33401G Series
Plug-In Electronic
Load module
Operation manual

S/N:90033401G2 REV:D

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. PRODIGIT assumes no liability for the *customer's failure to comply with these requirements.*

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category I, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 80% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the ac power supply mains through a three conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired Fuses or short circuited fuse holder. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT EXCEED INPUT RATINGS.

This instrument may be equipped with a line filter to reduce electromagnetic interference and must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0 mA peak.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a PRODIGIT ELECTRONICS Sales and Service Office for service and repair to ensure that safety features are maintained.

Instruments which appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

PRODIGIT Instrument Professional	DECLARATION OF CONFORMITY	CE

Company Name: PRODIGIT ELECTRONICS CO., LTD
Address: 8/F,No.88, Baojhong Rd., Sindian District, New Taipei City,Taiwan.

Declares under sole responsibility that the product as originally delivered
Product Names: DC Electronic Loads
Model Numbers: 33401G, 33402G, 33403G, 3300G, 3302G, 3305G
(And other customized products based upon the above)
Product Options:
This declaration covers all options and customized products based on the above products.
Complies with the essential requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly.
EMC Information:
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:

Safety Information:
Safety standards following:
IEC 61010-1:2010

November,22, 2011
Date

Larsson Tsou / R&D Assistant Manager

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.

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.

33401G series module load operation manual

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Chapter 1 Introduction

1-1. General description

The 33401G of Electronic Load modules are designed to test and evaluate a wide range of DC Sources. They are often used in the burn-in and validation of DC power supplies and the testing of batteries. The 33401G of electronic load modules are operated from within a suitable mainframe. The 3300G/3302G/3305G mainframes allow 1, 2 or 4 modules to be operated. The mainframes provide the necessary mains power conversion along with computer and analogue interfaces. A front panel memory function is provided. 150 memory locations are available to store the set-up of the load modules within the mainframe. It is also possible to program and recall a test sequence consisting of different steps against time. Please refer to the separate 3300G/3302G/3305G operating manuals for the mainframe functions.

Each load module is capable of sinking a wide range of voltage and current values. The load modules are limited by the maximum power they can sink. For example the 33401G CHA and CHB can sink up to 6A and 500Vdc at a maximum of 150W. So if the maximum voltage of 500Vdc is present at the load's input terminals a maximum load current of 0.24A is possible. Conversely if the 33401G is required to sink 6A the voltage must be limited to 50V.

The power contour of each load module in the 33401G is shown in Fig 1-1.

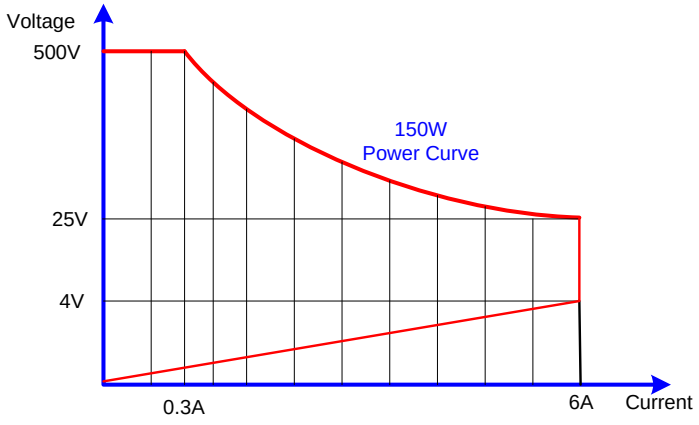


Fig 1-1 33401G CHA and CHB 500V/6A/150W power contour

The power contour of each load module in the 33402G is shown in Fig 1-2.

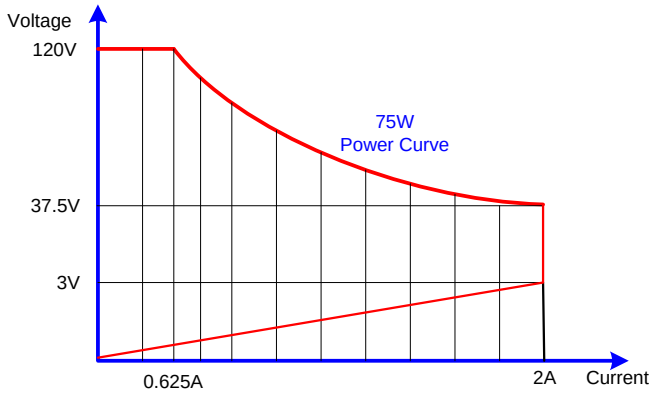


Fig 1-2 33402G CHA and CHB 120V/2A/75W power contour

The power contour of each load module in the 33403G is shown in Fig 1-3.

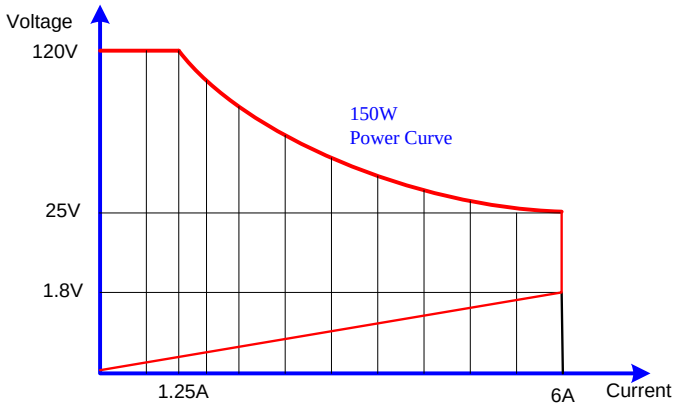


Fig 1-3 33403G CHA and CHB 120V/6A/150W power contour

The 33401G series of electronic load modules feature 4 operating modes. These are Constant Current (CC) mode, Constant Resistance (CR) mode, Constant Voltage (CV) mode, and LED mode.

