AMETEK®
PROGRAMMABLE POWER

Sorensen

SLD Series Dual Input DC Electronic Load Module

Operation and Programming Manual

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Important Safety Instructions

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

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

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

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

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

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

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

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

SAFETY SYMBOLS
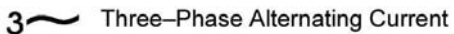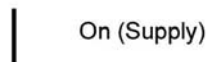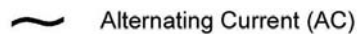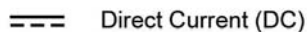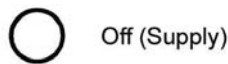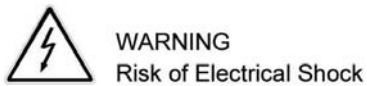
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Product Family: SLD Series Dual Input DC Electronic Load Module

Warranty Period: One Year

WARRANTY TERMS

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

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

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

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

PRODUCT RETURN PROCEDURE

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

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

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

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

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

   - Model number
   - Serial number
   - Description of the problem

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

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

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ABOUT THIS MANUAL

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

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

CONTENTS

List of Tables

List of Figures

SECTION 1
INTRODUCTION

1.1 General Description

The SLD-series Electronic Load modules are designed to test, evaluate and burn-in multi-output DC power supplies and batteries. Each SLD-series Electronic load module is a two-channel programmable DC Electronic load. Each module has its own control and display with CC, CR. CV, Dynamic, and Short operation modes, 150 sets Store/Recall memory, and GO/NG check sorting. The modules operate in the SLM Mainframe by manual control or by programmable GPIB and RS-232 remote control.

The SLM Mainframe accommodates up to four SLD-series modules, except for the 550W module, for combination testing requirements. The size of the 550W module, a dual load, requires two mainframe bays in the mainframe, and can be installed in channels 1 & 2, 2 & 3 or 3 & 4 of the SLM-4 mainframe. The channel identification will be the rightmost bay. Figure 1-1 through Figure 1-4 show the power contours for each model of the SLD-series Electronic Load:

a) b) c)
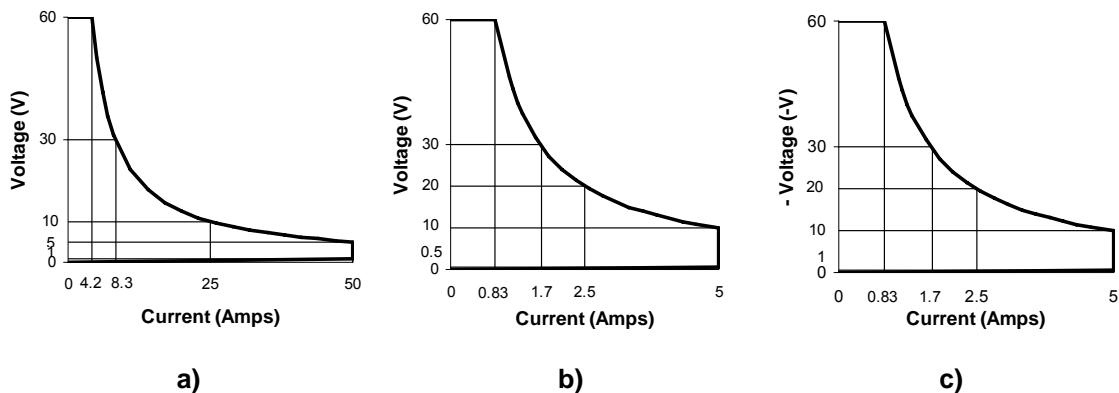
Figure 1-1 Power contour for: a) Channel A of SLD-60-505-255 and SLD-61-505-255; b) Channel B of SLD-60-505-255; c) Channel B of SLD-61-505-255 electronic loads
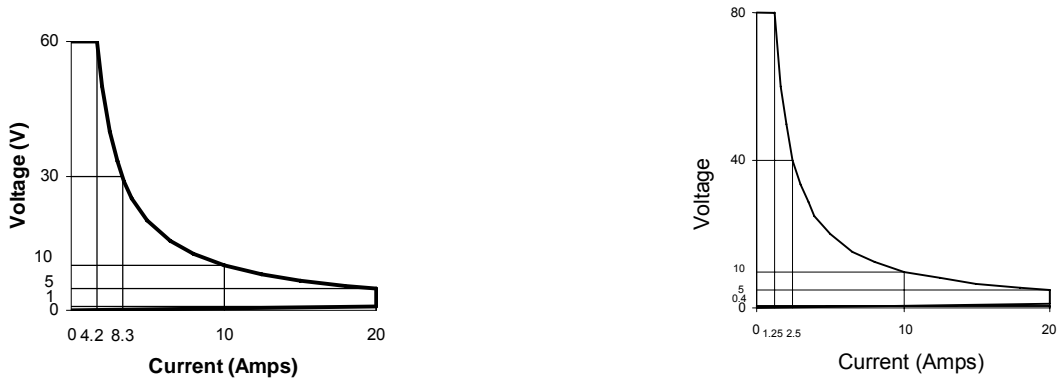
Figure 1-2 Power Contours for SLD-60-20-102 and SLD 80-20-102 Electronic Load Channels A and B

SLD-61-5-752 Channel A   SLD-61-5-752 Channel B, SLD-62-5-752 Channel A and B
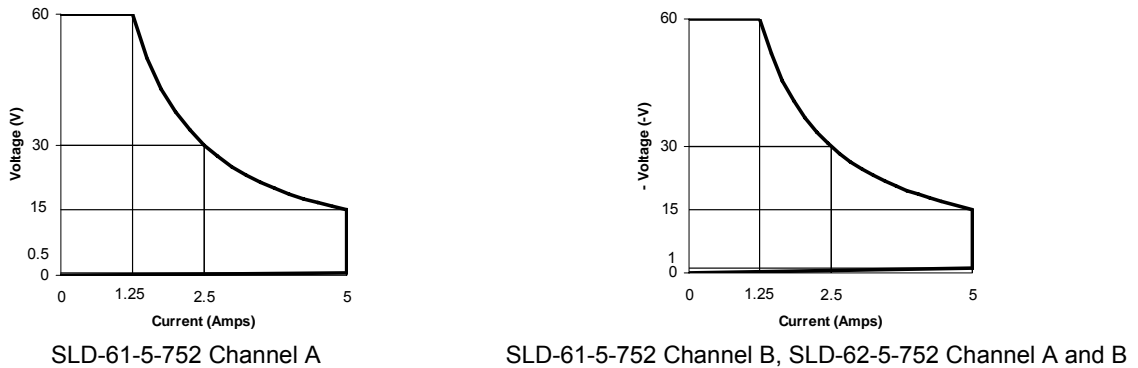
Figure 1-3 Power Contours for SLD-61-5-752 and SLD-62-5-752 Electronic Load Modules

Channel A   Channel B
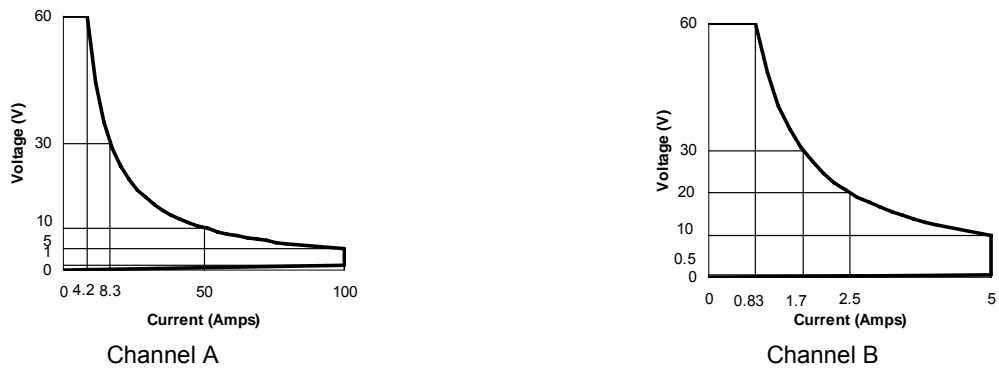
Figure 1-4 Power Contours for SLD-60-105-550 Electronic Load

1.1.1   Operating Modes

The operating modes of the SLD-series Electronic Load include Constant Current (CC) mode, Constant Resistance (CR) mode, and Constant Voltage (CV) mode. The wide range dynamic load with rise/fall current slew rate is available in CC mode only.

CC Mode: (Constant Current mode)

With the operating mode of constant current, the SLD-series Electronic load will sink a current in accordance with the programmed value regardless of the input voltage (see Figure 1-5).
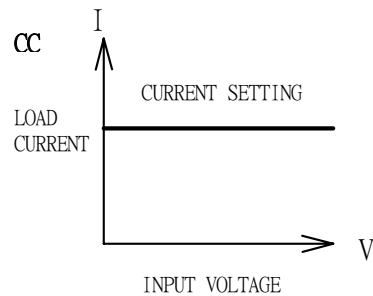
Figure 1-5 Constant Current Mode

CR Mode: (Constant Resistance Mode)

At constant resistance mode; the SLD-series Electronic Load will sink a current linearly proportional to the load input voltage in accordance with the programmed resistance setting (see Figure 1-6).
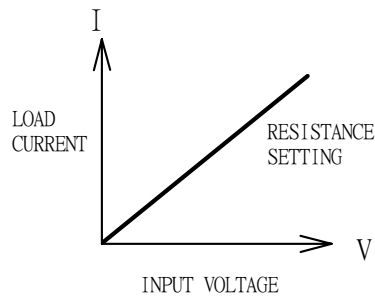
Figure 1-6 Constant Resistance Mode

CV Mode: (Constant Voltage Mode)

At constant voltage mode; the SLD-series Electronic Load will attempt to sink enough current until the load input voltage is equaled to the programmed value (see Figure 1-7).
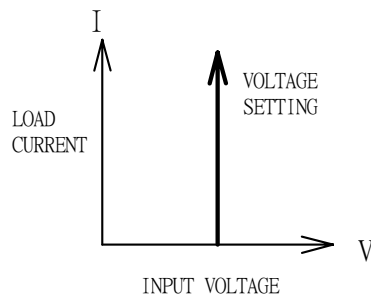
Figure 1-7 Constant Voltage Mode

Dynamic Waveform Definition:

There are six parameters to generate dynamic waveform or pulse waveform: High Load Level, Low Load Level, T_{HIGH}, T_{LOW}, and Rise and Fall Slew Rates. The SLD-series Electronic Load will sink current from the power source proportional to the dynamic waveform, the definition for which is shown in Figure 1-8. The period of dynamic waveform is T-high + T-low.

Dynamic frequency = 1 /(T-high + T-low)
Duty cycle = T-high / (T-high + T-low)
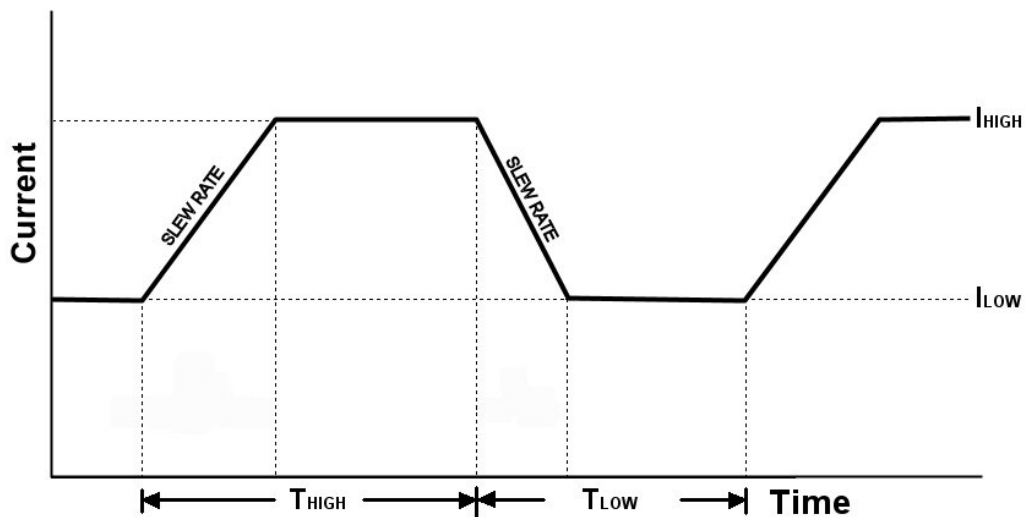
Figure 1-8 Dynamic Waveform

1.2   Features of the SLD-Series Dual DC Electronic Load

The SLD-series dual DC Electronic load includes six models, where 200-300W models are suitable for PS/2,ATX personal computer power supply testing, 150W models are for low power output power supply (ex. DC/DC converter) testing applications, the 550W module is designed for higher power computer server power supply applications.

- Very flexible Dual Load configuration to SLM mainframe with maximum power up to 300W (250W+50W) for single-bay module or up to 550W for the dual bay module; it meets multiple output power supply test requirements.

- Both Front panel and Remote control are available; the remote interface can be built-in RS-232 or GPIB with setting and read-back capability. (GPIB is optional in the SLM-1 chassis).

- Dual Voltage and current meter display with 16-bit high accuracy/resolution A/D converter.

- Built-in Dynamic pulse generator for dynamic loading control.

- Meter reading GO/NG check capability.

- Short circuit load testing capability with short circuit current measurement.

- Built-in 150 sets Store/Recall EEPROM memory.

- Protection against Over Voltage, Over current, Over power, Over temperature, and reverse polarity.

- Built-in power supply OCP and OVP testing function.

- Power supply output automatic testing by the auto-sequence function of mainframe.

- Programmable Load ON and Load OFF voltage control.

- Advance Cooling Fan control, the fan speed is proportional to the load power, the fan noise can be reduced in low power applications.

