33501 Series
High power
Electronic Load
Operation manual

S/N:90033503 REV:G

PRODIGIT
INSTRUMENT PROFESSIONAL

Material Contents Declaration

(材料含量宣称)

(Part Name) 零件名称	Hazardous Substance (有毒有害物质或元素)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴 联苯 (PBB)	多溴 二苯醚 (PBDE)
PCBA (印刷电路装配件)	X	O	X	0	0	0
Electrical part not on PCBA's 未在PCBA上的电子零件	X	O	X	0	0	0
Metal parts **金属零件**	0	0	0	X	0	0
Plastic parts 塑料零件	0	0	0	0	X	X
Wiring 电线	X	0	0	0	0	0
Package **封装**	X	0	0	0	0	0

对销售之日的所售产品,本表显示, PRODIGIT 供应链的电子信息产品可能包含这些物质。注意:在所售产品中可能会也可能不会含有所有所列的部件。This table shows where these substances may be found in the supply chain of Prodigit electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product. ○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T 11363-2006 标准规定的限量要求以下。○：Indicates that the concentration of the hazardous substance in all homogeneous materials in the parts is below the relevant threshold of the SJ/T 113632006 standard. ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T 11363-2006 标准规定的限量要求。×： Indicates that the concentration of the hazardous substance of at least one of all homogeneous materials in the parts is above the relevant threshold of the SJ/T 11363-2006 standard.

Note(注释):

1.Prodigit has not fully transitioned to lead-free solder assembly at this moment；However, most of the components used are RoHS compliant.
(此刻，Prodigit 并非完全过渡到无铅焊料组装；但是大部份的元器件一至于RoHS的规定。)

2. The product is labeled with an environment-friendly usage period in years.

The marked period is assumed under the operating environment specified in the product specifications.
(产品标注了环境友好的使用期限制(年)。所标注的环境使用期限假定是在此产品定义的使用环境之下。)

Example of a marking for a 10 year period:
(例如此标制环境使用期限为10年)

SAFETY SYMBOLS

 Direct current (DC)

 Alternating current (AC)

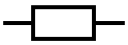
 Both direct and alternating

 Three-phase alternating current

 Protective earth (ground)

 On (Supply)

 Off (Supply)

 Fuse

 **Caution ! Refer to this manual before using the meter.**

 Caution, risk of electric shock

CAT IV – Is for measurements performed at the source of the low-voltage installation.

CAT III – Is for measurements performed in the building installation.

CAT II – Is for measurements performed on circuits directly connected to the low-voltage installation.

CAT I – Is for measurements performed on circuits not directly connected to Mains.

This equipment is not for measurements performed for CAT II, III, and IV.

Approved by:
Vincent Tan
Acts Certification and Testing Services
2008/5/6
Document holder:
Prodigit Electronics Co., Ltd.
Type of product:
DC Electronic Loads
Type designation:
33501, 33511, 33521, 33531, 33541, 33512,33513,33514,33515,33532,33533
Technical data:
115/230 Vac, 50 / 60 Hz, 300 W,
Class I

A sample of the product has been assessed with respect to CE-marking according to the Low Voltage Directive (73/23/EEC & 93/68/EEC) and EMC Directive (89/336/EEC, 92/31/EEC, & 93/68/EEC) and Found to comply with the essential requirements of the Directives.The Standard(s) used for showing the compliance and the full details of the results are given in the Test Reports as detailed below:

Standard(s)	Report No.	Report Issued Date
IEC/EN 61010-1: 2001	ACT201078	December 14, 2005
EN 61326+A1+A2+A3, EN 55011+A1+A2, EN 61000-3-2, EN 61000-3-3+A1, EN 61000-4-2+A1+A2, EN 61000-4-3+A1, EN61000-4-4+A1+A2, EN61000-4-5+A1, EN 61000-4-6+A1, EN 61000-4-8+A1, EN 61000-4-11	E940757	November 23,2005

The holder of the verification is authorized to use this verification in connection with the EC declaration Of conformity according to the Directives. The CE marking may only be used if all releveant and effective EC Directives are complied with. Together with the manufacturer’ s own documented production control,The manufacturer (or his European authorized representative) can in his EC Declaration of Conformity Verify compliance with the directives.

33501 Series High Power Electronic load operation manual
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FIGURES

Tables

Chapter 1 Introduction

1-1. General description

The 33501 Series Electronic Load is designed to test, evaluation and burn-in of DC power supplies and batteries. The 335011 Series electronic load can be operated for manual and GPIB operation. The power contour of 33501 1800 Watts Electronic Load is shown in Fig 1-1.1~1-1.5, it has an input from 0-360A, and 0 -60V current and voltage operating range respectively. The power contour of 33501 series. The prodigit 33501 Series high power electronic Load can be controlled locally at the front panel or remotely via computer over the GPIB/RS-232C. Current (CC) mode, Constant Resistance (CR) mode, and Constant Voltage (CV) mode. and Constant Power (CP) mode. The wide range dynamic load with independent rise and fall current slew rate and analog programming input with arbitrary wave-form input is available in Constant Current mode.

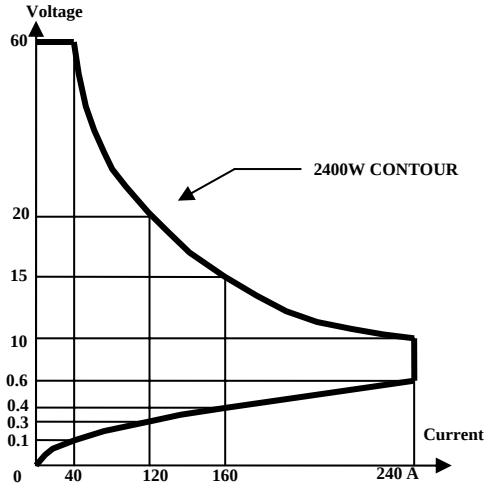


Fig 1-1.1 33501 0-60V / 0-240A 2400W Power Contour

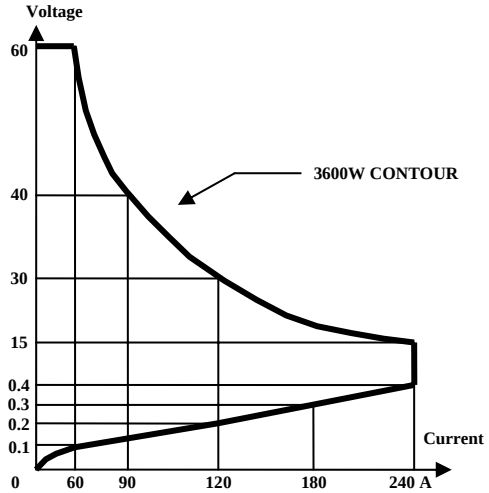


Fig 1-1.2 33511 0-60V / 0-240A 3600W Power Contour

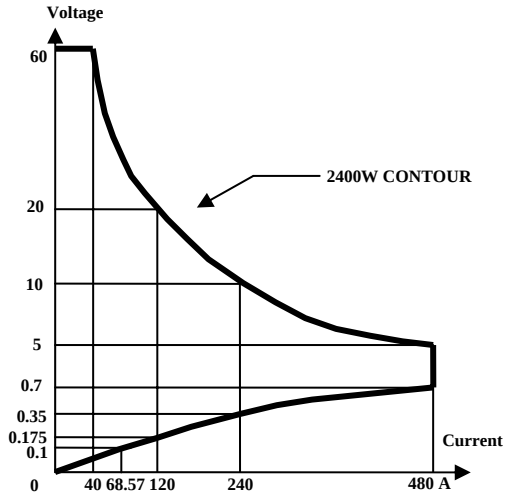


Fig 1-1.3 33521 0-60V / 0-480A 2400W Power Contour

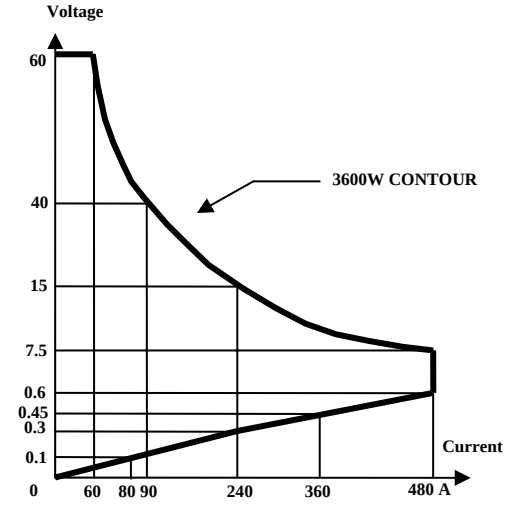


Fig 1-1.4 33531 0-60V / 0-480A 3600W Power Contour

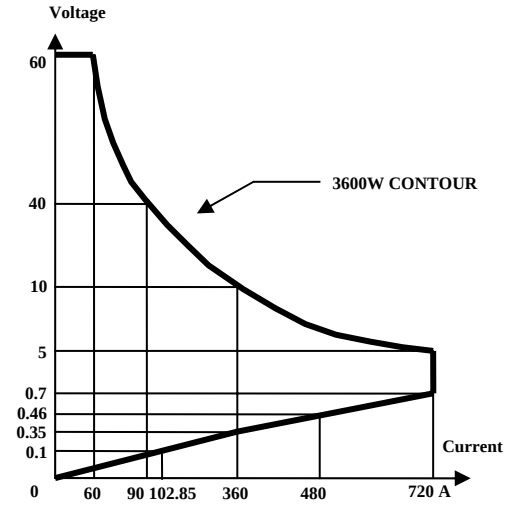


Fig 1-1.5 33541 0-60V / 0-720A 3600W Power Contour

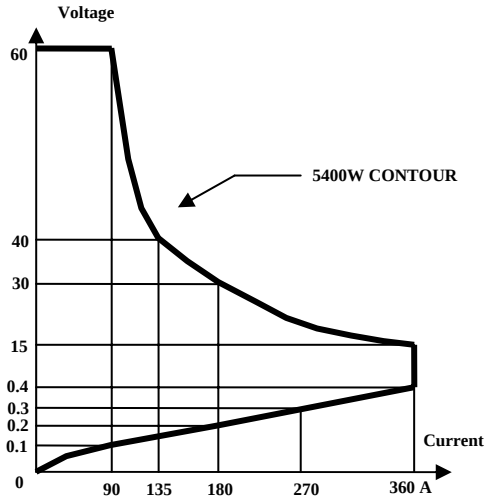


Fig 1-1.6 33512 0-60V / 0-360A 5400W Power Contour

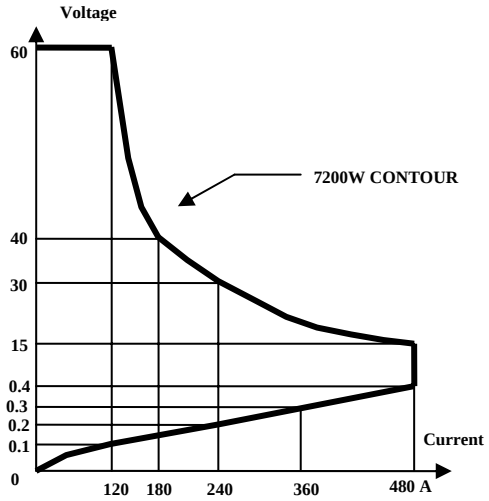


Fig 1-1.7 33513 0-60V / 0-480A 7200W Power Contour

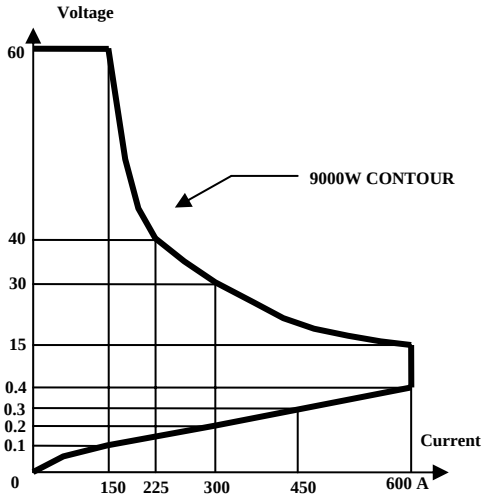


Fig 1-1.8 33514 0-60V / 0-600A 9000W Power Contour

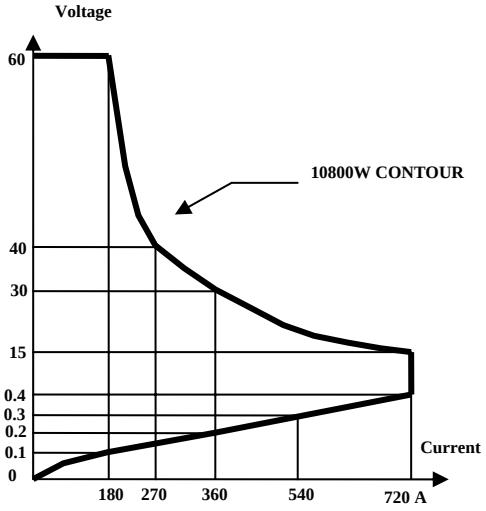


Fig 1-1.9 33515 0-60V / 0-720A 10800W Power Contour

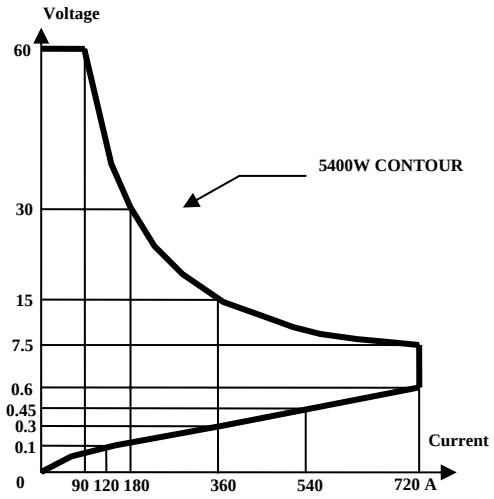


Fig 1-1.10 33532 0-60V / 0-720A 5400W Power Contour

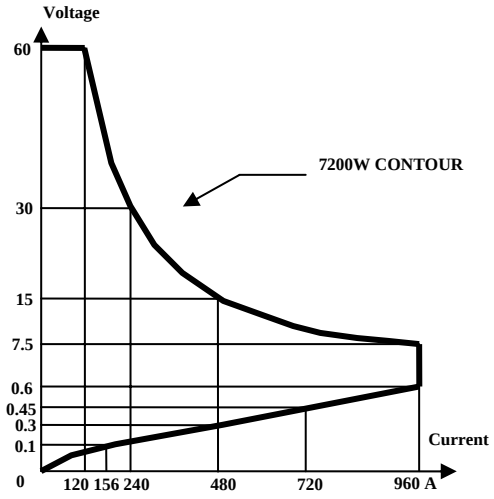


Fig 1-1.11 33533 0-60V / 0-960A 7200W Power Contour

CC Mode:
With the operating mode of constant current, the 33501 Series Electronic load will sink a current in accordance with the programmed value regardless of the input voltage (see Fig.1-2).

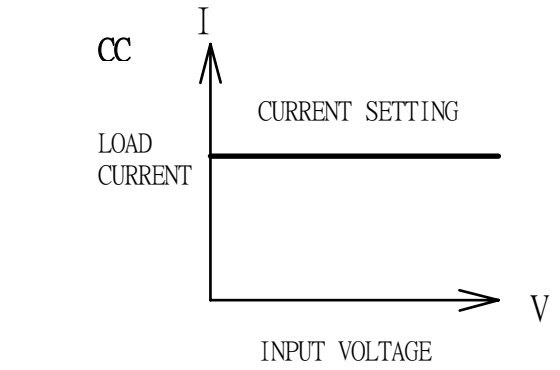


Fig 1-2 Constant Current mode

CR Mode:

At constant resistance mode, The 33501 Series Electronic Load will sink a current linearly proportional to the load input voltage in accordance with the programmed resistance setting (see Fig 1-3).

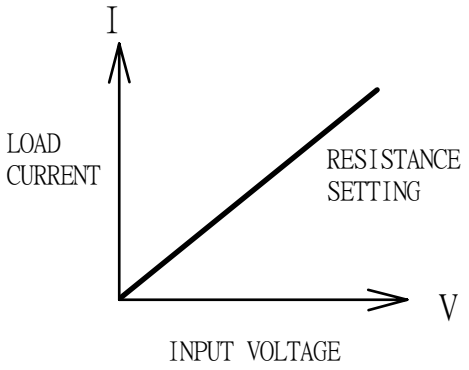


Fig 1-3 Constant Resistance mode

CV Mode:

At constant voltage mode, the 33501 Series Electronic Load will attempt to sink enough current until the load input voltage is equaled to the programmed value (see Fig 1-4).

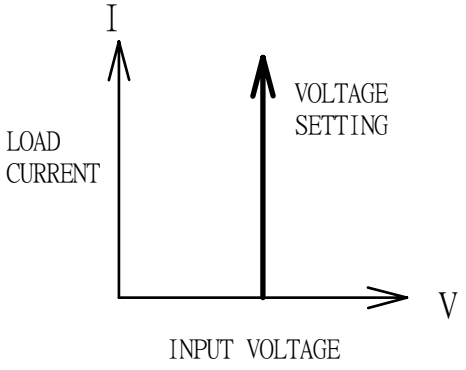


Fig 1-4 Constant Voltage mode

CP Mode:

At Constant Power mode, the 33501 Series Electronic Load will attempt to sink load power (load voltage x load current) in accordance with the programmed power. (See Fig 1-5).