1.1.1. CC Mode

With the operating mode of Constant Current, the 33401G series electronic load will sink a current in accordance with the programmed value regardless of the input voltage (see Fig.1-4).

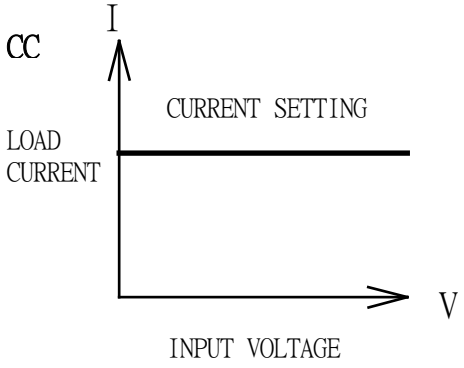


Fig 1-4 Constant Current mode

1.1.2. CR Mode:

At Constant Resistance mode, the 33401G series electronic Load will sink a current linearly proportional to the load input voltage in accordance with the programmed resistance setting (see Fig 1-5).

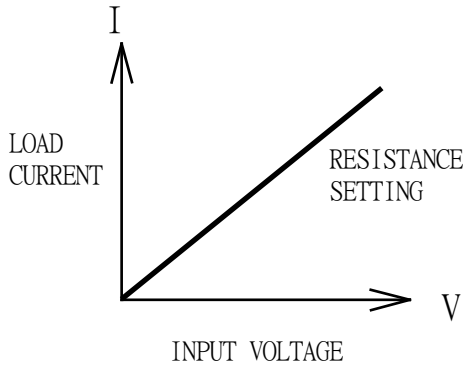


Fig 1-5 Constant Resistance mode

1.1.3. CV Mode:

At Constant Voltage mode, the 33401G series electronic Load will attempt to sink enough current until the load input voltage reaches the programmed value (see Fig 1-6).

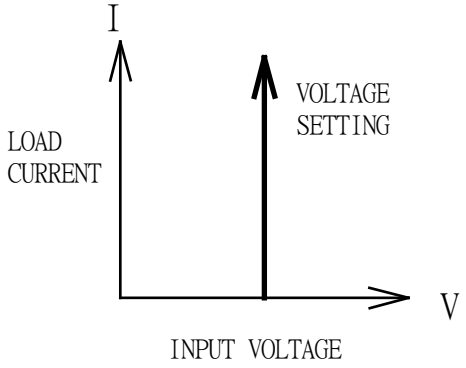


Fig 1-6 Constant Voltage mode

1.1.4. LED Mode

In the LED mode of operation, Voltage is applied to the 33401G series electronic load until the voltage is greater than Vd load on, Vo = (Io * Rd) + Vd last provided by LED DRIVER corresponding to a constant current Io Io and Vo Vo for their work to this point shown in Figure 1-7.

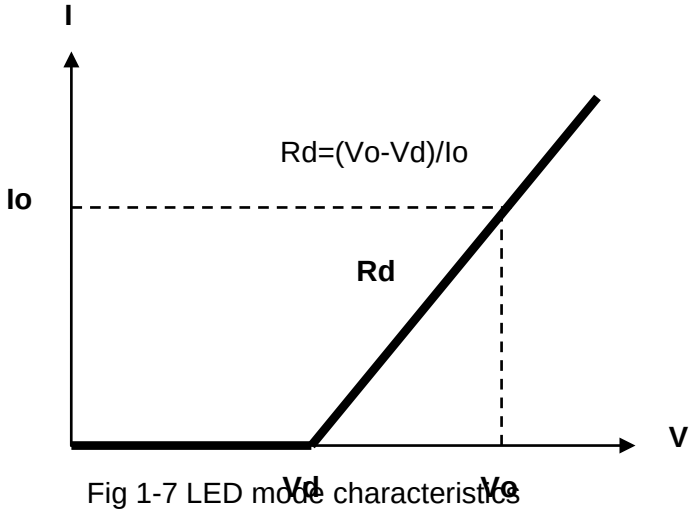


Fig 1-7 LED mode characteristics

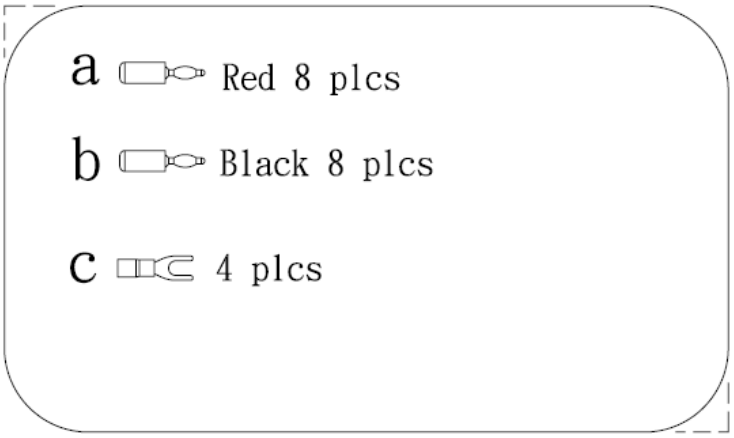
1-2. Features

The main features of the 33401G series of load modules are highlighted below.

