Sorensen

SLM-Series AC/DC Electronic Load

Operation and Programming Manual

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SAFETY NOTICE

<u>Before applying power</u> to the system, verify that the SL Series is configured properly for the user's particular application.

⚠️ **WARNING!**

HAZARDOUS VOLTAGES IN EXCESS OF 300 VRMS, 600V PEAK MAY BE PRESENT WHEN COVERS ARE REMOVED. QUALIFIED PERSONNEL MUST USE EXTREME CAUTION WHEN SERVICING THIS EQUIPMENT. CIRCUIT BOARDS, TEST POINTS, AND OUTPUT VOLTAGES MAY BE FLOATING ABOVE (BELOW) CHASSIS GROUND.

Installation and service must be performed by <u>qualified personnel</u> who are aware of dealing with attendant hazards. This includes even the simple tasks, such as fuse verification.

Ensure that the AC power line ground is connected properly to the SL Series input connector or chassis. Similarly, other power ground lines including those to application and maintenance equipment <u>must</u> be grounded properly for both personnel and equipment safety.

⚠️ During 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 generated normally on the input terminals. Ensure that the input power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is eliminated. To guard against risk of electrical shock during open cover checks, <u>do not touch</u> any portion of the electrical circuits. Even when the power is off, capacitors can retain an electrical charge. Use safety glasses during open cover checks to avoid personal injury by any sudden failure of a component.

Some circuits are live even with the front panel switch turned off. Service, fuse verification, and connection of wiring to the chassis must be accomplished at least <u>five minutes</u> after power has been removed via external means; all circuits and/or terminals to be touched must be safety grounded to the chassis.

After the unit has been operating for some time, the metal in a module may be hot enough to cause injury. Let the unit cool before handling.

Qualified service personnel need to be aware that some heat sinks are not at ground, but at high potential.

These operating instructions form an integral part of the equipment and must be available to the operating personnel at all times. All the safety instructions and advice notes are to be followed.

Neither Sorensen, San Diego, California, USA, nor any of the subsidiary sales organizations can accept any responsibility for personal, material or consequential injury, loss or damage that results from improper use of the equipment and accessories.

SAFETY SYMBOLS

⚠️ CAUTION
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

SORENSEN ONE–YEAR WARRANTY

Sorensen, a division of Elgar Electronics Corporation, warrants its products to be free from defects in material and workmanship. This warranty is effective for one year from the date of shipment of the product to the original purchaser. Liability of Sorensen under this warranty shall exist provided that:

- the Buyer exposes the product to normal use and service and provides normal maintenance on the product;

- Sorensen is promptly notified of defects by the Buyer and that notification occurs within the warranty period;

- the Buyer receives a Return Material Authorization (RMA) number from Sorensen's Repair Department prior to the return of the product to Sorensen for repair, phone 800-73ELGAR (1-800-733-5427);

- the Buyer returns the defective product in the original, or equivalent, shipping container;

- if, upon examination of such product by Sorensen it is disclosed that, in fact, a defect in materials and/or workmanship does exist, that the defect in the product was not caused by improper conditions, misuse, or negligence; and,

- that Sorensen QA seal and nameplates have not been altered or removed and the equipment has not been repaired or modified by anyone other than Sorensen authorized personnel.

This warranty is exclusive and in lieu of all other warranties, expressed or implied, including, but not limited to, implied warranties of merchantability and fitness of the product to a particular purpose. Sorensen, its agents, or representatives shall in no circumstance be liable for any direct, indirect, special, penal, or consequential loss or damage of any nature resulting from the malfunction of the product. Remedies under this warranty are expressly limited to repair or replacement of the product.

CONDITIONS OF WARRANTY

- To return a defective product, contact a Sorensen representative or the Sorensen factory for an RMA number. Unauthorized returns will not be accepted and will be returned at the shipper's expense.

- For Sorensen products found to be defective within thirty days of receipt by the original purchaser, Sorensen will absorb all ground freight charges for the repair. Products found defective within the warranty period, but beyond the initial thirty-day period, should be returned prepaid to Sorensen for repair. Sorensen will repair the unit and return it by ground freight pre-paid.

- Normal warranty service is performed at Sorensen during the weekday hours of 7:30 am to 4:30 pm Pacific time. Warranty repair work requested to be accomplished outside of normal working hours will be subject to Sorensen non-warranty service rates.

- Warranty field service is available on an emergency basis. Travel expenses (travel time, per diem expense, and related air fare) are the responsibility of the Buyer. A Buyer purchase order is required by Sorensen prior to scheduling.

- A returned product found, upon inspection by Sorensen, to be in specification is subject to an inspection fee and applicable freight charges.

- Equipment purchased in the United States carries only a United States warranty for which repair must be accomplished at the Sorensen factory.

Sorensen

Power Evolved

ABOUT THIS MANUAL

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 Symbols on page ii).

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SECTION 1
FEATURES, FUNCTIONS, AND SPECIFICATIONS

1.1   GENERAL DESCRIPTION

SLM-Series, 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.

1.1.1   Power Contours

The power contours of the SLM-Series AC/DC Electronic Loads are shown in the following figures.
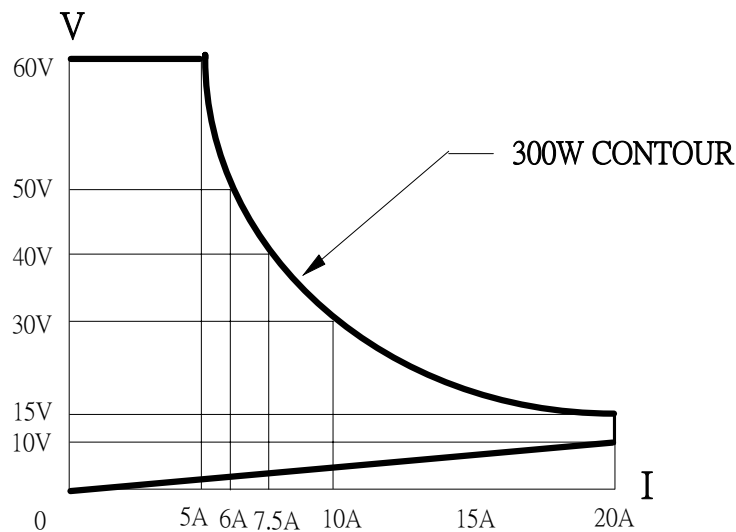
Figure 1-1 SLM-60-20-300 Electronic Load Power Curve
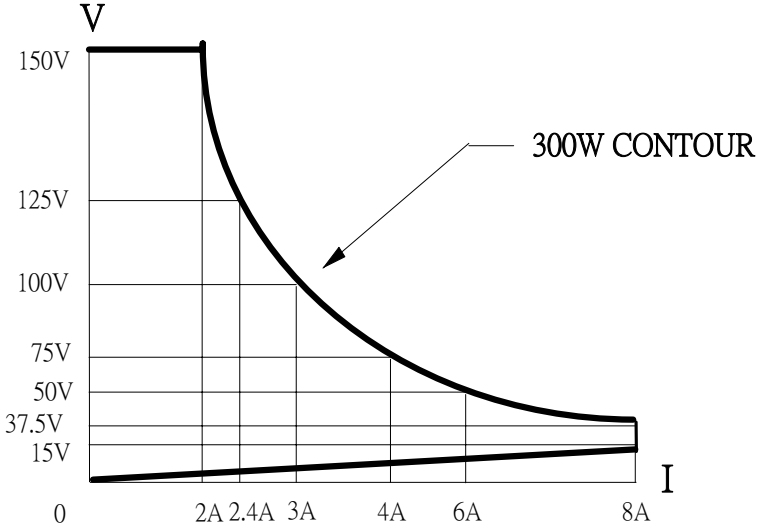
Figure 1-2 SLM-150-8-300 Electronic Load Power Curve
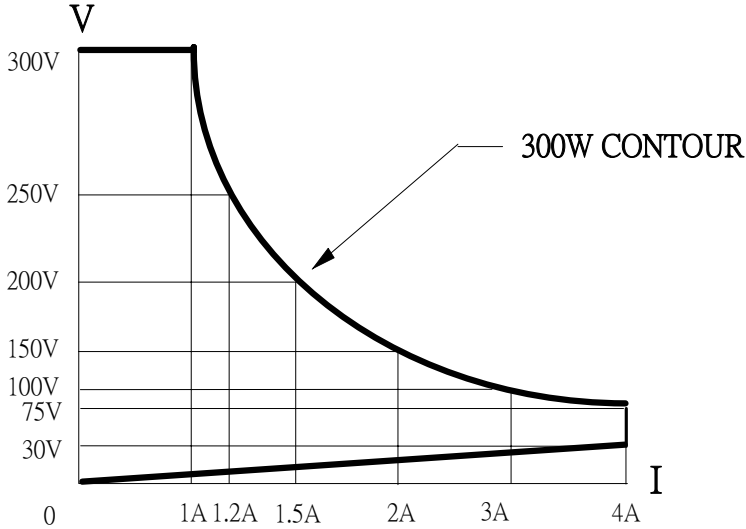
Figure 1-3 SLM-300-4-300 Electronic Load Power Curve
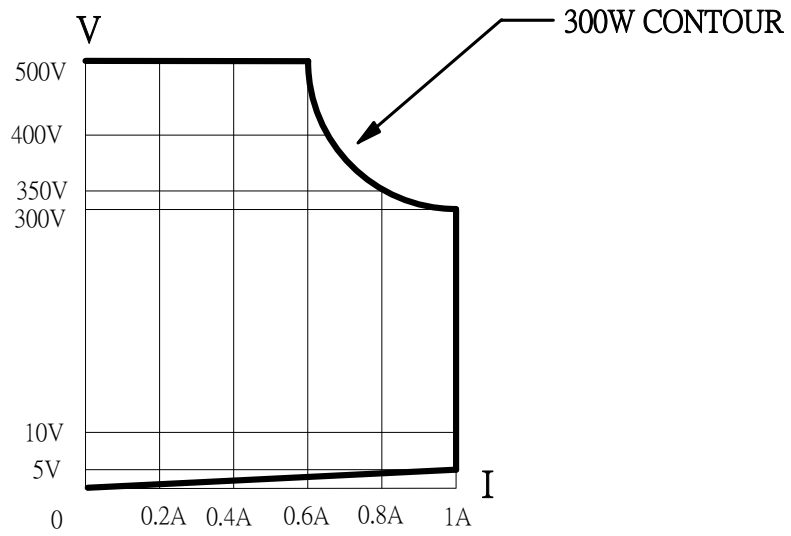
Figure 1-4 SLM-500-1-300 Electronic Load Power Curve

1.1.2   Operating Modes

The work mode of SLM-Series AC/DC Electronic Load includes Constant Current (CC) and Constant Resistance (CR).