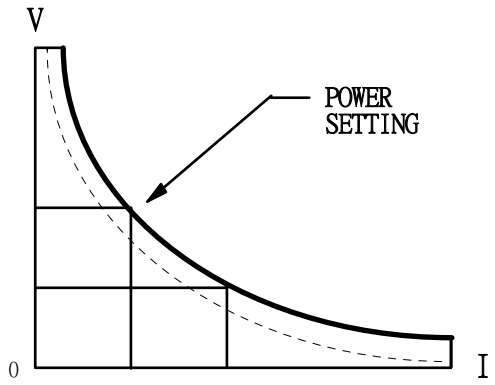


Fig 1-5 Constant Power mode

Dynamic wave form definition:

There are six parameters to generate dynamic wave form or pulse wave form, the 33501 Series Electronic Load will sink current from power source proportional to the dynamic wave form, the dynamic wave form definition is shown in Fig 1-6. The period of dynamic wave form is Thigh + Tlow, dynamic frequency = 1 / (Thigh + Tlow), the Duty cycle = Thigh / (Thigh + Tlow)

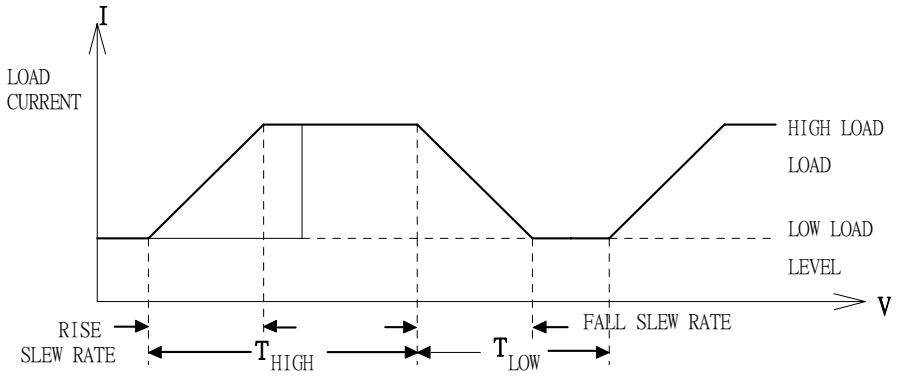


Fig 1-6 Dynamic Wave form

The load current level and load status are can be set with Front panel on each module, GPIB command. It is called manual operation and GPIB operation respectively, the load input voltage and load current can be read back to computer through GPIB.

The GPIB operation is described in Chapter 4 GPIB operation.

Slew Rate:
Slew rate is defined as the change in current or voltage over time. A programmable slew rate allows a controlled transition from one load setting to another to minimize induced voltage drops on inductive power wiring, or to control induced transients on a test device (such as would occur during power supply transient response testing).

In cases where the transition from one setting to another is large, the actual transition time can be Calculated by dividing the voltage or current transition by the slew rate. The actual transition time is Defined as the time required for the input to change from 10% to 90% or from 90% to 10% of the Programmed excursion. In cases where the transition from one setting to another is small, the small Signal bandwidth of the load limits the minimum transition time for all programmable slew rates. Because Of this limitation, the actual transition time is longer than the expected time based on the slew rate, as
Shown in Figure 1-7

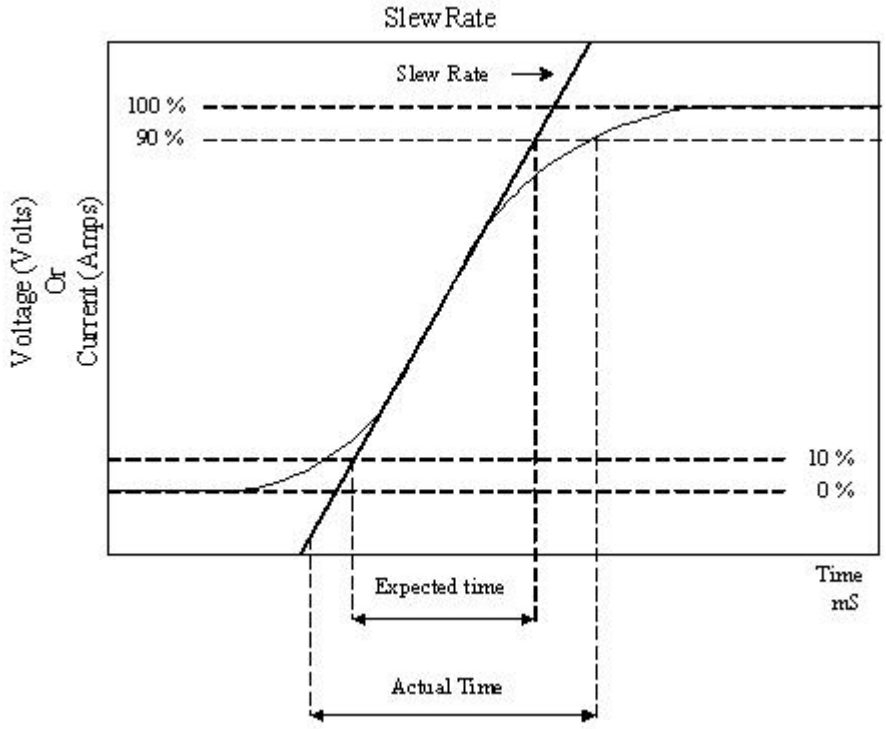


Fig 1-7 Rise Time Transition Limitation

1-2. Features

1-2-1 CC, CR, CV, CP, Dynamic, and Short Operating Mode.
1-2-2 Fully GPIB control of Load condition setting and meter read back.
1-2-3 Dual high accuracy & resolution 4 1/2 digit voltage and current meter.
1-2-4 Built-in pulse generator includes wide Thigh/Tlow dynamic load range, independent Rise/Fall load current slew rate control, and High/Low Load level.
1-2-5 Controllable load current slew rate of load level change, load ON/OFF switch change, and power supply turn ON.
1-2-6 Short circuit current measurement capability, low short resistance and reliable short circuitry is implemented by turn ON Power MOSFET and heavy duty relay.
1-2-7 Automatic voltage sense capability.
1-2-8 Full protection from over power, over temperature, over voltage, and reverse polarity.
1-2-9 Isolated Imonitor BNC output, 10V full scale.
1-2-10 Up to 150 Sets Store/Recall EEROM memory
1-2-11 Analog programming input capability at rear panel.
1-2-12 Digital Calibration

1-3. Accessories

1-3-1	6mm Binding Post Plug (Black)	1PC
	6mm Binding Post Plug (Red)	1PC
1-3-2	4mm Binding Post Plug (Black)	1PC
	4mm Binding Post Plug (Red)	1PC
1-3-3	SPADE Type Large size terminal (Yellow)	2PCS
	SPADE Type Small size terminal (Red)	2PCs
1-3-4	Hexagon sleeve (5mm)	1PC
	Hexagon sleeve (3mm)	1PC
1-3-5	33501 series operation manual	1PC
1-3-6	M6 ROUND SCREW	2PCS

1-4. Option

1-4-1 IEEE-488 cable (1 Meter)
1-4-2 IEEE-488 cable (2 Meter)
1-4-3 9931 Remote Controller
1-4-4 D-sub-9Pin to D-sub-9Pin cable (1M) for 9931.

1-5. Specifications

AC INPUT	LINE	115V ± 10%	230V ± 10%
	FREQUENCY	50/60 Hz	
	FUSE	2A/250V(5x20 mm)	1A/250V(5x20 mm)
	MAX. POWER CONSUMPTION	150 W×2	
DIMENSIONS (W * H * D)		483 mm × 365 mm × 445Dmm/EA	
WEIGHT		NET:2400W→38.8Kgs、3600W→47.2Kgs	

Table 1-1 AC INPUT Specifications

Model	33501	33511	33521	33531	33541
INPUT RATINGS					
Power (Watt)	2400 W	3600W	2400W	3600W	3600 W
Current (Ampere)	240 A	240 A	480 A	480 A	720A
Voltage (Volt)	60 V	60 V	60 V	60 V	60 V
PROTECTIONS					
OPP	2520W	3780W	2520W	3780W	3780W
OCP	252A	252A	504A	504A	756A
OVP	63V	63V	63V	63V	63V
OTP	85℃	85℃	85℃	85℃	85℃
CC MODE					
RANGE	0~24/240A	0~24/240A	0~48/480A	0~48/480A	0~72/720A
RESOLUTION	6.4mA /64mA	6.4mA /64mA	12.8mA /128mA	12.8mA /128mA	19.2mA /192mA
ACCURACY	±0.2% OF (SETTING + RANGE)				
CR MODE					
RANGE	0.0134~0.25~937.5Ω	0.0134~0.25~937.5Ω	0.0066~0.125~468.7Ω	0.0066~0.125~468.7Ω	0.0044~0.083~312.5Ω
RESOLUTION	0.067mΩ/1.066ms	0.067mΩ/1.066ms	0.033mΩ/2.133ms	0.033mΩ/2.133ms	0.022mΩ/3.2ms
ACCURACY	±0.2% OF (SETTING + RANGE)				
CV MODE					
RANGE	0~60V	0~60V	0~60V	0~60V	0~60V
RESOLUTION	0.016V	0.016V	0.016V	0.016V	0.016V
ACCURACY	±0.1% OF (SETTING + RANGE)				
CP MODE					
RANGE	0~2400W	0~3600W	0~2400W	0~3600W	0~3600W
RESOLUTION	0.64W	0.96W	0.64W	0.96W	0.96W
ACCURACY	±0.5% OF (SETTING + RANGE)				
4 1/2 DVM					
RANGE	15.00/60.00V	15.00/60.00V	15.00/60.00V	15.00/60.00V	15.00/60.00V
RESOLUTION	0.5mV/ 2mV	0.5mV/2mV	0.5mV/2mV	0.5mV/2mV	0.5mV/2mV
ACCURACY	±0.05% OF(READING + RANGE)				
4 1/2 DAM					
RANGE	24/240A	24/240A	48/480A	48/480A	72/720A
RESOLUTION	0.8mA /8mA	0.8mA /8mA	1.6mA /16mA	1.6mA /16mA	2.4mA /24mA
ACCURACY	±0.5% OF (READING + RANGE)				
Dynamic	50us to 9.999Sec				
Operation	16mA~1000mA/us	16mA~1000mA/us	32mA~2000mA/us	32mA~2000mA/us	48mA~3000mA/us
THIGH/TLOW	160mA~10000mA/us	160mA~10000mA/us	320mA~20000mA/us	320mA~20000mA/us	480mA~30000mA/us
SLEW-RATE					
ACCURACY	±10% ±10us				
Load ON Voltage	0.1-25V	0.1-25V	0.1-25V	0.1-25V	0.1-25V
Load OFF Voltage	0-25V	0-25V	0-25V	0-25V	0-25V
Imonitor (Isolated)	24A/V	24A/V	48A/V	48A/V	72A/V
Maximum					
Short Resistance	0.0025Ω	0.0017Ω	0.0015Ω	0.0013Ω	0.001Ω

Model	33512	33513	33514	33515	33532
INPUT RATINGS Power (Watt) Current (Ampere) Voltage (Volt)	 5400 W 360 A 60 V	 7200W 480 A 60 V	 9000W 600 A 60 V	 10800W 720 A 60 V	 5400 W 720A 60 V
PROTECTIONS OPP OCP OVP OTP	 5670W 378A 63V 85℃	 7560W 504A 63V 85℃	 9450W 630A 63V 85℃	 11340W 756A 63V 85℃	 5670W 756A 63V 85℃
CC MODE RANGE RESOLUTION ACCURACY	0~36/360A 9.6mA /96mA	0~48/480A 12.8mA /128mA	0~60/600A 16mA /160mA	0~72/720A 19.2mA /192mA	0~72/72019.2 mA /192mA
	±0.2% OF (SETTING + RANGE)				
CR MODE RANGE RESOLUTION ACCURACY	0.0088~0.1666~625Ω 0.044mΩ/1.6ms	0.0066~0.125~468.7Ω 0.033mΩ/2.133ms	0.0052~0.1~375Ω 0.026mΩ/2.66ms	0.0044~0.0833~312.3Ω 0.022mΩ/3.201ms	0.0044~0.083~312.3Ω 0.022mΩ/3.201ms
	±0.2% OF (SETTING + RANGE)				
CV MODE RANGE RESOLUTION ACCURACY	 0~60V 0.016V	 0~60V 0.016V	 0~60V 0.016V	 0~60V 0.016V	 0~60V 0.016V
	±0.1% OF (SETTING + RANGE)				
CP MODE RANGE RESOLUTION ACCURACY	0~5400W 1.44W	0~7200W 1.92W	0~9000W 2.4W	0~10800W 2.88W	0~5400W 1.44W
	±0.5% OF (SETTING + RANGE)				
4 1/2 DVM RANGE RESOLUTION ACCURACY	 15.00/60.00V 0.5mV/ 2mVV	 15.00/60.00V 0.5mV/2mV	 15.00/60.00V 0.5mV/2mV	 15.00/60.00V 0.5mV/2mV	 15.00/60.00V 0.5mV/0.2mV
	±0.05% OF(READING + RANGE)				
4 1/2 DAM RANGE RESOLUTION ACCURACY	 36/360A 1.2mA /12mA	 48/480A 1.6mA /16mA	 60/600A 2mA /20mA	 72/720A 2.4mA /24mA	 72/720A 2.4mA /24mA
	±0.5% OF (READING + RANGE)				
Dynamic Operation THIGH/TLOW SLEW-RATE ACCURACY	50us to 9.999Sec				
	24mA~1500mA/us 240mA~15000mA/us	32mA~2000mA/us 320mA~20000mA/us	40mA~2500mA/us 400mA~25000mA/us	48mA~3000mA/us 480mA~30000mA/us	48mA~3000mA/us 480mA~30000mA/us
	±10% ±10us				
Load ON Voltage Load OFF Voltage	0.1-25V 0-25V	0.1-25V 0-25V	0.1-25V 0-25V	0.1-25V 0-25V	0.1-25V 0-25V
Imonitor (Isolated)	36A/V	48A/V	60A/V	72A/V	72A/V
Maximum Short Resistance	 0.002Ω	 0.0015Ω	 0.0012Ω	 0.001Ω	 0.001Ω

Model		33533
INPUT RATINGS Power(Watt) Current(Ampere) Voltage(Volt)		 7200 W 960 A 60 V
PROTECTIONS Over Power Protection(OPP) Over Current Protection(OCP) Over Voltage Protection(OVP) Over Temp. Protection(OTP)		 ≒ 7560W ≒ 1008A ≒ 63V ≒ 85℃
CC MODE	RANGE RESOLUTION ACCURACY	0～96/960 A 25.6mA/256mA ±0.2% OF (SETTING + RANGE)
CR MODE	RANGE RESOLUTION ACCURACY	0.0032Ω ～ 0.0625Ω ～ 234.3Ω 0.016mΩ/4.266mS ±0.2% OF (SETTING + RANGE)
CV MODE	RANGE RESOLUTION ACCURACY	0～60V 0.016V ±0.1% OF (SETTING + RANGE)
CP MODE	RANGE RESOLUTION ACCURACY	0～7200W 1.92W ±0.5% OF (SETTING + RANGE)
4 1/2 DVM	RANGE RESOLUTION ACCURACY	0 ～15.000/60.00V 0.5mV/2mV ±0.05% OF(READING RANGE)
4 1/2 DAM	RANGE RESOLUTION ACCURACY	0～96.00/960.0A 3.2mA/32mA ±0.2% OF (READING + RANGE)
Dynamic Operation	THIGH/TLOW	50uS to 9.999 Sec
	SLEW-RATE	64mA ～ 4000mA/uS | 640mA ～ 40000mA/uS
	ACCURACY	±10% ±10uS
Load ON Voltage		0.1-25V, 1% of (Setting + Range)
Load OFF Voltage		0-25V, 0.05% of (Setting +Range)
Imonitor (Isolated)		96A/V
Maximum Short Resistance		1.05mΩ

Table 1-2 33501-Series Specifications

1-6. Block diagram

The functional block diagram of 33501 Series Electronic Load is illustrated in Fig 1-8.

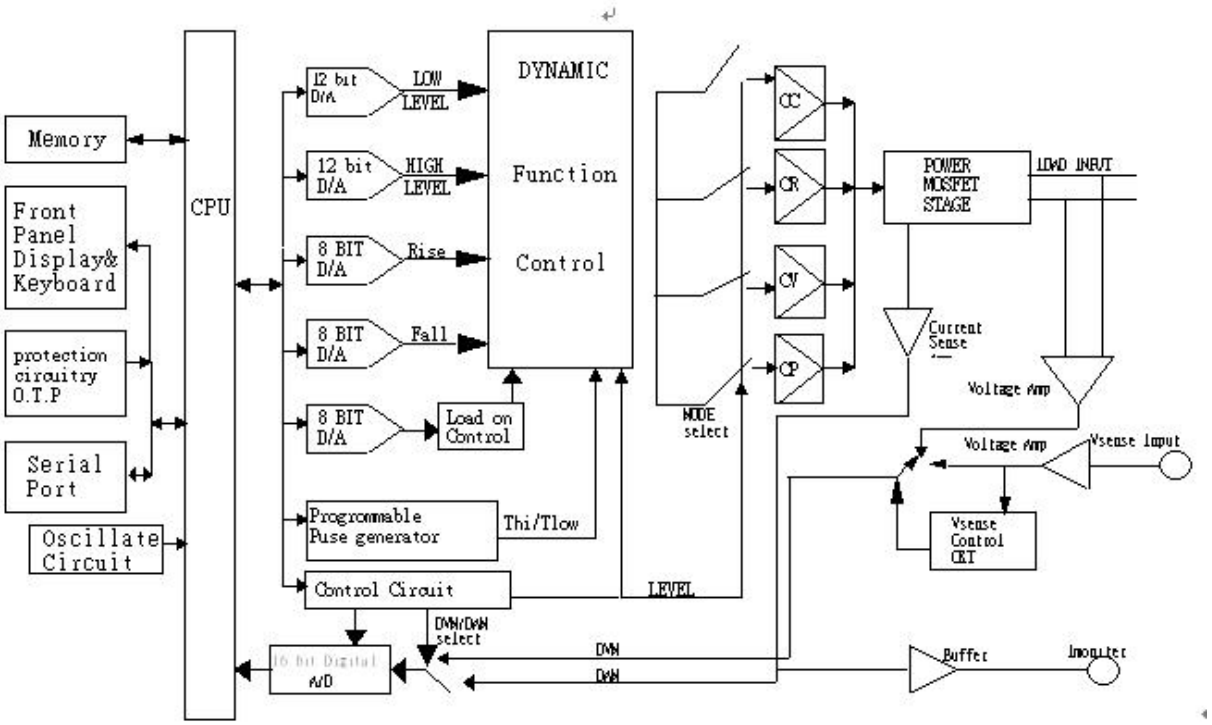


Fig 1-8 Block Diagram of 33501 Series Electronic Load

The load current level and load status are received from front panel of 33501, the two 12 bit D/A converter receive digital data of load current and transfer as an analog signal, the load current slew rate is controlled by the two 8 bit D/A converters, the Thigh and Tlow duration is set by two 16 bit trimmer, these six parameters constitute the wide range pulse generator, and can be used to test the power supply. (Unit under Test)

The Constant Current (CC), Constant Resistance (CR), and Constant Voltage (CV) control circuitry and Constant Power (CP) Constant and range circuitry is selected depending upon which operating mode and range.

The drive circuit controls the load current flow through power MOSFET is proportional to the analog control signal. The Short ON/OFF signal through short drive circuit turns the Power MOSFET fully ON.

The voltage Auto-sensing circuit selects the Load input terminal or Vsense BNC input depends on the Vsense cable is connected or not. The Auto ranged 4 1/2 high accuracy digit voltage meter indicates the input voltage.