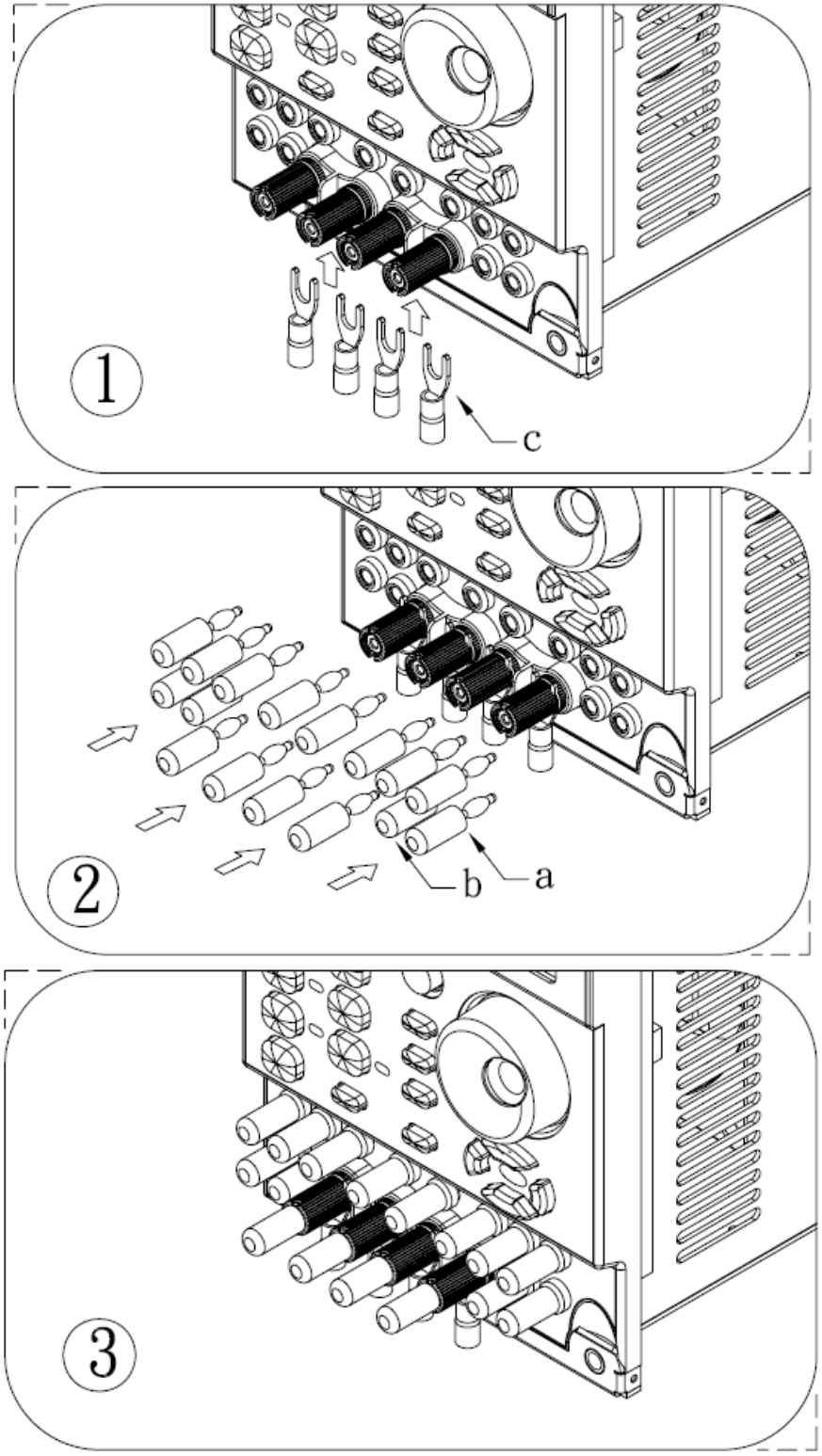
- Bench top and rack mounting flexibility with single, dual and 4 slot mainframes
- CC, CR, CV, LED, and Short Operating Mode.
- Remote control via a choice of computer interfaces.
- High accuracy & resolution with 16 bit voltage and current meter.
- Short circuit test with current measurement
- Dedicated over current test functions
- Full protection from over-temperature, overvoltage, and reverse polarity.
- Digital Calibration
- Advance Fan speed control
- Ability to save load set-ups via the mainframe memory (150 store/recall locations)
- Auto sequence function allowing test routines to be set from the mainframe

1-3. Standard Accessories

a	2mm Banana Plug (Red)	8 PCS
b	2mm Banana Plug (Black)	8 PCS
c	Hook Terminal Y type small size terminal	4 PCS
d	33401G series operation manual	1PC