1.2.1   Accessories for Each Module

Accessories	SLD-60-505-255	SLD-61-505-255	SLD-60-20-102/ SLD-80-20-102	SLD-61-5-752	SLD-62-5-752	SLD-60-105-550
Miniature banana plug (Red)	2	1	2	1	0	2
Miniature banana plug (Black)	2	2	2	2	2	2
Miniature banana plug (White)	0	1	0	1	2	0
Banana plug (Red)	2	1	2	1	0	4
Banana plug (Black)	2	2	2	2	2	4
Banana plug (White)	0	1	0	1	2	0
Heavy spread lug terminal	2	2	0	0	0	4
Spread lug terminal	2	2	4	4	4	2
Operation manual	1	1	1	1	1	1

Table 1-1 Accessories Included with Each SLD-series Module

1.2.2   Specifications

The following specifications apply 25°C ± 5°C

MODEL	SLD-60-505-255		SLD-61-505-255		SLD-60-20-102	SLD-80-20-102	SLD-61-5-752	SLD-62-5-752	SLD-60-105-550	
INPUT RATING										
Voltage	CH. A: +60V	CH. B: +60V	CH. A: +60V	CH. B: -60V	+60V x 2	+80V x 2	CH.A: +60V, CH. B: -60V	CH. A: -60V, CH. B: -60V	CH. A: +60V	CH. B: +60V
Current	50A	5A	50A	5A	20A x 2	20A x 2	5A X 2	5A X 2	100A	5A
Power	250W	50W	250W	50W	100W x 2	100W x 2	75W x 2	75W x 2	500W	50W
Min. Voltage (Full Current):	0.4V	0.4V	0.4V	0.9V	0.4V	0.4V	0.4V	0.3V	0.4V	0.4V
CC MODE										
Range	0 - 5A / 50A	0-0.5A / 5A	0 - 5A / 50A	0-0.5A / 5A	0 - 2.0A / 20A		0 - 0.5A / 5A	0 - 0.5A / 5A	0 - 1.0A / 100A	0 - 0.5A / 5A
Resolution	1.34 / 13.4mA	0.134 / 1.34mA	1.34 / 13.4mA	0.134 / 1.34mA	0.534 / 5.34mA		0.134 / 1.34mA	0.134 / 1.34mA	2.66/26.6mA	0.134 / 1.34mA
Accuracy	0.2% of (Setting + Range)						0.2% of (Setting + Range)			
CR MODE										
Range 1 (I>0.02% of rating)	1.2-4500Ω	12 - 45000Ω	1.2-4500Ω	12 - 45000Ω	3 - 11250Ω	4 - 15000Ω	12 - 45000Ω		0.6 - 2250Ω	12 - 45000Ω
Range 2 (I>0.2% of rating)	0.04-1.2Ω	0.4 - 12Ω	0.04-1.2Ω	0.4 - 12Ω	0.1 - 3Ω	0.134 - 4Ω	0.4 - 12Ω		0.02 - 0.6Ω	0.4 - 12Ω
CV MODE										
Range	0 – 60V				0 - 60V	0 - 80V	0 – 60V			
Resolution	16mV				16mV	21.3mV	16mV			
Accuracy	0.2% of (Setting + Range)						0.2% of (Setting + Range)			
SHORT MODE										
Resistance	8mΩ	0.08Ω	8mΩ	0.18Ω	0.02Ω	0.02Ω	0.2Ω	0.06Ω	4mΩ	0.08Ω
Current	50A	5A	50A	5A	20A	20A	5A	5A	100A	5A
DYNAMIC MODE										
THIGH / TLOW	50μsec to 9.999 sec						50μsec to 9.999 sec			
Slew Rate	4 - 200 mA/μs	0.4 - 20 mA/μs	4 - 200 mA/μs	0.4 - 20 mA/μs	1.6-80 mA/μs		0.4 - 20 mA/μs		8-400 mA/μs	0.4 - 20 mA/μs
	40-2000 mA/μs	4 - 200 mA/μs	40-2000 mA/μs	4 - 200 mA/μs	16-800 mA/μs		4 - 200 mA/μs		80-4000 mA/μs	4 - 200 mA/μs
Resolution	0.8 mA/μs	0.08 mA/μs	0.8 mA/μs	0.08 mA/μs	0.32 mA/μs		0.08 mA/μs		1.6 mA/μs	0.08 mA/μs
	8 mA/μs	0.8 mA/μs	8 mA/μs	0.8 mA/μs	3.2 mA/μs		0.8 mA/μs		16 mA/μs	0.8 mA/μs
Accuracy	±10% OF (Setting + 10μs)						±10% OF (Setting + 10μs)			
4 1/2 DVM										
Range	15V / 60.00V					20V / 80V	15V / 60.00V			
Resolution	0.001V / 0.01V									
Accuracy	0.05% of (Reading + Range)									
4 1/2 DAM										
Range	15A / 50A	1.5A / 5A	15A / 50A	1.5A / 5A	2.0A/20A		1.5A / 5A		10/100A	1.5A / 5A
Resolution	1mA / 10mA	0.1mA / 1mA	1mA / 10mA	0.1mA / 1mA	0.1mA / 1mA		0.1mA / 1mA		1/10mA	0.1mA / 1mA
Accuracy	0.2% of (Reading + Range)						0.2% of (Reading + Range)			
Load ON Volt.										
Range	0.1-25V									
Resolution	0.1V									
Accuracy	1% of Setting + 0.25V									
Load OFF Volt.										
Range	0-25V									
Resolution	1mV									
Accuracy	1% of Setting + 0.25V									
Weight	3.5 kgs. / 7.7 lbs.								7 kgs. / 15.4 lbs.	

Table 1-2 SLD-series Specifications

1.2.3 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

1.2.4 System Equivalent Circuit and Block Diagram

The equivalent polarity circuit diagrams of SLD-series Dual DC Electronic Load are shown below:
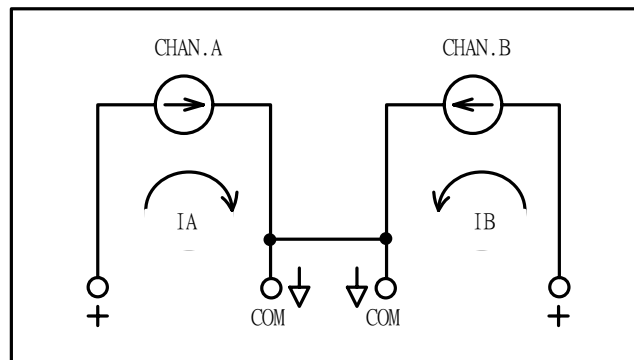
Figure 1-9 SLD-60-xxx-xxx: Dual Positive Load Channel
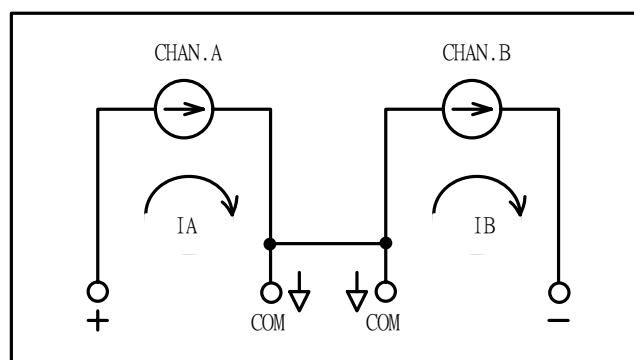
Figure 1-10 SLD-61-xxx-xxx: Channel A/B is Positive/Negative Load Channel, Respectively
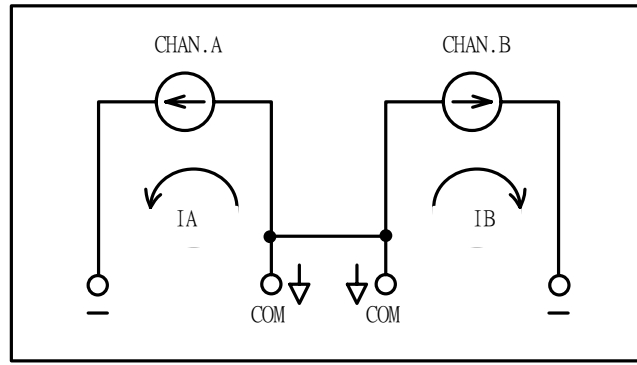
Figure 1-11 SLD-62-xxx-xxx: Dual Negative Load Channel

The system functional block diagram of SLD-series Electronic Load module is illustrated in Figure 1-12. The functional block diagram of the mainframe is described in the SLM mainframe operation manuals.
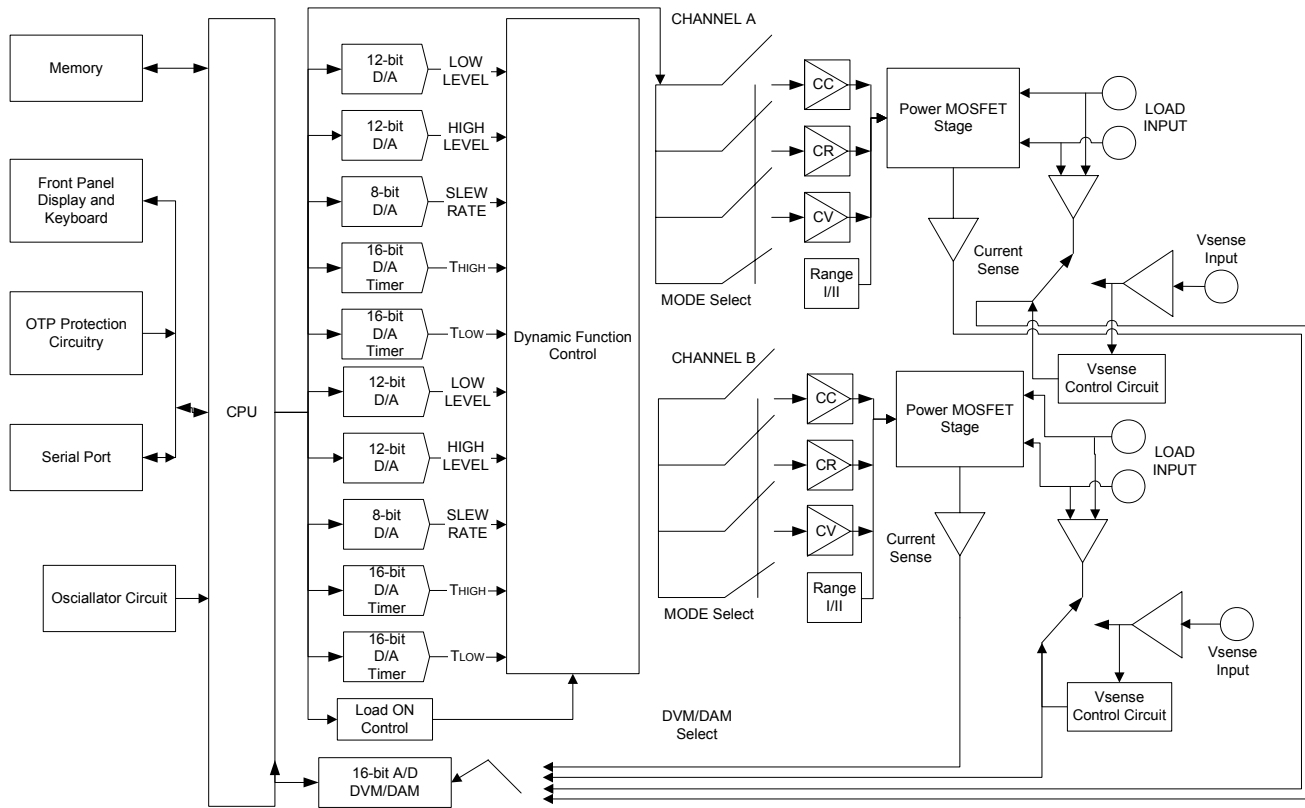
Figure 1-12 SLD-series Block Diagram

Each load channel receives the load levels and load status from the chassis via either serial optical isolated bus or keyboard.

- two 12-bit D/A converters receive digital data of the high and low load levels and transfer them as an analog signal to the Dynamic Function Generator (DFG)

- two 8-bit D/A converters control the load current slew rate and feed into the DFG

- two 16-bit timers set current T_{HIGH} and T_{LOW} duration and feed into the DFT

- the DFG sends analog signals to the Load Control Circuit

- one of Constant Current (CC), Constant Resistance (CR), or Constant Voltage (CV) and one range level is selected, depending on which mode and range are operating

- the drive circuit controls the load current flow through power MOSFET

- the current sense Amplifier, built into the power MOSFET stage, feeds the load current signal to 16-bit DAM.

- the voltage V-sensing circuit selects the Load input terminal or V-sense BNC input, depending on the CONFIG key's V-sense ON/OFF setting, and feeds the voltage signals to 16-bit DVM

The 16-bit voltage and current meter digital bus feeds back to the CPU circuitry; each SLD-series load module can transfer to chassis through isolated serial circuitry.

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SECTION 2
INSTALLATION

This Section discusses the installation and removal of SLD-series Electronic load modules from the SLM mainframe. The SLD-series load module plugs into any channel of the SLM mainframe and does not need any adjustment after plug in.