The 4 1/2 digit voltage meter and 4 1/2 digit current meter digital bus is connected to CPU circuitry.

Chapter 2 Installation

2-1. Inspection

The 33501 Series high power load was carefully inspected before shipment. If instrument damage has occurred during transport, please inform Prodigit's sales and service office or representative.

Your 33501 Series high power load was shipped with a power cord for the type of outlet used at your location. If the appropriated cord was not included, please contact your nearest Prodigit sales office to obtain the correct cord. Refer to “check line voltage “to check the line voltage selection and fuse type.

2-2. Check line voltage

The 33501 Series high power load can operation with 115, 230Vac input as indicated on the label on the rear panel.

Make sure that the factory check mark corresponds to your nominal line voltage. Skip this procedure if the label is corrected marked.

2-2-1 With the 33501 Series load power OFF, disconnect the power cord.

2-2-2 Refer the drawing on the rear panel of 33501 Series high power load in Fig 2-1, set the switches to the proper voltage as describe in the following:

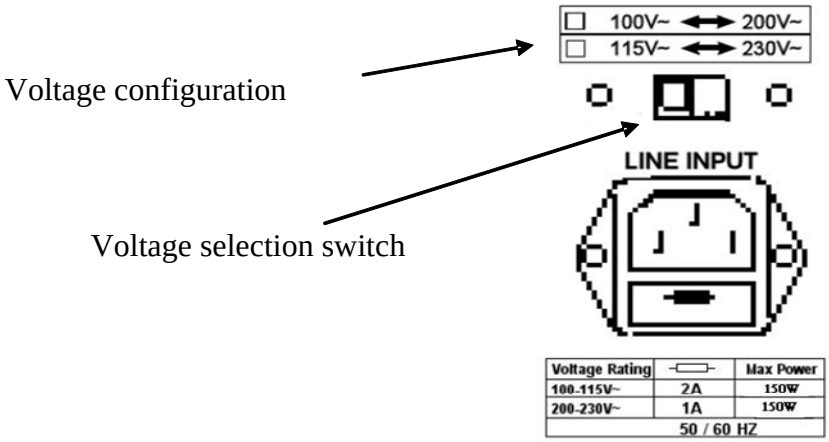


Fig 2-1 SET OF SWITCH

2-2-3 Mark the correct voltage on the rear panel of 33501 Series high power load.

2-2-4 Check the rating of the line fuse and replace it with the correct fuse if necessary.

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

2-2-6 Reinstall fuse holder and connect the power cord.

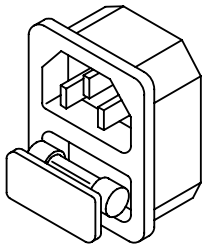


Fig 2-2 AC LINE RECEPTACLE

2-3. Grounding requirements

The 33501 Series high power load is equipped with three conductor cable which plugs in an appropriate receptacle to ground the instrument's cover.

2-4. Adjust the feet

The 33501 Series high power load is equipped with feet and tilt stands installed and is ready for used as a bench instrument.
The feet provide a good viewing angle for bench-top use.

2-5. Rack mount

The 33501 Series high power load is designed to permit mounted in a standard 19 inches rack for system application.

2-6. Environmental requirements

- For indoor use only
- installation Category I
- Pollution Degree 2
- Altitude up to 2000 meters
- Relative Humidity 80% RH Max

2-7. Repair

If the instrument is damaged, please attach a tag to the instrument to identify the owner and indicated the require service or repairing. And inform the Prodigit sales and service office or representative.

2-8. GPIB connection

The GPIB connector on the rear panel connects the 33501 Series high power load to the controller and to other GPIB devices. An GPIB system can be connected in any configuration (star, linear, or both) as long as

2-8-1 The maximum number of devices including the controller is no more than 15.

2-8-2 The maximum length of all cable in no more than 2 meters times the number of devices connected together, up to 20 meters maximum.

Please make sure the lock screws are firmly hand - tightened, use a screw-driver only for the removal of screws. Fig 2-3 shows the rear panel of 33501 Series high power load, the GPIB connector on the rear panel of 33501 Series high power load. The GPIB address of the 33501 Series high power load is factory set to address 05.

The GPIB address can be set by FRONT PANEL, GPIB address is set by press STATE 4 + STATE 5 simultaneously, press UP or DOWN key to select 1-9 address number, press STATE 2 to exit GPIB address setting mode.

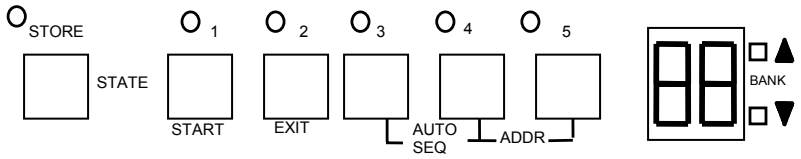


Fig 2-3 33501 FRONT/REAR PANEL

2-9. RS-232C Connection

The RS-232C connector (Female) on the rear panel Connects 33501 Series HIGH POWER LOAD to RS-232C port of computer in one by one configuration.

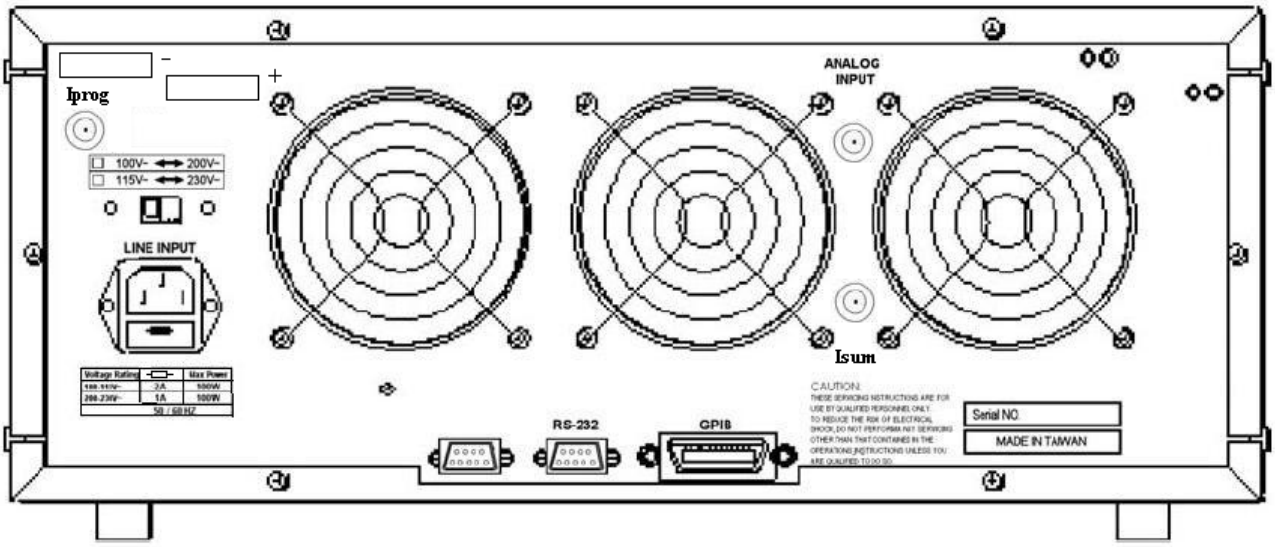


Fig 2-4 33501 Series High Power Load Rear panel

2-10.Remote control Port

The D-sub 9 pin connector on the rear panel connects the 33501 Series high power load to the PRODIGIT mode 9931C remote controller and to replace the RECALL option key 1 to 5 on the front panel of 33501 Series high power load.

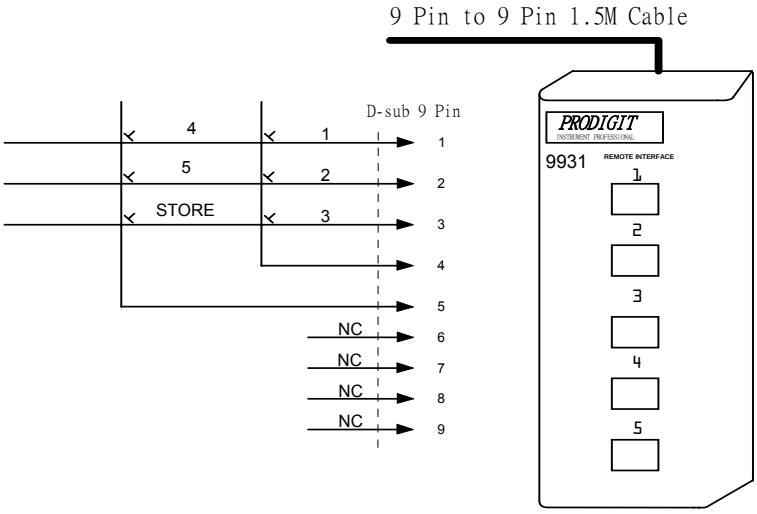


Fig 2-5 Diagram of Remote Control Port

2-11 Analog programming BNC input

The BNC connector on the rear panel connects .

The 0 to 10V Analog signal can program the 0 to full scale input range in the CC mode (0 to 24A range when load current setting is less than 24A, or 0 to 240A range when load current setting is higher than 24A) or in the CP mode (0 to 2400W). The analog programming signal can act alone or it can be summed with the programmed value via GPIB, RS-232, or the front panel. Fig 3-3 shows the analog programming signal (4 Vac, 500Hz) is summed with the 96A programmed setting in CC mode of 33501 Load module.

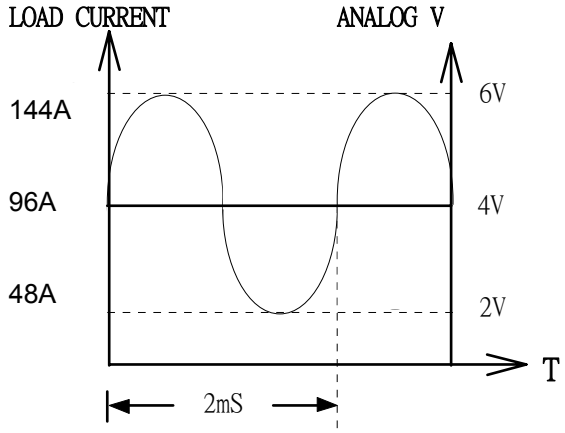


Fig 2-6 Analog programming load current in CC mode operation

2-12 Power on status

2-12-1 Local/manual operation mode.

2-12-2 STORE/RECALL：All LED is OFF, BABK LED display shows 01.

2-12-3 GPIB address setting：

GPIB address is set by press STATE 4+STATE 5 simultaneously, press UP or DOWN key to select 0－31 address number, press STATE 2 to exit GPIB address setting mode.

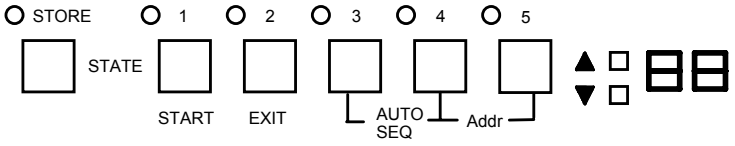


Fig 2-7 front panel key switch

2-13 STORE / RECALL operation

The eight function keys on the front panel are designed for high testing throughput purpose. There are 5 and 150 operation states or testing steps can be store in the EEROM memory, each state can save or recall the load status and level for four Electronic load modules simultaneously.

2-13-1 STORE procedure:

2-13-1-1 Set the load status and load level from load module within the mainframe respectively.

2-13-1-2 Press the STORE key on the front panel, the STORE LED annunciator is flashing (about two times every second) to indicate ready to store. Press Store key again or wait for about 20 sec to exit the store operation.

Press one of the state 1-5 key, the appropriate state key's LED annunciator will be lit immediately, the load level and status of 33501 series load module is stored into the EEROM memory this time. then the STORE LED annunciator turns to OFF, it means the STORE procedure is completed.

Note:

After press the STORE key, the STORE LED annunciator will flash for 20 seconds, if the STATE 1-5 key is not pressed within this 20 seconds, the STORE LED annunciator will be OFF, it indicated the STORE process is not available now, please repeat the STORE procedure for a new STORE operation.

After press the STORE key, then press the STORE key, the STORE LED annunciator will be blank, it indicate the STORE process is not available.

After press the STORE key, it is available and useful to operate the front panel key on the 33501 series Electronic load . However, the STATE LED will be OFF if any key on any load module is operated, this indicates the front panel state of load module is not the same as STORE state.

2-13-2 STORE function:

Please refer chapter section on the 33501 series electronic load module operation manual to more detail operation flow-chart for store and recall operation.

It can store up to states of 33501 series load module setting simultaneously, if you store 2 different states in the same state key, the later state will overcome the previous state, it acts as update the new data.

2-13-3 RECALL operation:

2-13-2-1 For 33501 series, using UP and Down key to select the Memory Bank, then follow the procedure for the Memory Recall operation.

2-14 AUTO SEQUENCE testing function description

There are two modes in AUTO SEQUENCE function, EDIT MODE and TEST MODE, The AUTO SEQ mode can be entered by press S3 + S4 key simultaneously, then press STORE key again to enter the EDIT MODE, or press START key to enter the TEST MODE, Please refer to the flow chart operation below:

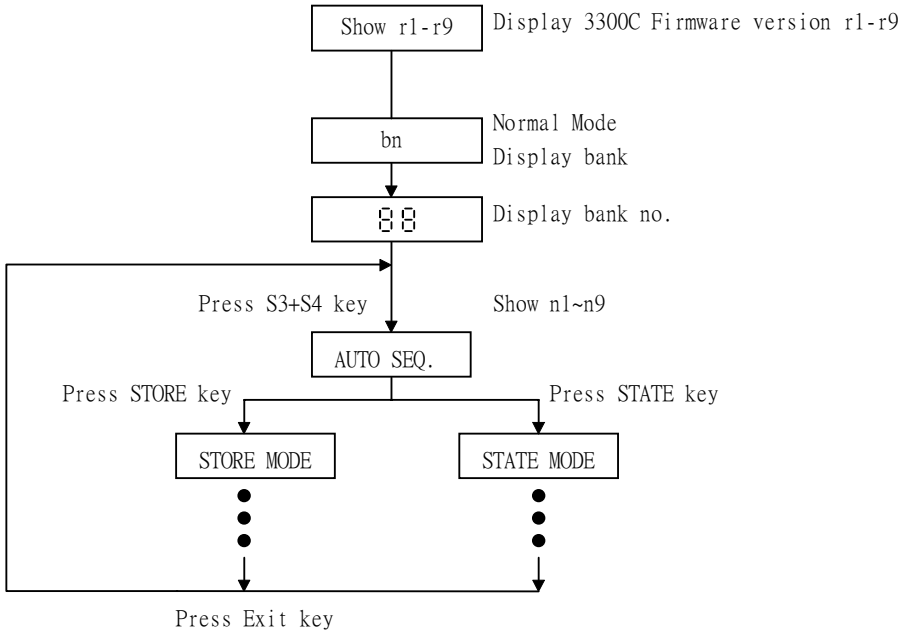


Fig 2-8 AUTO SEQ function operation flow chart

2-14-1 EDIT MODE

The TEST Mode of Auto-Sequence function is entered by press S3 + S4 key simultaneously, The EDIT mode of Auto Sequence function is entered by press S3 + S4 key simultaneously, the S3 and S4 LED are ON to indicate Auto-sequence mode, then the Edit mode of Auto-sequence function is proceed by press STORE key.

The EDIT MODE flow chart is described below:

2-14-1-1 There are nine Auto Sequence (n1-n9) can be edit within 33501 series.

2-14-1-2 Each Auto Sequence has up to 16 Test step, where each step is any one memory of 150 sets Store memory which is 30 memory Bank with 5 memory state.

2-14-1-3 Each test step has t1 (test time) and t2 (delay time), the unit is 100mS, the range is 0.1S - 9.9S in 100mS resolution. 33501 series mainframe will check each module GO/NG at the end of t1 (test time), the next step will be started after duration t2 (delay time).

2-14-1-4 The test step sequence can be up to 16 step, and can be terminated by press EXIT key if less than 16 step is required.

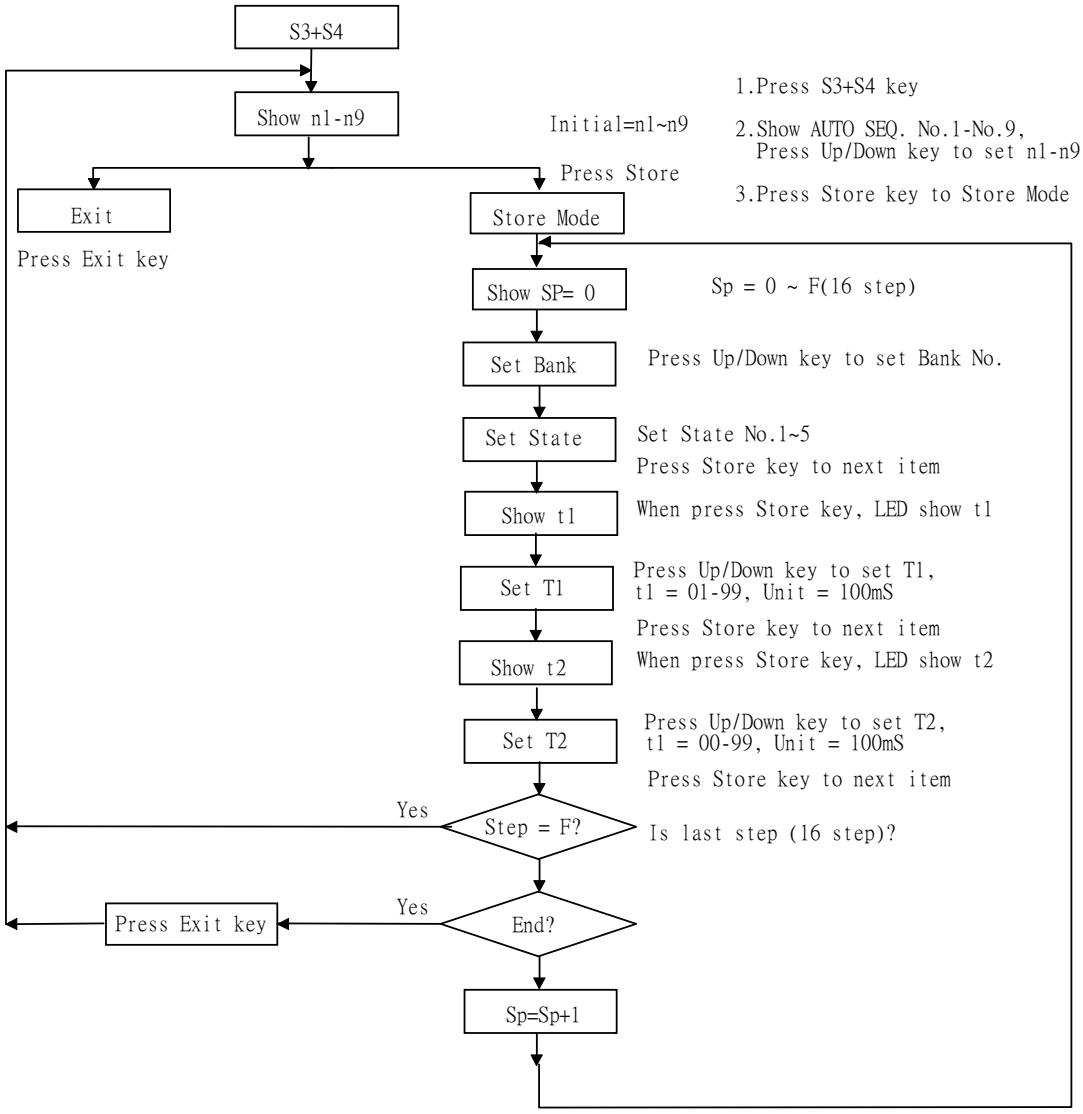


Fig 2-9 STORE (EDIT) MODE OPERATIONO FLOW-CHART

2-14-2 TEST MODE

The TEST Mode of Auto-Sequence function is entered by press S3 + S4 key simultaneously, the S3 and S4 LED are ON to indicate Auto-sequence mode, then the Test mode of Auto-sequence function is proceed by press START key.