CC Mode

During CC mode, the load current input into SLM-Series, AC Electronic Load depends on the current setting regardless of the input voltage, i.e., the current setting remains unchanged.
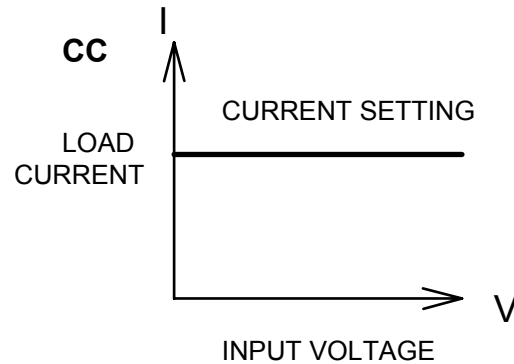
Figure 1-5 Characteristics of CC Mode

CR Mode

During C.R. mode, the load current input into SLM-Series 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 Figure 1-6 below.
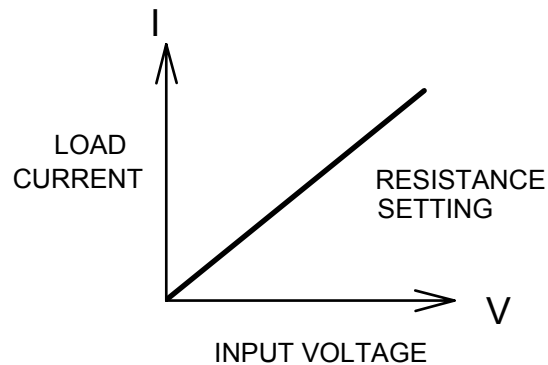
Figure 1-6 Characteristics of CR Mode

The load setting of SLM-Series 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.

1.2   FEATURES AND FUNCTIONS

- Modular design facilitates fast and flexible install/uninstall procedures
- Interface function of full GPIB control, including setting of load condition and read-back of Vmeter and Ameter
- Software calibration ability
- Dual High Accuracy/High Resolution 4 ½ -digit Vmeter and Ameter
- In CC mode, frequency width can reach to 70Hz with the set table range of 1KHz
- In CC mode, the settable Crest Factor can be set to Maximum 3.5
- Isolated Current Monitor BNC output with full scale of 10V
- Automatic judging ability for GO/NG
- Switchable automatic voltage sensing ability.
- Protection functions include Over-Voltage, Over-Current, Over-Power and Over-Temperature
- Cooling fan control device with revolution change function

1.3   ACCESSORIES

- Vsense Input BNC Connector   1 EA
- Banana Terminal (Black)   1 EA
- Banana Terminal (Red)   1 EA
- Hook-Type Terminal   2 EA
- SLM-Series AC/DC Electronic Load Operation and Programming
  Manual (this manual)   1 EA

1.4   SPECIFICATIONS

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

MODEL	SLM-60-20-300	SLM-150-8-300	SLM-300-4-300	SLM-500-1-300
INPUT RATINGS				
Power (VA)	300 VA	300 VA	300 VA	300 VA
Current(Ampere)	20 Arms	8 Arms	4 Arms	1 Arms
Voltage(Volt)	60 Vrms	150 Vrms	300 Vrms	500Vdc/300 Vrms
Frequency	DC, 40 - 70Hz (CC Mode) ; DC - 70Hz (CR Mode)			
CC MODE				
Range	0-10 / 10-20 A	0-4 / 4-8 A	0-2 / 2-4 A	0-0.5 / 0.5-1 A
Resolution	2.5 / 5 mA	1 / 2 mA	0.5 / 1 mA	0.125 / 0.25 mA
Accuracy	$\pm$0.5% of (setting + range)			
Low current	0 - 1 A	0 - 0.4 A	0 - 0.2 A	0 - 0.05 A
Accuracy	$\pm$ 2% of (setting + range)			
CR MODE				
Range II/I	0.3-1.2 / 1.2-4.8K	1.875-7.5 / 7.5-30K	7.5-30 / 30-120K	50-200 / 200-800K
Resolution	0.83 / 0.2083 mS	0.13 / 0.033 mS	0.033 /0.0083 mS	0.005 / 0.00125 mS
Accuracy	$\pm$0.5% of (setting + range)			
4 1/2 DVM				
Range	60 V	150 V	300 V	500 V
Resolution	0.01 V	0.01 V	0.1 V	0.1 V
Accuracy	$\pm$(0.5% of reading + 0.2% of range)			
4 1/2 DAM				
Range	20 A	8 A	4 A	1 A
Resolution	0.01 A	0.001 A	0.001 A	0.001 A
Accuracy	$\pm$(0.5% of reading + 2% of range) ; $\pm$0.5% of (reading + range) @ 50/60Hz			
4 1/2 WATT METER				
Range	300 W			
Resolution	0.1 W			
Accuracy	$\pm$ (0.5% of reading)$\pm$ 3W			
VA METER	Vrms$\times$Arms			
Imonitor	5 A/V	2 A/V	1 A/V	0.2 A/V
PROTECTION				
OPP	~315 VA	~315 VA	~315 VA	~315 VA
OCP	~21 A	~8.4 A	~4.2 A	~1.05 A
OVP	~63 V	~175.5 V	~315 V	~525 V
OTP	85℃	85℃	85℃	85℃

Table 1-1 SLM-Series AC/DCSpecifications

1.5   REGULATORY COMPLIANCE

- Certified to UL 61010-1, CSA C22.2 No. 61010.1 and IEC/EN 61010-1

- CE Compliant:

  o Low Voltage Directive (73/23/EEC) using EN 61010-1

  o EMC Directive (89/336/EEC) using EN 61326

- FCC Compliant to 21 CFR, Subpart J

SECTION 2
INSTALLATION AND MAINTENANCE

2.1 INTRODUCTION

This section discusses the installation and removal procedures for the SLM-Series AC/DC load module and the SLM four-module mainframe. The SLM-Series AC/DC load module does not need any adjustment after plugging into the SLM mainframe.

> **Warning:**
> **Only qualified personnel should do installation and removal**.

2.2 INSPECTION

The SLM-Series 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.

Unless the SLM mainframe and the SLM-Series AC/DC electronic load module were purchased separately, the load module should be installed in the mainframe before shipment from Sorensen. The SLM-Series AC/DC electronic load module operates in the SLM mainframe for front panel, mainframe's 150 sets store/recall and remote control feature.

2.2.1 Installation

1. **Turn the SLM mainframe power OFF** before inserting any load module, or damage may occur to the plug-in module circuitry.
2. Align the upper and lower grooves of the mainframe with the upper and lower guides of the selected compartment (Figure 2-1).
3. Push the module in and press firmly on the binding posts of the front panel to seat the circuit board into the interconnecting jack.
4. Using a screwdriver, tighten the screw on the lower right corner of the SLM-Series load module front panel.
5. DO NOT turn the mainframe power ON until after all of the electronic modules are completely installed.
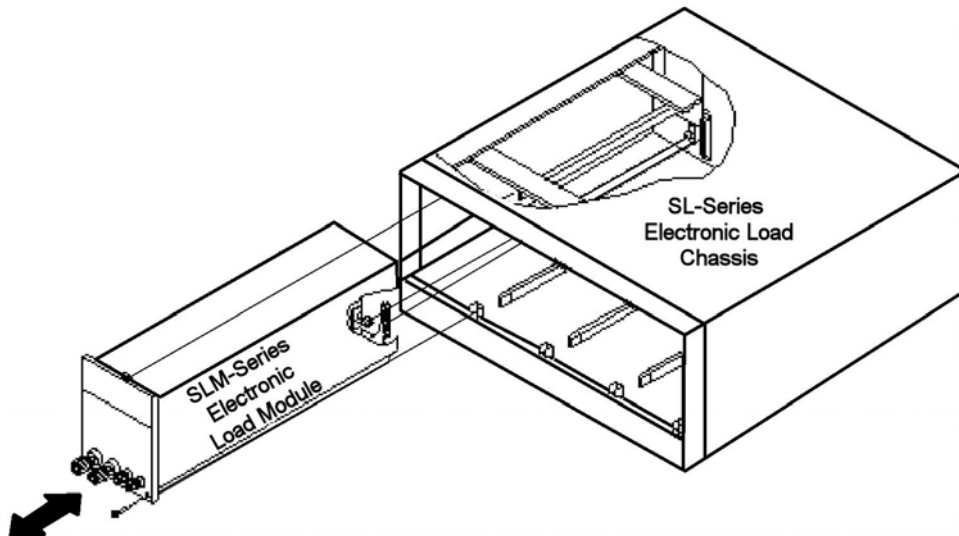
Figure 2-1 Plug-in Installation and Removal

2.2.2   Removal

1. **Turn the SLM mainframe power OFF**. Damage may occur to the plug-in module circuitry if removed under power.
2. Using a screwdriver, loosen the screw on the lower right corner of the front panel.
3. Turn the adjustment knob of the black binding post counter-clockwise until it is fully loosened.
4. Pull on the black adjustment knob of binding post until the interconnecting jack at the rear of the load module disengages.
5. Finish pulling the SLM-Series load module out from the mainframe.

2.2.3   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

2.2.4   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.

2.3   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).

2.3.1   Input Binding Post and Wire Considerations

The output of the device under test (DUT) can be connected to the load by one of five methods, each described in the following subsections. Connect he positive (+) and negative (-) binding posts to the wires/cables according to the following guidelines. 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 cable resistance from affecting measurements and regulation.

Plug Connectors

This is the most common 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 SLM-Series AC/DC Electronic Load attachments include two (2) hook-type terminals for connecting the equipment to be measured with the wire of the AC electronic input connector. 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 simplest 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, because it provides higher current rating and lower impedance of the connecting wire.

Plug Connectors and Direct Insertion

This method is also recommended when input current is greater than 20A or when the connecting lead wire is longer.

