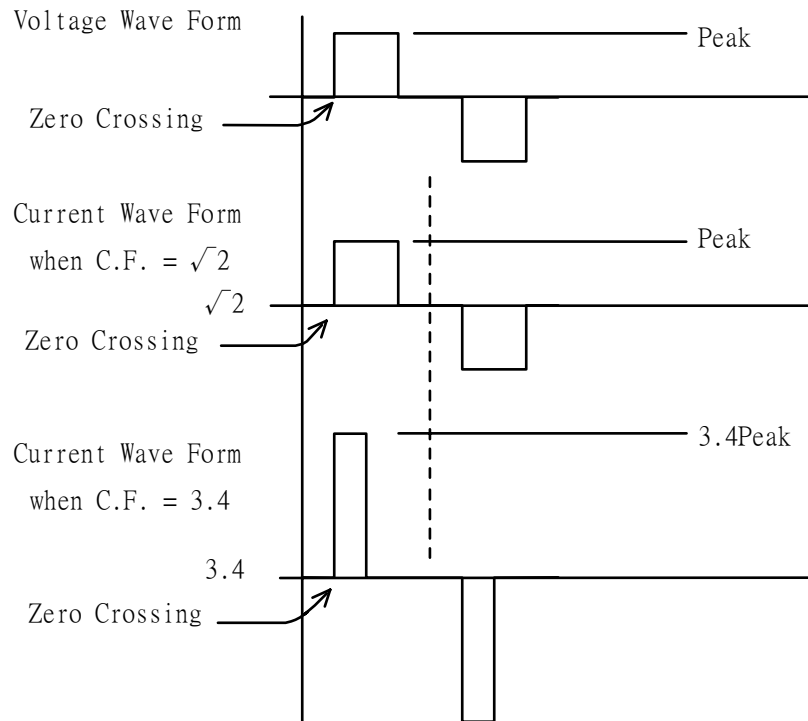
There are five DC waveforms in Bank 10, shown in the figure below:
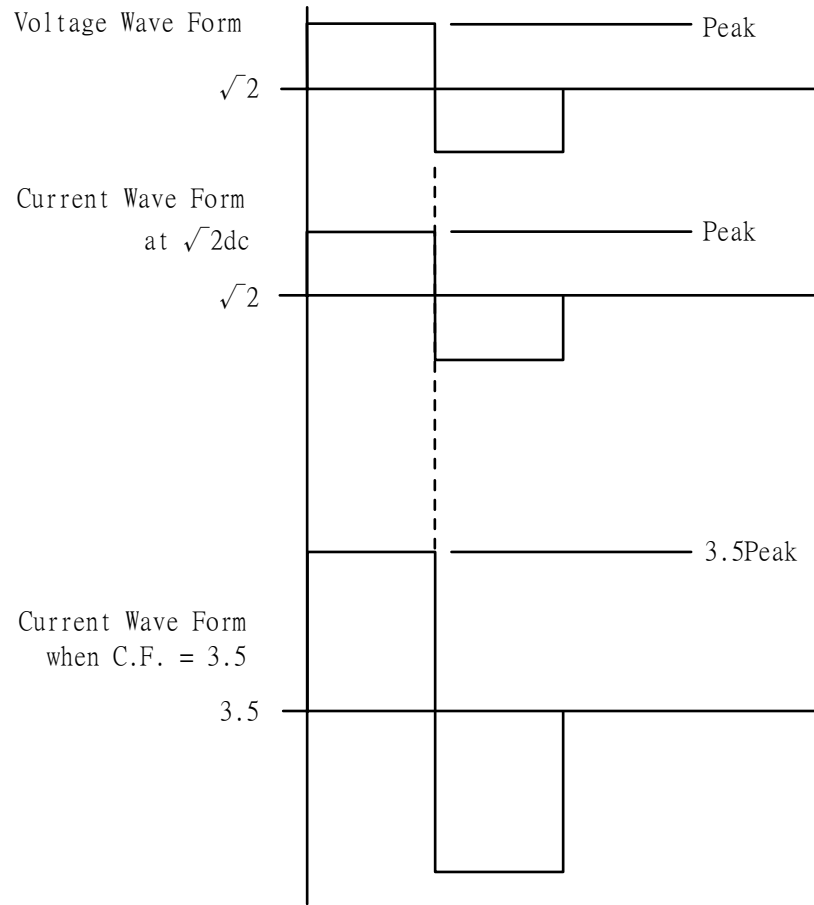
APPENDIX C
SETTING THE AC OR DC ELECTRONIC LOAD