WARNING: Only qualified personnel should do installation and removal.
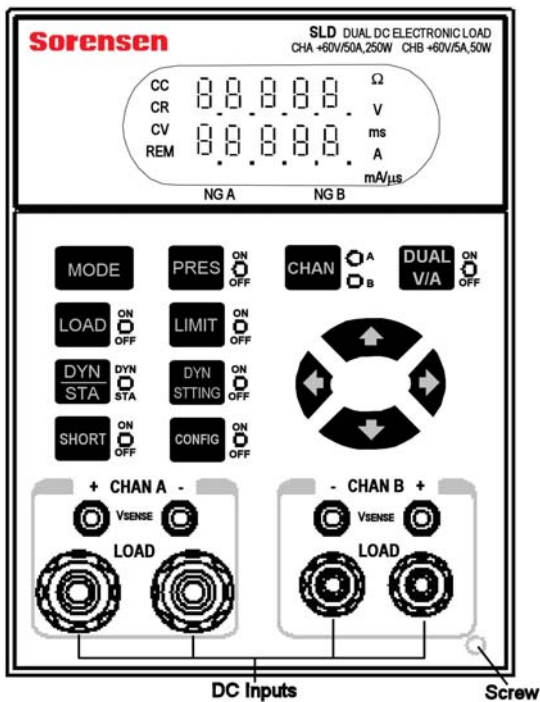
Figure 2-1 Load Input Connector and Screw for Single-Bay Unit
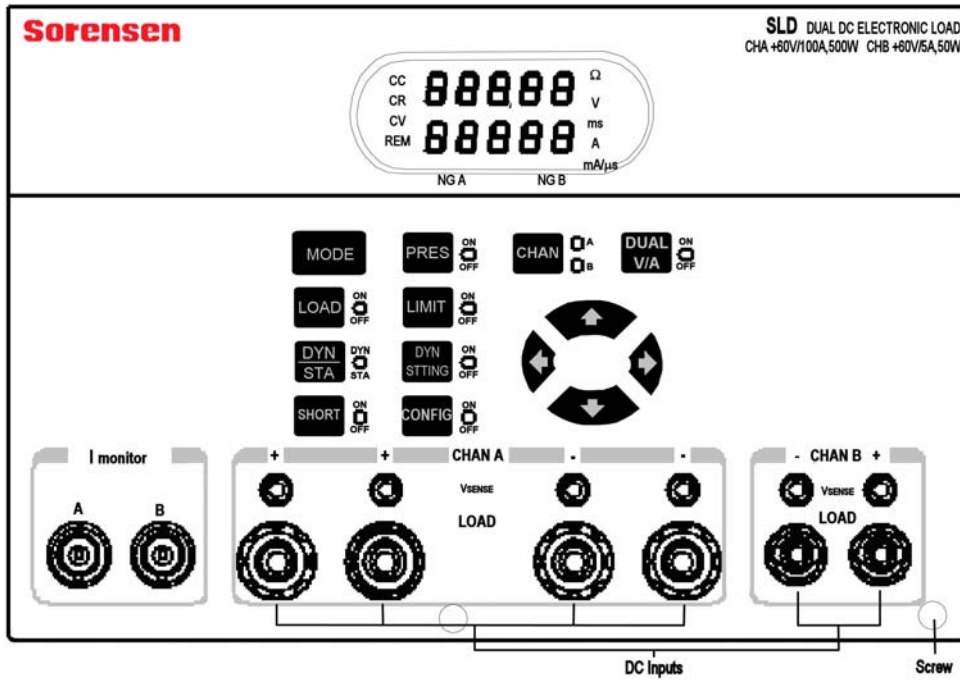
Figure 2-2 550W Load Input Connector and Screw for Double-Bay Unit

2.1 Installation and Removal of SLD-Series Module

Unless the SLM mainframe and SLD-series Electronic load module were purchased separately, the SLD-series Electronic load module should be installed in the mainframe before shipment from Sorensen.

The SLD-series Electronic load module operates in SLM mainframe for front panel and remote control feature, but cannot be operated without the mainframe.

When you want to install or remove the SLD-series load module into or from the SLM mainframe for configuration or reconfiguration purposes, please follow the procedures in Section 2.1.1 or 2.1.2.

CAUTION: PREVENT DAMAGE TO THE LOAD. Do NOT apply voltage or current with chassis 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).

2.1.1   Installation

1. Turn the chassis power OFF before inserting the SLD-series 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.

3. Push the SLD-series load module in and press firmly on the binding posts of the front panel to seat the circuit board in the interconnecting jack.

4. Fasten the screw on the lower and right hand side corner of the SLD-series front panel with screwdriver, the screw location is shown on Figure 2-2.

5. Turn the chassis power ON until all of the electronic modules are completely installed.

2.1.2   Removal

1. Turn the chassis power OFF first; otherwise, damage may occur to the plug-in circuitry.

2. Loosen the screw on the front panel of SLD-series with screwdriver.

3. Turn the adjustment knob of the black binding post counter clockwise until the adjustment knob is fully moved out; Then pull on the black adjustment knob of binding post until the interconnecting jack disengages and SLD-series load module will slide out.
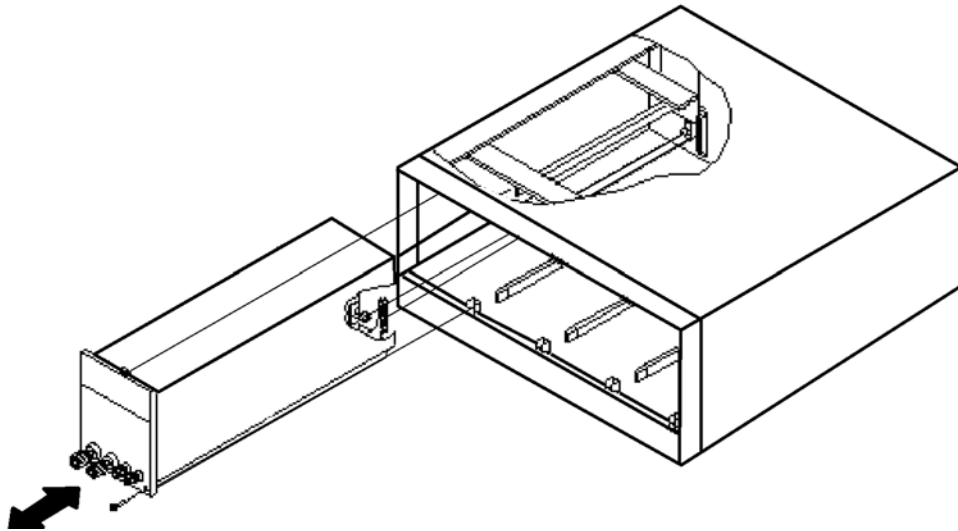
Figure 2-3 Single Bay, Dual Input Electronic Load Module Plug-in and Removal
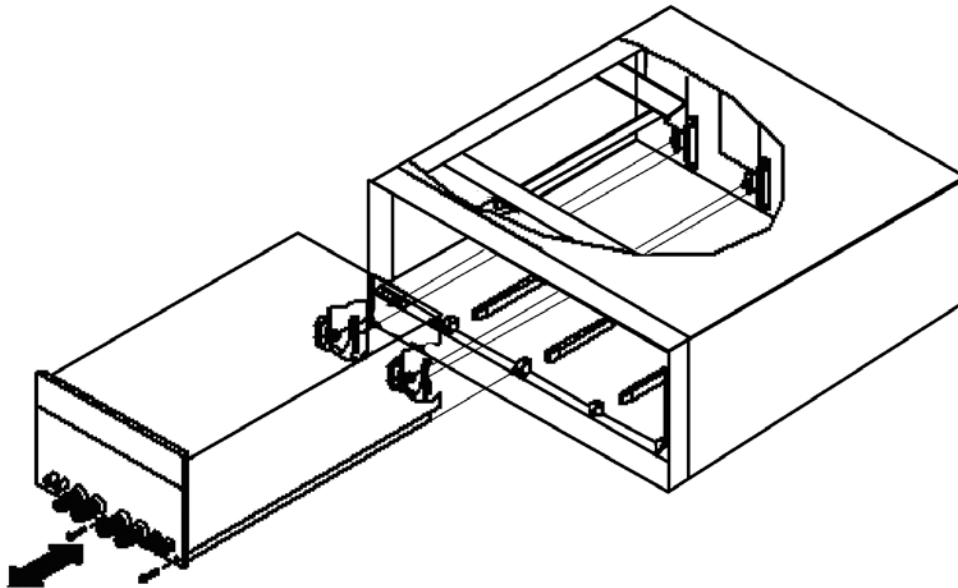
Figure 2-4 Dual Bay Electronic Load Plug-in and Removal

2.2   Input Binding Post and Wire Considerations

There are five ways that binding posts (+, com and -) can connect the input wires to the Electronic:

2.2.1   Plug Connectors

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

2.2.2   Hook Terminals

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

2.2.3   Direct Insertion into Binding Posts

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

2.2.4   Plug Connectors and Hook Terminals

This method is recommended when input current is greater than 20A or long lead wires.

2.2.5   Plug Connectors and Direct Insertion

This method is also recommended when input current is greater than 20A or long lead wires. 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.

Note:

SLD-series dual Electronic Load's Channel A and Channel B Load input connector has common connections, this means the ground common point (Black binding post) for Channel A and B is wired together.

- 2 positive (+) load modules should be used for two positive output power supply test applications
- one positive (+) one negative (-) load module should be used for one positive (+) one negative (-) output power supply test application
- 2 negative (-) load modules should be used for two negative output power supply test applications,

However, each Dual DC Electronic Load module common input is isolated to the other Load module, therefore, please make a polarity combination consideration for power supply and the Dual Load module. See Figure 1-9 to Figure 1-11.

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SECTION 3
OPERATION

This chapter describes the front panel operation of each SLD-series Dual DC load module. The GPIB and RS-232 remote programming are described in the SLM mainframe operation manual.

3.1 Front Panel Controls and Indicators
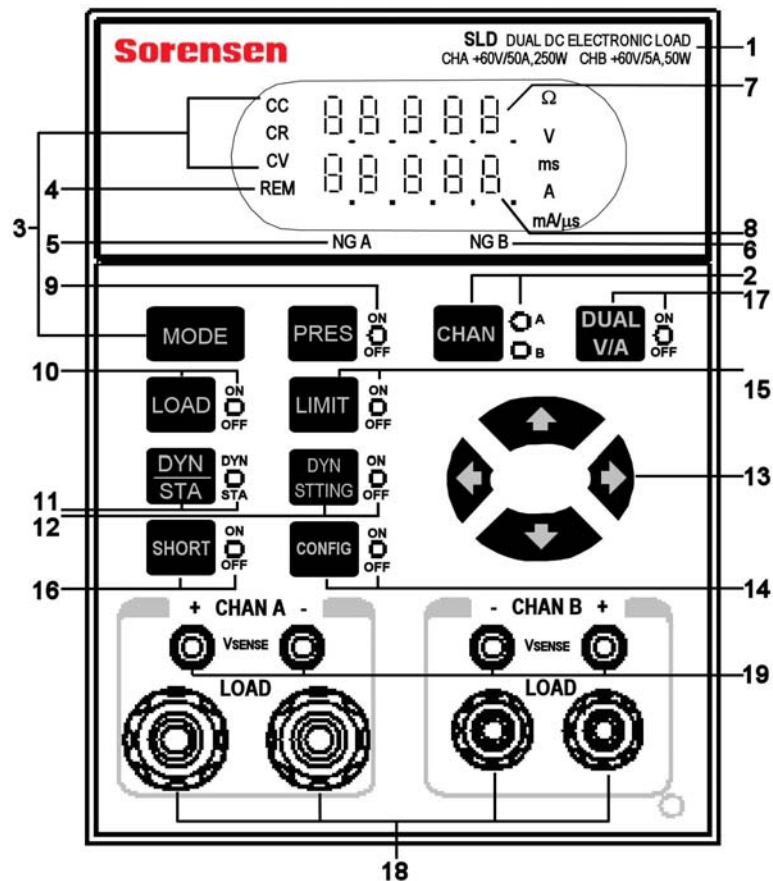
Figure 3-1 SLD-series Dual DC Electronic Load Front Panel, Single Bay
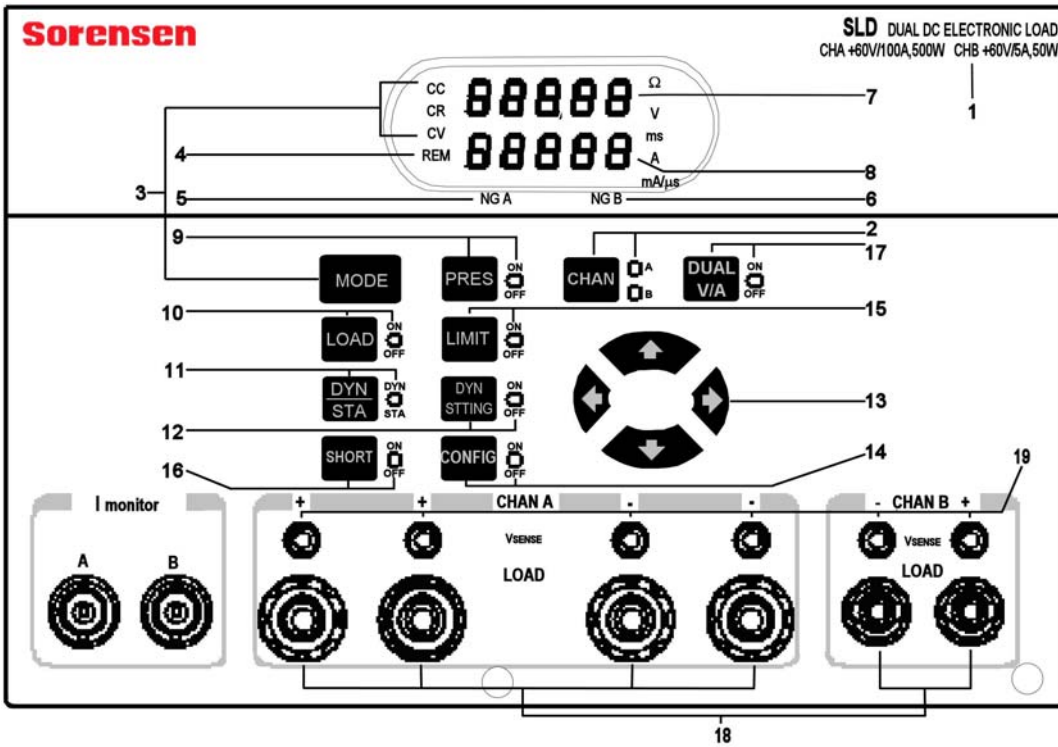
Figure 3-2 SLD-series Dual DC Electronic 550W Load Front Panel, Double Bay

3.1.1   Descriptions

1   Module Label

Shows the load model name and its maximum ratings.

2   CHAN Key and A/B LEDs

Selects either channel A or B for front panel control (REM LED and DUAL V/A key do not apply).

- CHAN key toggles control selection between Channel A and Channel B.
- LEDs indicate which channel is selected:
  - A = front panel is controlling Channel A
  - B = front panel is controlling Channel B

3   MODE Key and CC, CR, CV LEDs

Selects among Constant Current, Constant Resistance, or Constant Voltage modes.

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

4   REM LED

Indicates remote operation:

- When lit, the unit is under remote control and cannot be operated through the front panel keys.

- When off, the unit is under local control and can be manually operated using the front panel keys.

5   NG A LED

When enabled and Channel A is selected (CHAN A LED is lit), indicates whether or not Voltage and/or Current exceed(s) the upper or lower limit set for channel A.

- Lit = "No Go" – Channel A Voltage and/or Current limits exceeded.

- Not lit = "Go" (no fail) for Channel A.

NOTE: Use the CONFIG key, **14**, to set NG ON/OFF to ON, to enable this function.

6   NG B LED

When enabled and channel B is selected (CHAN B LED is lit), indicates whether or not Voltage and/or Current exceed(s) the upper or lower limit set for channel B.

- Lit = "No Go" – Channel B Voltage and/or Current limits exceeded.

- Not lit = "Go" (no fail) for Channel B.