2.3.2   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 2-2 and Figure 2-3.
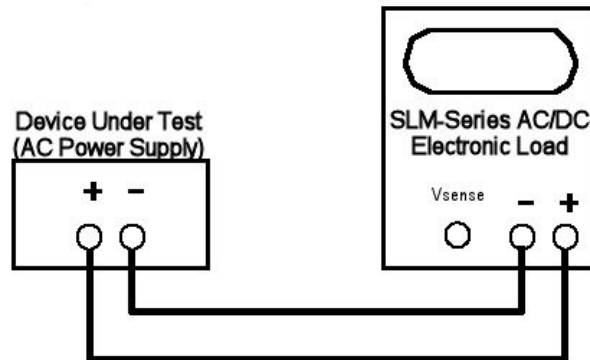
Figure 2-2 Connection Method for Small Load Current Condition
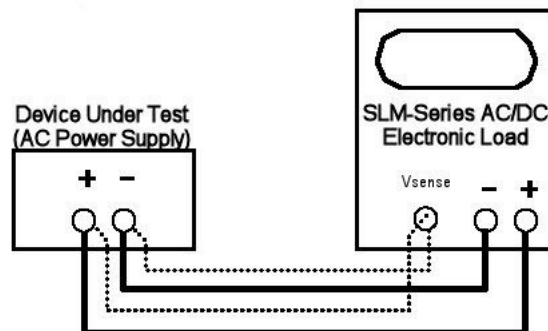
Figure 2-3 Typical Connection for SLM-Series AC/DC Electronic Load

2.3.3   RS-232C and GPIB Connections

For these connections, refer to the SL-series mainframe operation manual(s).
RS-232 and GPIB programming operation are addressed in Section 4 of this manual.

2.4   MAINTENANCE

WARNING: Avoid electrical shock or damage to the meter.
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.

SECTION 3
OPERATION

3.1 FRONT PANEL CONTROLS AND INDICATORS

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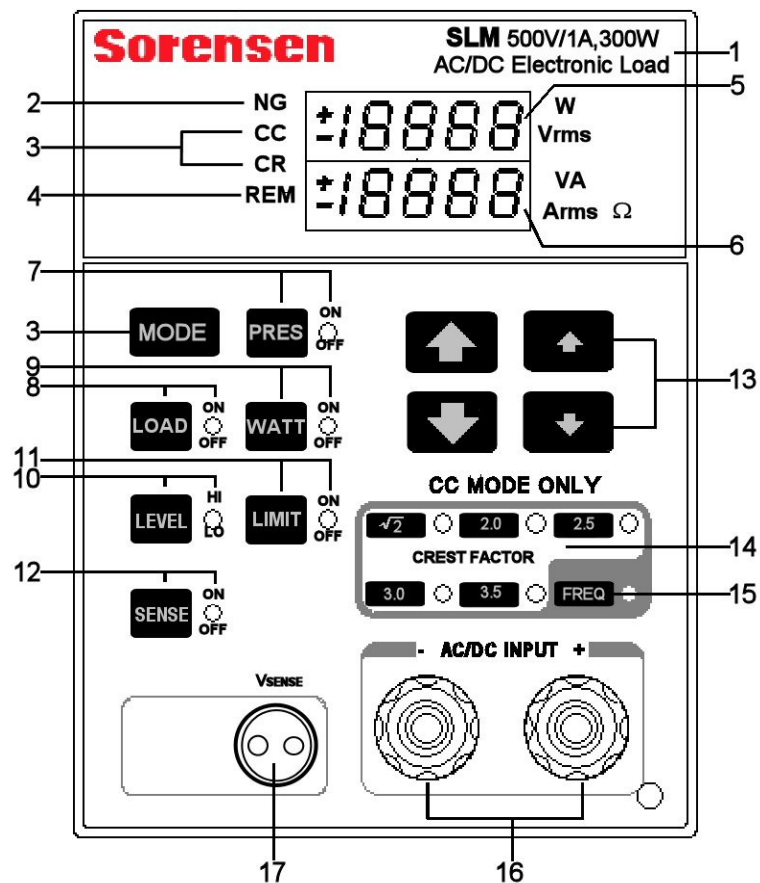
Figure 3-1 Front Panel of SLM-Series AC/DC Electronic Load

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 or Vsense BNC input.
   • 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 Preset OFF, 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 Lo and Hi in "Arms".
   • In CR Mode (see **3**), displays the set value of CR Level Lo and Hi 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**):
  - o For frequency ("FrEq") setting, displays DC, 0.1 - 70.0, Auto.
  - o For bank ("bAn") selection, displays 0 - 10.
  - o 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:
  - o upper DM displays the voltage input to electronic load as "Vrms" (Vrms LED lit)
  - o lower DM displays the current flowing into electronic load as "Arms" (Arms LED lit)
- During Preset ON, PRES ON/OFF LED lit,
  - o 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:
  - o upper DM displays the value in Watts consumed for electronic loading ("W" LED is lit);
  - o 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:
  - o 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.
  - o 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 Lo/Hi LED
   Key toggles between Low, LED off, and Hi, 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:
  - o Voltmeter with the unit as "Vrms".
  - o Ammeter with the unit as "Arms".
  - o Wattmeter with the unit as "W".

    o VA meter with the unit as "VA"..
- Lower DM displays the lower limit of:
    o Voltmeter with the unit as "Vrms".
    o Ammeter with the unit as "Arms".
    o Wattmeter with the unit as "W".
    o 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**):
  o The larger arrows (⇧⇩) coarse tune the value by larger increments/decrements.
  o The smaller arrows (↑ ↓) fine tune the value by smaller increments/decrements.
- During LIMIT ON (see **11**):
  o 3.1.13.2.1 ⇧⇩:Upper limit value Up/Down Key.
  o 3.1.13.2.2 ↑ ↓:Lower limit value Up/Down Key.
- When FREQ (see **15**) LED lit:
  o "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.
  o "bAn" displayed in upper DM,:⇧ ↑ is Fine Tuning Up Key ⇩ ↓ is Fine Tuning Down Key.
  o "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
  o FREQ (For Frequency Setting) : Setting Range: DC, 0.1 - 70.0 Hz, Auto.
  o BANK (For Bank Setting) : 0 - 10 totaling 11 banks (Not valid for DC).
- SYNC (Current Bank Sync Signal Selection):
  o ON is external Sync
  o OFF is internal Sync.

16 AC/DC Load Input Connector
Must not exceed the rated specification of the voltage and current of the SLM-Series AC/DC Electronic Load.

Warning: Upon wiring, please refer to Section 3.2 to avoid damage to internal circuit and connector.

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.
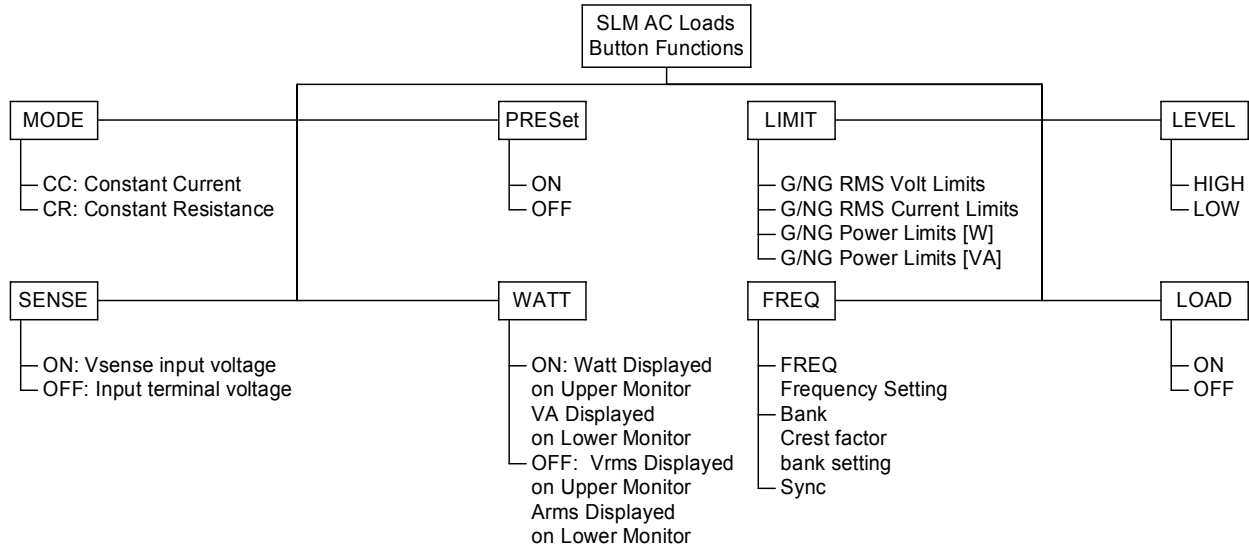
Figure 3-2 Front Panel Button Functions for SLM-Series AC/DC Unit

3.2   SET-UP PROCEDURES

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

3.2.1   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).

3.2.2   Frequency Setting:

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

1. Press the FREQ key (15) until its LED lights and "FrEq" appears on the upper DM.
2. 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.

3.2.3   Current Synchronization

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 SLM-Series AC/DC Electronic Load, the phase of load current will synchronize to the zero crossing of the external signal.
*   The external SYNC signal must be a 50% duty cycle.

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

Internal SYNC signal (SYNC OFF)
*   The internal SYNC signal source of SLM-Series AC/DC 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.
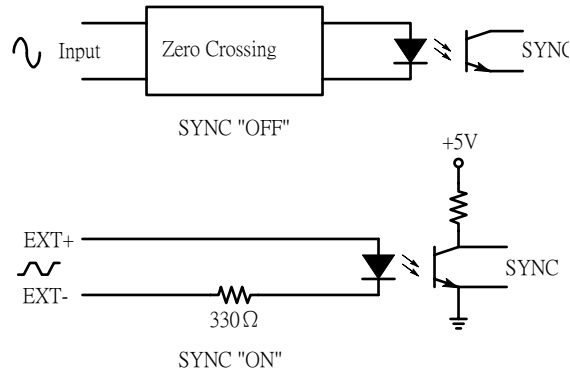
Figure 3-3 Illustration of Sync

3.2.4   Crest Factor

The SLM-Series AC/DC electronic load module provides 11 built-in sets totaling 55 waveforms.

- Select the waveforms from the memory banks. 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).
- Select the crest factor through the √ 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.

1. Press FREQ key (15). The associated LED will light. The first selection is for frequency, as described in the section, "Frequency Setting" above.
2. Verify that the frequency does not read "dc". If it does, use the ⇧⇩↑↓ keys to adjust the frequency from "dc".
3. Press the "FREQ" key until "bAn" appears on the upper DM.
4. Use the ⇧ ⇩↑↓ keys to select the desired bank.

5. Press the "FREQ" key two times to exit setting mode.

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

3.2.5   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.

- To return to normal display mode, press the "WATT" key again.