The SLH-series High Power AC/DC Electronic load is a full function electronic load for AC and DC. The setting of electronic load for AC or DC depends on the output frequency of the device under test (DUT). The setting is described as follows:

Setting of the AC Electronic Load

When SLH-series High Power AC/DC Electronic load is used for AC, the frequency of SLH-series High Power AC/DC Electronic load must be set to the same frequency of the DUT. Even if the output frequency of the DUT is 50 Hz, the frequency of SLH-series High Power AC/DC Electronic load must be set to 50.0 Hz by means of the FREQ function.

Setting of the DC Electronic Load

When SLH-series High Power AC/DC Electronic load is used for DC, SLH-series High Power AC/DC Electronic load must be set to DC. When the frequency is set to, the Bank function is not available and will not be displayed on the monitor.

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

D.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.

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

D.2.1   Ship Kit Included with System

- SLH-Series Model Name plate   QTY = 1
  Iidentifies the model number, voltage, current, and watt rating of the high power load system.

- Parallel Bus-bar: QTY = (n-1) × 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×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) × 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) × 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.

D.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

D.3   Master and Slave System Connection

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

WARNING

D.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.**

CAUTION **The rear supports are for a 2-unit configuration only. Any system comprised of three or more units must be installed into a cabinet.**
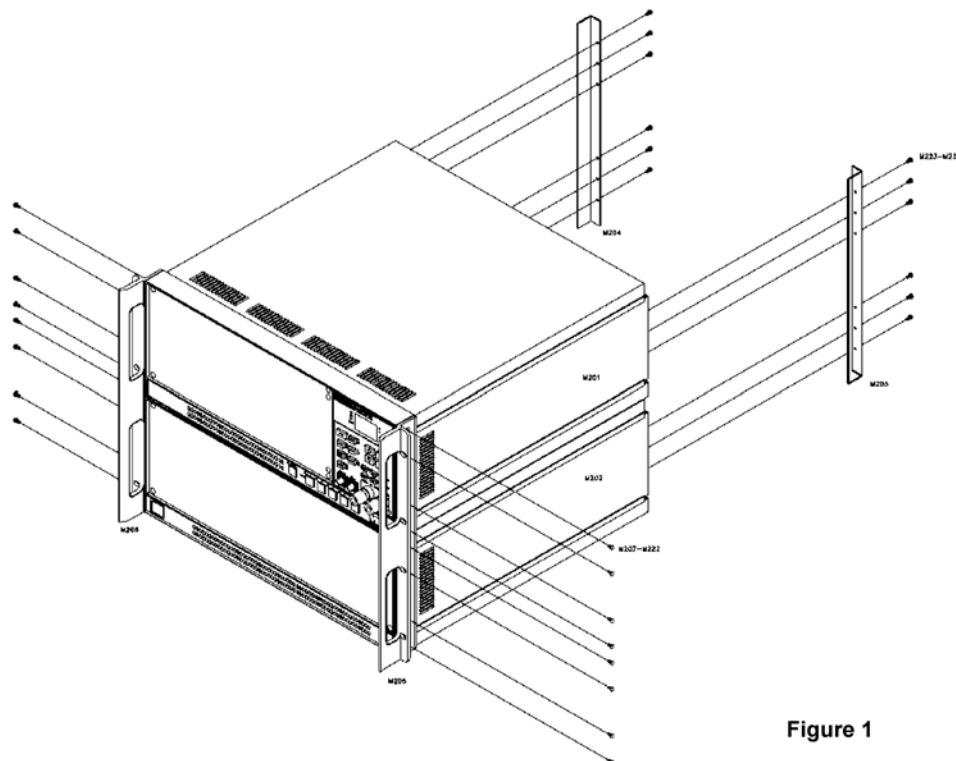
Figure 1

WARNING

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

Load Input for 30Arms and Greater Systems

Use cables 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 open terminal blocks.