NOTE: Use the CONFIG key, **14**, to set NG ON/OFF to ON, to enable this function.

7   Upper 5-Character Display and Associated LEDs

Multi-purpose display, depending on selected mode:

- In PRESet OFF mode, displays voltage of DC input terminal or V$_{SENSE}$ BNC input.

- In PRESet ON mode, displays values being programmed for CR or CV.

- In DYN STTING On mode, displays dynamic waveform parameters for:
    - High Level Current (Curr-H)
    - Low Level Current (Curr-L)
    - High Load Duration (T-Hi)
    - Low Load Duration (T-Lo)
    - Slew Rate (Sr)

- In LIMIT ON mode:
    - displays GO/NG limit values for voltage
    - displays "AH" or "AL" when current limits a being programmed (see DYN STTING key, **12**)

- In CONFIG ON mode:
    - displays SENSE to indicate V$_{SENSE}$ control
    - displays voltage settings for LOAD ON or for LOAD OFF

- Protection notice:

  - Displays "Prot" when over- protection is triggered (lower display reveals which protection feature was triggered).

Associated LEDs indicate the displayed value's unit:

- Ω = Value displayed is in Ohms

- V = Value displayed is in Volts

- ms = Value displayed is in milliseconds

- A = Value displayed is in Amps

- mA/μs = Value displayed is in Amps per microsecond (or milliamps per microsecond)

8   Lower 5-Character Display and Associated LEDs

Multi-purpose display, depending on selected mode:

- In PRESet (key **9**) OFF mode:

  - displays actual load current when SHORT status is OFF
  - displays short circuit current when SHORT status is ON

- In PRESet ON mode, displays:

  - value being programmed for CC
  - values being programmed for T_{HIGH}/T_{LOW} when in Dynamic mode
  - values being programmed for Curr-H/Curr-L when in Dynamic mode
  - values being programmed for RISE/FALL slew rates when in Dynamic mode

- In LIMIT (key **15**) ON mode:

  - displays oVP (over voltage), oCP (over current), oPP (over power), or oTP (over temperature) when in protection mode
  - displays GO/NG low limit values for voltage, current, and power
  - displays Auto or On setting for V_{SENSE} control
  - displays either Ld-on or Ld-off to indicate whether Load voltage setting mode is On or Off

Associated LEDs indicate the displayed value's unit:

- Ω = Value displayed is in Ohms

- V = Value displayed is in Volts

- ms = Value displayed is in milliseconds

- A = Value displayed is in Amps

- mA/μs = Value displayed is in Amps per microsecond (or milliamps per microsecond)

9   PRES Key and ON/OFF LED

- PRES key This key toggles between Preset ON and Preset OFF

- LED indicates the status of the Preset function:

  - ◦ Lit = Preset function is on.
  - ◦ Not lit = Preset function is off.

10 LOAD Key and ON/OFF LED

- LOAD key toggles ON/OFF the DC load input function. (Does not affect the programmed settings).

- LED indicates the status of the Load function:

  - ◦ lit = Load function is ON and ready to sink current from the DC input.
  - ◦ not lit = Load circuit is open function is OFF.

11 DYN / STA Key and LED

- DYN/STA key toggles between Dynamic and Static modes only when in Constant Current mode.

- When the SLD-series Load module is in Constant Resistance mode or Constant Voltage mode, this key is not functional, and the module defaults to Static Mode.

- LED indicates whether the load module is in Dynamic or Static mode:

  - ◦ lit = Dynamic mode is active.
  - ◦ not lit = Static mode is active.

12 DYN STTING Key and ON/OFF LED

This key scrolls through the five waveform parameters so that you can set the Dynamic load level for each: Current High, Current Low, Time High, Time Low, and Slew Rate, displayed as Curr-H, Curr-L, T-Hi, T-Lo, and Sr, respectively.

- LED indicates the status of the Dynamic Setting function:

  - ◦ lit = Dynamic Setting function is ON.
  - ◦ not lit = Dynamic Setting function is OFF.

NOTE: Setting the duration (T-Hi and T-Lo) for one channel (either A or B), simultaneously sets the other channel to the same duration.

13 Navigation Keys

- The left/right arrows select the digit to be modified.

- The increment/decrement arrows increase/decrease the value of the selected (blinking) digit.

14 CONFIG Key and ON/OFF LED

- This key scrolls through the parameters to be configured for either setting values or for enabling/disabling (ON/OFF) functions: Vsense On/Off, NG check On/Off, Load-on voltage, Load-off voltage, Istart, Istop, Istep, voltage threshold, test (OCP or Normal), and parallel On/Off **(Parallel not available for SLD-61 Models due to +/- polarity difference).**

- Use the Navigation keys, **13**, with the Configuration function to make the desired

ON/OFF selections or value changes.

- The LED indicates the status of the Configuration function:

  ◦ lit = Configuration function is ON.
  ◦ not lit = Configuration function is OFF

15 LIMIT Key and ON/OFF LED

Scrolls among the parameters whose limits you can set.

- The Limit key sequentially selects the following parameters to program their settings:

  ◦ upper Voltage limit
  ◦ lower Voltage limit
  ◦ upper Current limit
  ◦ lower Current limit
  ◦ returns to OFF and the loop repeats

- the Navigation keys, **13**, are used with the Limit function to set the desired values.

- The LED indicates whether limits are being programmed or not:

  ◦ lit = Limit function isON.
  ◦ not lit = Limit function is OFF.

16 SHORT Key and ON/OFF LED

- The SHORT key toggles the short circuit of the input terminal On and Off.

- LED indicates the ON/OFF status of the short circuit

  ◦ lit = ON
  ◦ not lit = OFF

17 DUAL V/A Key and ON/OFF LED

This key is used to display the dual voltage or current.

- DUAL V/A scrolls in the following sequence:

  ◦ Voltage for Channel A in upper display (**7**) and for Channel B in lower display (**8**)
  ◦ Current for Channel A in upper display and for Channel B in lower display
  ◦ returns to OFF and the loop repeats

- The LED indicates whether or not the digital meter is displaying dual voltage or current for channels A and B.

  ◦ lit = dual voltage or current is being displayed in the digital meter display
  ◦ not lit = OFF

- Associated LEDs:

  ◦ V = Value displayed is in Volts
  ◦ A = Value displayed is in Amps

18   -/+ DC INPUT Binding Posts

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

- Connect the red, positive (+) Load input connector to the power source's positive output.

- Connect the white, negative (-) load input connector to the power source's negative output.

- Connect the black, ground (com) output for a negative output power supply.

NOTE: Before testing, ensure that the voltage and current do not to exceed the maximum rating of each SLM-series DC load module and the connection method utilized.

Also check the polarity of DC input connection before testing.

19   VSENSE

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

- Connect the red, positive (+) V-sense connector to the power source's positive output.

- Connect the white, negative (-) V-sense connector to the power source's negative output.

- Connect the black, ground (com) V-sense connector to the power source's common output.

NOTE: Use the CONFIG key to set the VSENSE function to ON.

I monitor (double bay unit only; see Figure 2-2)

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

3.1.2   Summary Chart

The front panel controls are summarized in Figure 3-3.
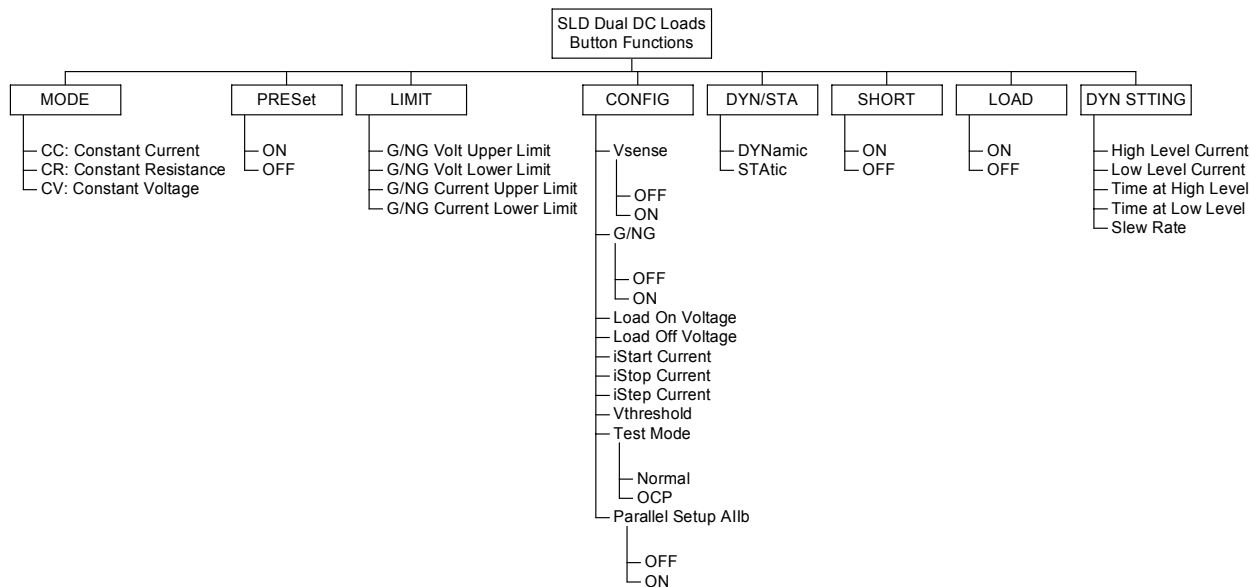
Figure 3-3 Organization of Front Panel Controls of SLD Electronic Load

3.2   Operation – Setup and OCP Test

The SLD-series dual input DC loads can operate in five modes: Constant Current (CC), Constant Voltage (CV), Constant Resistance (CR), Shorts, and Dynamic. Dynamic mode allows controlled current transitions between two states in CC.

The following procedure is outlined in Figure 3-4.   The number within parentheses following a front panel key name, refers to the labels in Figure 3-1 and Figure 3-2

3.2.1   Overview of Front Panel Operation

Select channel A or B (**2**) to input settings. Next, set Limits (**15**) for the go/no go upper and lower limits for voltage and current. Then configure (**14**) the remainder of the system settings for V-sense control, load On voltage, load Off voltage, and OCP test setup.

Once you've set up the initial parameters, use the MODE key (**3**) to select CC, CR, or CV mode and set up the applicable parameters for each. Select either Static mode (**11**) for any of CC, CR, or CV, or Dynamic mode (**11**) for CC only. In Dynamic mode, use the Dynamic Setting key (**12**) to set values for the required T_HIGH, T_LOW, and Slew parameters.

Finally, apply load to the input terminals with the Load key (**10**), which toggles the Load On and Off.

3.2.2   Limits –Pass/Fail, Go/No Go

If pass/fail limits are not desired, skip to the Configuration setup.

Voltage:

1. Press the LIMIT (**15**) key until the LIMIT LED is on and the "V" LED (**5**) is lit. The upper 5-character display (**7**) shows the upper voltage limit; the lower 5-character display (**8**) shows "UH" for Voltage High.

2. Use the ⇦⇨ keys (**13**) to select each place-value to change, then press the ⇧ ⇩ keys (**13**) to set the upper limit.

3. Press the LIMIT key again. The upper 5-character display now shows the lower voltage limit; the lower 5-character display shows "UL" for Voltage Lower.

4. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the lower limit.

Current:

1. Press the LIMIT key until the LIMIT LED is on and the "A" LED (**5**) is lit. The upper 5-character display shows "AH" for Current High; the lower 5-character display shows the upper current limit.

2. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the upper current limit.

3. Press the LIMIT key. The upper 5-character display shows "AL" for Current Lower; the lower 5-character display shows the lower current limit. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the lower limit.

4. To turn the Go/NG limits on, press the CONFIG key until "nG" appears on the upper display.

5. Press any ⇦⇨⇧⇩ setting key to toggle the limits set above inactive/off or active/on.

3.2.3   Configuration

Vsense:

1. Press the CONFIG key (**14**) until SEnSE appears on the display.

2. Press any ⇦⇨⇧⇩ setting key to toggle external Vsense off/on.

    a) If set to ON, the 5-character voltmeter displays the voltage of V-sense BNC input.

    b) If set to OFF, the voltmeter displays measurement of the voltage at the input terminals.

LOAD ON/OFF Voltage:

These settings automatically set the load current to zero if the input voltage falls below the LOAD OFF voltage or will keep the load current at zero until the voltage rises above the LOAD ON voltage.

1. Press the CONFIG key until "Ld-on" appears on the display.

2. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the load ON voltage. **The LOAD ON voltage must be higher than the LOAD OFF voltage. The load will not allow the LOAD OFF voltage to be set lower than the LOAD OFF setting.**

3. Press the CONFIG key until "LdoFF" appears on the display.

4. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the LOAD OFF voltage. **The LOAD OFF voltage must be lower than the LOAD ON voltage. The load will not allow the LOAD OFF voltage to be set higher than the LOAD ON voltage setting.**

Over Current Test (OCP Test):

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

1. Press the CONFIG key to step through the settings for each of the four setup parameters.

2. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set the value.

3.2.4   Test Mode

Test modes are normal and OCP. All modes except OCP are "normal" mode (CC, CV, CR, Dynamic, and Static).

1. Press the CONFIG key until tESt appears on the display.

2. Use the ⇧⇩ arrows to set normal or OCP modes.

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

    b) To run an OCP test, recall the memory location where the test was saved.

    c) To return to normal mode, press the CONFIG key until tESt appears on the display. Use the ⇩ key until "nor" appears on the display.

3.2.5   Parallel (SLD-60-xxx-xxx and SLD-62-xxx-xxx models only.)

1. Press the CONFIG key until "AllB" appears on the display.

2. Press any ⇦⇨⇧⇩ setting key to toggle the parallel setting.

When set to "ON", the current display for either channel A or channel B will show the total current for both channels.