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 SLM-Series AC/DC Electronic Load Module Setup 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.
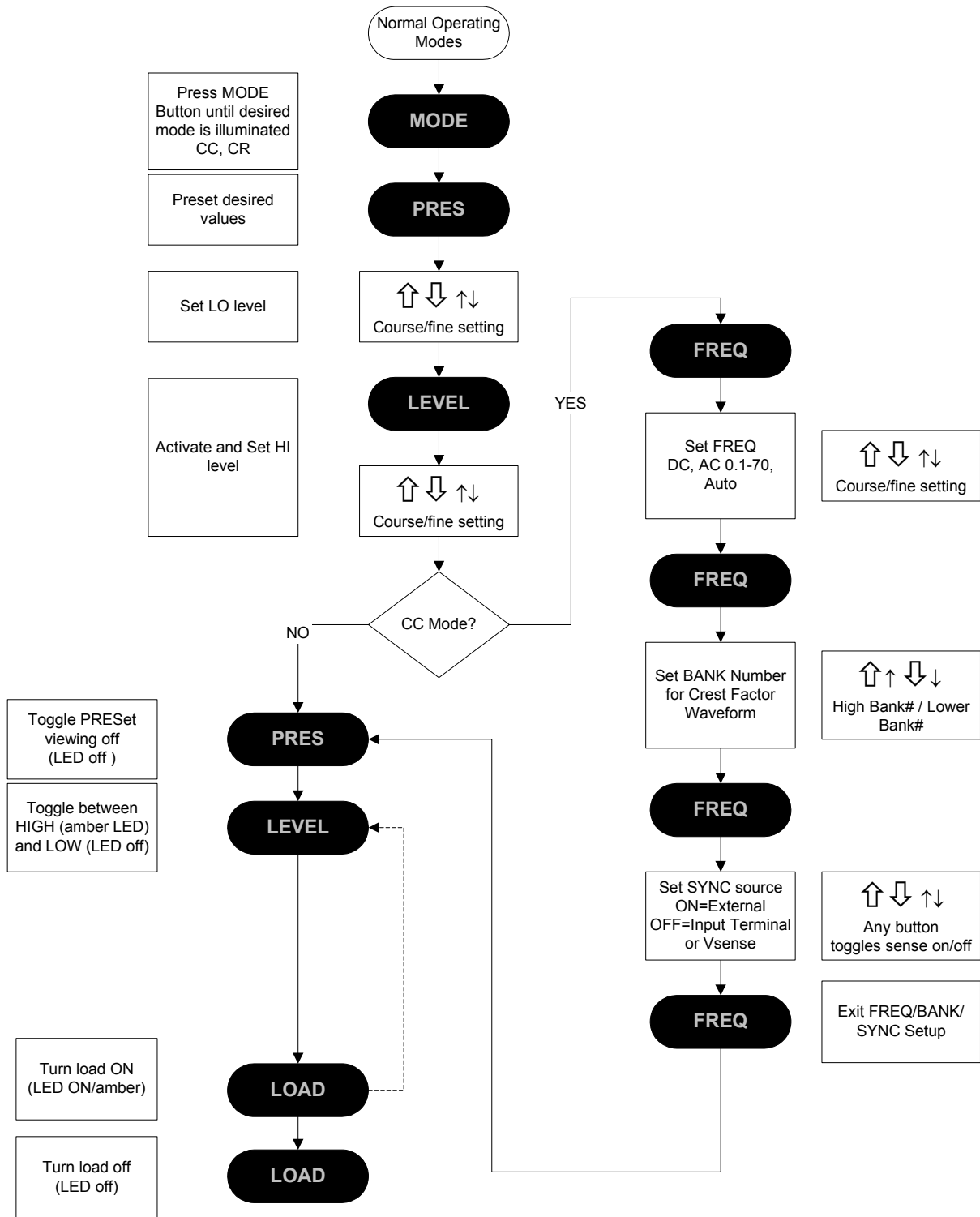
Figure 3-5 SLM-Series AC/DC Electronic Load Operation Flow Char

3.4   INITIAL SETTINGS OF SLM-SERIES AC/DC ELECTRONIC LOAD

The initial setting parameters of SLM-Series AC/DC Electronic Load are described in Table 3-2.

Description	SLM-60-20-300	SLM-150-8-300	SLM-300-4-300	SLM-500-1-300
MODE	CC	CC	CC	CC
LOAD	OFF	OFF	OFF	OFF
LEVEL	LO	LO	LO	LO
SENSE	OFF	OFF	OFF	OFF
PRES	OFF	OFF	OFF	OFF
WATT	OFF	OFF	OFF	OFF
LIMITS				
V LIMIT High [V_{RMS}]	100.0	200.0	400.0	600.0
ALIMIT High [A_{RMS}]	25.00	10.00	5.000	2.000
WLIMIT High [W]	400.0	400.0	400.0	400.0
VALIMIT High [VA]	400.0	400.0	400.0	400.0
All Lower Limits	0.00	0.0	0.0	0.0
C.F	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$
FREQ [Hz]	60	60	60	60
BANK	0	0	0	0
SYNC	OFF	OFF	OFF	OFF
CC Level LO [A_{RMS}]	0.000	0.000	0.000	0.000
CC Level HI [A_{RMS}]	0.000	0.000	0.000	0.000
CR Level LO [Ω]	4800	30E3	120E3	80E3
CR Level HI [Ω]	4800	30E3	120E3	80E3

Table 3-3Table 3-2 SLM-Series AC/DC Electronic Load Initial Settings

Last Setting

All SLM-Series AC/DC Electronic Loads retain the last settings used prior to powering down, so that those same settings are still set at next power-on.

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 SLM-Series 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 SLM-Series AC/DC Electronic Load as shown in Table 3-2 until the key is released.

Description	SLM-60-20-300	SLM-150-8-300	SLM-300-4-300	SLM-500-1-300
MODE	CC	CC	CC	CC
LOAD	OFF	OFF	OFF	OFF
LEVEL	LO	LO	LO	LO
SENSE	OFF	OFF	OFF	OFF
PRES	OFF	OFF	OFF	OFF
WATT	OFF	OFF	OFF	OFF
LIMITS				
V LIMIT High [V_{RMS}]	100.0	200.0	400.0	600.0
ALIMIT High [A_{RMS}]	25.00	10.00	5.000	2.000
WLIMIT High [W]	400.0	400.0	400.0	400.0
VALIMIT High [VA]	400.0	400.0	400.0	400.0
All Lower Limits	0.00	0.0	0.0	0.0
C.F	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{2}$
FREQ [Hz]	60	60	60	60
BANK	0	0	0	0
SYNC	OFF	OFF	OFF	OFF
CC Level LO [A_{RMS}]	0.000	0.000	0.000	0.000
CC Level HI [A_{RMS}]	0.000	0.000	0.000	0.000
CR Level LO [Ω]	4800	30E3	120E3	80E3
CR Level HI [Ω]	4800	30E3	120E3	80E3

Table 3-3 SLM Series AC/DC Module Factory/Reset Settings

3.4.2   Load current course/fine increase/decrease adjustment key

The maximum load current of the SLM-Series AC/DC Electronic Load Modules can be adjusted to 20.00A, 8.000A, 4.000A, or 1.000A, as depicted in Table 3-4.

The relationship between the adjustment variation of the load current or resolution and their keys is also shown in Table 3-4. Pressing and holding any of the arrow keys for more than one second, speeds the rate of changing the selected value.

SLM-60-20-300		Range I		Range II	
FULL SCALE LOAD CURRENT		10 A		20 A	
CURRENT	RANGE	20.00 A			
METER	RESOLUTION	0.01 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		⇧⇩	↑↓	⇧⇩	↑↓
CC Mode		25 mA	2.5 mA	50 mA	5 mA
CR Mode		2.083mS	0.208mS	8.333mS	0.833mS

SLM-150-8-300		Range I		Range II	
FULL SCALE LOAD CURRENT		4 A		8 A	
CURRENT	RANGE	8.000 A			
METER	RESOLUTION	0.001 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		⇧⇩	↑↓	⇧⇩	↑↓
CC Mode		10 mA	1 mA	20 mA	2 mA
CR Mode		0.333mS	0.033mS	1.333mS	0.133mS

SLM-300-4-300		Range I		Range II	
FULL SCALE LOAD CURRENT		2 A		4 A	
CURRENT	RANGE	4.000 A			
METER	RESOLUTION	0.001 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		⇧ ⇩	↑↓	⇧ ⇩	↑↓
CC Mode		5 mA	0.5 mA	10 mA	1 mA
CR Mode		0.083mS	0.008mS	0.333mS	0.033mS

SLM-500-1-300		Range I		Range II	
FULL SCALE LOAD CURRENT		0.5 A		1 A	
CURRENT	RANGE	1.000 A			
METER	RESOLUTION	0.001 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		⇧ ⇩	↑↓	⇧ ⇩	↑↓
CC Mode		1.25 mA	0.125 mA	2.5 mA	0.25 mA
CR Mode		0.013mS	0.001mS	0.050mS	0.005mS

Table 3-4 Range, Resolution, andCoarse/Fine and Increment/Decrement Values

3.5   PROTECTION FEATURES

There are four protection functions for the SLM-Series 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 notice, indicating which protection function is active.

3.5.1   Over Voltage Protection (OVP)

The over voltage protection (OVP) point is preset in the SLM-Series AC/DC Electronic load. Table 3-5 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.

3.5.2   Over Current Protection (OCP)

The over current protection (OCP) point is preset in the SLM-Series AC/DC Electronic load. Table 3-5 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.

3.5.3   Over Power Protection (OPP)

The over power protection (OPP) point is preset in the SLM-Series AC/DC Electronic load. Table 3-5 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.

3.5.4   Over Temperature Protection (OTP)

SLM-Series AC/DC Electronic load is provided with a temperature sensor. Over temperature protection (OTP) is tripped when the heat dissipater temperature exceeds about 85ºC ±5ºC, 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.

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 3-5 SLH AC-series Protection Setting Values

GPIB/RS-232 PROGRAMMING OPERATION

4.1   INTRODUCTION

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

4.2   GPIB COMMANDS

The following GPIB setting commands are *channel-dependent*, except the "CHAN" command, which is *channel-specific*; therefore, for proper testing program execution, the *channel-specific* command "CHAN" should be sent first, followed by the *channel-dependent* command.

Example:
>   Short ON of channel 1 of SLM-Series Electronic Load module, the GPIB programming command is: CHAN 1:SHOR ON.

The following GPIB commands with [GLOB:] option can set all the SL-series load modules in the SLM *chassis* to be active simultaneously. This feature can greatly reduce the testing time and increase efficiency.

4.3   RS-232 INTERFACE AND COMMANDS

The *following* RS-232 commands are the same as GPIB commands. The RS-232 protocol in SLM chassis 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-232 interface are shown below; Figure 4-1a depicts the connector wire diagram, and Figure 4-1b depicts the connections using a standard RS-232 cable.