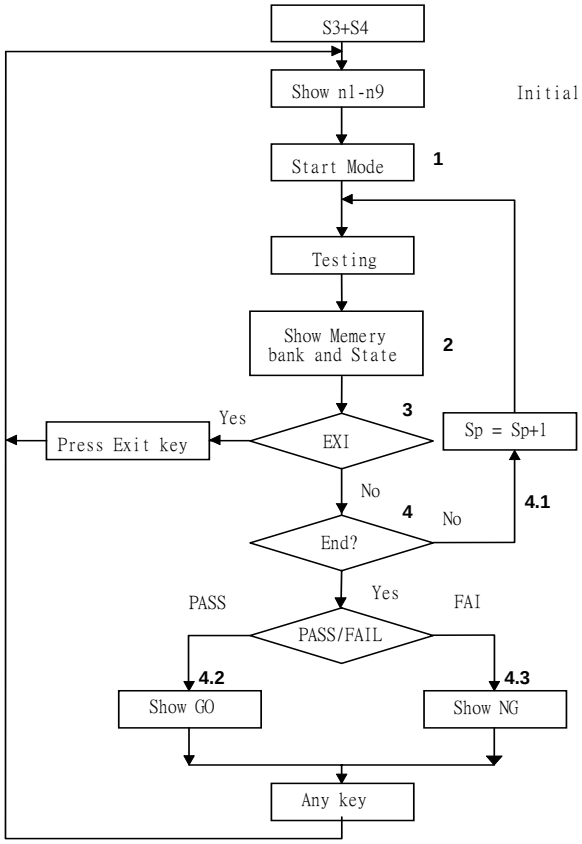
The TEST MODE flow chart is described below:

2-14-2-1 After press START key, the 33501 series controls within the mainframe to recall correspond memory which had been stored in Auto-sequence (n1~n9) memory.

2-14-2-2 The sequence start from (Step 0 - t1 - t2), then (step 1 - t1 - t2), and so on until last step or stop by press EXIT key.

2-14-2-3 The two digit LED display will show GO (flash) if all the test in all module is pass, and will show nG (flash) if there is at least one failure during the test.

2-14-2-4 User can press Start key to continue another test, or the 33501 series can quit from Auto-Sequence mode by press EXIT key.



1.Press S3+S4 key, and S3 and S4 LED are ON

2.Show AUTO SEQ. No.1-No.9,
Press Up/Down key to set n1-n9

3.Press Start key to Start Mode

Press Start key

1.To recall correspond memory which had been stored in n1-n9 memory

2.Check the GO/NG indicator

3.Press Exit key to quit the AUTU SEQ mode

4.If test is GO, than step is last?

4.1 If no than Step + 1, continue another step.

4.2 If "Yes", than if all the test in all module is pass, Show GO.

4.3 If "Yes", than if there is at least one failure during the test, Show NG.

Fig 2-10 TEST MODE OPERATION FLOW-CHA

2-15. Load current slew rate setting.

What is the load current slew rate during load current level change, power supply turn ON/OFF switch between ON, and OFF? The 33501 Series Electronic load provides all of the above load current slew rate in controllable condition, the rise and fall current slew rate can be set independently from front panel operation or remote programming.

The slew rate determines a rate at which the current changes to a new programmed value. The slew rate can be set at the front panel or via GPIB on the rear panel of 33501 Series high power load.

The rise and fall slew rate can be independently programmed from 160mA/usec to 10A/usec (33501 Load) in the 240A current range and from 16mA/usec to 1A/usec in the 24A current range. This allows a independent controlled transition from Low load current level to High load current level (Rise current slew rate) or from High load current level to Low load current level(Fall current slew rate) to minimize induced voltage drops on the inductive wiring, or to control induced transients on the est. device (power supply transient response testing).

This controllable load current slew rate feature also can eliminate the overload current phenomenon and emulate the actual load current slew rate at turn ON the power supply under test. Fig 2-6 shows the load current slew rate is according to the power supply's output voltage, load level setting and Load ON/OFF switch. So, you could do all items of power supply testing task by using Constant current mode only, it can significantly improve the testing quality and process as well as efficiency.

There are two load current range in 33501 Load, Range I and Range II, the slew rate of range I, range II, RISE/FALL slew rate are listed in chapter 1-5 specifications.

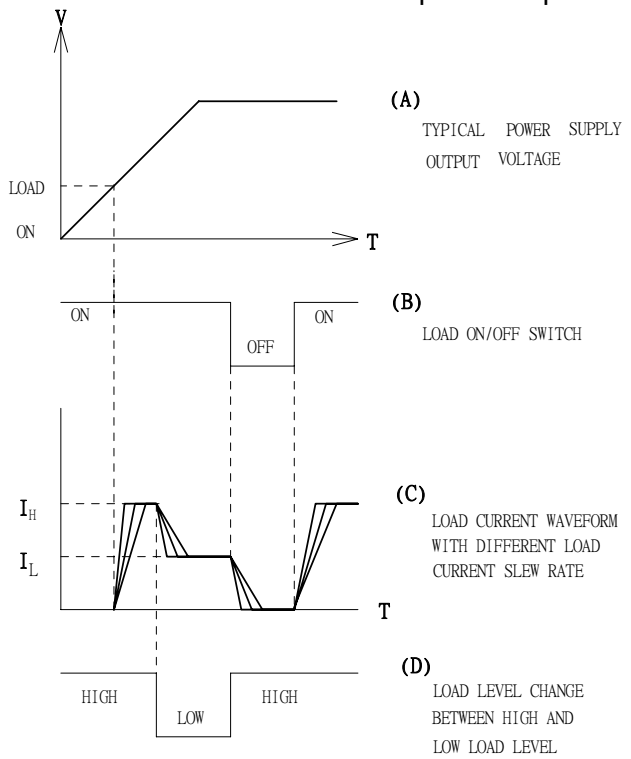


Fig 2-11 The relationship of load current load ON/OFF, load level and output voltage of DC power supply at turn ON

Chapter 3 Operation

This chapter describes the front panel function and operation of each 33501 Series load, the memory Store/Recall, GPIB and RS-232 remote programming are described in the mainframe operation manual. Please refer to the mainframe's operation manual for mainframe store/recall and GPIB/RS-232C programming.

3-1. Front panel description and 3-1-1 33501 External Diagram

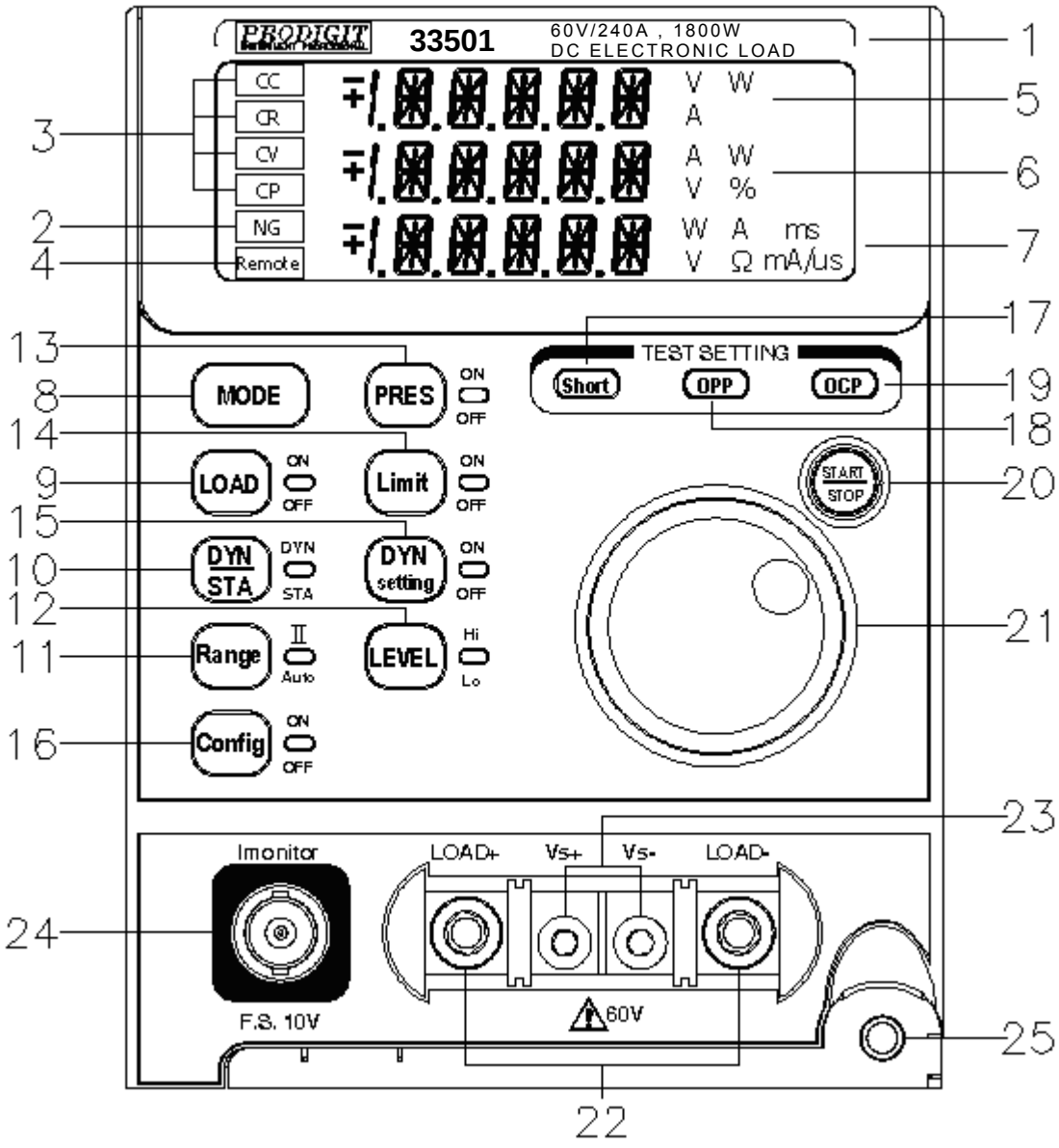


Fig 3-1 33501-Series High Power Front Panel

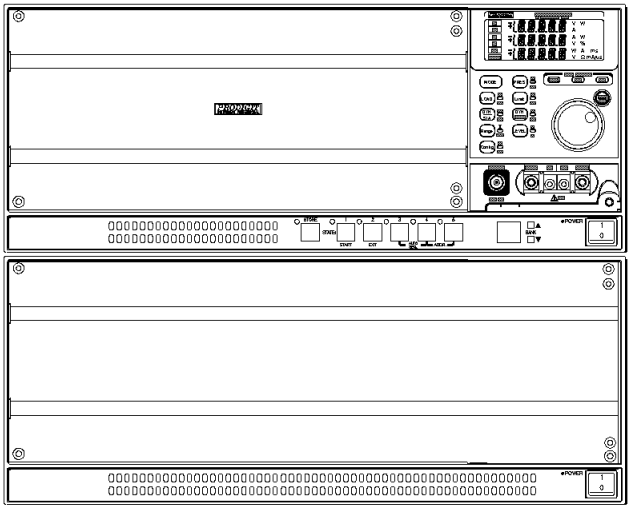


Fig 3-2 33501 Series High Power electronic load

3.1.1 33501 60V/240A，2400W DC ELECTRONIC LOAD

It indicates the model number and specifications of 33501 series electronic load.

3.1.2 NG Indicator

When the reading of Vmeter, Ameter, and Watt meter exceeds the upper or lower limit set, this indicator will display.

3.1.3 MODE and CC, CR, CV, CP Indicator

There are four operating modes can be selected by press the " MODE " key on the 33501 series Electronic Load.

The sequence is Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV), Constant Power (CP) and then repeat while press the" MODE " key, the CC, CR, CV, CP mode LED will be lit respectively when the appropriate operating mode is selected.

There are two programming ranges in Constant Current and Constant resistance mode respectively; the 33501 series can adjust to the best fit range automatically according to the programmed load level. The rule is described below:

3.1.3.1 In Constant Current mode: (example of 33501)

The Range I (24A) indicates low load current operating range, Range II (240A) indicated high load current operating range, the detail specification of range load current is listed on the Table 1-1, the current range is changed automatically in accordance to the programmed load current.

The range 1 is selected automatically if the programmed load current is less than the maximum current of range 1 (24A), and will set to range II automatically when the programmed current is higher than the maximum current of range 1 (24A).

3.1.3.2 In Constant Resistance mode:

Range I indicates low load resistance operating range, Range II indicates high load resistance operating range, the detail resistance range specifications is shown in table 1-1. The resistance range is changed automatically in accordance to the programmed load resistance.

The 33501 Series electronic load will set to range 1 automatically if the programmed load resistance is higher than the minimum load resistance of range 1, and will set to Range II when the programmed load resistance is lower than the minimum load resistance of range 1.

3.1.4 Remote LCD Indicator

The Remote LCD Indicator is used to indicate the status of remote operation, all of the front panel operation can not be operated while Remote LCD is ON, in case of Local mode or manual operation, the Remote LCD is OFF.

3.1.5 Upper 5 digit LCD display

The 5 digit LCD display is a multi-function display, the functions are described below:
Normal mode :
There is a 5 digit DVM display, display measuring data of the DC input terminal or V-sense input terminal if V-sense AUTO is programmed, or the 5 digit voltage meter displays the voltage of V-sense input terminal if V-sense ON is programmed.

When the auto-sense of V-sense function is programmed, the auto-sense circuit of 33501 series electronic load can check the V-sense cable is connected or not, the V-sense BNC input is detected if it is greater than 0.5V (33501, 33511) or 2.5V (33521) or not, if yes then the 5 digit DVM measures the sense BNC input, otherwise, the 5 digit DVM measures the DC input terminals of the load module.

Test Setting Mode:
Short : Short test Enable and Short Setting programming：Display will show “Short”.
OPP : OPP test Enable and OPP Setting programming：Display will show”OPP”.
OCP : OCP test Enable and OCP Setting programming：Display will show”OCP”.
Short testing、OCP testing and OPP testing programming, will show Vsense’s voltage or load Input voltage.

3.1.6 Middle 5 digit LCD display

Normal mode:
There is a 5 digit DAM display. The 5 digit DAM displays the measuring current of the DC load When Load ON programming.

Setting Mode:

3.1.6.1 Config ON programming: Display will individually show”SENSE”, “LDon”, “LDoff” and “POLAR”.

3.1.6.2 Limit ON programming：Display will individually show”V_Hi”, “V_Lo”, “A_Hi”, “A_Lo”, “W_Hi”, “W_Lo” and “NG”.

3.1.6.3 DYN setting ON programming：Display will individually show ”T-Hi”, ”T-Lo”, ”RISE” and “FALL”.

3.1.6.4 Short test Enable、OCP test Enable and OPP test Enable programming: Display will individually show 「PRESS」.

3.1.6.5 Short setting programming：Display will individually show “TImE”, “V-Hi” and “V-Lo”.

3.1.6.6 OPP setting programming：Display will individually show “PSTAR”, “PSTEP”, “PSTOP” and “Vth”.

3.1.6.7 OCP setting programming：Display will individually show “ISTAR”, “ISTEP”, “ISTOP” and ”Vth”.

3.1.6.8 Short testing programming, the current of actual load current, the unit is "A".

3.1.6.9 OCP testing programming, the seting current , the unit is "A".

3.1.6.10 OPP testing programming, the seting watt , the unit is "A"

3.1.6.11 When Over current protect：Display will show 「OCP」.

3.1.7 Lower 5 digit LCD display

Normal mode：The Lower 5 digit LED display is show load Consumption duty.

Setting Mode: Setting value is by rotating knob switch.

3.1.7.1 PRESET ON mode display will individually show：

3.1.7.1.1 CC mode's current programming value display, the unit is "A".

3.1.7.1.2 CR mode's resister programming value display, the unit is “Ω”

3.1.7.1.3 CV mode's voltage programming value display, the unit is “V”.

3.1.7.1.4 CP mode's power programming value display, the unit is “W”.

3.1.7.2 LIMIT ON mode display will individually show :

3.1.7.2.1 V_Hi(upper limit voltage) & V_Lo(lower limit voltage) value display, the unit is "V".

3.1.7.2.2 A_Hi(upper limit current) & A_Lo(lower limit current) value display, the unit is "A"

3.1.7.2.3 W_Hi(upper limit power) & W_Lo(lower limit power) value display, the unit is "W"

3.1.7.2.4 NG programming display will show 「ON」or 「OFF」.

3.1.7.3 DYN setting ON mode display will individually show :

3.1.7.3.1 T-Hi(level high time)& T-Lo(level low time) programming value display, the unit is "ms".

3.1.7.3.2 Rise/Fall current slew rate programming value display, the unit is "A/us" or "A/mS".

3.1.7.4 Config ON mode display will individually show :

3.1.7.4.1 SENSE programming display will show「ON」or「AUTO」.

3.1.7.4.2 LDon & LDoff value display, the unit are "V".

3.1.7.4.3 Load polarity value display will show「＋LOAD」or「－LOAD」.

3.1.7.5 Short test Enable、OCP test Enable and OPP test Enable mode will show 「START」.

3.1.7.6 Short Setting mode

3.1.7.6.1 Short setting display will show “CONTI”, Short time setting, the unit is “mS”.

3.1.7.6.2 V-Hi & V-Lo value display, the unit is "V".

3.1.7.7 OPP Setting mode

3.1.7.7.1 OPP PSTAR、OPP PSTEP and OPP PSTOP value display, the unit is “W”.

3.1.7.7.2 OPP Vth value display, the unit is “V”.

3.1.7.8 OCP Setting mode

3.1.7.8.1 OCP ISTAR, OCP ISTEP and OCP ISTOP value display, the unit is “A”.

3.1.7.8.2 OCP Vth value display, the unit is “V”.

3.1.7.9 OCP test & OPP test mode display will show「RUN」

3.1.7.10 When Over power protect：Display will show 「OPP」.

3.1.7.11 When Over temperature protect：Display will show 「OTP」.

3.1.8 MODE and CC, CR, CV, CP Indicator

There are four operating modes can be selected by press the " MODE " key on the 33501 series Electronic Load module.