1.3.1 Accessories Installation Description



1-4. Specifications

MODEL	33401G		33402G	
Power	150W × 2		75W × 2	
Current	0 – 1.5A	0 – 6A	0 – 0.6A	0 – 2A
Voltage	0~600V		0~120V	
Min. Operating Voltage	4V @ 6A		3V @ 2A	
Constant Current Mode				
Range *1	0 – 1.5A	0 – 6A	0 – 0.6A	0 – 2A
Resolution	0.025mA	0.1mA	0.01mA	0.04mA
Accuracy	± 0.1% OF(SETTING + RANGE)		± 0.1% OF(SETTING + RANGE)	
Constant Resistance Mode				
Range	CRL:1Ω ~3KΩ (300V)	CRH:2Ω ~6KΩ (600V)	CRL:1.5Ω ~1.5KΩ (60V)	CRH:3Ω ~3KΩ (120V)
Resolution	16.666uS	8.333uS	33.33uS	16.66uS
Accuracy	± 0.2% OF (SETTING + RANGE)		± 0.2% OF (SETTING + RANGE)	
Constant Voltage Mode				
Range	60V/300V/600V		30V/60V/120V	
Resolution	0.001V/0.005V/0.01V		0.0005V/0.001V/0.002V	
Accuracy	± 0.05% OF (SETTING + RANGE)		± 0.05% OF (SETTING + RANGE)	
LED Mode				
Vo Voltage Range	LEDL:60V / LEDM:300V / LEDH:600V		LEDL:30V / LEDM:60V / LEDH:120V	
Rd Resistance Range	LEDL : 1 ~ 200Ω @ Vo-Vd = 0~6V LEDL: 10 ~ 2KΩ @ Vo-Vd = 6~60V LEDM: 5~ 1KΩ @ Vo-Vd = 0~30V LEDM: 50 ~ 10KΩ @ Vo-Vd = 30~300V LEDH: 10 ~ 2KΩ @ Vo-Vd = 0~60V LEDH: 100 ~ 20KΩ @ Vo-Vd = 60~600V		LEDL: 1.25 ~ 1.5KΩ @ Vo-Vd = 0~3V LEDL: 12.5 ~ 15KΩ @ Vo-Vd = 3~30V LEDM: 2.5 ~ 3KΩ @ Vo-Vd = 0~6V LEDM: 5 ~ 30KΩ @ Vo-Vd = 6~60V LEDH: 5 ~ 6KΩ @ Vo-Vd = 0~12V LEDH: 50 ~ 60KΩ @ Vo-Vd = 12~120V	
Resolution	16Bits		16Bits	
Accuracy	Vd : ± (0.05% OF SETTING + 0.1% OF RANGE), Rd : ± (0.05% OF SETTING + 0.1% OF RANGE)		Vd : ± (0.05% OF SETTING + 0.1% OF RANGE), Rd : ± (0.05% OF SETTING + 0.1% OF RANGE)	
Measturement				
Voltage Read Back				
Range	60V/300V/600V		30V/60V/120V	
Resolution	1mV/5mV/10mV		0.5mV/1mV/2mV	
Accuracy	± 0.025% OF (READING + RANGE)			
Current Read Back				
Range	1.5A	6A	0.6A	2A
Resolution	0.025mA	0.1mA	0.01mA	0.04mA
Accuracy	± 0.1% OF (READING + RANGE)			
Power Read Back				
Range	150W		75W	

Accuracy *2	± 0.1% OF (READING + RANGE)	
Gernaral		
Short Signal Output	12V/100 mAmax	12V/100 mAmax
Dimming Control		
Level Range	0~12V	
Resolution	0.048V	
Accuracy	1% of (SETTING + RANGE)	
Frequency Range	DC~1KHz	DC~10KHz
Resolution	10Hz	100Hz
Duty Range	0.01~0.99(1%~99%)	0.1~0.9(10%~90%)
Resolution	0.01	0.1
Temperature Coefficient	100ppm/℃(typical)	
Power	Supply from mainframe	
Operating Temperature *3	0~40℃	
Dimension(HxWxD)	143x108x405mm	
Weight	3.5Kg	3.5Kg
Safety & EMC	CE	

MODEL	33403G	
Power	150W × 2	
Current	0 – 1.5A	0 – 6A
Voltage	0~120V	
Min. Operating Voltage	1.8V @ 6A	
Constant Current Mode		
Range *1	0 – 1.5A	0 – 6A
Resolution	0.025mA	0.1mA
Accuracy	± 0.1% OF(SETTING + RANGE)	
Constant Resistance Mode		
Range	CRL:0.2Ω ~2.4KΩ (60V)	CRH:0.4Ω ~4.8KΩ (120V)
Resolution	83.333uS	41.666uS
Accuracy	± 0.2% OF (SETTING + RANGE)	
Constant Voltage Mode		
Range	12V/60V/120V	
Resolution	0.2mV / 1mV / 2mV	
Accuracy	± 0.05% OF (SETTING + RANGE)	
LED Mode		
Vo Voltage Range	LEDL:12V / LEDM:60V / LEDH:120V	
Rd Resistance Range	LEDL : 0.2 ~ 240 Ω @ Vo-Vd = 0~1.2V LEDL : 2 ~ 2.4KΩ @ Vo-Vd = 1.2~12V LEDM: 1 ~ 1.2KΩ @ Vo-Vd = 0~12V LEDM: 10 ~ 12KΩ @ Vo-Vd = 12~60V LEDH: 2 ~ 2.4KΩ @ Vo-Vd = 0~60V LEDH:20 ~ 24KΩ @ Vo-Vd = 60~120V	
Resolution	16Bits	
Accuracy	Vd : ± (0.05% OF SETTING + 0.1% OF RANGE), Rd : ± (0.05% OF SETTING + 0.1% OF RANGE)	
Measturement		

Voltage Read Back		
Range	12V/60V/120V	
Resolution	0.2mV/1mV/2mV	
Accuracy	± 0.025% OF (READING + RANGE)	
Current Read Back		
Range	1.5A	6A
Resolution	0.025mA	0.1mA
Accuracy	± 0.1% OF (READING + RANGE)	
Power Read Back		
Range	150W	
Accuracy *2	± 0.1% OF (READING + RANGE)	
Gernaral		
Short Signal Output	12V/100 mAmax	
Dimming Control		
Level Range	0~12V	
Resolution	0.048V	
Accuracy	1% of (SETTING + RANGE)	
Frequency Range	DC~1KHz	
Resolution	10Hz	
Duty Range	0.01~0.99(1%~99%)	
Resolution	0.01	
Temperature Coefficient	100ppm/℃(typical)	
Power	Supply from mainframe	
Operating Temperature *3	0~40℃	
Dimension(HxWxD)	143x108x405mm	
Weight	3.5Kg	
Safety & EMC	CE	

Table 1-1 33401G Series Specification

Note *1: The range is automatically or forcing to range II only in CC mode
Note *2: Power F.S. = Vrange F.S. x Irange F.S.
Note *3 : Operating temperature range is 0~40℃, All specifications apply for 25℃±5℃

Chapter 2 Installation

This chapter details the installation and removal procedure of the 33401G series load module when used in conjunction with the 3300G (quad module mainframe). The same procedure is used for the 3302G (single module mainframe) and the 3305G (dual module mainframe).