Fig. 4.1a   Fig. 4.1b
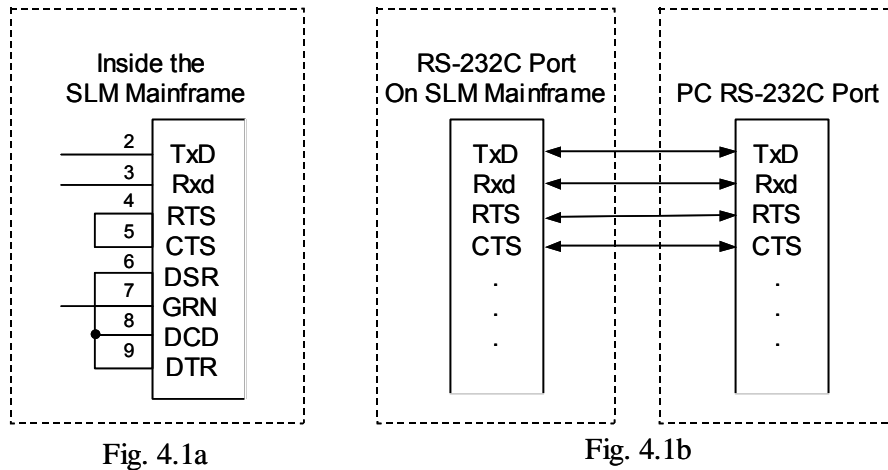
Figure 4-1 RS-232 Interface Diagram

The following RS-232 setting commands are *channel-dependent* commands except "CHAN" which is a *channel-specific* command; therefore, for proper program execution "CHAN" should be sent first, and then the *channel-dependent* command.

For example:
Short ON of Channel 1 of SL-series Electronic Load module, the RS-232 programming command is: CHAN 1;SHOR ON.

As with the GPIB commands, the following RS-232 commands with [GLOB:] option can set all the SL-series Electronic load modules in the SLM chassis to be active simultaneously. This feature can greatly reduce the testing time and increase efficiency.

4.4   GPIB/RS-232C COMMAND LIST

4.4.1   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 SLM chassis are listed in Table 4-1.

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

Table 4-1 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 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 4-2 presents a summary of the GPIB/RS-232 Setting commands, and Table 4-3
summarizes the GPIB/RS-232 preset Query commands with applicable module types. Table
4-4 is a summary of State commands, the System commands are in Table 4-5, Measure and
Limit commands are in Table 4-6, and the Global commands are in Table 4-7.

Setting Preset Numeric Command	Model			Remark
	SLM DC	SLD	SLM AC	
[PRESet:] BANK{SP}{d}{;|NL}			•	d=0~30
[PRESet:] WAVE{SP}{m}{;|NL }			•	M=0~5
[PRESet:] FREQuency{SP}{NR2}{;|NL}			•	40.0~70.0Hz
[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 4-2 GPIB/RS-232 Setting Command Summary

Query Preset Numeric Command	Model			RETURN
	SLM DC	SLD	SLM AC	
[PRESet:] BANK{SP}{?}{;|NL}			•	0~10
[PRESet:] WAVE{SP}{?}{;|NL}			•	1~5
[PRESet:] FREQuency{?}{;|NL}			•	40.0~70.0
[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:(A|B){?}{;|NL}			•	###.####
(PRESet:] CC:{HIGH|LOW}{?}{;|NL}	•	•		###.####
(PRESet: CP:{HIGH|LOW}{?}{;|NL}	•			###.####
[PRESet:] CR{?}{;|NL}		•		###.####
[PRESet:] CR:{A|B}{?}{;|NL}			•	###.####
[PRESet:] CR:{HIGH|LOW}{?}{;|NL}	•	•		###.####
[PRESet:] CV:{HIGH|LOW}{?}{;|NL}	•			###.####
[PRESet:] CV{?}{;|NL}		•		###.####

Table 4-3 GPIB/RS-232 Preset Query Command Summary with Applicable Module Types

STATE Command	Model			RETURN
	SLM DC	SLD	SLM AC	
[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:] RANGe{SP}{I|II}{;|NL}				
[STATe:] RANGe{?}{;|NL}				0:I, 1:II
[STATe:] LEVEl{SP}{HIG|LOW|AIB}{;|NL}	•		•	
[STATe:] LEVEl{?}{;|NL}	•		•	0:=LOW, 1:=HIGH
[STATe:] DYNamic{SP}{ON|OFF}{;|NL}	•	•		
[STATe:] DYNamic{?}{;|NL}	•	•		0=:OFF, 1:=ON
[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:] DUAL{SP}{DVM|DAM|OFF}{;|NL}		•		
[STATe:] PARAllel{SP}{ON|OFF}{;|NL}		•		
[STATe:] NGAB{SP}{ON|OFF}{;|NL}		•		0:=OK, 1:=NG
[STATe:] NGAB{?}{;|NL}		•		0:=OK, 1:=NG
[STATe:] NG{?}{;|NL}	•	•	•	0:=OK, 1:=NG
[STATe:] PROTect{?}{;|NL}	•	•	•	Dddddddd

Table 4-4 State Command Summary

COMMAND	NOTE	RETURN
[SYStem:] CHANnel{SP}{1|2|3|4}[A|B]{;|NL}		
[SYStem:] CHANnel{SP}{?}{;|NL}		{1|2|3|4}[A|B]
[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 4-5 System Commands - All Modules

COMMAND	SLM DC	SLD	SLM AC	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 4-6 Measure and Limit Commands

COMMAND	SLM DC	SLD	SLM AC	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:] LEVEL{SP}{A|B}{;|NL}			•	
GLOBal:[STATe:] RANGe{SP}{I|II}{;|NL}	•	•		
GLOBal:MEASure:CURRent{?}{;|NL}	•	•	•	###.##
GLOBal:MEASure:VOLtage{?}{;|NL}	•	•	•	###.##

Table 4-7 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 : 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.

4.5   GPIB/RS-232 COMMAND DESCRIPTION

4.5.1   Setting Commands

CHANNEL

Purpose:
"CHAN" selects the multiple Electronic load channel to which all subsequent channel-specific commands will be directed.

Command Syntax:
All Modules: CHAN{SP}n{;|NL}

Description:
"CHAN" command selects the specified Electronic load module from 1 through 4 as the Electronic load module number (from left to right). Up to 4 channels of the Electronic load module can be installed in one chassis. This command is a channel *independent* command; therefore, this command should be programmed before an electronic load channel *dependent* command.

The load channel number is arranged as 1, 2, 3, 4 from left side to the right side. Module SLD-60-105-550 is a dual bay module that utilizes the channel number corresponding to the bay occupied by the right side of the module. E.g., if a dual bay module takes up bays 1 and 2, its channel number shall be 2.

Example:
CHAN 2 select channel 2 of SL-series mainframe.

Note:
      Please refer to Appendices C, D and E for proper programming procedure of SL-series electronic load modules.

CURRENT Level

Purpose:
The load current setting in Constant Current mode.

Command Syntax:
All SLM Modules: CC:{LOW|HIGH}{SP}{NR2}{;|NL}

SLD Modules: CC{SP}{NR2}{;|NL}

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

Sets the current level of SLM-Series AC/DC or DC Electronic Load modules.

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

This command is used to set the load current level for CC static mode of SLD-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. 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 SLM-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 SLM-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 SLM-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 C, D and E for proper programming procedure of SL-series electronic load modules.

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:

All SLM Modules: CR:{HIGH|LOW}{SP}{NR2}{;|NL}
SLD Modules   CR:{SP}{NR2}{;|NL}

Description:

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

This command is used to set the LOW/HIGH load resistance level of SLM series AC and DC electronic load module.

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

This command is used to set the load resistance level of SLD-Series load module.

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 SLM-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 SLM-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 SLM-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 Appendices C, D and E for proper programming procedure of SL-series electronic load modules.

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 :

SLM DC Modules: CV:{HIGH|LOW}{SP}{NR2}{;|NL}
SLD Modules: CV:{SP}{NR2}{;|NL}

Description:

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

This command is used to set the load voltage level of SLM-Series DC electronic load modules.

CV {SP}{NR2}{;|NL}

This command is used to set the load voltage level of SLD-series electronic load modules.

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 SLM-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 SLM-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 SLM-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 Appendices C, D and E for proper programming procedure of SL-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:

SLM DC Modules: CP:{HIGH|LOW}{SP}{NR2}{;|NL}

Description:

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

Note : Mode CP is available in SLM-Series DC loads only.

LOAD ON/OFF

Purpose:

Turn the Electronic load module input ON or OFF.

Command Syntax:

All Modules: [GLOB:]LOAD{SP}{0FF|ON}{NL}

Description:

This command sets the Electronic load to sink current from power source. GLOB:LOAD ON All the Electronic load modules in the SLM chassis are ready to sink current from power source.

Example:

GLOB:LOAD OFF ; All load modules in the SLM chassis are at input OFF condition.

CHAN 3:LOAD ON ; Set the channel 3 load module to LOAD ON status, this load module is ready to sink current from the power source.

CHAN 1:LOAD 0; Set the channel 1 load module to LOAD OFF.

LOAD ON VOLTAGE Setting

Purpose:

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

Command Syntax:

SLM DC, SLD Modules: LDON{SP}{NR2}{;|NL}

Description:

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

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 modules.

Command Syntax:

SLM DC, SLD Modules: 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 (Res. = 0.1V. The load will stop to sink current if power source output voltage is lower than Load Off voltage.

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, or LEVEL A/B of AC electronic loads.

Command Syntax:

All Modules: [GLOB:] 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 programming load level.

Command Syntax:

All Modules: [GLOB:]PRES{SP}{0|1|OFF|ON}{NL}

Description:

GLOB:PRES ON is set all the load module in the SLM chassis to preset on status.

MODE

Purpose:

Select the operating mode of Electronic load module.

Command Syntax:

All Modules: [GLOB:]MODE{SP}{0|1|2|3|CC|CR|CV|CP}{NL}

Description:

GLOB:MODE CC ; set the presently operating mode to Constant Current mode for all load module in the SLM chassis.

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.

Note:
        MODE CV is available in DC loads only.
        MODE CP is available in DC, single input loads only.

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:

SLM DC, SLD Modules: STOR{SP}{m[,n]}{;|NL}
SLM AC Modules: 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.

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 the EEPROM memory in the electronic loads.

Example:

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

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:

SLM DC, SLD Modules: REC{SP}{m[,n]}{;|NL}
SLM AC Modules: 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.

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

SYNCHRONOUS ON/OFF

Purpose:

To set synchronous function ON/OFF of SLM AC series electronic load module.

Command Syntax:

SLM AC Modules: 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 SLM AC series electronic load module.