Note: For systems rated at 30Arms and lower, the rear terminals are not present.
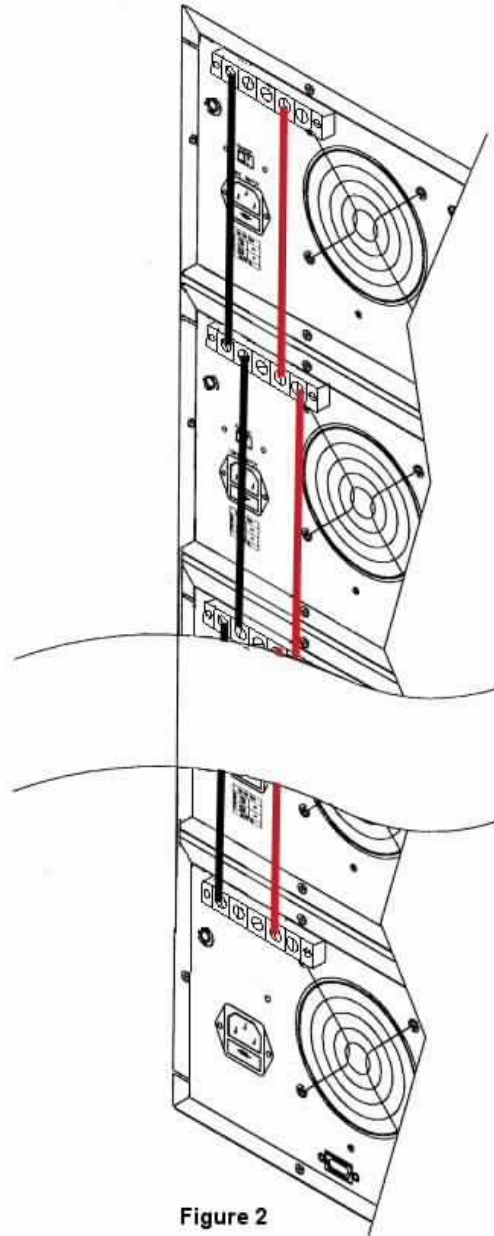
Figure 2

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.

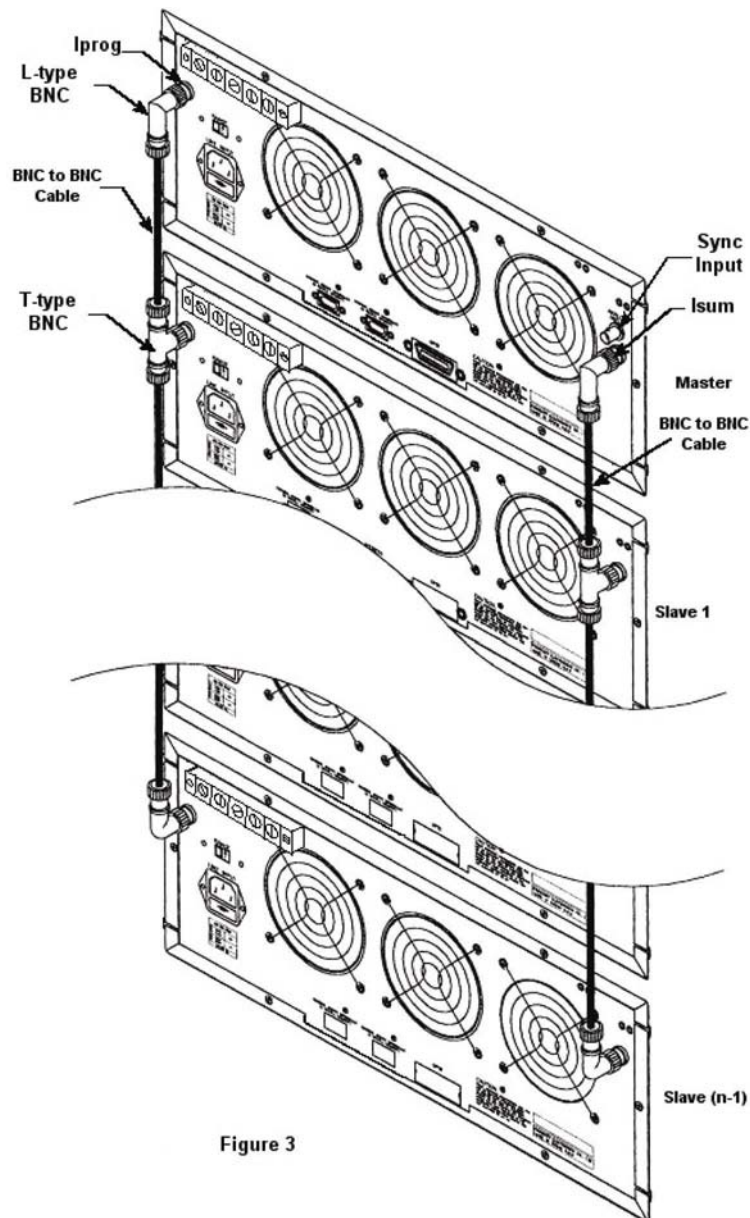Figure 3 illustrates these connections.