Please note that the 33401G series load module does not need any user adjustment after it has been plugged in to the mainframe.

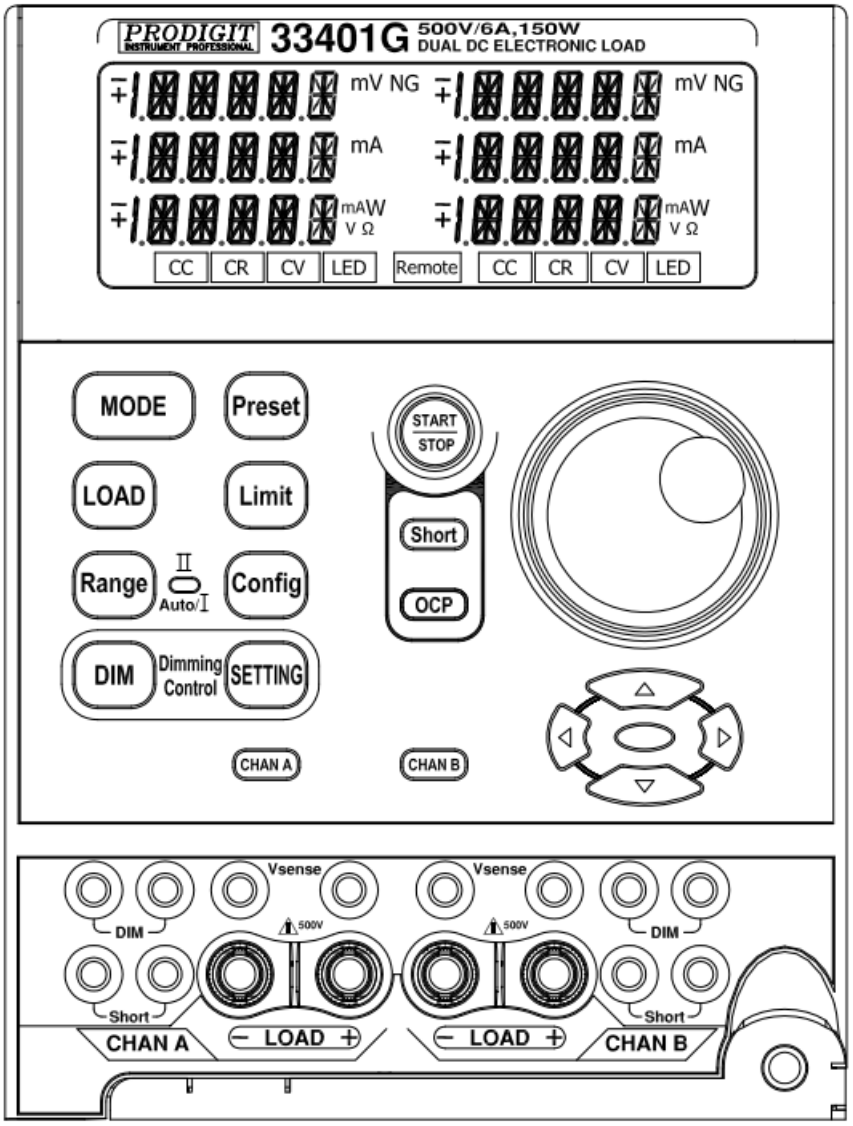


Fig 2-1 Binding post and withdraw handle on the front panel of 33401G Plug-in load module

2-1. Installation and removal of 33401G series plug-in load module

The 33401G series electronic load module operates from within the 3300G/3302G/3305G mainframe. The mainframe is required to provide power to the module's control circuitry. It is also needed for the computer interfaces, analogue programming input and the 150 store/recall memory.

Unless the 3300G/3302G/3305G mainframe and 33401G series electronic load module were purchased separately, the 33401G series electronic load module should be installed in the 3300G mainframe before shipment from Prodigit.

One of the benefits of the modular approach is that different models of load module can be operated from within the same mainframe. It is easy for the user to reconfigure the mainframes by changing or adding different load modules.

The following procedure should be followed for installing or removing the 33401G series load module in or out from the 3300G /3302G/3305G.

2.1.1. Installation of 33401G series plug-in load:

2.1.1.1 Turn the 3300G/3302G/3305G mainframe power OFF before inserting The 33401G series load module. Failure to switch the mains power off May result in damage to the plug-in module's circuitry.

2.1.1.2 Align the upper and lower grooves of the 3300G mainframe with the Upper and lower guides of the selected compartment.

2.1.1.3 If correctly positioned the 33401G series load module will slide in easily until some 30-40mm is left protruding from the mainframe. At this point a little more force will be required to seat the load module's circuit board in the Interconnecting jack of the mainframe. It is recommended that the binding Posts on the load module's front panel be used to push the module home.

2.1.1.4 Use the supplied screw to fasten the load module to the mainframe. The Screw hole is located at the end of the pull out handle at the bottom right Hand Corner of the 33401G series load module.
The screw location is shown on Fig 2-1 and is below and to the right of The LOAD + binding post.

2.1.1.5 Only after all the load modules are installed to the 3300G/3302G/3305G Mainframe should the mains power be switched ON.

2.1.2. Removal of 33401G series plug-in load:

2.1.2.1. Firstly ensure that the mains power to the 3300G/3302G/3305G Mainframe is switched off. Failure to do so may result in damage to the Load module.