Command Syntax:

SLM AC Modules: 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:

SLM AC Modules: 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 4-8.

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 4-8 Waveform Information

WAVEFORM

Purpose:

To set waveform for AC electronic load modules.

Command Syntax:

SLM AC Modules: WAVE{SP}{m}{;|NL} m:1-5

Description:

This command is to set the current 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 4-8. For details, please refer to SLM AC Operation Manual.

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:

SLM AC Modules: 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 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 chassis 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:

SLM DC Modules: 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:

SLM AC Modules: 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.

PERIOD

Purpose:

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

Command Syntax:

SLM DC, SLD Modules: 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 Tlow / Thigh range.
2. Example: CHA and CHB use the same T-high and T-low controller in the SLD-series modules.

Example:

PERI:LOW 0.125;PERI:HIGH 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:

SLM DC Modules: 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 SLM-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 SLM DC series load module, the fastest RISE slew rate will be sent to the load module. Please verify the range I/II command before execute the load RISE slew rate setting command, otherwise the 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:
SLM DC Modules: FALL{SP}{NR2}{NL}

Description:
Programs the FALL load current slew rate of load level change or dynamic load. The FALL slew rate of SLM 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 I/II 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.

SLEW Rate

Purpose:
Set the load current slew rate of SLD-series electronic load module.

Command Syntax:
SLD Modules: SLEW{SP}{NR2}{;|NL}

Description:
Rise and Fall slew rate is the same for the SLEW command setting of SLD electronic load module.

The Slew rate has two ranges, and it follows the CC mode range change automatically: when CC Dynamic mode is in Range I, the slew rate is in range I, if CC Dynamic mode is in range II, then Slew rate is in range II.

SHORT ON/OFF

Purpose:
Short the DC input of Electronic load module.

Command Syntax:
SLM 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:
GLOB:SHOR ON ; set all load module load input to short state.

CHAN 2;SHOR OFF ; set channel l, 2 load module load input short open state.

SENSE ON/OFF

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

Command Syntax:
All Modules: [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. If Vsense is set to On, voltage is measured at the Vsense input. On SLM-seris 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) or 3V (on 250 and 500V models).

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

CHAN 2;SENS OFF set channel l, 2 load module V-sense input to sense OFF state.

DYNAMIC ON/OFF

Purpose:
Set DYNamic ON or OFF command.

Command Syntax:
SLM DC, SLD Modules: [GLOB:]DYN{SP}{0|1|OFF|ON}{NL}

Description:
GLOB:DYN OFF ; set all DC load modules in the SLM chassis to static load mode.

CHAN 4;DYN 1 ; set channel 4 load module to dynamic load mode.

NG Enable /Disable

Purpose:
Set Meter GO/NG check ON or OFF.

Command Syntax:
SLD Modules: NGAB{SP}{OFF|ON}{;|NL}

Description:
Setting NG ON or OFF indicates that the NG check is enabled or disabled; the NG ON or OFF can be changed by NGAB ON/OFF command. The Load GO/NG check includes

voltage and current meter GO/NG check, so user can set the current's Upper limit to max. and set the lower to min. if the current meter NG check is not required and vice versa.

> Note :   When CH A NG is set to OFF, the front panel NG A LED is disabled.
> Note :   When CH B NG is set to OFF, the front panel NG B LED is disabled.

PARAllel ON/OFF

Purpose:

A // b; Parallel Load Channel A and B for SLD-series electronic load.

Command Syntax :

Common Voltage SLD Modules: PARA{SP}{ON|OFF}{;|NL}

Description:

The parallel ON/OFF command is available for SLD-60-505-255-SLD-60-20-102 and SLD-62-5-752 modules. PARA command to set ON (Parallel) or OFF (Not Parallel). Dual Load parallel operation is available for same polarity load in a module; it can be a two positive or two negative load.

During the parallel loading operation, the load level and status of CH A and B is still independent. Only the current meter shows the CH A + CH B load current on Channel A's and B's current meter; user can use the DUAL command setting to display load current for CH A and B.

For the 2+ or 2- load parallel operation, user should make a wire connection from each load channel input to power supply output.

DUAL

Purpose:

Setting the Dual voltage or Dual current meter display of the SLD-series electronic load module.

Command Syntax:

SLD Modules: DUAL{SP}{DVM|DAM|OFF}{;|NL}

Description:

The Dual V/A command is not controlled by CH A/B operation; it is an independent command operation. This command is used for dual voltage meter or current meter to be displayed on the two 5-digit LED displays.

DUAL DVM; To set the meter is in dual voltage meter mode, the engineering unit is "V".

DUAL DAM; To set the meter is in dual current meter mode, the engineering unit is "A".

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.

4.5.2   Query Commands

<u>CHANNEL</u>

Purpose:

The active channel query command.

Command Syntax:

System: CHAN?{NL}

Description:

CHAN? return the active channel, "1-4" indicate the active channel is channel "1-4".

<u>CURRENT Level</u>

Purpose:

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

Command Syntax:

All SLM Modules: CC:{HIGH|LOW}{?}{;|NL}

SLD Modules: CC{?}{;|NL}

Description:

CURR:LOW? return the presently programmed low load current level in Constant Current mode of SLM-Series DC or AC electronic load module.

CURR? return the presently programmed load current level in Constant Current mode of SLD-series electronic load module.

<u>RESISTANCE Level</u>

Purpose:

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

Command Syntax:

All SLM Modules: CR:{HIGH|LOW}{?}{;|NL}

SLD Modules: CR{?}{;|NL}

Description:

RES:LOW? returns the presently programmed low load resistance level in Constant Resistance mode of SLM-Series DC or AC electronic load module.

RES? returns the presently programmed load resistance level in Constant Resistance mode of SLD-series electronic load module.

The engineering unit is "OHM".

VOLTAGE Level

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

Command Syntax:

SLM DC Modules: CV:{LOW|HIGH}?{NL}

SLD Modules: CV:{NL}

Description:

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

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

The engineering unit is "V".

POWER Level

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

Command Syntax:

SLM DC Modules: CP:{LOW|HIGH}?{NL}

Description:

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

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

The engineering unit is "W".

LOAD ON/OFF

Purpose:

LOAD ON or LOAD OFF status query command.

Command Syntax:

All Modules: 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:

SLM DC, SLD Modules: LDON?{;|NL}

Description:

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

LOAD OFF Voltage

Purpose:
LOAD OFF voltage level query command.

Command Syntax:
SLM DC, SLD Modules: LDOF?{;|NL}

Description:
LDOF? returns the present load off voltage of SLD-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:
SLM Modules: 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, CR, CV or CP operating mode query command.

Command Syntax:
All Modules: 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.

CV MODE is available DC electronic loads (except 500V models).

CP MODE is available in SLM DC electronic load modules.

NAME

Purpose:
Electronic Load module model number query command.

Command Syntax:
All Modules: NAME?{NL}
Description:
NAME? return the active Electronic Load channel'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 that occurred on the SLM-Series Electronic load. The PROT status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.

bit 7   bit 0

7	6	5	4	3	2	1	0

OPP
OTP
OVP
OCP
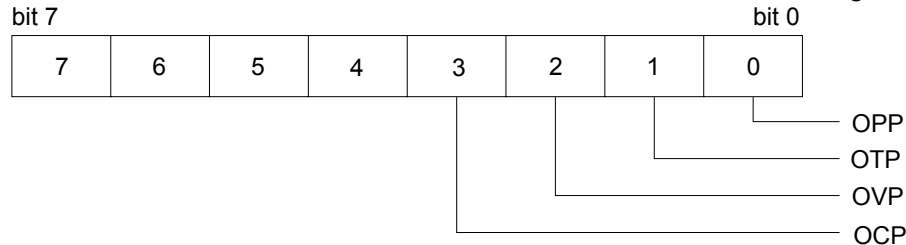
Figure 4-2 Protection Status Register

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 SLM-Series electronic load. The ERR status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.

bit 7   bit 0

7	6	5	4	3	2	1	0

Limited
Range Changed
Invalid Command
Invalid Operating
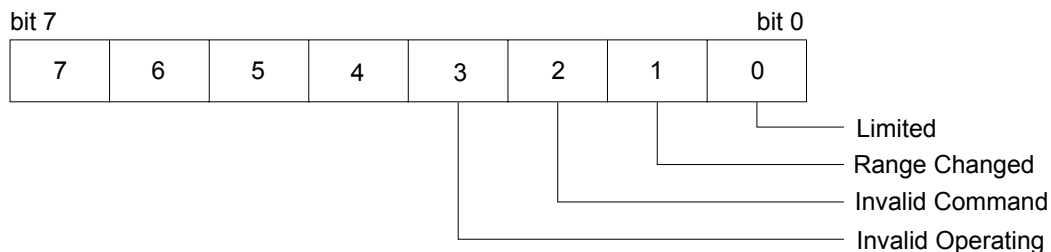
Figure 4-3 Error Status Byte Register

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

Example:
Module SLM-60-60-300
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 SLM-60-60-300
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 SLM-60-60-300
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:
All Modules: 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:
All Modules: 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:

SLM Modules: 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:

SLM AC Modules: MEAS:VA?{;|NL}

Description:

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

GLOB:GLOBAL (All channels active at the same time)

If a channel does not have a module installed, read back will be 9999, to input buffer.

GLOB:MEAS:VOLT

Purpose:

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

Command Syntax:

All Modules: GLOB:MEAS:VOLT?{NL}

Description:

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

Example:

GLOB:MEAS:VOLT?

read back data is 4.998, 12.002, 9999., 11.998 where channel 1 voltage is 4.998V, channel 2 voltage is 12.002V, channel 3 is non-installed, channel 4 voltage is 11.998V.

GLOB:MEAS:CURR

Purpose:

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

Command Syntax:

All Modules: GLOB:MEAS:CURR?{NL}

Description:

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

Example:

GLOB:MEAS:CURR?

read back data is 4.998, 3.002, 9999., 0.998 where channel 1 current is 4.998 A, channel 2 current is 3.002 A, channel 3 is non installed, channel 4 current is 0.998 A.

SYNCHRONOUS ON/OFF

Purpose:
To read the setting condition of SYNC.

Command Syntax:
SLM AC Modules: SYNC?{;|NL}

Description:
SYNC? Reada 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:
All Modules: 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:
SLM Modules: 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:
SLM AC Modules: 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:
SLM AC 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:

SLM AC Modules: 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:

All Modules: 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:

All Modules: 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:

SLM DC Modules: 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:

SLM AC Modules: 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:

All Modules: 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.

NG Enable /Disable

Purpose:

To read NG ON/OFF setting.