Figure 3

D.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.
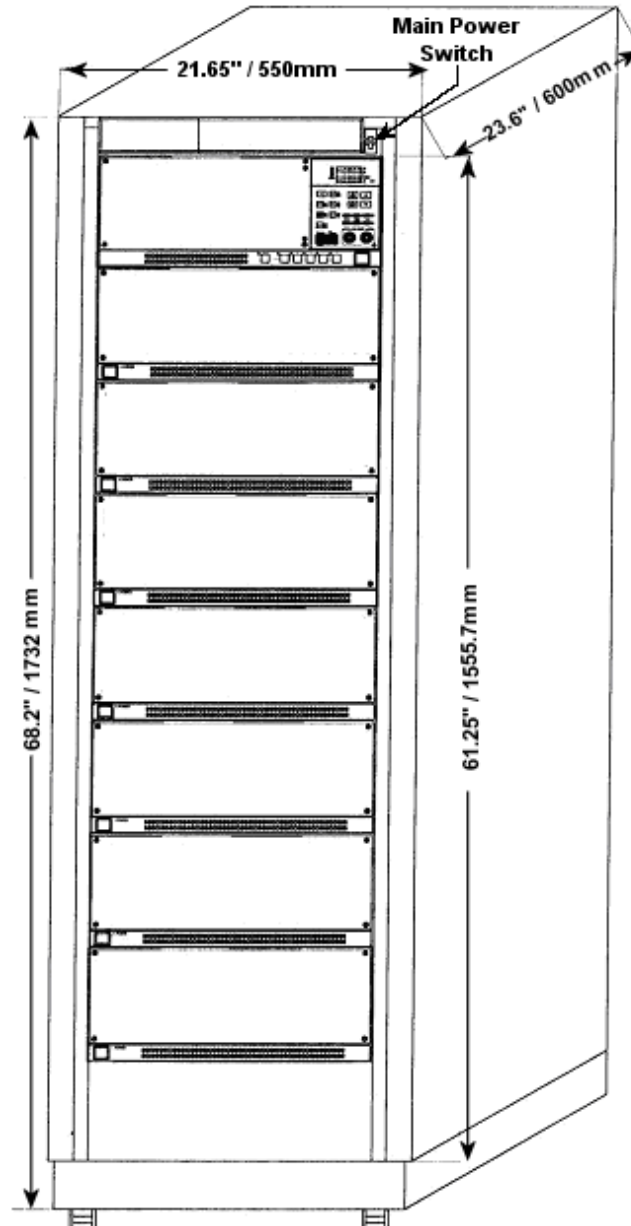
Figure 4

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.