The level settings for each channel are set independently.
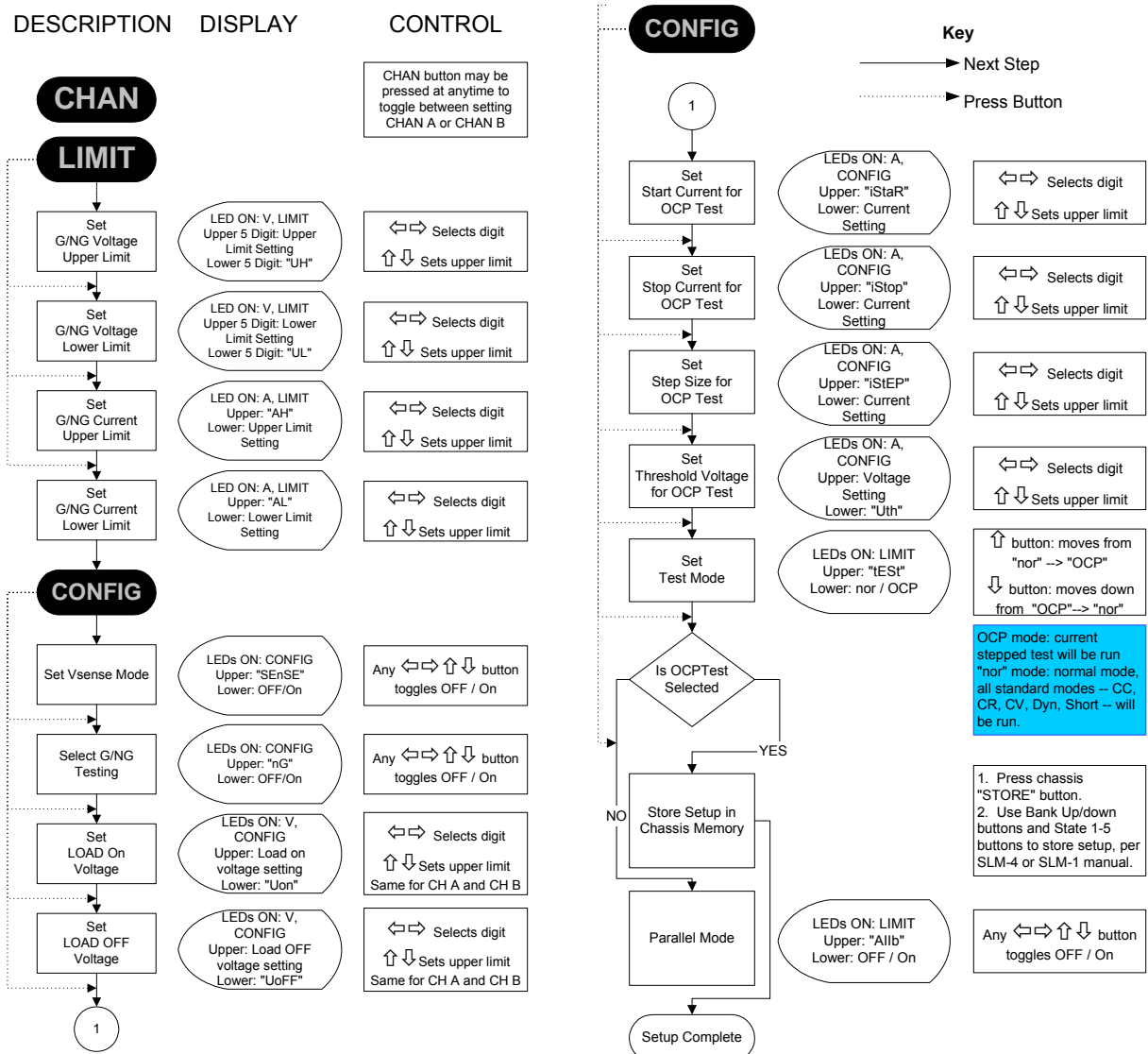
Figure 3-4 Setup of SLD Series Electronic Load

3.3 Normal Operating Modes

After setting parameters with the LIMIT and CONFIG keys, Static mode is available for CR and CV mode, while both Static and Dynamic modes are available for CC mode. In Dynamic mode, settings for the T$_{HIGH}$, T$_{LOW}$ and slew parameters are also required, using the DYN STTING key (**12**). The LOAD key (**10**) toggles on/off for the load to apply load the input terminals. Use the CHAN key (**2**) to select a channel prior to setting load values in the different modes.

3.3.1 CC Mode

CC mode can be either static (fixed DC level) or dynamic (two levels with timing and slew rates programmed). Dynamic mode is described in Section 3.3.4. In static mode, two levels can be set to allow for quick switching between two current levels.

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

2. Press the PRES key (**9**) to view the programmed values.

3. Set the current level with the ⇦⇨ (**13**) keys to select each place-value to change, and then press the ⇧ ⇩ keys (**13**) to set the desired current level.

4. Exit the preset mode by pressing the PRES key until its LED is not lit.

5. Press the LOAD key (**10**) to toggle the load off or on.

- Change the current at any time using the ⇧ ⇩ keys.

- View the values set by pressing the PRES key.

3.3.2 CR Mode

CR mode static (fixed DC level) mode is set similar to CC mode. However, the ⇧ key (**13**) **decreases** the resistance setting and the ⇩ key (**13**) **increases** the resistance setting.

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

2. Press the PRES key (**9**) to view the programmed values.

3. To set the resistance level, use the ⇦⇨ keys (**13**) to select each place-value to change, then press the ⇧ ⇩ keys (**13**) to set to the desired resistance level.

4. To exit the preset mode, press the PRES key until its LED is not lit.

5. Press the LOAD key (**10**) to toggle the load off or on.

- Change the current at any time using the ⇧ ⇩ keys.

- View the values set by pressing the PRES key.

3.3.3   CV Mode

CV mode operates in Static mode only.

1. Press the MODE key (**3**) until the CV LED (**3**) is lit.

2. Press the PRES key (**9**) to view the programmed values.

3.   To set the voltage level, use the ⇦⇨ keys (**13**) to select each place-value to change, then press the ⇧ ⇩ keys (**13**) to set to the desired voltage level.

4.   To exit the preset mode, press the PRES key until its LED is not lit.

5.   Press the LOAD key to toggle the load off or on.

- Change the voltage at any time using the ⇧ ⇩ keys.

- View the value set by pressing the PRES key.

3.3.4   Dynamic Mode

Dynamic mode allows fast state switching in either current or power mode. The dwell time and current slew rate are controlled in addition to the high and low values.
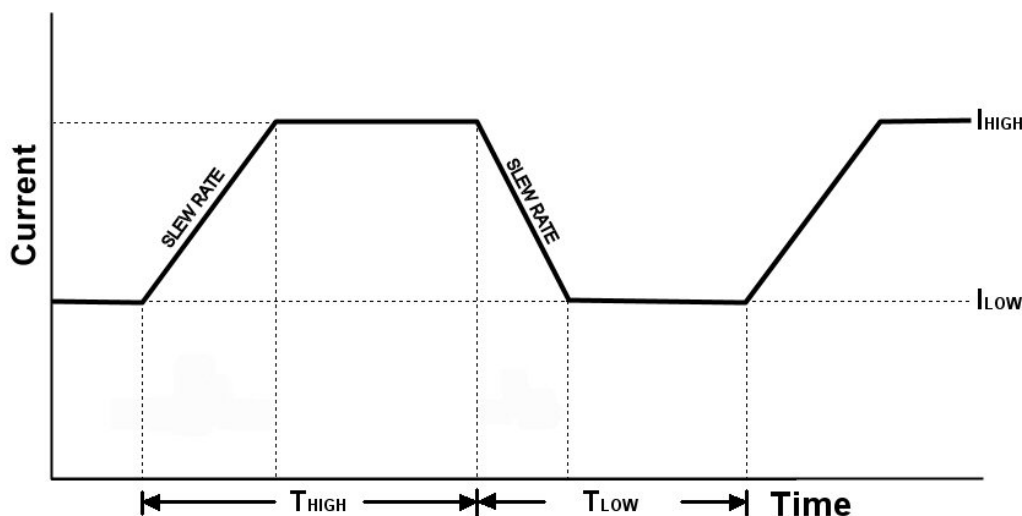
1. Press the MODE key (**3**), until the CC LED (**3**) is lit.

2. Set high and low values

    a. Press the DYN STTING key (**12**) until its LED is lit to view the programmed values. The high level must be higher than the low level; in setting the values below, the load will not allow the HIGH level to be lower than the LOW level.

    b. To set the high level, press the DYN STTING key until "CurrH" appears on the upper display. The lower display shows its value.

    c. Use the ⇦⇨ keys (**13**) to select each place-value to change, and press the ⇧ ⇩ (**13**) keys to set to the desired high current level.

d. To set the low level, press the DYN STTING until "CurrL" appears on the upper display. The lower display shows its value.

e. Use the ⇦⇨ keys to select each place-value to change, and press the ⇧ ⇩ keys to set to the desired low current level.

3. Set the dwell time

a. Press the DYN STTING key until "t-Hi" appears on the upper display. The lower display shows its value.

b. Use the ⇦⇨ keys to select each place-value to change, then press the ⇧ ⇩ keys to set to the desired time (ms) at the high current level.

c. Press the DYN STTING key until "t-Lo" appears on the upper display. The lower display shows its value.

d. Use the ⇦⇨ keys to select each place-value to change, and press the ⇧ ⇩ keys to set to the desired time (ms) at the low current level.

4. Set the current SLEW rate

a. Press the DYN STTING key until "Sr" appears on the upper display. The lower display shows its value.

b. Use the ⇦⇨ keys to select each place-value to change, and press the ⇧ ⇩ keys to set to the desired slew rate mA/μs. The slew rate is common for rise and fall.

5. Operating in Dynamic Mode

a. Press the MODE key (**3**), until the CC LED (**3**) is lit.

b. Press the DYN/STA key (**11**) until its LED is lit.

c. Press the LOAD key (**10**) to toggle the load on and off.

3.3.5   Shorts Mode

Shorts mode puts the load in minimum resistance/maximum current state. When the LOAD key (**10**) is toggled to ON while in Shorts mode, the load simulates a short by sinking maximum rated current at minimum resistance.

1. To activate Shorts mode, press the SHORT key (**16**) until its LED turns on. This overrides any selection made with the MODE key.

2. To exit Shorts mode, press the SHORT key until its LED turns off.
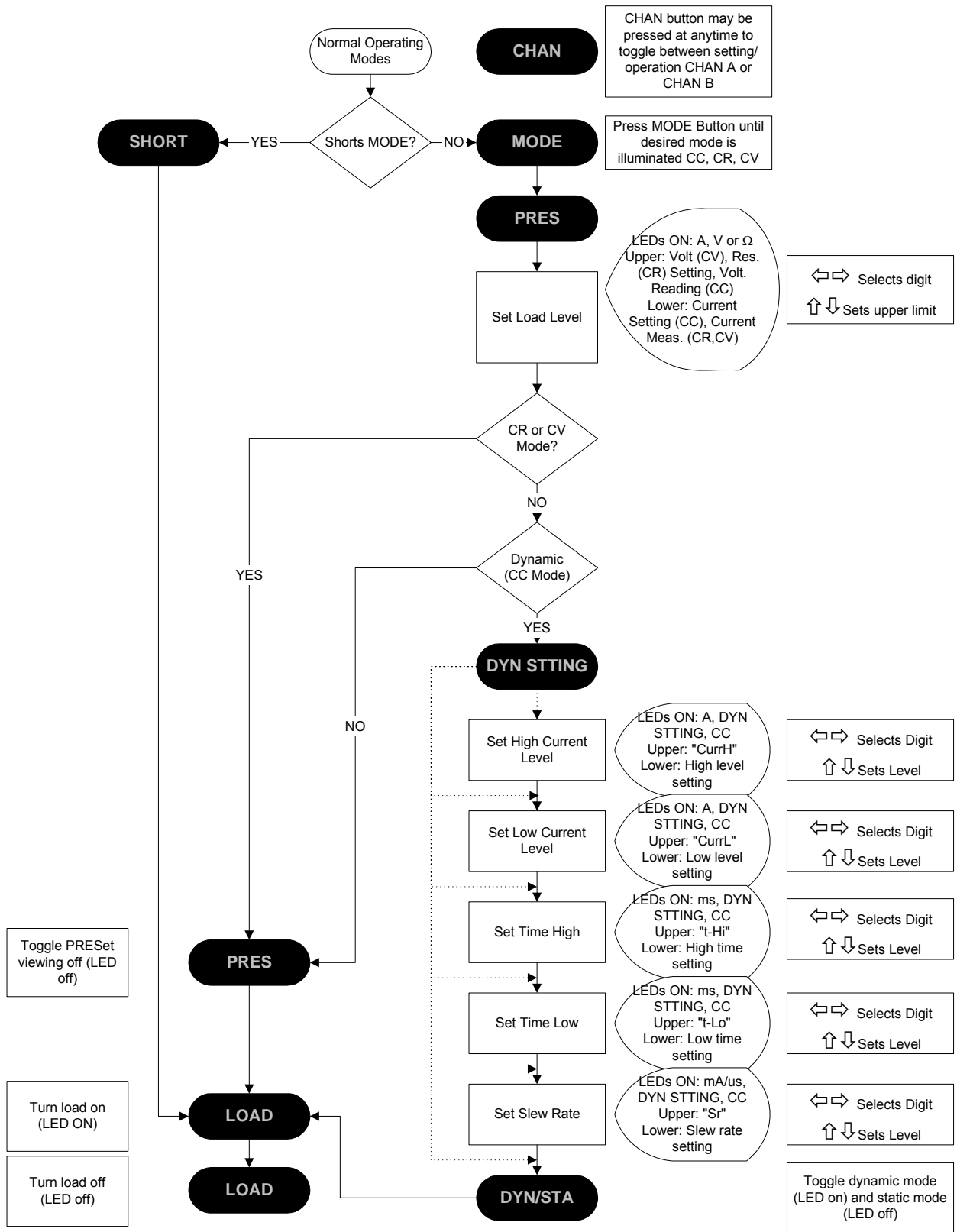
Figure 3-5 SLD-series Operation Flow Chart

3.4 Initial Settings

Tables 3-1 to 3-2 list the initial settings after power ON for SLD-series Dual DC Electronic Loads.