Command Syntax:

SLD Modules: NGAB{?}{;|NL}

Description:

NGAB? returns the presently NG ON/OFF status, "0" indicates NG disable, and "1" indicates NG enable.

PERIOD

Purpose:

The dynamic mode's Tlow or Thigh duration query command

Command Syntax:

SLM DC, SLD Modules: 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:

SLM DC Modules: 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:

SLM DC Modules: 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:
SLM DC, SLD Modules: 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:
SLM DC, SLD Modules: 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
GPIB PROGRAMMING EXAMPLE

Example Program in C

/* Link this program with appropriate *cib*.obj. */

/* This application program is written in TURBO C 2.0 for the IBM PC-AT compatible. The National Instruments Cooperation (NIC) Model PC-2A board provides the interface between the PC-AT and a SORENSEN ELECTRONIC LOAD. The appropriate *cib*.obj file is required in each program to properly link the NIC board to C LANGUAGE and include the <decl.h> HEADER FILE to C LANGUAGE. */

```
#include <stdio.h>
#include <dos.h>
#include <math.h>
#include "decl.h"        /* NI GPIB CARD HEADER FILE */

main()
{
   char ouster[20],rdbuf[15],spec[10];
   int i,ch,load;
/* Assign unique identifier to the device "dev5" and store in variable load. check for error.
ibfind error = negative value returned. */
   if((load = ibfind("dev5")) < 0)          /*  Device variable name is load  */
    {                                 /*  GPIB address is  5  */
      printf("\r*** INTERFACE ERROR ! ***\a\n");
      printf("\r\nError routine to notify that ibfind failed.\n");
      printf("\r\nCheck software configuration.\n");
      exit(1);
    }
/*  Clear the device  */
   if((ibclr(load)) & ERR);
    {
      printf("INTERFACE ERROR ! \a");
      exit(1);
    }
   clrscr();
/* Clear load error register */
   for(i=1,ch=0;i<=4;i++,ch++)
    {
     outstr=chan[ch];
     ibwrt(load,outstr,6);
     ibwrt(load,"CLER",4);
    }
   ibwrt( load,"NAME?",5);             /*  Get the SL-series module load specification  */
   strset(rdbuf,'\0');                 /*  Clear rdbuf string buffer  */
   strset(spec,'\0');                  /*  Clear spec string buffer  */
```

```
   ibrd(load,spec,20);
   if (spec[3] == '9')
      printf("\n SLM series specification error !");
/*  Set the channel 1, preset off, current sink 1.0 amps and load on commands to the load. */
   ibwrt( load,"chan 1;pres off;curr:low 0.0;curr high 1.0;load on ",51);
   ibwrt( load,"meas:curr ?",11);
/*  Get the load actially sink current from the load  */
   ibrd( load,rdbuf,20);
/*  go to local.  */
   ibloc(load);
}
```

Example Program in BASICA

LOAD DECL.BAS using BASICA MERGE command.

```
100 REM You must merge this code with DECL.BAS
105 REM
110 REM Assign a unique identifier to the device "dev5" and store it in variable load%.
125 REM
130     udname$ = "dev5"
140     CALL ibfind (udname$,load%)
145 REM
150 REM Check for error on ibfind call
155 REM
160     IF load% < 0 THEN GOTO 2000
165 REM
170 REM Clear the device
175 REM
180     CALL ibclr (load%)
185 REM
190 REM Get the module load specification
195 REM
200     wrt$ = "NAME?" : CALL ibwrt(load%,wrt$)
210     rd$ = space$(20) : CALL ibrd(load%,rd$)
215 REM
220 REM Set the channel 1, preset off, current sink 1.0 amps and load on commands to the
load.
225 REM
230     wrt$ = "chan 1;pres off;curr:low 0.0;curr high 1.0;load on"
240     CALL ibwrt(load%,wrt$)
245 REM
250 REM Get the load actially sink current from the load
255 REM
260     wrt$ = "meas:curr?" : CALL ibwrt(load%,wrt$)
270     rd$ = space$(20) : CALL ibrd(load%,rd$)
275 REM
280 REM Go to local
285 REM
290 CALL ibloc(load%)

2000 REM Error routine to notify that ibfind failed.
2010 REM Check software configuration.
                              2020 PRINT "ibfind error !" : STOP
```

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APPENDIX B
RS-232 PROGRAMMING EXAMPLE