The sequence is Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV), Constant Power (CP) and then repeat while press the" MODE " key, the CC, CR, CV, CP mode indicator will be lit respectively when the appropriate operating mode is selected.

3.1.9 LOAD ON/OFF key and LED

The 33501 series Electronic Load input can be toggled ON/OFF at the front panel's LOAD ON/OFF key. The load current slew rate change uses the slew rate setting, so the load current slew rate will change at the programmed Rise/Fall slew rate setting respectively.

Turning the LOAD OFF does not affect the programmed settings. The LED is OFF to indicate LOAD OFF status. The LOAD will return to the previously programmed values when the LOAD key is turned to ON again.

The Load ON LED indicates the 33501 series electronic load is ready to sink current from DC input.

3.1.9.1 Load ON/OFF key: Switch load ON to load OFF in the load module, the fall slew rate is according to the slew rate setting on the front panel.

3.1.9.2 DC input voltage: There is a load ON and load OFF voltage control circuit in 33501 series electronic load.
When the Device under Test turns ON, the output voltage of D.U.T will increase up from 0 to rated output voltage. The 33501 series electronic load will start to sink current after load voltage is higher than load ON voltage setting within the Config key.

The programmed load ON voltage for model 33501 series electronic load module is from 0 to 25V

When the Device under Test turns OFF, the output voltage of D.U.T will decrease down to 0 volt. The 33501 series electronic load will stop to sink current after load voltage is lower than load OFF voltage setting within the Config key.

The programmed load OFF voltage for model 33501 series load module is from 0 to load ON voltage.

3.1.10 DYN / STA key and LED

This Key is available in Constant Current and Constant Power mode only. In Constant Resistance and Constant Voltage mode, there is no any function in this key and the LED is OFF, the 33501 series load module will automatically adjust to static mode. In Constant Current and Constant Power mode, the Static or Dynamic mode is toggled by this key; the LED will be lit at Dynamic mode.

3.1.11 Range key and LED

Range AUTO / II Key is for range setting, if Range AUTO LED is OFF, load will setting to Range I or II in accordance with the actual current value. When Range II, LED will ON, the current programming will setting to Range II .

Note: Coercion Range II only in CC Mode.

3.1.12 LEVEL key and LED

In the dynamic mode of Constant Current mode, there is no any effect to the 33501 series load module although the LED can be indicated the High or Low level in the Static mode. The only fact is switching the 33501 series load module from Dynamic load to Static load; it can determine the load current is High or Low load current level.

In Static mode, the LEVEL key is used to program the High or Low level load current in Constant Current mode, the High or Low load resistance value in Constant Resistance mode, the High or Low voltage value in Constant Voltage mode, and the High or Low power value in Constant Power mode.

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3.1.13 PRES ON/OFF key and LED

At Preset OFF state, the load input voltage is shown on the upper 5 digit Meter, and load input current is shown on the middle 5 digit Meter, the load input power is shown on the lower 5 digit Meter, the engineering unit "V", "A" and "W" LED will be lit respectively.
At Preset ON state, the PRES. LED is ON, the lower 5 digit Meter will be affected by the CC, Dynamic, CR, CV, and CP operating mode.

In Preset ON condition, the 5 digit DCM indicates the setting load current which cab be from front panel setting or remote system setting.

3.1.13.1 In Constant Current mode:
The High/Low level load current value can be preset at lower 5 digit LCD display, the unit is "A", the "A" LED will be lit as well.

3.1.13.2 In Dynamic load mode:
The Thigh/Tlow parameters value of High/Low load current duration and Rise/Fall setting can be displayed on the lower 5 digit LCD display, the unit is "mS", the "mS" LED will be lit as well.

3.1.13.3 In Constant Resistance mode:
The High/Low level load resistance value can be preset on the lower 5 digit LCD display, the engineering unit is "Ω", the "Ω" LED will be lit as well.

3.1.13.4 In Constant Voltage mode:
The High/Low level load voltage value can be preset on the upper 5 digit LCD display, the unit is "V", the "V" LED will be lit as well.

3.1.13.5 In Constant Power mode:
The High/Low level load power value can be preset on the upper 5 digit LCD display, the unit is "W", the "W" LED will be lit as well.

3.1.14 Limit key and LED

In the 33501 series electronic load module, the Limit key setting includes the GO/NG check of Digital Voltage meter Upper/Lower limit, Current meter Upper/Lower limit, and Watt meter Upper/Lower limit within the Limit key setting. The setting sequence is shown below:

OFF → DVM Upper/Lower limit → DAM Upper/Lower limit → DWM Upper/Lower limit → GO/NG check ON/OFF → OF F→ Repeat

3.1.15 DYN setting key and LED

DYN setting key is setting Dynamic Mode parameter, There are rise, fall, Thigh and Tlow parameters, Setting the parameter is rotating the knob switch. Press any key to escape the DYN parameters setting mode.

3.1.15.1 Press DYN setting key, LED will ON

3.1.15.2 Setting level High Period, Middle 5 digit LCD display will show “T-Hi” Lower 5 digit LCD display will show setting value，the unit is “ms”.

3.1.15.3 Setting level Low period, Middle 5 digit LCD display will show “T-Lo”, Lower 5 digit LCD display will show setting value，the unit is “ms”.

3.1.15.4 Setting ries time，Middle 5 digit LCD display will show ”RISE”, Lower 5 digit LCD display will show setting value，the unit is “mA/μs” or “A/uS”.

3.1.15.5 Setting fall time，Middle 5 digit LCD display will show ”FALL”, Lower 5 digit LCD display will show setting value，the unit is “mA/μs” or “A/uS”.

3.1.16 Config key and LED

The Config key setting includes the Sense AUTO/ON, Load ON/OFF voltage and Load Polarity. The setting sequence is shown delow.

OFF → SENSE AUTO/ON → Load ON/OFF Voltage → Polarity setting → OF F→ Repeat

3.1.17 SHORT key and LED

3.1.17.1 Short test function Enable/Disable Key.
Press “ SHORT” key to enable the short test function and the indicator LED is lit on. The LCD display show “SHORT” on upper 5 digits LCD display, shows “PRESS” on middle 5 digits LCD display and shows “START” on lower 5 digits LCD display.

3.1.17.2 Short test function parameter setting key.
There are 3 parameter for the SHORT test function. The parameter as TIME, V-Hi and V-Lo.Press “SHORT” key again to set short test time when SHORT test function is enabled. Press SHORT key again to next parameter by the sequence of TIME, V-Hi, V-Lo and disable, press another key to exit the setting and save the setting. The short test parameter description as following.

3.1.17.3 TIME : setting the short test time, The LCD display shows “SHORT”, “TIME” and CONTI(initial) from upper to lower 5 digits LCD display, the setting range is “CONTI” means continue, 400mS to 9999mS step 200mS by clockwise rotate the setting knob.
The short test will be no time limitation when setting to CONTI until press “START/STOP” key to stop the short test.

3.1.17.4 V-Hi : Short test voltage check upper limitation setting, The LCD display shows “SHORT”, “V-Hi” and 0.00V(initial) from upper to lower 5 digits, the V-Hi setting range from 0.00 to 60.00 step 0.01V by rotating the setting knob.

3.1.17.5 V-Lo : Short test voltage check lower limitation setting, The LCD display shows “SHORT”, “V-Lo” and 0.00V(initial) from upper to lower 5 digits, the V-Hi setting range from 0.00 to 60.00 step 0.01V by rotating the setting

knob.

Note. The V-Hi and V-Lo parameter is difference with the V-Hi and V-Lo in the LIMITfunction.

3.1.17.6 START/STOP Test key.
Press START/STOP key to start or stop the short test by SHORT test setting parameter when SHORT test function is enabled.

The Load will goes to “ON” automatically when press START/STOP key to start the short test and the Load will goes to “OFF” automatically when press START/STOP key to stop the short test. The Load will stay to “ON” If load was “ON” before short test.

The SHORT test function for test the UUT’s short protection, The SHORT test will sink load’s full scale current until to fit in with the test condition, and the UUT’s drop voltage is between V_Hi and V_Lo limitation, then lower 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

Press any key to goes to normal mode of LCD display.

3.1.18 OPP key and LED

3.1.18.1 OPP test function Enable/Disable Key.

Press “ OPP” key to enable the OPP test function and the indicator LED is lit on. The LCD display show “OPP” on upper 5 digits LCD display, shows “PRESS” on middle 5 digits LCD display and shows “START” on lower 5 digits LCD display.

3.1.18.2 OPP test function parameter setting key.

There are 4 parameter for the OPP test function. The parameter as PSTAR, PSTEP, PSTOP and Vth.
Press “OPP” key again to set OPP test parameter PSTAR(start power point) When OPP test function is enabled. Press OPP key again to next parameter by the sequence of PSTEP, PSTOP, Vth and disable, press another key also can to exit the setting and save the setting. The OPP test parameter description as following.

3.1.18.3 PSTAR : setting the start power, The LCD display shows “OPP”, “PSTAR” and 0.00WI(initial) from upper to lower 5 digits LCD display, the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.

3.1.18.4 PSTEP : setting the increment step power, The LCD display shows “OPP”, “PSTEP” and 0.00WI(initial) from upper to lower 5 digits LCD display, the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.

3.1.18.5 PSTOP : setting the stop power, The LCD display shows “OPP”, “PSTOP” and 2400WI(33501 initial) from upper to lower 5 digits LCD display, the

setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.

3.1.18.6 Vth : Setting threshold voltage; The LCD display shows “OPP”, “Vth” and 0.50VI(initial) from upper to lower 5 digits LCD display, the setting range is 0.00V to the full scale of the Voltage specification. The setting is by rotating the setting knob.

3.1.18.7 START/STOP Test key.

Press START/STOP key to start or stop the OPP test by OPP test setting parameter when OPP test function is enabled.

The Load will goes to “ON” automatically when press START/STOP key to start the OPP test and the Load will goes to “OFF” automatically when press START/STOP key to stop the OPP test. The Load will stay to “ON” If load was “ON” before OPP test.

The OPP test function for test the UUT’s over power protection, The OPP test will start sink current from PSTART to increase PSTEP current until the UUT’s output voltage drop-out lower than the threshold voltage(V-th setting), and the OPP trip point is between P_Hi and P_Lo limitation, then lower 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

Press any key to goes to normal mode of LCD display.

3.1.19 OCP key and LED

3.1.19.1 OCP test function Enable/Disable Key.

Press “ OCP” key to enable the OCP test function and the indicator LED is lit on. The LCD display show “OCP” on upper 5 digits LCD display, shows “PRESS” on middle 5 digits LCD display and shows “START” on lower 5 digits LCD display.

3.1.19.2 OCP test function parameter setting key.

There are 4 parameter for the OCP test function. The parameter as ISTAR, ISTEP, ISTOP and Vth.

Press “OCP” key again to set OCP test parameter ISTAR(start current point) When OCP test function is enabled. Press OCP key again to next parameter by the sequence of ISTEP, ISTOP, Vth and disable, press another key also can to exit the setting and save the setting. The OCP test parameter description as following.

3.1.19.3 ISTAR : setting the start current point, The LCD display shows “OCP”, “ISTAR” and 0.000AI(initial) from upper to lower 5 digits LCD display, the setting range is 0.000A to the full scale of the CC mode specification. The setting is by rotating the setting knob.

3.1.19.4 ISTEP : setting the increment step current point, The LCD display shows “OCP”, “ISTEP” and 0.000AI(initial) from upper to lower 5 digits LCD display, the setting range is 0.000A to the full scale of the CC mode specification. The setting is by rotating the setting knob.

3.1.19.5 ISTOP : setting the stop current point, The LCD display shows “OCP”, “ISTOP” and 240.0AI(33501 initial) from upper to lower 5 digits LCD display, the setting range is 0.000A to the full scale of the CC mode specification. The setting is by rotating the setting knob.

3.1.19.6 Vth : Setting threshold voltage; The LCD display shows “OCP”, “Vth” and 0.50VI(initial) from upper to lower 5 digits LCD display, the setting range is

0.00V to the full scale of the Voltage specification. The setting is by rotating the setting knob.

3.1.19.7 START/STOP Test key.
Press START/STOP key to start or stop the OCP test by OCP test setting parameter when OCP test function is enabled.

The Load will goes to “ON” automatically when press START/STOP key to start the OCP test and the Load will goes to “OFF” automatically when press START/STOP key to stop the OCP test. The Load will stay to “ON” If load was “ON” before OCP test.

The OCP test function for test the UUT’s over current protection, The OCP test will start sink current from I-START to increase ISTEP current until the UUT’s output voltage drop-out lower than the threshold voltage(V-th setting), and the OCP trip point is between A_Hi and A_Lo limitation, then lower 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

Press any key to goes to normal mode of LCD display.

3.1.20 START/STOP key

3.1.20.1 Press START/STOP key to start or stop the short test by SHORT、OCP & OPP test setting parameter when SHORT、OCP & OPP test function is enabled.

3.1.20.2 The Load will goes to “ON” automatically when press START/STOP key to start the short test and the Load will goes to “OFF” automatically when press START/STOP key to stop the short test. The Load will stay to “ON” If load was “ON” before short test.

3.1.20.3 The SHORT、OCP & OPP test function for test the UUT’s short protection, The SHORT、OCP & OPP test will sink load’s full scale current(3311D 60A) until to fit in with the test condition, and the UUT’s drop voltage is between V_Hi and V_Lo limitation, then lower 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

Press any key to goes to normal mode of LCD display.

3.1.21 Knob and CLICK key

3.1.21.1 Clockwise：Increasing value or switch ON / OFF

3.1.21.2 Anti-clockwise：Decreasing value or switch ON / OFF

3.1.21.3 CLICK：click the knob switch can shift left or shift right the setting cursor.

3.1.22 +/- DC INPUT Terminal.

The positive and negative terminal of load input connector, it should connect to the positive and ground output for a positive output power supply, or the ground and negative output for a negative output power supply respectively.

Please take care of the voltage and current rating not to excess the maximum rating of each 33501 series load module. Please check the polarity of DC input connection also before testing.

3.1.23 V-sense input terminal

To measure the specific voltage points through the V-sense input terminal, refer Fig 3-3 for detail application information.

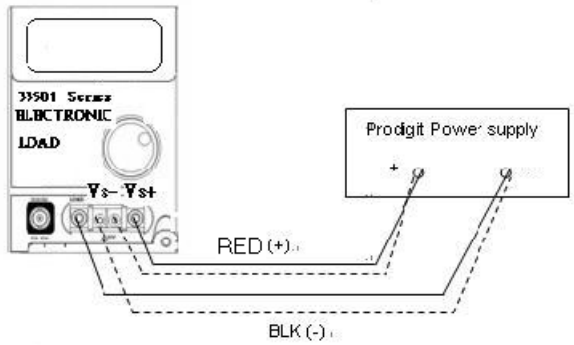


Fig 3-3 Remote sense connection on front panel(when current ≦60A)

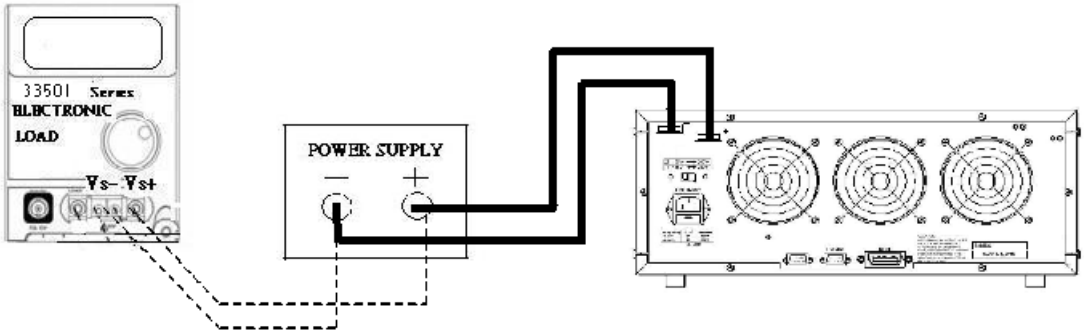


Fig 3-4 Remote sense connection on rear panel(When current >60A)

3.1.24 I-monitor

The I-monitor analog signal is proportional to the load current flow through the electronic load module.
This is virtual isolated to the Load input, it provides the load current waveform output to an oscilloscope to evaluate the voltage and current waveform of a power supply under test.
Note : Don ‘t use Imonitor with different channel to avoid common ground problem.

Please refer chapter 1, Table 1-1 for voltage /current relationship of each 33501 series module.

3-2. Initial setting of 33501 series load module

When you receive the 33501 series electronic load, the load value initial setting after power ON is listed in table 3-1~3-5 respectively, this is the factory or initial setting.