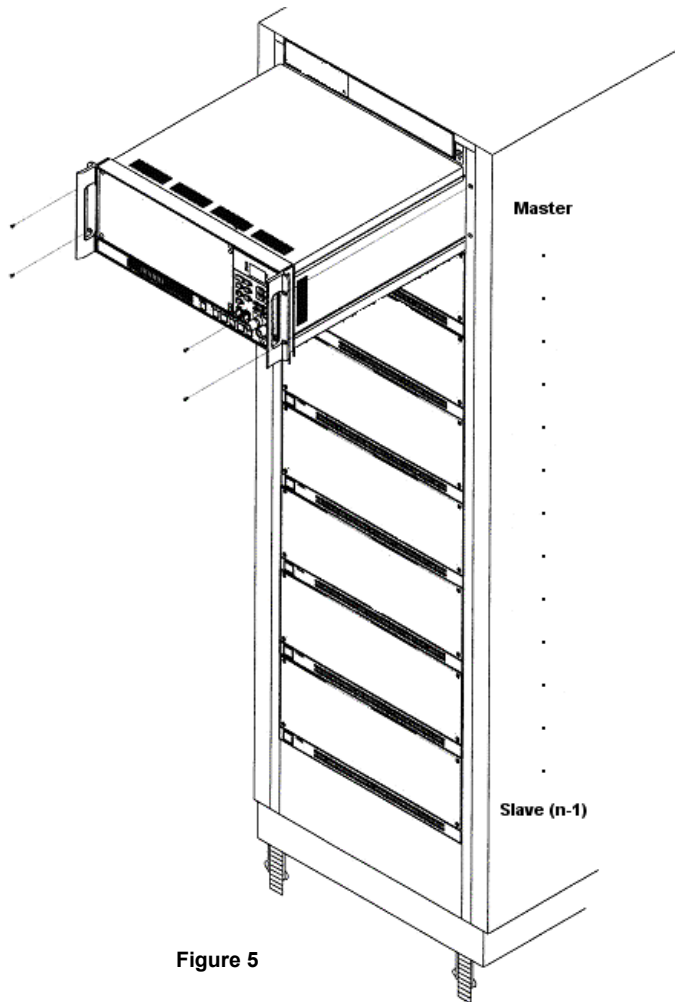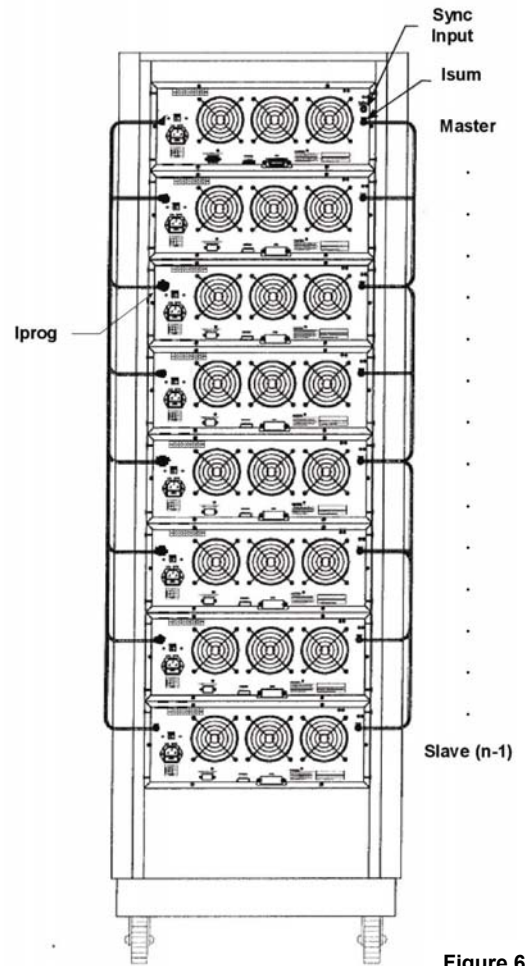Figure 6 shows the finished rear panel system connection.

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.
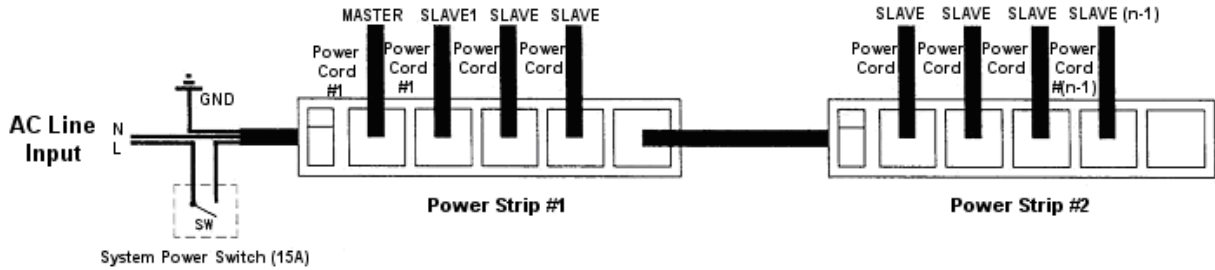

Figure 7

D.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 1 applies per basic load unit, i.e. for each master or slave unit.