	SLD-60-505-255		SLD-61-505-255		SLD-60-20-102	SLD-80-20-102
	CHAN A	CHAN B	CHAN A	CHAN B	CHAN A/B	CHAN A/B
CC	0.000A	0.0000 A	0.000A	0.0000 A	0.0000 A	0.0000 A
CR	4500 Ω	45000 Ω	4500 Ω	45000 Ω	15000 Ω	11250 Ω
CV	60.00 V	60.00 V	60.00 V	-60.00 V	60.00 V	80.00 V
AH	60.00 A	6.000 A	60.00 A	6.000 A	20.00 A	20.00 A
AL	0.000 A	0.0000 A	0.000 A	0.0000 A	0.0000 A	0.0000 A
VH	60.00V	60.00V	60.00V	-60.00V	60.00V	80.00V
VL	0.000V	0.000V	0.000V	0.000V	0.000V	0.000V
T HI	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms
T LOW	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms
LOAD ON	1.0V	1.0V	1.0V	1.0V	1.0V	1.0V
LOAD OFF	0.5V	0.5V	0.5V	0.5V	0.5V	0.5V
Test Mode	Normal	Normal	Normal	Normal	Normal	Normal
SLEW Rate	100.0mA/uS	10.0mA/uS	100.0mA/uS	10.0mA/uS	10.0mA/uS	10.0mA/uS

Table 3-1 200W and 300W SLD Series Modules Factory and Power On Settings

	SLD-61-5-752		SLD-62-5-752	SLD-60-105-550	
	CHAN A	CHAN B	CHAN A/B	CHAN A	CHAN B
CC	0.0000 A	0.0000 A	0.0000 A	0.000A	0.0000 A
CR.	45000 Ω	45000 Ω	45000 Ω	2250 Ω	45000 Ω
CV	60.00 V	60.00 V	60.00 V	60.00 V	60.00 V
AH	60.00 A	6.000 A	6.000 A	120.00 A	6.000 A
AL	0.000 A	0.000 A	0.0000 A	0.000 A	0.0000 A
VH	60.00V	60.00V	60.00V	60.00V	60.00V
VL	0.000V	0.000V	0.000V	0.000V	0.000V
T HI	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms
T LOW	0.500ms	0.500ms	0.500ms	0.500ms	0.500ms
LOAD ON	1.0V	1.0V	1.0V	1.0V	1.0V
LOAD OFF	0.5V	0.5V	0.5V	0.5V	0.5V
Test Mode	Normal	Normal	Normal	Normal	Normal
SLEW Rate	10.0mA/uS	10.0mA/uS	10.0mA/uS	200.0mA/uS	10.0mA/uS

Table 3-2 150W and 550W SLD Series Modules Factory and Power On Settings

3.5 Protection Features

The SLD-series Electronic Load modules have four protection states to prevent unit damage due to abnormal operating conditions: Over voltage, Over current, Over power and Over temperature. Reset the protection by removing the triggering condition first, and then press the "LOAD" key to "ON" state. The following subsections describe the protection features.

3.5.1   Over Voltage Protection (OVP)

The Over voltage protection circuit is set at a predetermined voltage 63V for all SLD-series modules. If the Over Voltage condition is triggered, the electronic load input turns OFF internally.

When the Over Voltage condition is triggered, the upper 5-character display indicates "Prot", and the lower 5-character display indicates "oVP".

.

CAUTION:
Never apply the AC line voltage or input voltage in excess of 60V, or it may cause damage to the Electronic load. **The OVP circuit does not protect against severe over voltage conditions. Voltages above 100V will permanently damage the electronic load. This damage will require factory repair.**

3.5.2   Over Current Protection (OCP)

The SLD-series Electronic load monitors the Load current, and when the load current is higher than 102% of rate current input, the load module will go to Load OFF state.

When the Over Current condition is triggered, the upper 5-character display indicates "Prot" and the lower 5-character display indicates "oCP".

3.5.3   Over Power Protection (OPP)

The SLD-series Electronic load can monitor the power dissipation of the load module, when the power dissipation is greater than 102% of rate power input, the load module turns the Load to OFF state internally.

When the Over Power condition is triggered, the upper 5-character display indicates "Prot" and the lower 5-character display indicates "oPP".

3.5.4   Over Temperature Protection (OTP)

The SLD-series electronic Loads are designed with temperature sensors. If the temperature of the module's heat sink rises to greater than 90°C, the Over Temperature protection is triggered, at which point the upper 5-character display indicates "Prot," the lower 5-character display indicates "otP," and the SLD-series Electronic Load turns the Load to OFF state internally until the heat sink temperature drops to 70°C or below.

To remove the condition that triggered the OTP, check the environmental requirements per Section 1.2.3, and ensure that the distance between the rear panel of Electronic load mainframe and wall is greater than 15cm.

3.5.5   Reverse Polarity

The SLD-series Electronic load conducts reverse current when the polarity of the DC source connection is incorrect. Please refer to the specifications in Section for the maximum reverse current.

> *CAUTION:*
> *If the reverse current exceeds the maximum reverse current, it may cause permanent damage to the SLD-series Electronic Load.*

When Reverse Polarity is triggered, the upper 5-character display indicates "Prot," and the lower 5-character display indicates "-V", a negative current reading.

Whenever a reverse current reading is displayed, turn OFF the DC power source immediately and make the correct connections.

SECTION 4
APPLICATIONS

This chapter describes the application information of SLM-series DC electronic load module.

4.1 Local Sense Connections

Figure 4-1 illustrates a typical set up with the electronic load connected to the DC power supply.

Local sensing is used in applications where lead lengths are relatively short, or where load regulation is not critical. The 5-character voltage meter of SLM-series DC electronic load measures the voltage of DC INPUT Terminal automatically; load leads should be bundled or tie-wrapped together to minimize inductance.
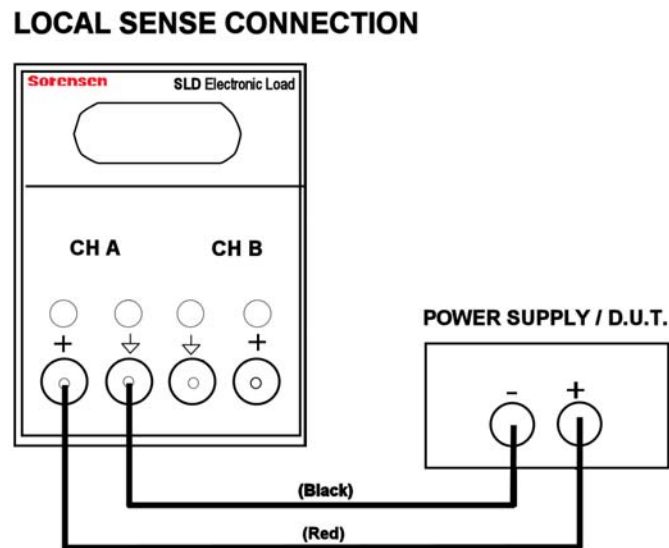
Figure 4-1 Local Voltage Sense Connections

4.2 Remote Sense Connections

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

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

Load leads should be bundled or tie wrapped together to minimize inductance.
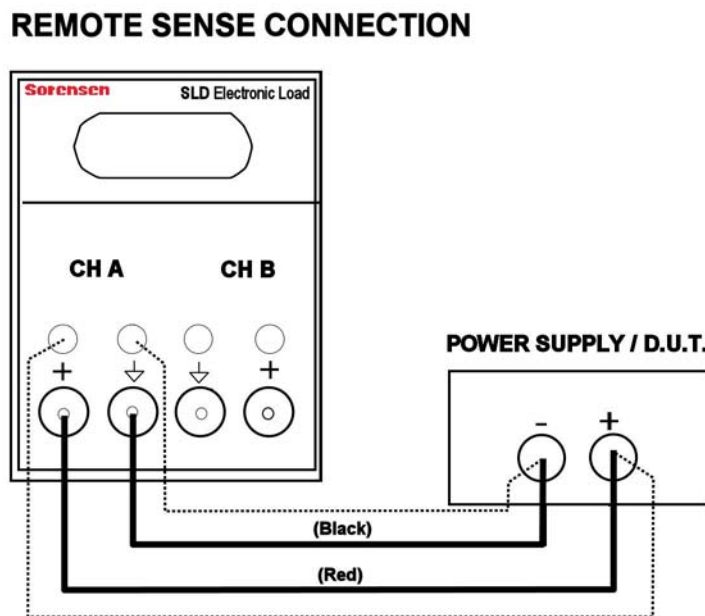
Figure 4-2 Remote Voltage Sense Connections

4.3 Constant Current (CC) Mode Application

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

4.3.1 Static Mode:

Major application (see Figure 4-3):

- Voltage source testing.
- Power supply load regulation testing
- Battery discharge testing
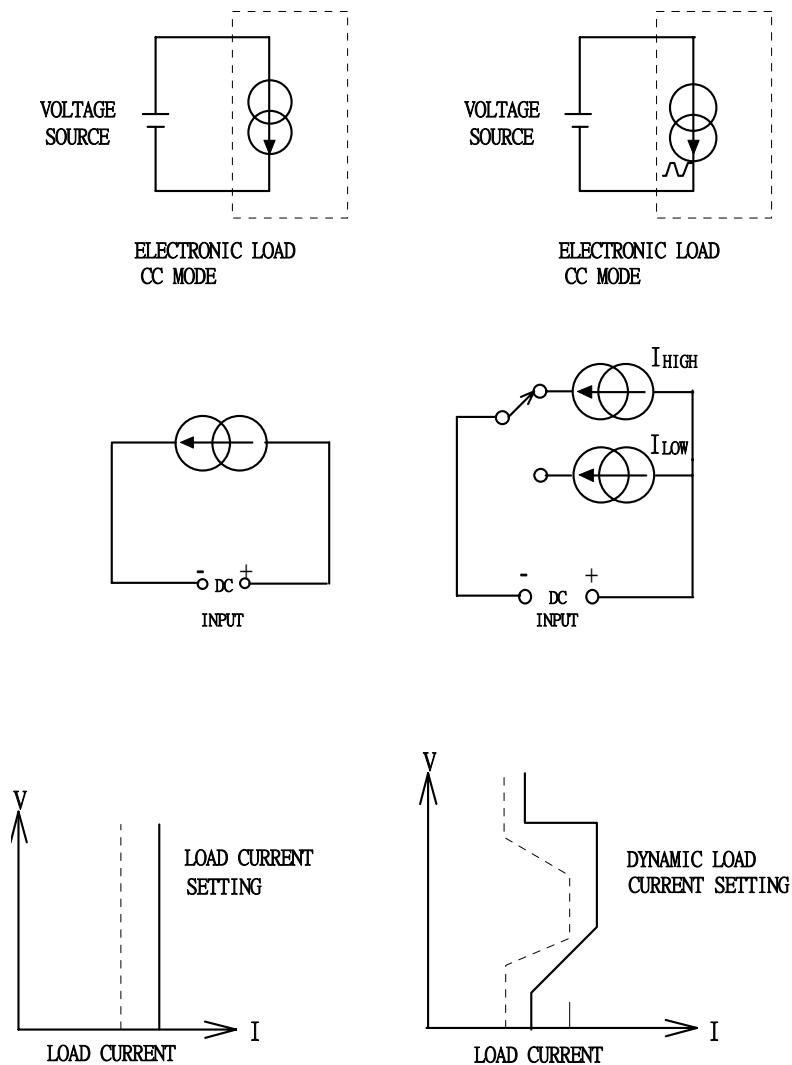
Figure 4-3 Constant Current Mode Application

4.3.2   Dynamic Mode:

Built-in Pulse Generator: (Fig 4-4)
Major application:

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

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

- Rise slew rate = | Ilow - Ihigh | / Ta (A/us)
- Fall slew rate = (Ihigh - Ilow) / Tb (A/us)
- Rise time = Ta = | Ilow - Ihigh | / Rise slew rate
- Fall time = Tb = (Ihigh - Ilow) / Fall slew rate

Major application:

Simulate real load condition, Battery discharge testing
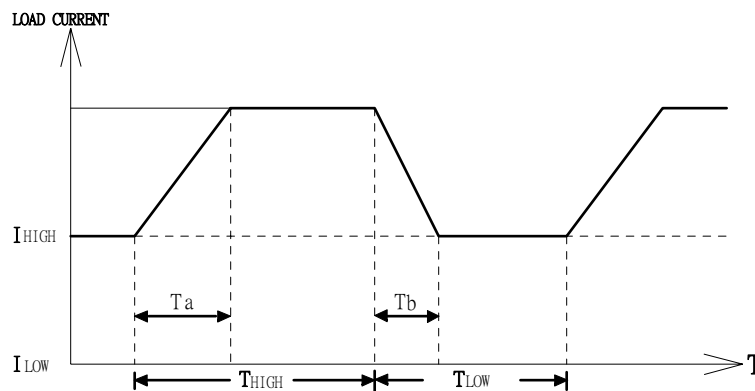
Figure 4-4 Dynamic Load Current with Independent Programmed Rise/Fall Slew Rate

4.4 Constant Voltage (CV) Mode Application

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

Current Source Testing

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

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

Current Limit Testing

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

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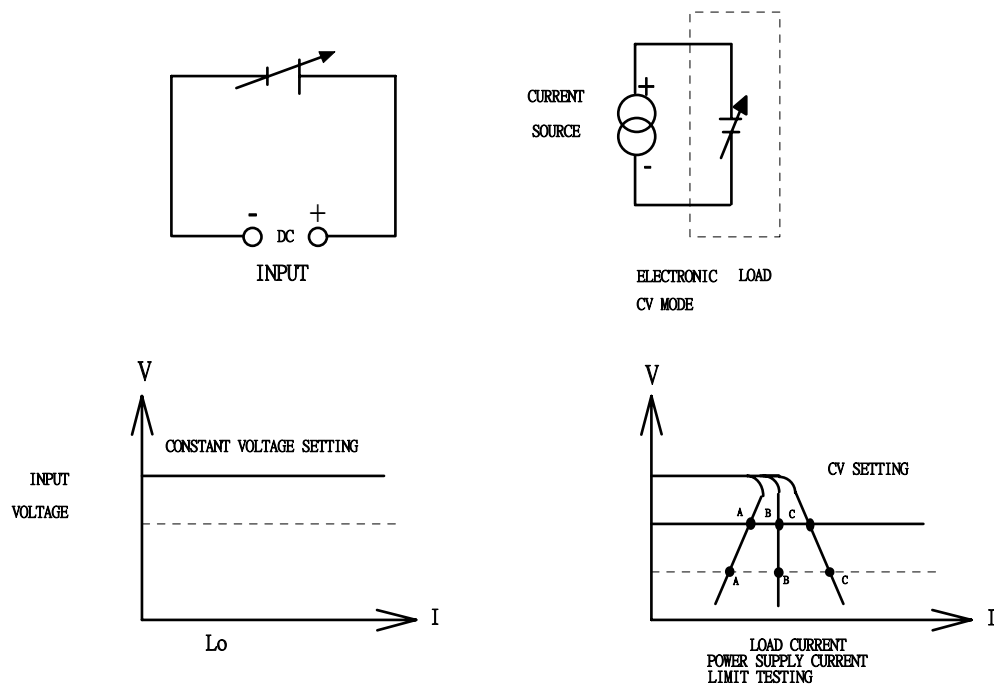
Figure 4-5 Constant Voltage Mode Application

4.5 Constant Resistance (CR) Mode Application

Major application: voltage source testing, current source testing, power supply power-up sequence

CR mode is used in conjunction with CC mode for testing switching power supplies.