2.1.2.2. Take the screw out of the pull out handle in the lower right corner of the Module.

2.1.2.3. After removal of the screw the handle can be pulled towards you to lever The module out of the mainframe.

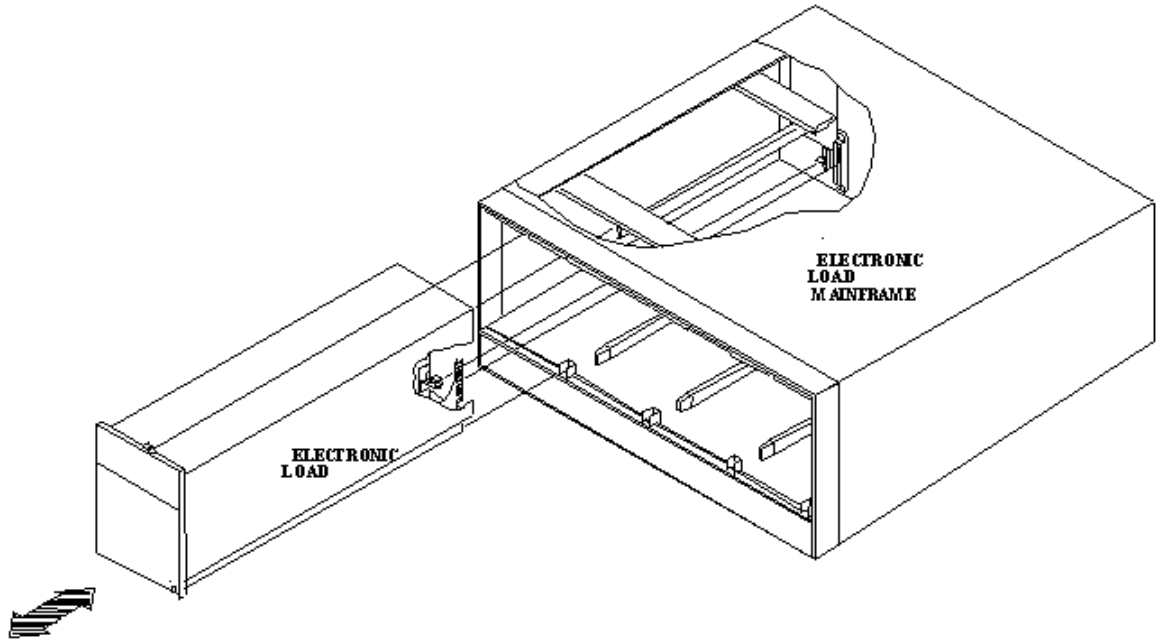


Fig 2-2 Plug-in installation and removal

2-2. Environmental requirements

- Indoor use.
- Measurement Category II.
- Pollution Degree 2.
- Relative Humidity 80% Max.
- Ambient Temperature 0 to +40°C
- Altitude up to 2000m.
- The equipment is not for measurements performed for CAT III and IV.
- Transient Overvoltage on the mains supply can be 2500V.

2-3. Observe the International Electrical Symbol listed below.

⚠ Warning ! Risk of electric shock

⚠ Caution ! Carefully read and understand the guidance in the operating manual Before performing any action.

2-4. Cleaning

Use a soft or slightly damp cloth to clean this product.

BEFORE you clean the unit, switch the mains power off and disconnect the input lead.

- Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
- Please ensure that no liquid is allowed to penetrate this product.

2-5. Power Up

The following procedure should be followed before applying mains power:

2.5.1 Check that the POWER switch is in the off (O) position
2.5.2 Check the rear panel voltage selector of the 3300G/3302G/33305G mainframe is Correctly set.
2.5.3 Check that nothing is connected to the DC INPUT (load input terminals) on the Front panel of the 33401G series load module.
2.5.4 Connect correct AC mains lead to the 3300G/3302G/33305G mainframe
2.5.5 Turn on (I) the POWER switch.

The load module will now go through a short self-check cycle. All digits on the front panel will illuminate then the module's part number and firmware revision will be displayed. The screen Will then go to into the default state showing V, A & W. The load module is now ready for use.

2-6. Operating flow chart for each load module operation

The following flow chart shows the typical load current level and status setting procedures of each load module within 3300G mainframe, the load channel number 1 to 4 is from left to right compartment on 3300G mainframe respectively, please skip Channel setting if single load mainframe 3302G is used.

The string between "____" in the flow chart is a RS232 or GPIB programming commends.

Please follow the flow chart sequence to have proper and effective load settings.

The Limit key set the GO/NG check upper and lower limit for DVM, DAM, and DWM respectively, the system configure setting of V-sense control, Load ON voltage, and load OFF voltage is within the Limit key setting.

Others key (Load ON/OFF, Short ON/OFF) can be controlled independently.