	LINE	100V/115V±10%	200V/230V±10%
AC INPUT	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 AC Line Input per Load Unit

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

| MODEL	SLH-300-36-3600
INPUT RATINGS	
Power (VA)	3600 VA
Current(Ampere)	36 Arms
Voltage(Volt)	300Vrms
Frequency	DC, 40 - 70Hz
CC MODE	
Range	0-18/0-36
Resolution	4.5 / 9.0 mA
Accuracy	±0.5% of (setting + range)
Low current	0 - 1.8 A
Accuracy	± 2% of (setting + range)
Crest Factor	$\sqrt{2} - 3.5$ (Maximum current = 2 x Rated Current)
Maximum Peak Current	72A
CR MODE	
nge 1 (I>0.5% of rating)	6.667 - 26,667 Ω
ange 2 (I>50% of rating)	1.667 - 6.667 Ω
4 1/2 DVM	
Range	300 V
Resolution	0.1 V
Accuracy	±(0.5% of reading + 0.2% of range)
4 1/2 DAM	
Range	0-36 A
Resolution	10 mA
Accuracy	±(0.5% of reading + 2% of range) ; ±0.5% of (reading + range) @
4 1/2 WATT METER	
Range	0-3600W
Resolution	0.9 W
Accuracy	± (0.5% of reading)± 3W
VA METER	Vrms×Arms
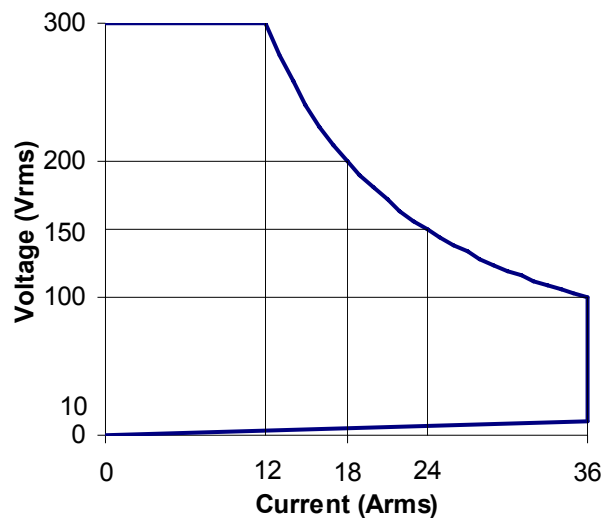
Table 2 SLH-Series Specifications

Figure 8 Power Curve

Product Family: SLH-Series AC High Power Electronic Load

Warranty Period: One (1) Year

WARRANTY TERMS

Xantrex provides this written warranty covering the Product stated above, and if the Buyer discovers and notifies Xantrex in writing of any defect in material or workmanship within the applicable warranty period stated above, then Xantrex 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 Xantrex in accordance with the return procedure specified below. Xantrex will, at its expense, deliver the repaired or replaced Product or parts to the Buyer. Any warranty of Xantrex will not apply if the Buyer is in default under the Purchase Order Agreement or where the Product or any part thereof:

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

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

PRODUCT RETURN PROCEDURE

1. Request a Return Material Authorization (RMA) number from the repair facility (**must be done in the country in which it was purchased**):

   - **In the USA**, contact the Xantrex Repair Department prior to the return of the product to Xantrex for repair:

     Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America)
     858-450-0085, ext. 2295 or ext. 2463 (direct)

   - **Outside the United States**, contact the nearest Authorized Service Center (ASC). A full listing can be found either through your local distributor or our website, www.programmablepower.com, by clicking Support and going to the Service Centers tab.

2. When requesting an RMA, have the following information ready:

   - Model number
   - Serial number
   - Description of the problem

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

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

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