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	937.5 Ω	AH	240.00 A
CR L	937.5 Ω	AL	0.000 A
CV H	60.00 V	WH	2400.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	1 A/uS	LD-OFF	0.0 V
RISE	1 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-1 33501 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	937.5 Ω	AH	240.00 A
CR L	937.5 Ω	AL	0.000 A
CV H	60.00 V	WH	3600.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	1 A/uS	LD-OFF	0.0 V
RISE	1 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-2 33511 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	468.7 Ω	AH	480.00 A
CR L	468.7 Ω	AL	0.000 A
CV H	60.00 V	WH	2400.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	2 A/uS	LD-OFF	0.0 V
RISE	2 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-3 33521 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	468.7 Ω	AH	480.00 A
CR L	468.7 Ω	AL	0.000 A
CV H	60.00 V	WH	3600.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	2 A/uS	LD-OFF	0.0 V
RISE	2 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-4 33531 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	312.4 Ω	AH	720.00 A
CR L	312.4 Ω	AL	0.000 A
CV H	60.00 V	WH	3600.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	3 A/uS	LD-OFF	0.0 V
RISE	3 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-5 33541 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	625 Ω	AH	360.00 A
CR L	625 Ω	AL	0.000 A
CV H	60.00 V	WH	5400.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	1.5 A/uS	LD-OFF	0.0 V
RISE	1.5 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-6 33512 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	468.7 Ω	AH	480.00 A
CR L	468.7 Ω	AL	0.000 A
CV H	60.00 V	WH	7200.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	2 A/uS	LD-OFF	0.0 V
RISE	2 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-7 33513 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	375 Ω	AH	600.00 A
CR L	375 Ω	AL	0.000 A
CV H	60.00 V	WH	9000.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	2.5 A/uS	LD-OFF	0.0 V
RISE	2.5 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-8 33514 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	312.3 Ω	AH	720.00 A
CR L	312.3 Ω	AL	0.000 A
CV H	60.00 V	WH	10800.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	3 A/uS	LD-OFF	0.0 V
RISE	3 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-9 33515 initialize

項 目	起始值	項 目	起始值
CC L	0.0000 A	VH	60.00 V
CC H	0.0000 A	VL	0.000 V
CR H	312.3 Ω	AH	720.00 A
CR L	312.3 Ω	AL	0.000 A
CV H	60.00 V	WH	5400.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	3 A/uS	LD-OFF	0.0 V
RISE	3 A/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-10 33532 initialize

項 目	起始值	項 目	起始值
CC L	0.000 A	VH	60.00 V
CC H	0.000 A	VL	0.000 V
CR H	234.3 Ω	AH	960.0 A
CR L	234.3 Ω	AL	0.000 A
CV H	60.00 V	WH	7200.0 W
CV L	60.00 V	WL	0.000 W
CP L	0.000W	SENSE	Auto
CP H	0.000W	LD-ON	0.1 V
FALL	4000 mA/uS	LD-OFF	0.0 V
RISE	4000 mA/uS	RANGE	AUTO
T HI	0.05 mS		
T L0	0.05 mS		

Table 3-11 33533 initialize

3-3 Input terminal and wire consideration

The five ways connect the input wires to the Electronic load the connection methods are made as follow:

3.3.1 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 is less than 20A in this connection for the current rating of the plug is rated to 20A. The maximum wire gage AWG14 can be used in this application.

3.3.2 Spade terminals: The spade terminal provides a good contact to the binding post, it is recommended to use anytime. The maximum wire gage 10 can be used in this application.

3.3.3 Insert the wire into the input terminal: This is the most convenient way to connect the load input and D.U.T. The maximum wire gage AWG14 can be used in this application.

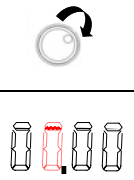
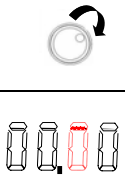
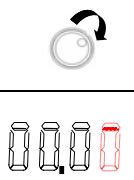
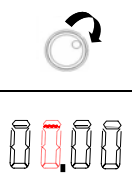
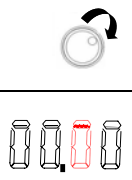
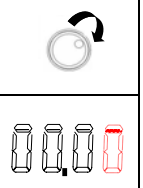
3.3.4 Both plug connectors and spade terminals:
It is recommended to use when input current is greater than 20A or long lead wires.

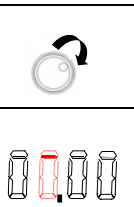
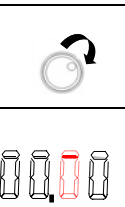
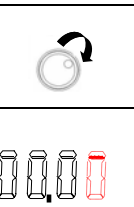
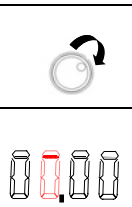
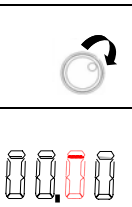
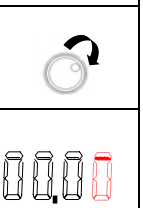
3.3.5 Both plug connectors and Insert the wire into the input terminal.
It is recommended to use when input current is greater than 20A or long lead wires.
A major consideration in making input connection is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires should be large enough

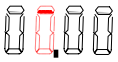
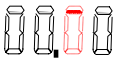
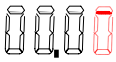
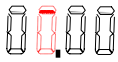
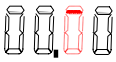
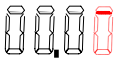
to limit the voltage drop to less than 0.5V per lead.

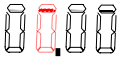
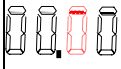
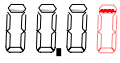
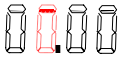
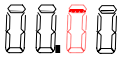
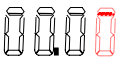
3-4. Load current course/fine increase/decrease adjustment knob

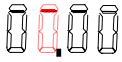
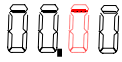
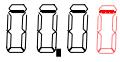
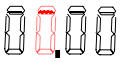
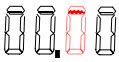
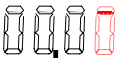
Change amount that CC/CR/CV/CP MODE(CR contrary) load current adjusts form Table 3-7 shows analyzes one degree of relations with knobing. Push the knob when operate (the figure will glimmer), can enter one and analogize , rotate increment right or rotate decrement left, will continue increasing or reducing and reach the minimum value or the maximum to establish constantly to adjust in load current, or the knob no longer continues rotating in the way.

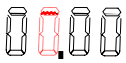
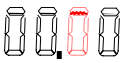
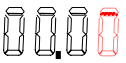
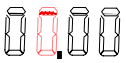
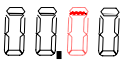
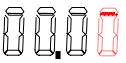
33501		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		24A			240 A		
CURRENT METER	RANGE	240.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD CURRENT ADJUSTMENT Knob							
CC Mode		640mA	64mA	6.4mA	6.4A	640mA	64mA
CR Mode		106.6ms	10.66ms	1.066ms	6.7mΩ	0.67mΩ	0.067mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		64W	6.4W	0.64W	64W	6.4W	0.64W

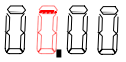
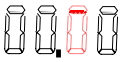
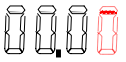
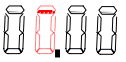
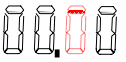
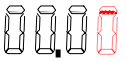
33511		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		24A			240 A		
CURRENT METER	RANGE	240.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD CURRENT ADJUSTMENT Knob							
CC Mode		640mA	64mA	6.4mA	6.4A	640mA	64mA
CR Mode		106.6ms	10.66ms	1.066ms	6.7mΩ	0.67mΩ	0.067mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		96W	9.6W	0.96W	96W	9.6W	0.96W

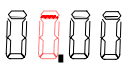
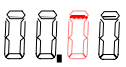
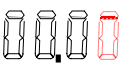
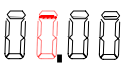
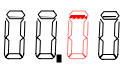
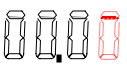
33521		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		48A			480 A		
CURRENT METER	RANGE	480.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT Knob							
CC Mode		1.28A	128mA	12.8mA	12.8A	1.28A	128 mA
CR Mode		213.3ms	21.33ms	2.133ms	3.3mΩ	0.33mΩ	0.033mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		64W	6.4W	0.64W	64W	6.4W	0.64W

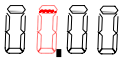
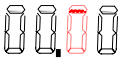
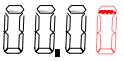
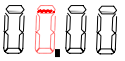
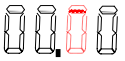
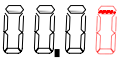
33531		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		48A			480 A		
CURRENT METER	RANGE	480.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT Knob							
CC Mode		1.28A	128mA	12.8mA	12.8A	1.28A	128 mA
CR Mode		213.3ms	21.33ms	2.133ms	3.3mΩ	0.33mΩ	0.033mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		96W	9.6W	0.96W	96W	9.6W	0.96W

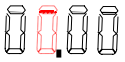
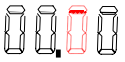
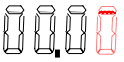
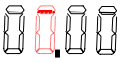
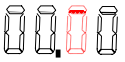
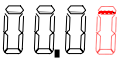
33541		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		72A			720 A		
CURRENT METER	RANGE	720.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT Knob							
CC Mode		1.92A	192mA	19.2mA	19.2A	1.92A	192mA
CR Mode		320ms	32ms	3.2ms	2.2mΩ	0.22mΩ	0.022mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		96W	9.6W	0.96W	96W	9.6W	0.96W

33512		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		36A			360 A		
CURRENT METER	RANGE	360.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		960mA	96mA	9.6mA	9.6A	960mA	96mA
CR Mode		106.66ms	10.666ms	1.066ms	6.7mΩ	0.67mΩ	0.067mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		144W	14.4W	1.44W	144W	14.4W	1.44W

33513		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		48A			480 A		
CURRENT METER	RANGE	480.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		1.28A	128mA	12.8mA	12.8A	1.28A	128 mA
CR Mode		213.3ms	21.33ms	2.133ms	3.3mΩ	0.33mΩ	0.033mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		192W	19.2W	1.92W	192W	19.2W	1.92W

33514		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		60A			600 A		
CURRENT METER	RANGE	600.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		1.6A	160mA	16mA	16A	1.6A	160mA
CR Mode		266ms	26.6ms	2.66ms	2.6mΩ	0.26mΩ	0.026mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		240W	24W	2.4W	240W	24W	2.4W

33515		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		72A			720 A		
CURRENT METER	RANGE	720.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		1.92A	192mA	19.2mA	19.2A	1.92A	192mA
CR Mode		320ms	32ms	3.2ms	2.2mΩ	0.22 mΩ	0.022mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		288W	28.8W	2.88W	288W	28.8W	2.88W

33532		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		72A			720 A		
CURRENT METER	RANGE	720.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		1.92A	192mA	9.2mA	19.2A	1.92A	192mA
CR Mode		320ms	32ms	3.2ms	2.2mΩ	0.22 mΩ	0.022mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		144W	14.4W	1.44W	144W	14.4W	1.44W

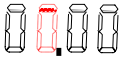
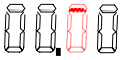
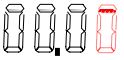
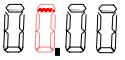
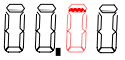
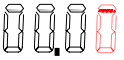
33533		RANGE I			RANGE II		
FULL SCALE LOAD CURRENT		96A			960 A		
CURRENT METER	RANGE	960.0 A					
	RESOLUTION	0.1 A					
COURSE/FINE LOAD							
CURRENT ADJUSTMENT KEY							
CC Mode		2.56A	256mA	25.6mA	25.6A	2.56A	256mA
CR Mode		426.6ms	42.66ms	4.266ms	1.6mΩ	0.16 mΩ	0.016mΩ
CV Mode		1.6V	0.16V	0.016V	1.6V	0.16V	0.016V
CP Mode		192W	19.2W	1.92W	192W	19.2W	1.92W

Table 3-12 the resolution of range I/II vs. Course/Fine load setting Key

3-5. I-monitor

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

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

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

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

3-6. Protection features

The 33501 Series Electronic load modules include the following protection features:

3-6-1 Over voltage
3-6-2 Over current
3-6-3 Over power
3-6-4 Over temperature
3-6-5 Reverse Polarity

The Over voltage protection circuit is set at a predetermined voltage (63V for 33501) which can not be changed. If the Over voltage circuit has tripped, it Electronic load input turns OFF immediately to protect the abnormal condition.

When the Over voltage condition is occurred, the Digital Current Meter's LCD display will indicate " OVP ".

CAUTION : Never apply the AC line voltage or input voltage excised than 60V, or it may cause damage of the electronic load module.

The 33501 Series Electronic load can monitor the power dissipation of the load module, when the power dissipation is greater than 105% of rate power input, the load module will turn load to OFF state internally.

When the Over power condition is occurred, the Digital Current Meter's LCD display will indicate " OPP ".

As soon as the temperature of 33501 Series heat sink greater than 85 degree, the Over temperature protection is occurred, the Digital Current Meter's LCD display will indicate " OtP " at same time, the 33501 Series Electronic Load will turn load to OFF state internally.
Please check the environment condition such as the ambient temperature and distance between the rear panel of Electronic load mainframe and wall is greater than 15cm.

The 33501 Series Electronic load can reset the Over voltage, Over correct, Overpower and over temperature protection if the protection condition is removed and press the " LOAD " key to " ON " state.

The 33501 electronic load conducts reverse current when the polarity of the DC source connection is incorrect. The maximum reverse current is 240A for 33501. If the reverse current excesses the maximum reverse current, it may cause damage of the 33501 Electronic Load.

When the reverse condition ，the reverse current is displayed on the 4 1/2 digit Current Meter on the front panel, and the 4 1/2 digit DCM indicates negative current reading, whenever the reverse current is displayed on the current meter, turn OFF power to the DC source and make the correct connections.

Chapter 4 GPIB/RS-232 programming operation

4-1. Introduction

The rear panel GPIB/RS-232 interface of 33501 Series electronic load is designed to connect PC (Personal Computer) or NOTEBOOK PC with GPIB interface, the NOTEBOOK PC acts as a remote controller of 33501 Electronic Load.

This feature can be used as an automatic load/cross load regulation and centering voltage testing for a switching power supply or a rechargeable battery charge/discharge characteristic testing. The function capability of rear panel GPIB interface not only can set the load level and load status, but also can read back the load voltage and load current.

4-2. The summary of RS-232 interface and command

The following RS-232 commands are same as GPIB commands. The RS-232 protocol in 33501 electronic load is listing below:

Baud-rate	: 9600
Parity	: none
Data bit	: 8 bits
Stop bit	: 1 bit
Command delay time	: 20 mSec.

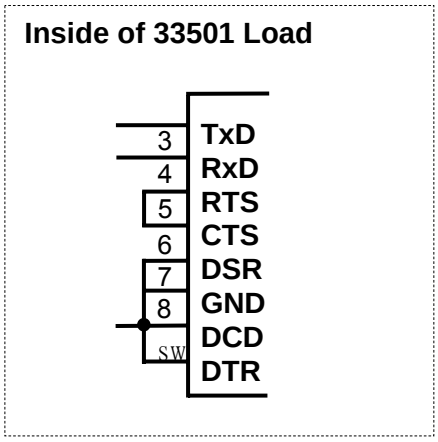


Figure 4-1.A

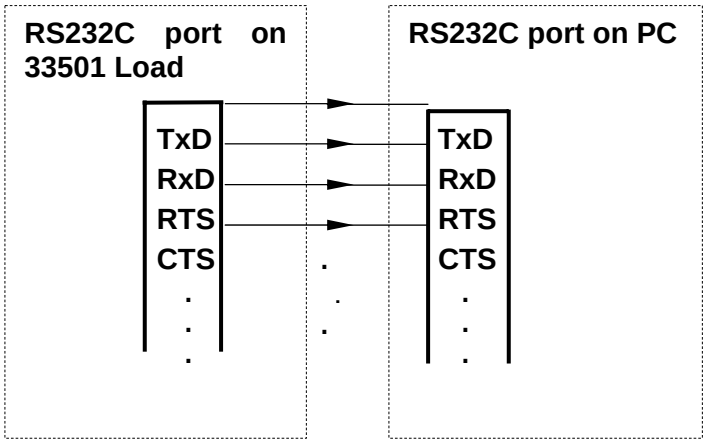


Figure 4-1.B

Fig 4-1 RS-232 INTERFACE DIAGRAM

4-3. GPIB/RS-232 COMMAND LIST

SETTING COMMAND		
Function	Command	Format
SET VOLTAGE	VOLT：{LOW|HIGH}{SP}{NR2}{；|NL}	
SET PERD	PERD：{LOW|HIGH}{SP}{NR2}{；|NL}	
SET RISE SLEW-RATE	RISE{SP}{NR2}{；|NL}	
SET FALL SLEW-RATE	FALL{SP}{NR2}{；|NL}	
SET SHORT ON/OFF	SHOR{SP}{0|1|OFF|ON}{；|NL}	
SET DYNAMIC ON/OFF	DYN{SP}{0|1|LOW|HIGH}{；|NL}	
SET CURRENT	CURR：{LOW|HIGH}{SP}{NR2}{；|NL}	NR2：###.####
SET RESISTANCE	RES：{LOW|HIGH}{SP}{NR2}{；|NL}	
SET LOAD ON/OFF	LOAD{SP}{0|1|OFF|ON}{；|NL}	
SET LEVEL LOW/HIGH	LEV{SP}{0|1|LOW|HIGH}{；|NL}	
SET PRESENT ON/OFF	PRES{SP}{0|1|OFF|ON}{；|NL}	
SET MODE	MODE{SP}{0|1|2|3|CC|CR|CV|CP}{；|NL}	
SET STORE STATE	STORE{SP}{m}{；|NL}	m：1 ～ 5
SET RECALL STATE	RECALL{SP}{m}{；|NL}	m：1 ～ 5
SET LEV STATE	LEV{SP}{0|1|LOW|HIGH}{；|NL}	
SET LOAD ON VOLTAGE	LDONv{SP} {NR2} { ；| NL}	
SET LOAD OFF VOLTAGE	LDOFfv{SP} {NR2} { ；| NL}	
SET POWER STATE	CP：{HIGH| LOW} {SP} {NR2}{ ；| NL}	
SET CURRENT LIMIT STATE	LIMIT：Current:{HIGH| LOW}{SP}{NR2}{ ；| NL}	
SET POWER LIMIT STEATE	LIMIT：Power：{HIGH| LOW}{SP}{NR2}{ ；| NL}	
SET VOLTAGE LIMIT STATE	LIMIT ： Voltage ： {HIGH | LOW}{SP}{NR2}{ ；	
SET SENSE ON/OFF	SENSE[SP]{ON/OFF}{;/NL}	
SET LOCAL STATE	LOCAL { ；| NL}	Only RS-232 command
SET REM STATE	REM { ；| NL}	Only RS-232 command

Table 4-1 GPIB/RS-232 SETTING COMMAND SUMMARY

REMARK:
1. d: 0 - 9
2. CURRENT ENGINEERING UNIT : A
3. VOLTAGE ENGINEERING UNIT : V
4. RESISTANCE ENGINEERING UNIT : Ω
5. PERIOD ENGINEERING UNIT : mS
6. SLEW-RATE ENGINEERING UNIT : A/uS

QUERY COMMAND		
Function	Command Syntax	ECHO
QUERY VOLTAGE	VOLT：{LOW|HIGH}？{；|NL}	±###.####
QUERY PERIOD	PERD：{LOW|HIGH}？{；|NL}	####.####
QUERY RISE SLEW-RATE	RISE？{；|NL}	#.####
QUERY FALL SLEW-RATE	FALL？{；|NL}	#.####
QUERY SHORT ON/OFF	SHOR？{；|NL}	1：ON, 0：OFF
QUERY DYNAMIC ON/OFF	DYN？{；|NL}	1：ON, 0：OFF
QUERY CURRENT	CURR：{LOW|HIGH}？{；|NL}	###.####
QUERY RESISTANCE	RES：{LOW|HIGH}？{；|NL}	###.####
QUERY LOAD ON/OFF	LOAD？{；|NL}	1：ON, 0：OFF
QUERY LEVEL A/B	LEV？{；|NL}	0：LOW, 1：HIGH
QUERY PRESET ON/OFF	PRES？{；|NL}	1：ON, 0：OFF
QUERY MODE CC/CR	MODE？{；|NL}	0：CC, 1：CR, 2：CV, 3：CP
QUERY NAME	NAME？{；|NL}	33501
QUERY PROTECT STATE	PROT？{；|NL}	0 ～ F(hex)
QUERY CURRENT METER	MEAS：CURR？{；|NL}	±###.####
QUERY VOLTAGE METER	MEAS：VOLT？{；|NL}	±##.####
QUERY POWER METER	MEAS：POW？{；|NL}	±##.####
QUERY LOAD ON VOLTAGE	LDONv{?}｛；|NL}	±###.####
QUERY LOAD OFF VOLTAGE	LDOFfv{?}{；|NL}	±##.####
QUERY POWER STATE	CP：{HIGH|LOW}{?}{；|NL}	±##.####
QUERY CURRENT LIMIT STATE	LIMIT：Current：{HIGH|LOW}{?}{；|NL}	±###.####
QUERY POWER LIMIT STATE	LIMIT：Power：{HIGH|LOW}{?}{；|NL}	±##.####
QUERY VOLTAGE LIMIT STATE	LIMIT：Voltage：{HIGH|LOW}{?}{；|NL}	
QUERY NG STATE	NG GOOD [?]{；|NL}	
QUERY SENSE STATE	SENES [?]{；|NL}	

Table 4-2 GPIB/RS-232 QUERY COMMAND SUMMARY

REMARK:

1. d: 0 - 9
2. CURRENT ENGINEERING UNIT：A
3. VOLTAGE ENGINEERING UNIT：V
4. RESISTANCE ENGINEERING UNIT：Ω
5. PERIOD ENGINEERING UNIT：mS
6. SLEW-RATE ENGINEERING UNIT：A/uS

4-4. The description of abbreviation

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

For Example：

80.12345, 5.0

The description of GPIB programming command syntax.