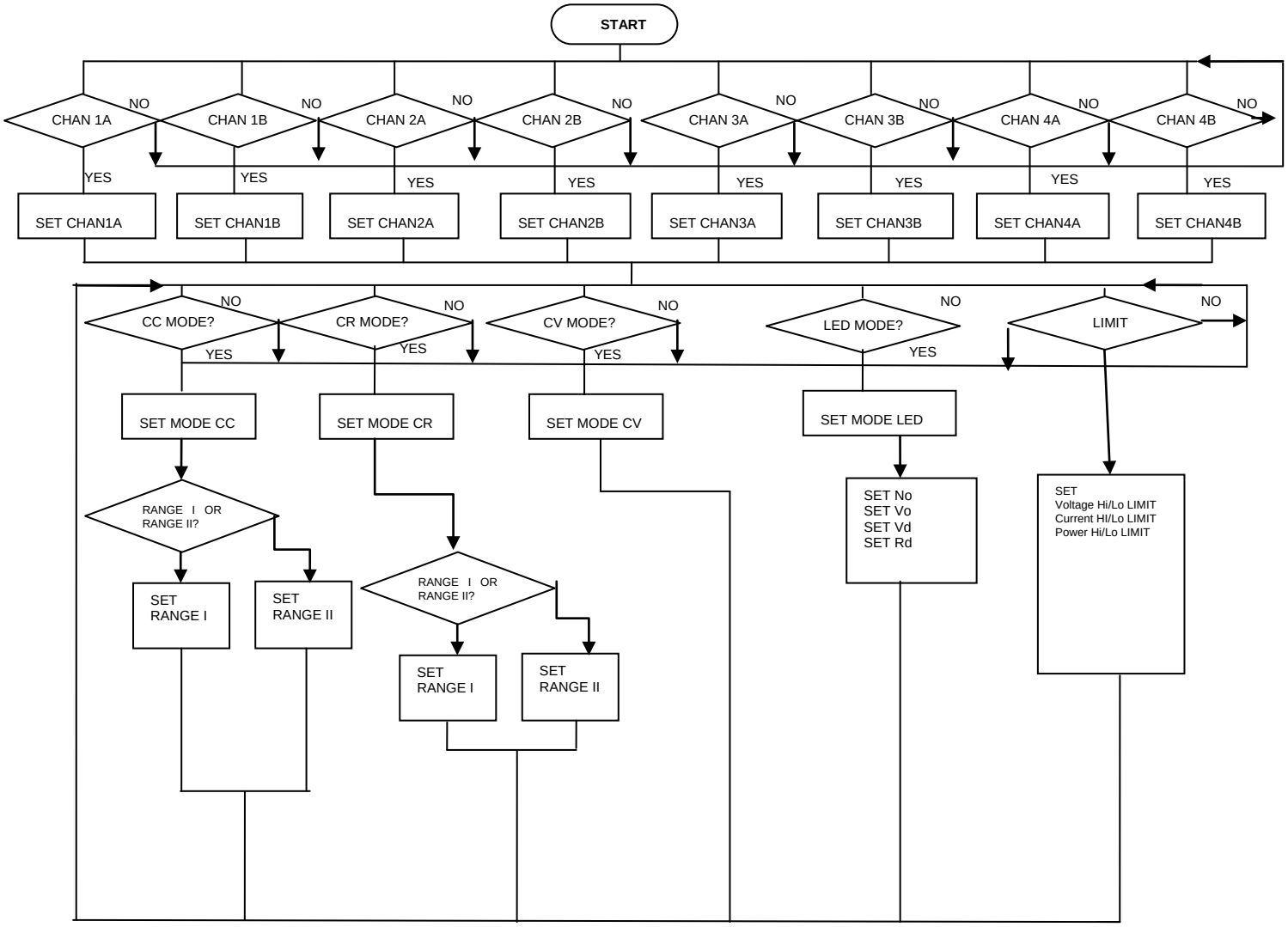


Fig 2-3 33401G series electronic load module load condition setting flow chart

Chapter 3 Operation

This chapter describes the front panel operation of each 33401G series load module. Please note that the memory store/recall function and the GPIB/RS-232C/USB/LAN remote programming terms are detailed in the separate 3300G/3302G/3305G mainframe operation manual.

3-1 Front panel description

The following sketch shows the layout of the front panel of the unit. Please refer to the relevant Section as indicated by the number assigned to a front panel function.