Caution must be exercised when using the CC mode in test set up; for example, A 5V/50A output power supply cannot deliver 50A over its start-up range of 0-5 volts. In many cases the power supply short circuit or over current protection circuit will shut the power supply down. This is due to the power supply trying to deliver 50A at 2V because the load tester is in the CC mode. The power supply is designed not to do this.

Therefore, when testing a power supply, the CR mode should be used to allow the power supply voltage and current to ramp up together. After ramp-up the CC mode should be used to complete testing. The need for manually switching from the CR to the CC mode is eliminated with SLD-series DC electronic loads. They can be programmed with proper current and slew rate in the CC mode, which allows a power supply to reach its specified output condition in the CC load mode.
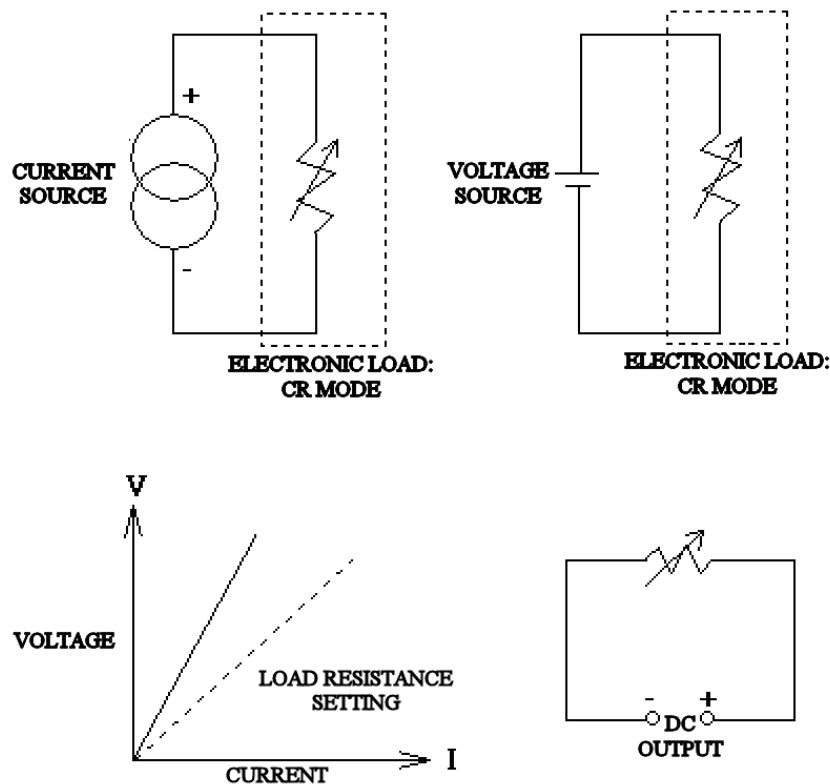
Figure 4-6 Constant Resistance Mode Application

4.6 Connection for a Multiple Output Power Supply

RULE for a multiple output power supply connection to the SLM-series DC electronic Loads:

The potential of positive input (Red binding post) must be greater than the potential of ground input (Black binding post), and the potential of ground input must be greater than the potential of negative input (White binding post).

Connect the **positive** (+) V-sense connector (RED) to the power source's **positive** output.
Connect the **negative** (-) V-sense connector (WHITE) to the power source's **negative** output.
Connect the **ground** (com) V-sense connector (BLACK) to the power source's **common** output.

Figure 4-7 is an example of +5V, -5V, +12V, -12V, +3.3V, +5V-sb, +40V and +24V Hex outputs power supply connected to four SLD-series dual electronic load modules.
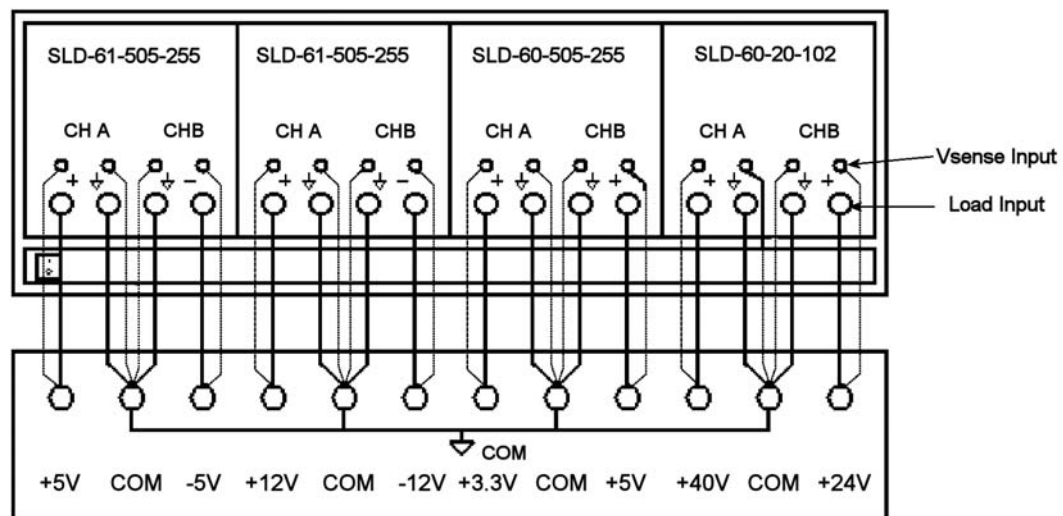
Figure 4-7 Example Connection, Six-output Power Supply to Four SLD-series Modules in an SLM-4 Chassis

4.7 Parallel Operation

When there is insufficient power or current rating on the electronic load module, two or more electronic load modules can be paralleled to operate as one unit. A parallel connection can extend the electronic load module to a higher power and current rating. In such a case, the total load current and power is equal to the sum of the two (or more) load modules.

CAUTION:
Only channels with identical voltage polarity rating should be parallel connected.
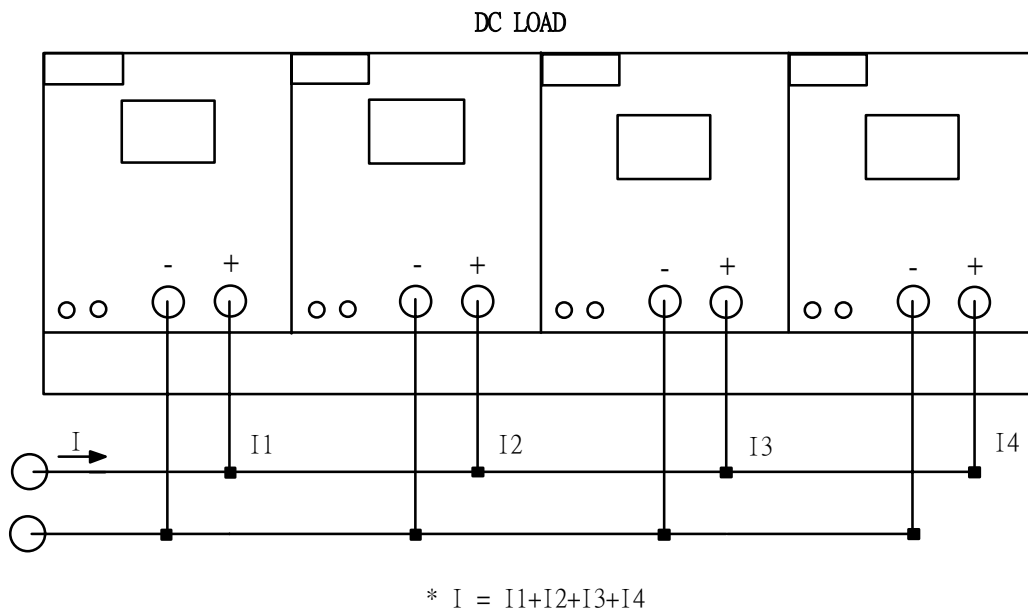
Figure 4-8 SLD-Series DC Plug-in Load Module Parallel Operation

SECTION 5
REMOTE PROGRAMMING

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

5.1 RS-232 Interface and Commands

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

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

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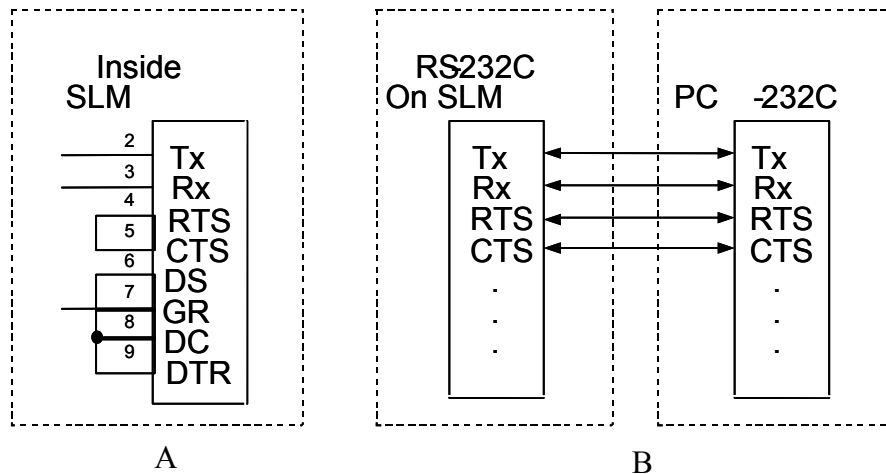
Figure 5-1 RS-232 Interface Diagram

5.2 GPIB/RS-232C Command List

5.2.1   Command Syntax Abbreviations

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

Example: 30.12345, 5.0

Description of GPIB Programming Command Syntax.

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

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

Table 5-1 GPIB Command Terminator

A terminator informs GPIB that it has reached the end of statement. Normally,
this is sent automatically by your GPIB programming statements. In this
manual, the terminator is assumed at the end of each example line of code. If it
needs to be indicated, it is shown by symbol (nl); which stand for "new line"
and represents ASCII code byte the 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 5-2 presents a summary of the GPIB/RS-232 Setting commands, and Table 5-3 summarizes
the GPIB/RS-232 preset Query commands with applicable module types. Table 5-4 is a summary of
State commands, the System commands are in Table 5-5, Measure and Limit commands are in Table
5-6, and the Global commands are in Table 5-7.

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

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

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

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

STATE Command	RETURN
[STATe:] LOAD{SP}{ON|OFF}{;|NL}	
[STATe:] LOAD{?}{;|NL}	0=OFF, 1=ON
[STATe:] MODE{SP}{CC|CR|CV|CP}{;|NL}	
[STATe:] MODE{?}{;|NL}	0=CC, 1=CR 2=CV, 3=CP
[STATe:] SHORt{SP}{ON|OFF}{;|NL}	
[STATe:] SHORt{?}{;|NL}	0=OFF, 1=ON
[STATe:] PRESet{SP}{ON|OFF}{;|NL}	
[STATe:] PRESe{?}{;|NL}	0=OFF, 1=ON
[STATe:] SENSe{SP}{ON|OFF}{;|NL}	
[STATe:] SENSe{?}{;|NL}	0=OFF, 1=ON
[STATe:] LEVEl{SP}{HIG|LOW|AIB}{;|NL}	
[STATe:] LEVEl{?}{;|NL}	0=LOW, 1=HIGH
[STATe:] RANGe?{;|NL}	1=AUTO, 2=FIXED RANGE II
[STATe:] DYNamic{SP}{ON|OFF}{;|NL}	
[STATe:] DYNamic{?}{;|NL}	0=OFF, 1=ON
[STATe:] WATT{SP}{ON|OFF}{;|NL}	
[STATe:] WATT{?}{;|NL}	0=OFF, 1=ON
[STATe:] CLEar{;|NL}	
[STATe:] ERRor{?}{;|NL}	Ddddddddd
[STATe:] NG{?}{;|NL}	0=OK, 1=NG
[STATe:] PROTect{?}{;|NL}	Ddddddddd

Table 5-4 State Command Summary

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

Table 5-5 System Commands - All Modules

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

Table 5-6 Measure and Limit Commands

COMMAND	SLD DC	RETURN
GLOBal:[STATe:] PRESet{SP}{ON|OFF}{;|NL}	•	
GLOBal:[STATe:] LOAD{SP}{ON|OFF}{;|NL}	•	
GLOBal:[STATe:] MODE{SP}{ON|OFF}{;|NL}	•	
GLOBal:[STATe:] SHORt{SP}{ON|OFF}{;|NL}	•	
GLOBal:[STATe:] DYNamic{SP}{ON|OFF}{;|NL}	•	
GLOBal:[STATe:] LEVEL{SP}{HIGH|LOW}{;|NL}	•	
GLOBal:[STATe:] cc{SP}R2{;|NL}	•	
GLOBal:MEASure:CURRent{?}{;|NL}	•	###.##
GLOBal:MEASure:VOLtage{?}{;|NL}	•	###.##

Table 5-7 Global Commands

REMARKS:

1. d : 0 - 9
2. GLOB : GLOBAL (ALL CHANNELS ACTIVE AT SAME TIME)
3. CURRENT ENGINEERING UNIT : A
4. VOLTAGE ENGINEERING UNIT : V
5. RESISTANCE ENGINEERING UNIT : 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.

5.3 GPIB/RS-232 Command Description

5.3.1   Setting Commands

CURRENT Level

Purpose:

The load current setting in Constant Current mode.

Command Syntax:

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

Description:

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

Note:

     a. The load current data must include the decimal point; otherwise, this command will not execute. The load current level can be programmed up to the sixth place after the decimal point.

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

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

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

     d. Engineering unit for load current is Amps.

     e. Please refer to Appendices proper programming procedure of SLH-series electronic load.

Example:

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

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

RESISTANCE Level

Purpose:

The load resistance setting in Constant Resistance mode.