1. { }：The contents of the { } symbol must be used as a part or data of the GPIB command, it can not be omitted.
2. [ ] ：The contents of the [ ] symbol indicts the command can be used or not. It depends on the testing application.
3. | ：This symbol means option. For example〝A|B〞means it can only use A or B as the command, it can choose only one as the setting command.
4. Terminator：You have to send the program line terminator character after send the GPIB command, the available command terminator characters which can be accepted in mainframe is listed in Table 4-3.

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

Table 4-3 GPIB command terminator

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

5. Semicolon〝;〞：The semicolon〝;〞is a back-up command, the semicolon allows you to combine command statement on one line to create command message.

4-5. GPIB command description

1. Setting Command

CURR

Purpose：The load current setting in Constant Current mode.

Command syntax：CURR：{LOW|HIGH}{SP}{NR2}{NL}

Description：This command is used to set the load current level.

Note:

1. The load current data must include decimal point, otherwise this command is unable to execute. The effective load current level can be programmed is the sixth digit after the decimal point.
2. The HIGH load level load current MUST be higher than LOW level load current for proper dynamic waveform definition, the load current difference between programmed HIGH and LOW level is 10 times of resolution at each range, the 33501 Series Electronic Load will adjust and limit of the programmed values.
   If the programmed HIGH level is equal or less than LOW level, the 33501 Series load will adjust and limit HIGH level to be higher 10 times programming resolution of LOW level, and vice versa at the programmed LOW level is equal or more than HIGH level.
3. If the programming loads current level over the maximum specification at programmed range of 33501 Series load, the full-scale current will be sent to the load.
4. Please make sure range I/II command before execute the load current setting command, otherwise the 33501 Series load will adjust to fit the load current after programming the RANGE command.
5. LOW|HIGH option is for 33501 Series electronic load.
6. Engineering unit for load current is Amps.

For Example：

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

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

RES

Purpose：The load resistance setting in Constant Resistance mode.

Command syntax：RES：{LOW|HIGH|A|B}{SP}{NR2}{NL}

Description:

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

Note：

1. The load resistance data must include decimal point, otherwise this command is unable to execute. The most effective load resistance level can be set is the sixth digit after the decimal point.
2. The HIGH load level load resistance MUST be higher than LOW level load resistance for proper HIGH/LOW resistance level definition, the load resistance difference between programmed HIGH and LOW level is 10 times of resolution at each range, the 33501 Series Electronic Load will adjust and limit of the programmed values.
   If the programmed HIGH level is equal or less than LOW level, the 33501 Series load will adjust and limit HIGH level to be higher 10 times programming resolution of LOW level, and vice versa at the programmed LOW level is equal or more than HIGH level.
3. If the programming load resistance level over the maximum specification at programmed range of 33501 Series load, the full-scale resistance will be sent to the load.

4. Please make sure range I/II command before execute the load current setting command, otherwise the 33501 Series load current after programming the RANGE command.
5. LOW|HIGH option is for 33501 series electronic load module.
6. The engineering unit for load resistance is Ohms.

For Example：

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

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

LOAD

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

Command syntax：LOAD {SP}{0FF|ON}{NL}

Description：

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

LOAD OFF; the 33501 Series Electronic load at input OFF condition.

LOAD 1; set to LOAD ON status, this load is ready to sink current from power source.

LEV

Purpose：Select Low or High level in static mode.

Command syntax：[GLOB：] LEV {SP} {0|1|LOW|HIGH} {NL}

Description：

LEV LOW ; Set LOW current level in CC mode, LOW resistance level in CR mode, or LOW voltage level in CV mode, LOW resistance level in CP mode.

LEV 1 ; Set HIGH current level in CC mode, HIGH resistance level in CR mode, or HIGH voltage level in CV mode, HIGH resistance level in CP mode.

PRES

Purpose：Set the upper or lower 4 1/2 digit multi-function meter to display the programming load level.

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

Description：

PRES ON 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.

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

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

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

STORE

Purpose：STORE the load level and load status into the non-volatile memory.

Command syntax：STORE {SP} {1|2|3|4|5} {NL}

Description：

5 different states with load status and load current into the non-volatile memory.

Note:

The new load level and load status can overcome the load level and status if STORE new state number, because the memory location is the same for same STORE state number.

For Example：

STORE 1
STORE 5

RECALL

Purpose：Recall the state of load level and status which is stored by GPIB STORE command.

Command syntax：RECALL {SP} {1|2|3|4|5} {NL}

Description：

This command is used to recall the non-volatile memory state which is store into the memory by GPIB store command, up to 5 states can be recalled.

For Example：

1. RECALL 1
2. RECALL 4

VOLT

Purpose：The load voltage setting in Constant Voltage mode.

Command Syntax：VOLT :{ LOW|HIGH} {SP} {NR2} {NL}

Description：

This command is used to set the load voltage level.

Note:

1. The load voltage data must include decimal point, otherwise this command is unable to execute. The most effective load voltage level can be set is the sixth digit after the decimal point.
2. The HIGH load level load voltage MUST be higher than LOW level load voltage for proper HIGH/LOW voltage level definition, the load voltage difference between programmed HIGH and LOW level is 10 times of resolution, the 33501 Series Electronic Load will adjust and limit of the programmed values.
   If the programmed HIGH level is equal or less than LOW level, the 33501 Series load will adjust and limit HIGH level to be higher 10 times programming resolution of LOW level, and vice versa at the programmed LOW level is equal or more than HIGH level.
3. If the programming loads voltage level over the maximum specification at programmed range of 33501 Series load, the full-scale voltage will be sent to the load module.
4. The engineering unit for load voltage is Volts.

For Example：

VOLT: LOW 3.0 ; set LOW level load voltage to 3.0 V.
VOLT: HIGH 45.123456 ; set HIGH level load voltage to 45.123456 V.

PRED

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

Command Syntax：PRED：{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 is unable to execute.
The effective PERIOD LOW and HIGH can be programmed is the sixth digit a after the decimal point. If the programming period of Tlow and Thigh setting over the maximum specification at programmed range of 33501 Series load, the maximum duration of Tlow and Thigh will be sent to the load.

Please make sure the appropriate timer range before execute the load the PERD LOW or HIGH command, otherwise the 33501 Series load will adjust to fit the Tlow and Thigh ranges after programming the PERD LOW or HIGH command. The engineering unit for PERD LOW and HIGH are〝ms〞.

Note:

There are four timer ranges in the Tlow / T high generator to produce a wide period dynamic range, these ranges are adjusted by 33501 Series load automatically which depends on the programmed Tlow / Thigh range.

For Example：

PRED：LOW 0.125 ; PRED：HIGH 0.8
The above GPIB command set LOW / HIGH load duration's are 0.125 ms and 0.8 ms respectively.

RISE

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 33501 Series Electronic Load can be fully independent to the FALL slew rate.

The RISE load current slew rate data must include decimal point, otherwise this command is unable to execute.

The effective RISE load current slew rate can be programmed is the sixth digit after the decimal point. If the programming loads current level over the maximum specification at programmed range of 33501 Series electronic load, the fastest RISE slew rate will be sent to the load module.

Please make sure range I/II command before execute the load RISE slew rate setting command, otherwise the 33501 Series load will adjust to fit the RISE slew rate after programming the RISE command. The engineering unit for RISE slew rate is〝A/us〞.

For Example：

RISE 28.56; set RISE slew rate to 28.56 A/us.

FALL

Purpose：FALL load current slew rate setting.

Command Syntax：FALL {SP} {NR2} {NL}

Description：

The FALL load current slew rate of load level change or dynamic load can be programmed by FALL command. The FALL slew rate of 33501 Series Electronic Load can be fully independent to the RISE slew rate.

The FALL load current slew rate data must include decimal point, otherwise this command is unable to execute. The effective FALL load current slew rate can be programmed is the sixth digit after the decimal point. If the programming loads current level over the maximum specification at programmed range of 33501 Series load, the fastest FALL slew rate will be sent to the load module.

Please make sure range I/II command before execute the load FALL slew rate setting command, otherwise the 33501 Series load will adjust to fit the FALL slew rate after programming the FALL command.
The engineering unit for FALL slew rate is〝A/us〞.

For Example：

FALL 0.0448; set FALL slew rate to 0.0448 A/us.

SHOR

Purpose：Short the DC input of Electronic load.

Command syntax：SHOR {SP} {0|1|OFF|ON} {NL}

Description：

This command applies the short across the input of the electronic load. The maximum short resistance is 0.004, 0.002 and 0.0014 ohms for 33501 Series, Executing SHOR does not effect any programmed settings and the electronic load will return to them when the short is removed.

For Example：

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

DYN

Purpose：Set DYNamic ON or OFF command.

Command syntax：DYN {SP} {0|1|OFF|ON} {NL}

Description：

DYN OFF; set load to static load mode.
DYN 1 ; set load to dynamic load mode.

SENSE ON/OFF

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

Command syntax：[GLOB:]SENS {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 them when
The short is removed.

LOAD ON VOLTAGE Setting

Purpose: The Load ON voltage setting

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

Description:

The Load On voltage can be adjusted by the LDON command, the adjust range is 0.1～60.0 V (Res. = 0.1V), the load on voltage setting .The load will start to sink current if power Source output voltage is higher than load on voltage.

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

LOAD OFF VOLTAGE Setting

Purpose: The Load OFF voltage setting
Command Syntax: LDOF {SP} {NR2} {;|NL}
Description:
The Load OFF voltage can be adjusted by the LDOF command, the adjust range is 0.1～60V load on voltage (Res. = 0.1V), the load off voltage setting. The load will stop to sink Current if power source output voltage is lower than load off voltage.

LDOF 2.0; Set the load off voltage is 2.0V, the load will start to sink current when power Source output voltage is lower than 2.0V.

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 33501 series electronic load.

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〞.

For Example：
LIM: VOLT: LOW 1.0; to set the lower limit value of threshold voltage is 1.0 V.
LIM: VOLT: HIGH 60.00; to set the upper Limit vale of threshold voltage is 60.00V.

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〞.

For Example：
LIM: CURR: LOW: 0.05; to set the lower limit value of threshold current is 0.05A.
LIM: CURR: HIGH: 120.0; to the upper limit value of threshold current is 120.0A.

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〞.

For Example：

LIN: POW: LOW 1.493; to set the lower limit value of threshold power (W) is 1.493 W.
LIM: POW: HIGH 1200.0; to set the upper limit value of threshold power (W) is 1200.0 W.

2.Query Command

CURR

Purpose：The Constant Current mode's LOW or HIGH load current level query command.

Command syntax：CURR:{LOW|HIGH}?{NL}

Description：

CURR: LOW? ; return the presently programmed low load current level in Constant Current mode.

CURR: HIGH? ; return the presently programmed high load current level in Constant Current mode.

RES

Purpose：The Constant Resistance mode's LOW or HIGH load resistance level query command.

Command syntax：RES :{ LOW|HIGH}?{NL}

Description：

RES: LOW? ; return the presently programmed low load resistance level in Constant Resistance mode.

RES: HIGH? ; return the presently programmed high load resistance level in Constant Resistance mode.

POWER

Purpose：The Constant Resistance mode's LOW or HIGH load resistance level query command.

Command syntax：CP :{ LOW|HIGH}? {NL}

Description：

RES: LOW? ; return the presently programmed low load resistance level in Constant Power mode.

RES: HIGH? ; return the presently programmed high load resistance level in Constant Power mode.

LOAD

Purpose：LOAD ON or LOAD OFF status query command.

Command syntax：LOAD?{NL}

Description：

LOAD? ; return the presently load status, 〝0〞 indicates LOAD OFF, and 〝1〞 indicates LOAD ON.

LEV

Purpose：Static mode's LEVel low or high status query command.

Command syntax：LEV? {NL}

Description：

LEV? ; return the presently level status, 〝0〞 indicates LEVel LOW, and 〝1〞 indicates LEVEL HIGH.

PRES

Purpose：PRESet ON or OFF status query command.

Command syntax：PRES?{NL}

Description：

PRES? ; return the presently 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? ; return the presently operating mode status, 〝0〞 indicates CC MODE, 〝1〞 indicates CR MODE, and 〝2〞 indicates CV MODE, , and 〝3〞 indicates CP MODE CP MODE is available in 33501 electronic load.

NAME

Purpose：33501 Series Electronic Load module model number query command.

Command syntax：NAME?{NL}

Description：

NAME? ; return the activate Electronic Load channel's model number, "33501" indicate the activate Electronic Load is 33501 Series Electronic load respectively.

PROT

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

Command syntax：PROT? {NL}

Description：

PROT? ; return the presently protection status, the status byte register summarizes all of the protection status events from all status register. Table 4-4 describes the status byte the happened on the 33501 Series electronic load. The PROT status byte register is cleared when a CLER command clear all of the PROT and ERR status registers.

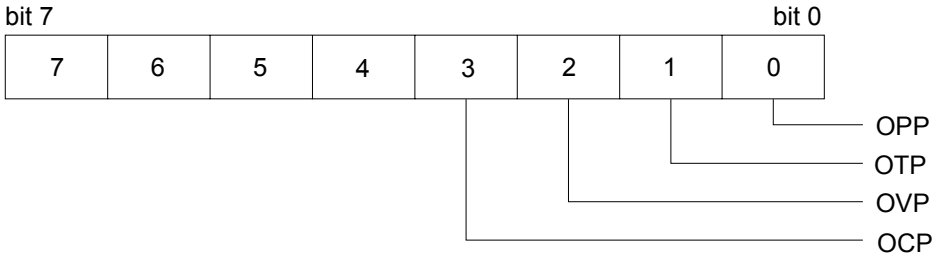


Table 4-4 PROT status byte register

MEAS：VLOT

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

Command syntax：MEAS：VOLT? {NL}

Description：

MEAS: VOLT? ; return the presently 4 1/2 digital voltage meter reading. The returned data format is shown in Table 4-2, the engineering unit is〝V〞.

MEAS：CURR

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

Command syntax：MEAS: CURR? {NL}

Description：

MEAS: CURR? ; return the presently 4 1/2 digital current meter reading. The returned data format is shown in Table 4-2, the engineering unit is〝A〞.

MEAS：POW

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

Command syntax：MEAS: POW? {NL}

Description：

MEAS: CURR? ; return the presently 4 1/2 digital current meter reading. The returned data format is shown in Table 4-2, the engineering unit is〝W〞.

VOLT

Purpose：The Constant Voltage mode's LOW or HIGH load voltage level query command.

Command syntax：VOLT :{ LOW|HIGH}? {NL}

Description：

VOLT: LOW? ; return the presently programmed low load voltage level in Constant Voltage mode.

VOLT: HIGH? ; return the presently programmed high load voltage level in Constant Voltage mode.

The returned data format is shown in Table 4-2, the engineering unit is "V".

PRED

Purpose：The dynamic mode's Tlow or Thigh duration query command

Command syntax：PRED :{ LOW|HIGH}?{NL}

Description：

PRED: LOW? ; Return the presently programmed low duration time in dynamic load mode.

PRED: HIGH? ; Return the presently programmed high duration time in dynamic load mode.

The returned data format is shown in Table 4-2, the engineering unit is〝ms〞.

RISE

Purpose：The dynamic load mode's RISE slew rate query command.

Command syntax：RISE? {NL}

Description：

RISE? ; return the presently programmed low load current level in Constant Current mode.

The returned data format is shown in Table 4-2, the engineering unit is〝A/us〞.

FALL
Purpose：The dynamic load mode's FALL slew rate query command.
Command syntax：FALL?{NL}
Description：
FALL? return the presently programmed low load current level in Constant Current mode. The returned data format is shown in Table 4-2, the engineering unit is〝A/us〞.

SHOR
Purpose：SHORt ON or OFF status query command.
Command syntax：SHOR?{NL}
Description：
SHOR? ; return the presently SHORt status, 〝0〞 indicates SHORt OFF, and 〝1〞 indicates SHORt ON.

DYN
Purpose：DYNamic ON or OFF status query command
Command syntax：DYN?{NL}
Description：
DYN? ; return the presently DYNamic ON or OFF status, 〝0〞 indicates static load mode or DYNamic OFF, and 〝1〞 indicates DYNamic load mode or DYNamic ON.