C Language Interface for DOS Handlers " pd_rs232.c "

```
#include <dos.h>
#include <stdio.h>
#include <conio.h>
#include <string.h>

#define COMPTR        44           /* command array pointer          */
#define QUELEN        1024         /* size of seriel input           */
#define SUCCESS       0            /* return value variable for success    */
#define OPER_ERR      -1           /* operate error                  */
#define TIME_OUT   1                     /* time_out                    */
int input_index = 0;               /* index of seriel input buffer      */
int rd_result = 0;                 /* return value variable of pd_rd()    */
int timeout = 0;                   /* timeout flag                   */
char queue[QUELEN];                      /* seriel input buffer           */
int ACE_DATA_REG;                  /* ACIA data register             */
int ACE_INT_ENB_REG;                     /* ACIA interrupt enable register      */
int ACE_INT_IDENT_REG;                   /* ACIA interrupt identification register*/
int ACE_LINE_CTL_REG;                    /* ACIA line control register         */
int ACE_MODEM_CTL_REG;                      /* ACIA modem control register*/
int ACE_LINE_STAT_REG;                   /* ACIA line status register          */
int ACE_MODEM_STAT_REG;                  /* ACIA modem status register         */
int COM_INT_NUM;                   /* ACIA communication port interrupt number*/
int IRQ_MASK;                            /* IRQ mask for PC IRQ flag           */
void pd_loc(void);                 /* function of disable interrupt routine */
void pd_rem(void);                 /* function of enable interrupt routine  */
int pd_init(int);              /* function of initial communication port*/
int pd_wrt(char *,int);        /* function of write to device          */
int pd_rd(char *,int);             /* function of read from device          */
int read_buf(void);
int pd_meas(char *,char*, int, int);

#define PIC_CTL_REG       0x20    /* 8259A PIC control register         */
#define PIC_INT_MASK_REG   0x21        /* 8259A PIC interrupt mask register    */
#define NON_SPEC_EOI      0x20  /* non-spacific end of interrupt       */
#define CTS           0x10 /* clear to send                  */
#define DSR           0x20 /* data set ready                 */
#define RI            0x40  /* ring indicator               */
#define DCD           0x80 /* data carrier detect             */
#define DCTS            1  /* delta clear to send             */
#define DDSR            2  /* delta data set ready            */
#define TERI            4  /* trailing edge ring detect          */
#define DDCD            8  /* delta data carrier detect          */
#define OE              2  /* overrun error                  */
```

```
#define PE              4     /* parity error                    */
#define FE              8     /* frame error                     */
#define BI          0x10   /* break interrupt                 */
#define THRE           0x20 /* transmit holding reg. empty      */

 /*  SLM series elec. load command sets  */
int pd_wrt(char *wrtbuf,int count)
{
   static char *combuf[COMPTR] = {"CHAN",     "CURR:HIGH",  "CURR:LOW",
                    "RES:HIGH",  "RES:LOW",   "VOLT:HIGH",
                    "VOLT:LOW",  "PERD:HIGH", "PERD:LOW",
                    "FALL",     "RISE",      "GLOB:LOAD",
                    "GLOB:LEV", "GLOB:PRES", "GLOB:SHOR",
                    "GLOB:DYN", "GLOB:RANG", "GLOB:MODE",
                    "CLER",     "CHAN?",     "MEAS:VOLT?",
                    "MEAS:CURR?","CURR:HIGH?", "CURR:LOW?",
                    "ERR?",     "RES:HIGH?", "RES:LOW?",
                    "VOLT:HIGH?","VOLT:LOW?", "NAME?",
                    "PERD:HIGH?","PERD:LOW?", "FALL?",
                    "RISE?",    "LOAD?",     "LEV?",
                    "PRES?",    "SHOR?",     "DYN?",
                    "RANG?",    "MODE?",     "PROT?",
                    "REMOTE",   "LOCAL" };
   int cnt,result,t;
   int comerr,err;
   char ch;
   char tempbuf[QUELEN];
   char intbuf[QUELEN];
/*   for (cnt = 0;cnt < 1024;cnt++)
   {
       intbuf[cnt] = ';
       tempbuf[cnt]=';
   }  */
   strset(intbuf,');
   strset(tempbuf,');
   for (cnt = 0;cnt < count+1;cnt++,wrtbuf++)
   {
      intbuf[cnt] = *wrtbuf;
   }
   cnt = cnt--;
   intbuf[cnt] = '\r';
   cnt = cnt++;
   count = count++;
   intbuf[cnt] = '\n';
   t = strcspn(intbuf," ");
   if (t >count)
   t = count-1;
   for (cnt = 0;cnt < t;cnt++)
   {
      tempbuf[cnt] = intbuf[cnt];
   }
```

```
         strupr(tempbuf);
         strupr(intbuf);
         cnt = 0;
         do
         {
            comerr = strncmp(tempbuf,combuf[cnt],t);
            cnt = cnt++;
         }while(( cnt != COMPTR) && (comerr != 0));
         if ( comerr == 0)
         {
            result = SUCCESS;
              for (cnt = 0;cnt < count+1;cnt++)
              {   while(inportb(ACE_LINE_STAT_REG) & THRE == 0);
                  ch = intbuf[cnt];
                  delay(20);
                outportb(ACE_DATA_REG, ch);
            }
            timeout = 0;
            for (cnt = 0; cnt <= count;cnt++)
            {
               ch = intbuf[cnt];
                 if(ch == '?')
                 {
                       do
                       {
                         read_buf();
                       }while((rd_result == 0)&&(timeout == 0));
                       rd_result = 0;
                 }
              }
              for (cnt = 0;cnt<= count;cnt++)
              {
                 intbuf[cnt] = '';
                 tempbuf[cnt] = '';
              }
            return(result);
         }
      return(OPER_ERR);
}
int pd_rd(char *buf,int count)
{
      char ch;
      int cnt = 0;
      do
      {
         ch = queue[cnt];
         *buf = ch;
         cnt = cnt++;
         buf = buf++;
      }while((ch != '\n') && (cnt != count));
       *buf = '\0';
```

```
    queue[0] = '\0';
    if (timeout == 1)
    {
        return(TIME_OUT);
    }
    return(SUCCESS);
}
int read_buf()
{
    char ch,ch1;
    int temp_index;
    unsigned long ticks;
    float sec1,sec2;
    rd_result = 0;
    ticks = biostime(0,0);
    sec1 = ticks/18.2;
    do
    {
        ticks = biostime(0,0);
        sec2 = ticks/18.2;
        if((sec2 - sec1) >= 20.0)                   /* delay about 1 Sec */
        {
            timeout = 1;
        }
        ch = inportb(ACE_INT_IDENT_REG);
        ch &= 0x06;
        switch(ch)
        {
            case 6:
                inportb(ACE_DATA_REG);              /* read the data register to empty it */
                break;
            case 0:
                break;
            case 2:
                break;
            case 4:                                 /* read character from data register  */
                ch1 = inportb(ACE_DATA_REG);
                temp_index = input_index + 1;       /* increment index of input buffer*/
                if (ch1 != '\n')            /* check terminate bit          */
                {
                    queue[input_index] = ch1;       /* store character to input buffer*/
                    input_index = temp_index;
                }
                else
                {
                    queue[input_index] = ch1;
                    input_index = temp_index;
                    input_index = 0;          /* if terminate bit was detected  */
                    temp_index = 0;
                    rd_result = 1;            /* clear index and set return value */
                }
```

```
            break;
        }                                 /* finally send the non-spacific  */
    }while ((rd_result == 0) && (timeout == 0));
}


int pd_init(int pd_com)
{
    if ((pd_com != 1) && (pd_com != 2))
        return(OPER_ERR);
    if (pd_com == 2)                            /* initial communication port 2     */
    {
            ACE_DATA_REG     =  0x2f8;
            ACE_INT_ENB_REG   =  0x2f9;
            ACE_INT_IDENT_REG =  0x2fa;
            ACE_LINE_CTL_REG  =  0x2fb;
            ACE_MODEM_CTL_REG =  0x2fc;
            ACE_LINE_STAT_REG =  0x2fd;
            ACE_MODEM_STAT_REG =  0x2fe;
            COM_INT_NUM       =    11;
            IRQ_MASK          =  0xf7;        /* IRQ mask for IRQ3  (11110111)     */
    }
    else                                  /* initial communication port 1       */
    {
            ACE_DATA_REG      =  0x3f8;
            ACE_INT_ENB_REG   =  0x3f9;
            ACE_INT_IDENT_REG =  0x3fa;
            ACE_LINE_CTL_REG  =  0x3fb;
            ACE_MODEM_CTL_REG =  0x3fc;
            ACE_LINE_STAT_REG =  0x3fd;
            ACE_MODEM_STAT_REG =  0x3fe;
            COM_INT_NUM       =    12;
            IRQ_MASK          =  0xef;        /* IRQ mask for IRQ4  (11101111)     */
    }
    bioscom(0, 0xe3, pd_com-1);                      /* boud rate : 9600, 1 start bit     */
    pd_rem();                                        /* no parity, 1 stop bit.          */
    pd_wrt("remote",6);              /* data bit : 8 bits            */
    return(SUCCESS);
}


int pd_meas(char *wrtmbuf, char *rdmbuf,int wrtmcnt,int rdmcnt)
{
    static char *wrtbuf[10] = { "CURR 1",  "CURR 2",  "CURR 3",  "CURR 4",
                    "VOLT 1",  "VOLT 2",  "VOLT 3",  "VOLT 4", }
    char tmpbuf[20] ={"chan "};
    int cnt,result,t,cmp,measerr;
    char ch;
    char rdtmpbuf[20],chanbuf[20];
    char measbuf[6];
    for (cnt = 0; cnt < wrtmcnt; cnt++, wrtmbuf++)
    {
        measbuf[cnt] = *wrtmbuf;
```

```
     }
  strupr(measbuf);
  cnt = 0;
  do
  {
     measerr = strncmp(measbuf,wrtbuf[cnt],6);
     cnt = cnt++;
  }while((cnt != 10) && (measerr != 0));
  if(measerr == 0)
  {
        result = SUCCESS;
     if (strncmp(measbuf,"CURR", 4) == 0)
     {
        ch = measbuf[5];
        switch(ch)
        {
        case '1':
           pd_wrt("chan 1",6);
           pd_wrt("meas:curr?",10);
           pd_rd(rdmbuf,rdmcnt);
           strncat(tmpbuf,chanbuf,1);
           pd_wrt(tmpbuf,6);
           break;
        case '2':
           pd_wrt("chan 2",6);
           pd_wrt("meas:curr?",10);
           pd_rd(rdmbuf,rdmcnt);
           strncat(tmpbuf,chanbuf,1);
           pd_wrt(tmpbuf,6);
           break;
        case '3':
           pd_wrt("chan 3",6);
           pd_wrt("meas:curr?",10);
           pd_rd(rdmbuf,rdmcnt);
           strncat(tmpbuf,chanbuf,1);
           pd_wrt(tmpbuf,6);
           break;
        case '4':
           pd_wrt("chan 4",6);
           pd_wrt("meas:curr?",10);
           pd_rd(rdmbuf,rdmcnt);
           strncat(tmpbuf,chanbuf,1);
           pd_wrt(tmpbuf,6);
           break;
        }
     }
        else if(strncmp(measbuf,"VOLT",4) == 0)
     {
        ch = measbuf[5];
        switch(ch)
        {
```

```
        case '1':
            pd_wrt("chan 1",6);
            pd_wrt("meas:volt?",10);
            pd_rd(rdmbuf,rdmcnt);
            strncat(tmpbuf,chanbuf,1);
            pd_wrt(tmpbuf,6);
            break;
        case '2':
            pd_wrt("chan 2",6);
            pd_wrt("meas:volt?",10);
            pd_rd(rdmbuf,rdmcnt);
            strncat(tmpbuf,chanbuf,1);
            pd_wrt(tmpbuf,6);
            break;
        case '3':
            pd_wrt("chan 3",6);
            pd_wrt("meas:volt?",10);
            pd_rd(rdmbuf,rdmcnt);
            strncat(tmpbuf,chanbuf,1);
            pd_wrt(tmpbuf,6);
            break;
        case '4':
            pd_wrt("chan 4",6);
            pd_wrt("meas:volt?",10);
            pd_rd(rdmbuf,rdmcnt);
            strncat(tmpbuf,chanbuf,1);
            pd_wrt(tmpbuf,6);
            break;
        }
    }
    }
    else
    {
        return(OPER_ERR);
    }
    return (result);
}

void pd_rem(void)
{
    char ch;
    outportb(ACE_INT_ENB_REG, 0xd);        /* enable ACIA interrupt register   */
    inportb(ACE_DATA_REG);                 /* empty receive data register      */
    inportb(ACE_LINE_STAT_REG);            /* clear line status register       */
    outportb(ACE_MODEM_CTL_REG, 0xb);      /* set RTS,DTR to enable modem and
*/
                                           /* turn on OUT2 to enable the
8250's  */
                                           /* IRQ interrupt to system
*/
}
```

```c
void pd_loc(void)
{
   char ch;
   outportb(ACE_INT_ENB_REG, 0);              /* disable all 8250 interrupt     */
   outportb(ACE_MODEM_CTL_REG, 0);            /* clear RTS,DTR to disable modem and
*/
                                              /* turn off OUT2 to disable the
8250's*/
                                              /* IRQ interrupt to system
*/
}/*   Program terminated. */
```

C Example Program

```c
/* Link this program with pd_rs232.obj */

#include <dos.h>
#include <stdio.h>
#include <conio.h>
#include <string.h>

main()
{
   int com;
   int io_err= 0;
   char rdbuf[1024];
   clrscr();
   printf("Input COM1/COM2 port is : ");
   scanf("%d", &com);
   if((io_err = pd_init(com)) == 0)           /* Initial RS-232 interface */
   {
       setstr(rdbuf,'');
       pd_wrt("chan 1",6);
       delay(200);
       pd_wrt("name?",5);
       if ((io_err = pd_rd(a,10)) == 0)
       {
          do
          {
/*  Set the channel 1, preset off, current sink 1.0 amps and load on commands to the load. */
             pd_wrt("chan 1",6);
             delay(200);
             pd_wrt("pres off",8);
             delay(200);
             pd_wrt("curr:low 0.0",12);
             delay(200);
             pd_wrt("curr high 1.0",13;
             delay(200);
             pd_wrt("load on",7);
             delay(200);
             pd_wrt("meas:curr ?",11);
```

```
/*  Get the load actially sink current from the load  */
                delay(200);
                pd_rd(rdbuf,20);
                io_err = 1;
           }while (io_err == 0);
        }
        else
        {
           printf("\a");
           printf("chan 1 I/O reading error !\n");
           exit(1);
        }
    pd_loc();     /*  Go to local */
    }
}
```

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SLM-SERIES AC/DC LOAD GPIB/RS-232 OPERATING FLOW CHART

START

REM Remote Indicator on Front Panel

CHANNEL 1? — NO
YES
Set "CHAN 1"

CHANNEL 2? — NO
YES
Set "CHAN 2"

CHANNEL 3? — NO
YES
Set "CHAN 3"

CHANNEL 4? — NO
YES
Set "CHAN 4"

Omit when installed in an SLM-1 Chassis

Module Setups

Vsense
Set "SENS ON|OFF"

Good/No Good
Set
"NG ON|OFF"
"IH NR2"
"IL NR2"
"VH NR2"
"VL NR2"

CC MODE?
YES
NO
NO

CR MODE?
YES

Set "MODE CC"

Set "MODE CR"

AC or DC?
DC
AC

AC or DC?
DC
AC

Set "FREQ 0.1" "SYNC ON|OFF"

Set "FREQ NR2" "SYNC ON|OFF" "BANK m"

Set "FREQ 0.1" "SYNC ON|OFF"

Set "FREQ NR2" "SYNC ON|OFF" "BANK m"

HIGH or LOW LEVEL?

HIGH or LOW LEVEL?

Set
"LEVE HIGH"
"CC:LOW I"*
"CC:HIGH NR2"
"WAVE n"

Set
"LEVE LOW"
"CC:HIGH L"
"CC:LOW NR2"*
"WAVE n"

Set
"LEVE LOW"
"CR:HIGH E"*
"CR:LOW NR2"

Set
"LEVE HIGH"
"CR:LOW D"*
"CR:HIGH NR2"

Set "LOAD ON"

* SEE TABLE FOR VALUES BY MODEL

	SLM-60-20-300	SLM-150-8-300	SLM-300-4-300	SLM-500-1-300
A	10	4	2.0	0.5
B	1.2	7.5	30.0	200
C	1.2	7.5	30.0	200
D	4800	30000	120000	800000
E	0.3	1.875	7.5	50
F	1.2	7.5	30.0	200
I	0	0	0.0	0
J	10	4	2.0	0.5
K	10	4	2.0	0.5
L	20	8	4.0	1