Command Syntax:

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

Description:

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

Note:

     a. The load resistance data must include the decimal point; otherwise, this command will not execute. The load resistance level can be programmed up to the sixth place after the decimal point.

b. The HIGH level load resistance MUST be higher than the LOW level load resistance (and vice versa) for proper dynamic waveform definition; if not, the SLH-series Electronic Load will adjust and limit the programmed values to be equal. The adjustment matches the second input value to the first input value.
This means that if the value for the LOW level is input first, and then the HIGH level value is input as less than the programmed LOW level, the SLH-series load module will adjust the HIGH level to be equal to the LOW level. If the value for the HIGH level is input first and the LOW level value is input as higher than the programmed HIGH level, the SLH-series load module will adjust the LOW level to be equal to the HIGH level.

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

d. Engineering unit for load resistance is Ohms.

e. Please refer to the Appendix for the programming flow chart for the SLH-series electronic load.

Example:

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

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

VOLTAGE Level

Purpose:
The load voltage setting in Constant Voltage mode.

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

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

Notes:

a. The load voltage data must include the decimal point; otherwise, this command will not execute. The load voltage level can be programmed up to the sixth place after the decimal point.

b. The HIGH level load voltage MUST be higher than the LOW level load voltage (and vice versa) for proper dynamic waveform definition; if not, the SLH-series Electronic Load will adjust and limit the programmed values to be equal. The adjustment matches the second input value to the first input value.
This means that if the value for the LOW level is input first, and then the HIGH level value is input as less than the programmed LOW level, the SLH-series load module will adjust the HIGH level to be equal to the LOW level. If the value for the HIGH level is input first and the LOW level value is input as higher than the programmed HIGH level, the SLH-series load module will adjust the LOW level to be equal to the HIGH level.

c. If the programmed load voltage level is over the maximum rated specification, the full scale voltage will be sent to the load module.

d. Engineering unit for load current is Volts.

e. Please refer to Appendix for proper programming procedure of SLH-series electronic load modules.

Example:

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

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

POWER Level

Purpose:

The load power setting in Constant Power mode.

Command Syntax:

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

Description:

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

LOAD ON/OFF

Purpose:

Turn the Electronic load module input ON or OFF.

Command Syntax:

LOAD{SP}{0FF|ON}{NL}

Description:

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

For Example :

LOAD OFF ; load are at input OFF condition.

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

LOAD ON VOLTAGE Setting

Purpose:

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

Command Syntax:

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

Description:

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

For Example:

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

LOAD OFF VOLTAGE Setting

Purpose:

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

Command Syntax:

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

Description:

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

For Example :

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

LEVEL HIGH/LOW

Purpose:

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

Command Syntax:

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

Description:

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

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

PRESET ON/OFF

Purpose:

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

Command Syntax:

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

Description:

PRES ON is set the load to preset on status.

MODE

Purpose:

Select the operating mode of Electronic load module.

Command Syntax:

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

Description:

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

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

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

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

CLEAR status register

Purpose:

CLEar the PROT and ERR status byte registers.

Command Syntax:

All Modules: CLER{NL}

Description:

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

STORE

Purpose:

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

Command Syntax:

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

Description:

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

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

Example:

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

RECALL

Purpose:

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

Command Syntax:

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

Description:

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

Example:

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

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

VOLTAGE Limit

Purpose:

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

Command Syntax:

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

Description:

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

Example:

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

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

CURRENT Limit

Purpose:

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

Command Syntax:

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

Description:

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

Example:

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

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

POWER Limit

Purpose:

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

Command Syntax:

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

Description:

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

Example:

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

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

PERIOD

Purpose:

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

Command Syntax:

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

Description:

The PERiod of dynamic waveform is composed by Tlow and Thigh. The PERIOD LOW and HIGH data must include decimal point, otherwise this command will not execute.
The value for PERIOD LOW and HIGH can be programmed up to the sixth place after the decimal point. If the period of Tlow and Thigh setting is over the maximum specification at programmed range of load module, the maximum duration of Tlow and Thigh will be sent to the load module.

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

Note:

1. There are four timer ranges in the Tlow / T high generator to produce a wide period dynamic range, these ranges are adjusted by the load module automatically which depends on the programmed Tlow / Thigh range.

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:

RISE{SP}{NR2}{NL}

Description:

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

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

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

Example:

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

FALL Time

Purpose:

FALL load current slew rate setting.

Command Syntax:

FALL{SP}{NR2}{NL}

Description:

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

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

SHORT ON/OFF

Purpose:

Short the DC input of Electronic load module.

Command Syntax:

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

Description:

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

Example:

SHOR ON ; set load input to short state.

SHOR OFF ; set load input short open state.

SENSE ON/OFF

Purpose:

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

Command Syntax:

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

Description:

Set the Vsense inputs Off or On. If Vsense is set to Off, voltage measurement is taken at the load input terminals. On SLH-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).

Example:

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

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

DYNAMIC ON/OFF

Purpose:

Set DYNamic ON or OFF command.

Command Syntax:

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

Description:

DYN OFF ; set the load to static load mode.

DYN 1 ; set load to dynamic load mode.

5.3.2   Query Commands

CURRENT Level

Purpose:

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

Command Syntax:

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

Description:

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

RESISTANCE Level

Purpose:

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

Command Syntax:

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

Description:

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

The engineering unit is "OHM".

VOLTAGE Level

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

Command Syntax:

CV:{LOW|HIGH}?{NL}

Description:

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

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

The engineering unit is "V".

POWER Level

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

Command Syntax:

CP:{LOW|HIGH}?{NL}

Description:

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

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

The engineering unit is "W".

LOAD ON/OFF

Purpose:

LOAD ON or LOAD OFF status query command.

Command Syntax:

LOAD?{NL}

Description:

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

LOAD ON Voltage

Purpose:

LOAD ON voltage level query command.

Command Syntax:

LDON?{;|NL}

Description:

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

LOAD OFF Voltage

Purpose:

LOAD OFF voltage level query command.

Command Syntax:

LDOF?{;|NL}

Description:

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

LEVEL HIGH/LOW

Purpose:

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

Command Syntax:

LEVE?{NL}

Description:

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

PRESET ON/OFF

Purpose:

PRESet ON or OFF status query command.

Command Syntax:

PRES?{NL}

Description:

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

MODE

Purpose:

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

Command Syntax:

MODE?{NL}

Description:

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

NAME

Purpose:

Electronic Load model number query command.

Command Syntax:

All Modules: NAME?{NL}

Description:

NAME? return the electronic load's model number.

PROTECTION Status Register

Purpose:

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

Command Syntax:

All Modules: PROT?{NL}

Description:

PROT? returns the present protection status; the status byte register summarizes all of the protection status events from all status register. the following figure describes the status byte the happened on the SLH-series Electronic load. The PROT status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.
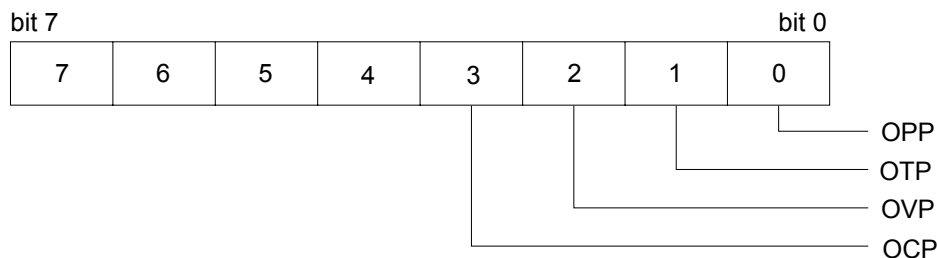
Figure 5-2 Protection Status Register

ERROR Status Register

Purpose:

ERRor status register query command.

Command Syntax:

All Modules: ERR?{;|NL}

Description:

ERR? returns the present error status; the status byte register summarizes all of the error status events from all status registers. the following figure describes the status byte the happened on the SLH-series electronic load. The ERR status byte register is cleared when a CLER command clears all of the PROT and ERR status registers.
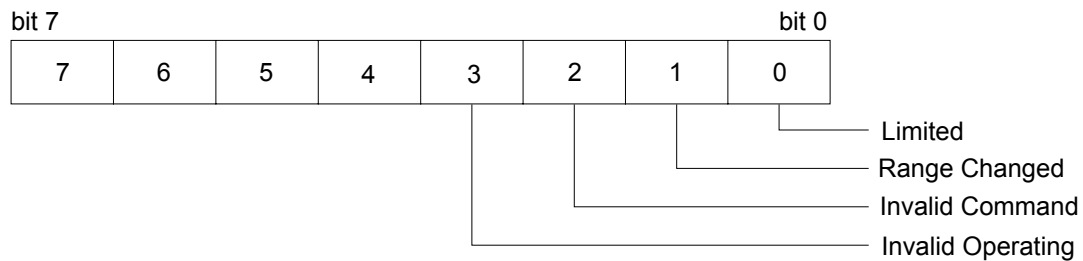
Figure 5-3 Error Status Byte Register

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

Example:
SLH-60-30-150
MODE CC
RANG 1

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

bit 1:Range Changed
This bit set to high by Electronic Module Load setting command causing change range. Reset by CLER command.

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

bit 2 :invalid command
This bit set to high by accepted illegal command.
bit 3 :invalid operating
This bit set to high by accepted invalid operating command.
Example:
SLH-60-120-1200
MODE CR
DYN ON
DYNAMIC function only supports CC MODE.

VOLTAGE METER

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

Command Syntax:

MEAS:VOLT?{NL}

Description:

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

CURRENT METER

Purpose:

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

Command Syntax:

MEAS:CURR?{NL}

Description:

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

POWER METER

Purpose:

To read the value of Watt meter.

Command Syntax:

MEAS:POW?{;|NL}

Description:

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

SENSE ON/OFF

Purpose:

To read the setting condition of Sense ON or OFF.

Command Syntax:

SENS?{;|NL}

Description:

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

WATT Meter ON/OFF

Purpose:

To read the setting condition of WATT.

Command Syntax:

WATT?{;|NL}

Description:

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

VOLTAGE Limit

Purpose:

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

Command Syntax:

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

Description:

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

CURRENT Limit

Purpose:

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

Command Syntax:

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

Description:

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

POWER Limit

Purpose:

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

Command Syntax:

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

Description:

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

NG

Purpose:

To read the set value of NG.

Command Syntax:

NG?{;|NL}

Description:

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

PERIOD

Purpose:

The dynamic mode's Tlow or Thigh duration query command

Command Syntax:

PERI:{LOW|HIGH}?{NL}

Description:

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

RISE Time

Purpose:

The dynamic load mode's RISE slew rate query command

Command Syntax:

RISE?{NL}

Description:

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

FALL Time

Purpose:

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

Command Syntax:

FALL?{NL}

Description:

FALL? returns the presently programmed low load current level in Constant Current mode

The engineering unit is "A/us".

SHORT ON/OFF

Purpose:

SHORt ON or OFF status query command.

Command Syntax:

SHOR?{NL}

Description:

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

DYNAMIC ON/OFF

Purpose:

DYNamic ON or OFF status query command

Command Syntax:

DYN?{NL}

Description:

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

APPENDIX A
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. */

```c
#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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RS-232 PROGRAMMING EXAMPLE

C Language Interface for DOS Handlers " pd_rs232.c "

```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                */
```

```c
#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          */
}
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

```
/* 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 */
    }
}
```

SLD-SERIES GPIB/RS-232 OPERATING FLOW CHART

The following flow chart shows the typical SLM-Series chassis remote control and load current level and status setting procedures of each SLD-series load module.

```
                              ┌─────────┐
                              │  START  │◀──────────────────────────┐
                              └─────────┘                           │
                                                                    │
        ┌─────┐         ┌─────┐         ┌─────┐        ┌─────┐   ┌──────────────┐
     ◇CHANNEL 1?◇ NO ◇CHANNEL 2?◇ NO ◇CHANNEL 3?◇ NO ◇CHANNEL 4?◇ NO │ Module Setups │
        │YES          │YES          │YES          │YES               └──────────────┘
    ┌────────┐     ┌────────┐    ┌────────┐    ┌────────┐          ┌──────────────┐
    │  Set   │     │  Set   │    │  Set   │    │  Set   │          │ Load On/Off  │
    │"CHAN 1"│     │"CHAN 2"│    │"CHAN 3"│    │"CHAN 4"│          │   Voltage    │
    └────────┘     └────────┘    └────────┘    └────────┘          │     Set      │
                                                                    │ "LDONV NR2"  │
                         ◇CHAN A or CHAN B?◇                         │ "LDOFV NR2"  │
                          │              │                          └──────────────┘
                      ┌────────┐     ┌────────┐                     ┌──────────────┐
                      │  Set   │     │  Set   │                     │   Vsense     │
                      │"CHAN A"│     │"CHAN B"│                     │    Set       │
                      └────────┘     └────────┘                     │"SENS ON|OFF" │
                                                                    └──────────────┘
        ◇CC MODE?◇ NO   ◇CR MODE?◇ NO  ◇CV MODE?◇ NO                ┌──────────────┐
          │YES            │YES           │YES                       │ Good/No Good │
      ┌────────┐     ┌────────┐     ┌────────┐                      │    Set       │
      │  Set   │     │  Set   │     │  Set   │                      │"NGAB ON|OFF" │
      │"MODE CC"│    │"MODE CR"│    │"MODE CV"│                     │"LIM:CURR:HIGH NR2"│
      └────────┘     └────────┘     └────────┘                      │"LIM:CURR:LOW NR2" │
                                                                    │"LIM:VOLT:HIGH NR2"│
   DYNAMIC ◇STATIC or DYNAMIC?◇                                     │"LIM:VOLT:LOW NR2" │
              │STATIC                                               └──────────────┘
 ┌──────────────┐  ┌────────┐   ┌────────┐    ┌────────┐
 │     Set      │  │  Set   │   │  Set   │    │  Set   │
 │   "DYN ON"   │  │"DYN OFF"│  │"DYN OFF"│   │"DYN OFF"│
 │ "CC:HIGH NR2"│  │"CC:NR2" │  │"CR:NR2" │   │"CV:NR2" │
 │ "CC:LOW NR2" │  └────────┘   └────────┘    └────────┘
 │"PERI:HIGH NR2"│
 │PERI:LOW NR2" │
 │  "SLEW NR2"  │
 └──────────────┘
                         ◇Is CHB/ CHA Set?◇
                              │
                          ┌────────┐
                          │  Set   │
                          │"LOAD ON"│
                          └────────┘
```