LOAD ON Voltage
Purpose：LOAD ON voltage level query command.
Command syntax：LDON? {;|NL}
Description：
LDON? return the presently programming load on voltage.

LOAD OFF Voltage
Purpose：LOAD OFF voltage level query command.
Command syntax：LDOF?{;|NL}
Description：
LDOF? return the presently programming load off voltage

SENSE ON/OFF
Purpose：To read the setting condition of Sense ON or OFF.
Command syntax：SENS?{；|NL}
Description：
SENS? Read back the setting condition of SENS. 〝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? Read back the lower limit set value of threshold voltage, unit is (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? Read back the lower limit set value of threshold current, unit is (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? Read back the lower limit set value of threshold power, unit is (W).

NG
Purpose：To read the set value of NG.
Command syntax：NG?{；|NL}
Description：
NG? Read 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.

Chapter 5 Applications

This chapter describes the application information of 33501 Series Electronic Load.

5-1. Local sense connections

Local sensing is used in application where lead lengths are relatively short, or where load regulation is not critical. The 4 1/2 digit voltage Meter of 33501 Series Electronic load measures the voltage of DC INPUT Terminal automatically; load leads should be bundled or tie-wrapped together to minimize inductance.

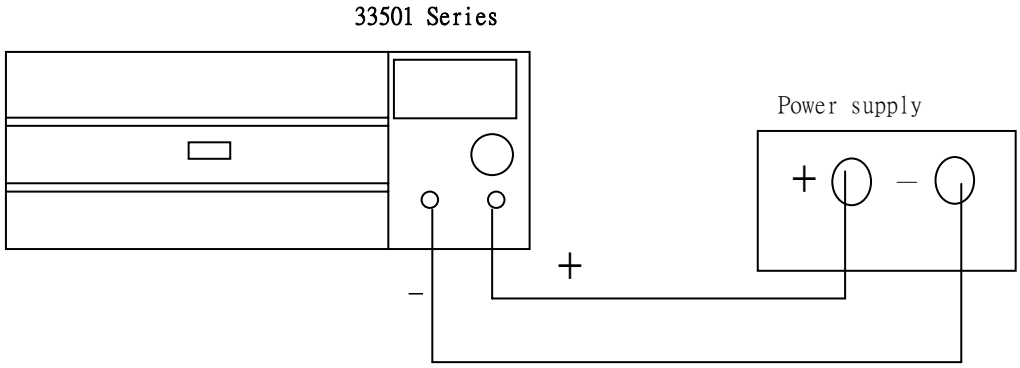


Fig 5-1 Local voltage sense connections

5-2. Remote sense connections

Fig 5-2 illustrates a typical set up with the electronic load connected for remote sense operation. The remote Vsense BNC cables 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 4 1/2 digit voltage Meter of 33501 Series electronic load measures the voltage of Vsense BNC input Terminal automatically, so the high accuracy 4 1/2 digit 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.

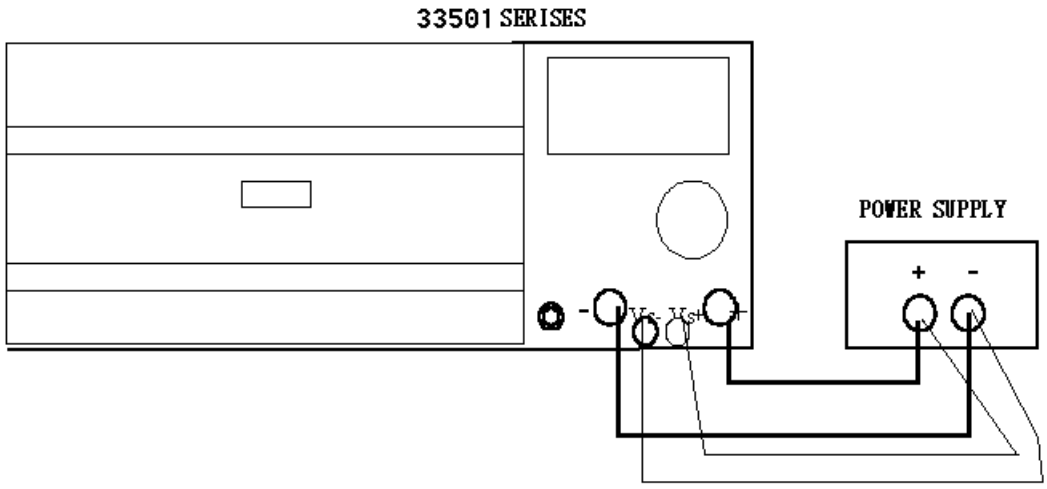


Fig 5-2 Remote voltage sense connections

5-3. Constant Current mode application

The Constant Current mode is very suitable to test the LOAD REGULATION, CROSS REGULATION, OUTPUT VOLTAGE and DYNAMIC REGULATION of the power supply testing, and test the DISCHARGE CHARACTERISTIC, LIFE CYCLE of the battery testing.

1.Static mode: (Fig 5-3)

Major application:

a. Voltage source testing.

b. Power supply load regulation testing

c. Battery discharge testing

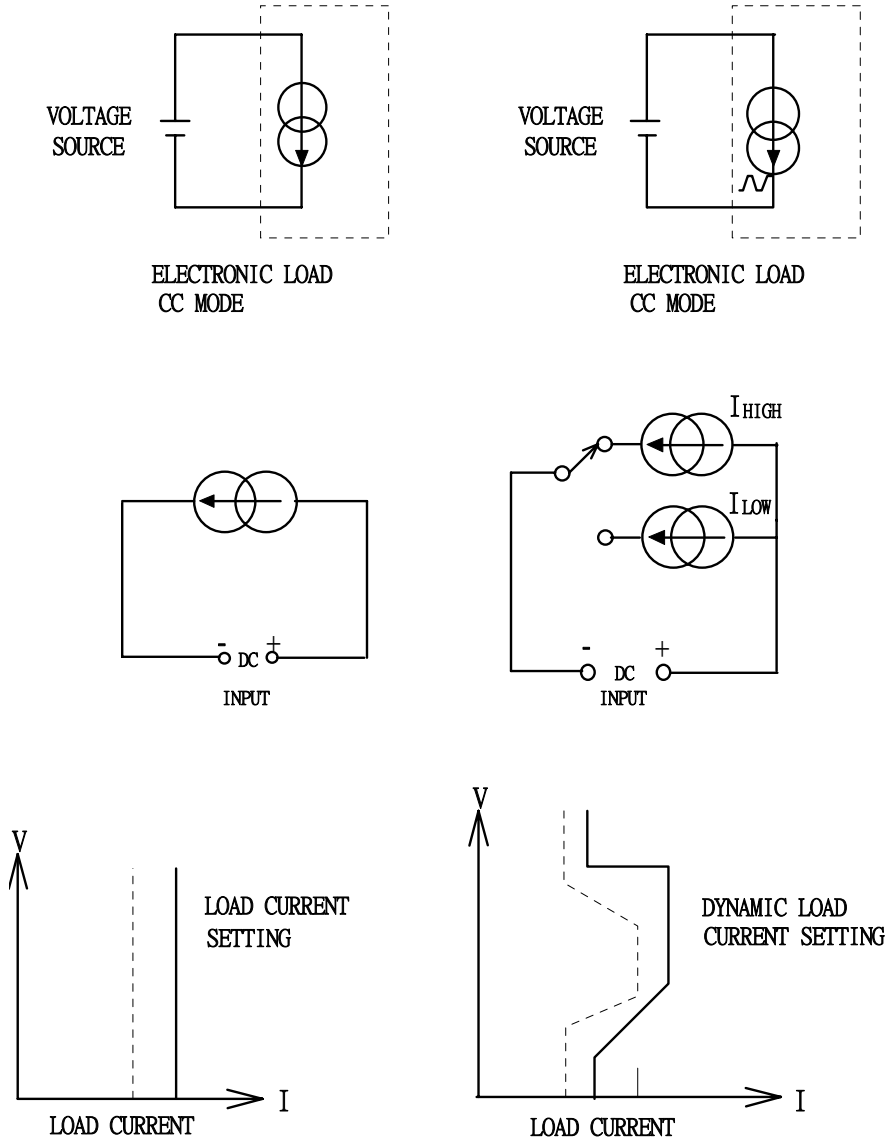


Fig 5-3 constant mode application

2. Dynamic mode:

I. Built-in Pulse generator: (Fig 5-4)
Major application:
a. Power supply load transient response testing
b. Power recovery time testing
c. Pulse load simulation
d. 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

ii.Analog programming input: (Fig 5-4)
Major application:
a. Simulate real load condition
b. Battery discharge testing

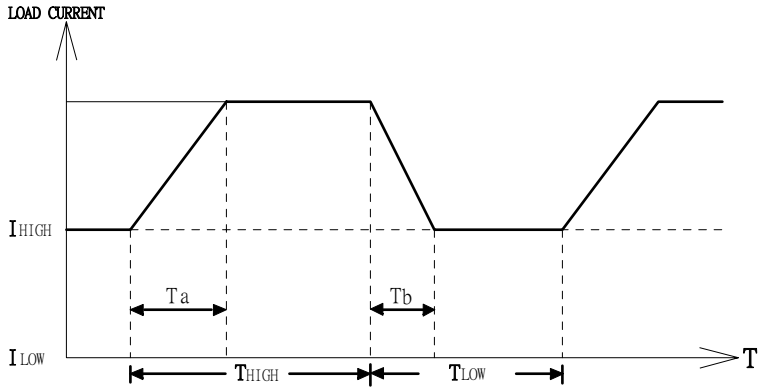


Fig 5-4 Dynamic load current with independent programmed Rise/Fall slew rate

5-4. Constant Voltage mode application

Major application:

a. Current source testing.

b. Power supply current limit characteristic testing

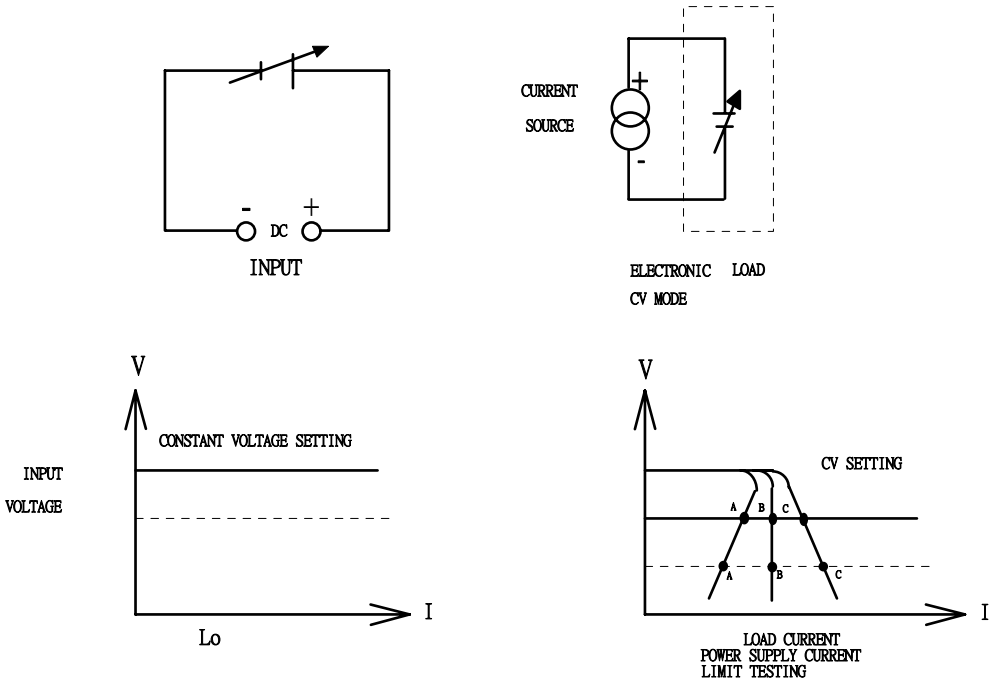


Fig 5-5 Constant Voltage mode application

5-5. Constant Resistance mode application

Major application:

a. Voltage source or Current source testing

b. Power resister simulation.

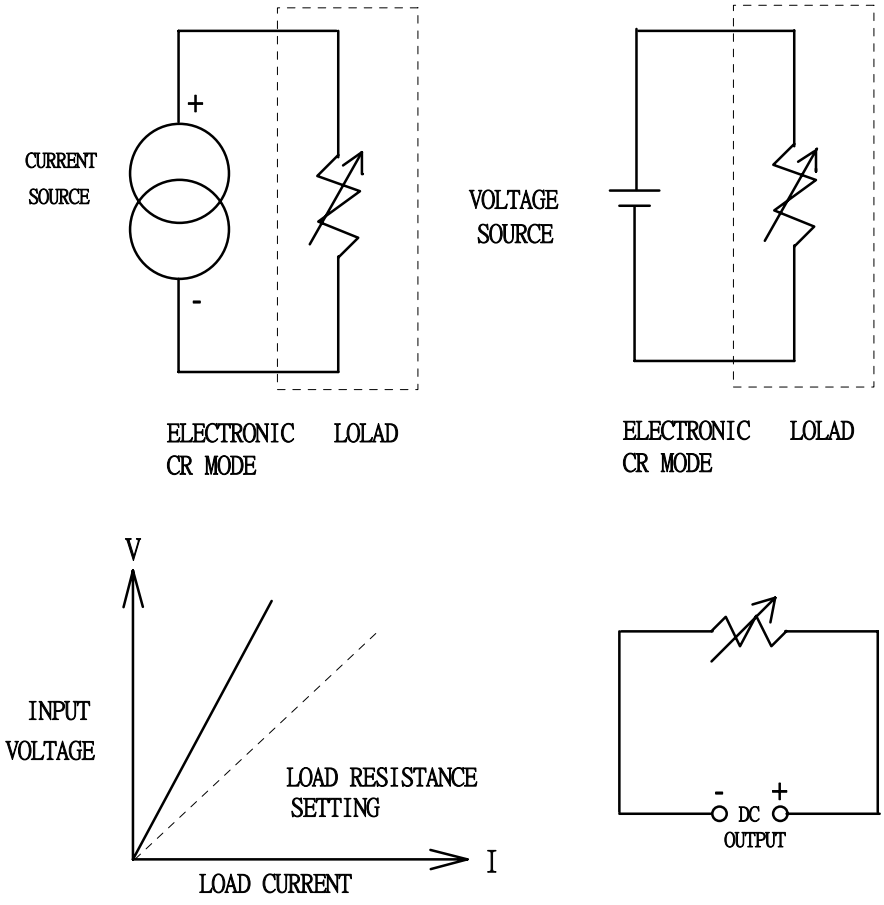


Fig 5-6 Constant Resistance mode Application

5-6. Constant current source operation

The Electronic load can also be used as a high current constant current source if the following connection is made. This function can be used as a battery charger or other application. It can also combine two or more modules as one unit by parallel connection for higher current operation.

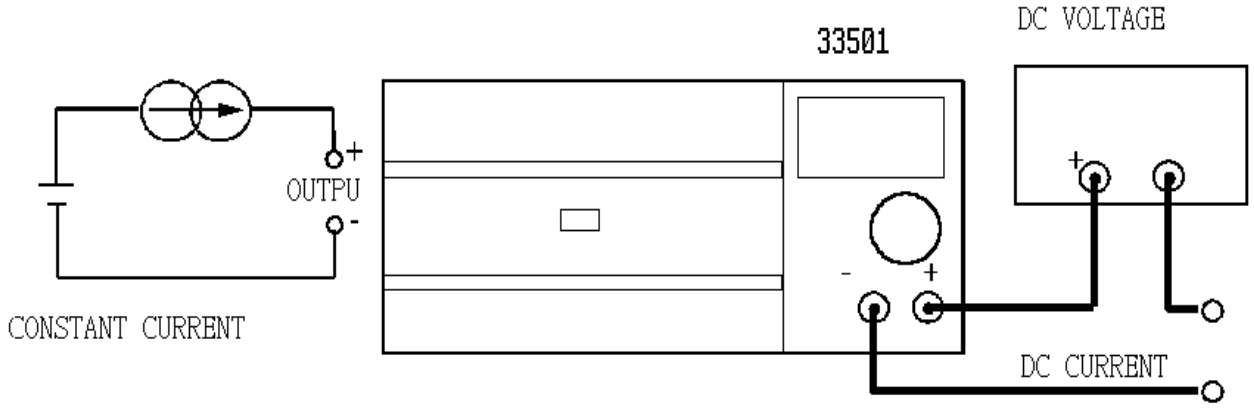


Fig 5-7 Constant current source connection

5-7. Zero-Volt loading application

As shown in Fig 5-8, the electronic load can be connected in series with a DC voltage source which output voltage greater than 5V. so that the device under test that are connected to the electronic load can be operated down to a Zero- Volt condition, the DC voltage source provides the minimum 5V operating voltage required by the Electronic load. This application is suitable for low voltage Battery cell with high discharge current testing.

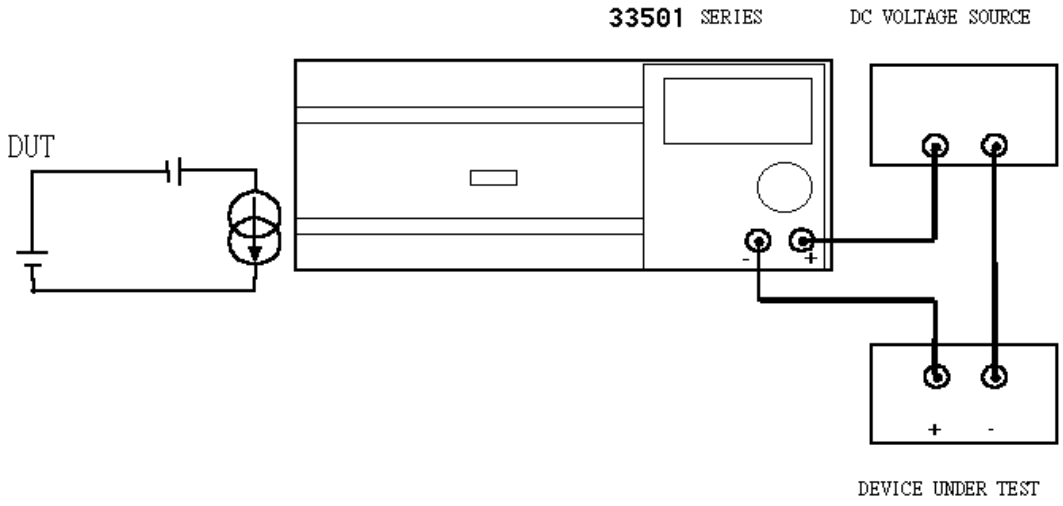


Fig 5-8 Zero-Volt loading connection