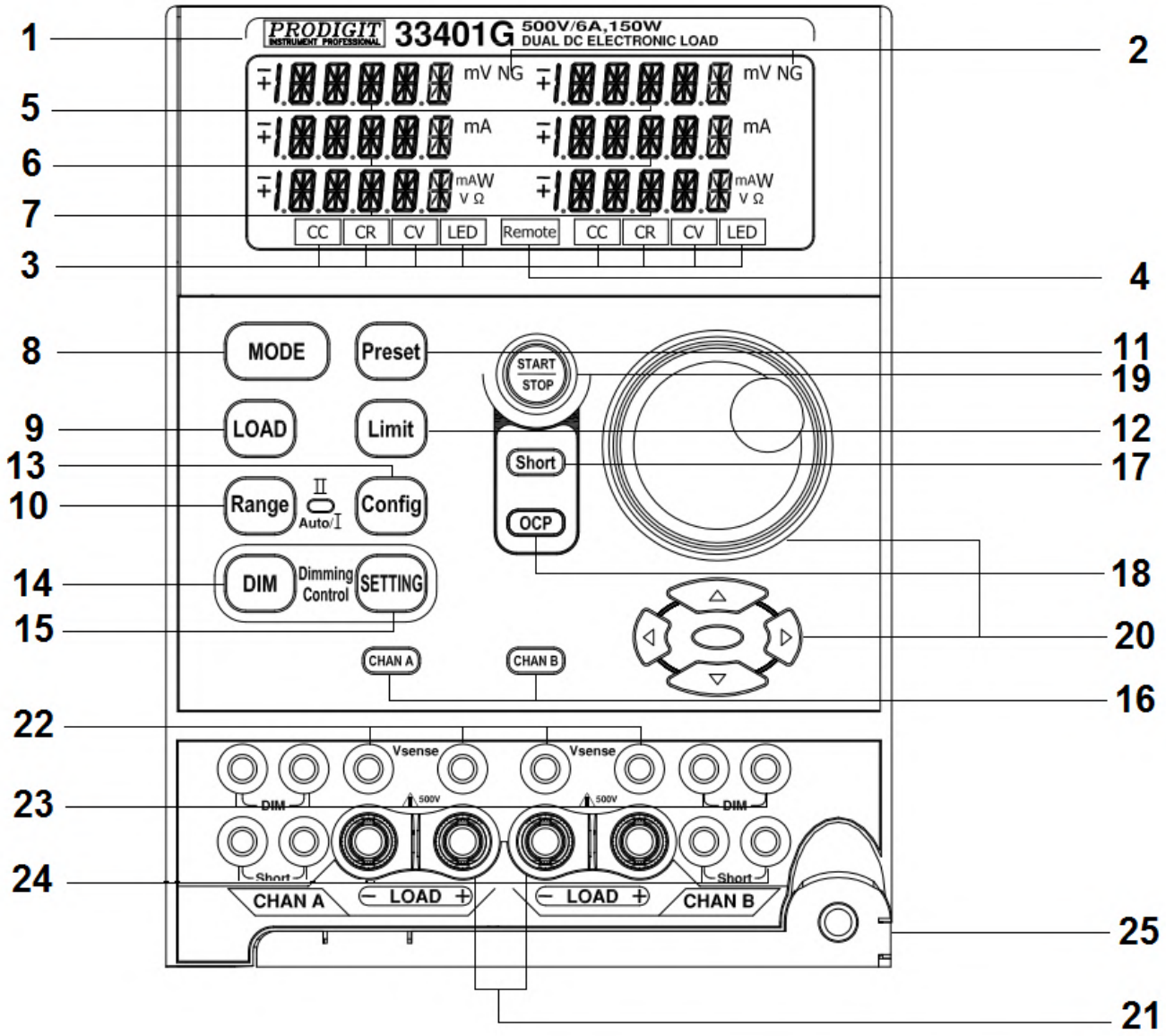


Fig 3-1 Front panel of 33401G series plug-in module

3-2 .Instructions

3.2.1. Model number and sink ranges

The model number along with maximum voltage, current and power values are Detailed in this position at the top of the load module's front panel.

3.2.2. NG Indicator

The user can adjust upper and lower limits for voltage, current and power within the CONFIG menu and turn the NG Indicator ON. If a Voltmeter, Ammeter or Wattmeter measurement is outside these set limits then the NG indicator will illuminate.

3.2.3. MODE and CC , CR , CV , LED mode, LCD Indicator

There are four operating modes that can be selected by pressing the "MODE" key on the 33401G series electronic Load module.

The sequence is Constant Current (CC), Constant Resistance (CR),Constant Voltage (CV) and LED mode. Each time the "MODE" key is pressed the operating mode is changed. The actual operating mode selected is indicated on the left hand side of the LCD.

The operating theorem of CC, CR, CV and LED modes are described in Section 1-1. Common application examples for the different operating modes are described in Section 4-3 to 4-6 respectively.

Note: 1. CR Mode can't automatically shift.

3.2.4. REM LCD Indicator

If the REMOTE LCD Indicator is illuminated this means that the unit is operating remotely via one of the optional interfaces. While REMOTE is lit it is not possible to make settings manually at the front panel. The LOCAL button on the mainframe can be used to revert back to front panel control. When the unit is operating from the front panel the REMOTE LCD will not be illuminated.

3.2.5. Upper 5 digit LCD display

The 5 digit LCD display is a multi-function display. The function of the display changes depending whether the user is in NORMAL mode or in a SHORT or OCP test modes:

<u>Normal mode:</u>

The upper 5 digit display displays the voltage present at the load's input terminals. The value displayed will include the automatic voltage compensation if the sense Terminals are also connected to the device under test (DUT)

Test Mode:
If the SHORT or OCP buttons are pressed the upper display will show a text Message that correlates with the selected test function.

SHORT test selected: upper display will show “Short”.
OCP test selected: upper display will show “OCP”.

During the test the upper display will show the load Input voltage.

3.2.6. Middle 5 digit LCD display
The middle 5 digit displays also changes function depending if the user is in Normal mode or has entered a setting menu

Normal mode:
In normal mode the middle LCD display functions as a 5 digit ammeter. The 5 digit DAM shows the load current flowing into the DC load when the Load is ON.

Setting Mode:
If CONFIG, LIMIT, SHORT or OCP buttons are pressed the middle LCD show a text message according to the setting function it is in. Each subsequent press of the button moves the display to the next available function. The sequence of each setting menu is detailed below

- **CONFIG**: Sequence is “LDon” → “LDoff” → “POLAR” → CV_bW → AVG → Rd_Io → bW.
- **LIMIT**: Sequence is ”V_Hi” → “V_Lo” → “I_Hi” → “I_Lo” → “W_Hi” → “W_Lo” → “NG”.
- **SHORT**: Sequence is “PRESS” → “TIME” → ”V_Hi” → “V_Lo”
- **OCP**: Sequence is “ISTAR” → “ISTEP” → “ISTOP” → ”Vth”.

3.2.7. Lower 5 digit LCD display

The lower 5 digit display also changes function depending if the unit is in normal mode or one of the setting menus has been activated.

Normal mode:
In normal mode the lower 5 digit display shows the power consumption in Watts (W).

Setting Mode:
The lower display together with the rotary adjustment knob is used to set values. The value changes according to the setting function that is active. The middle LCD provides a text message to tell the user which part of the setting menu is active.

3.2.7.1. **PRESET** mode. The value of the setting entered on the lower display Changes depending on the operating MODE that has been selected

- If CC mode is selected the lower display provides setting in amps "A".
- If CR mode is selected the lower display provides setting in ohms “Ω”
- If CV mode is selected the lower display provides setting in volts “V”.
- If LED mode No is selected the lower display provides setting in number.
- If LED mode Vo is selected the lower display provides setting in volts “V”.
- If LED mode VD is selected the lower display provides setting in volts “V”.
- If LED mode Rd is selected the lower display provides setting in ohms “Ω”.
- If LED mode Io is selected the lower display provides setting in amps "A".

3.2.7.2. **LIMIT.** Each press of the LIMIT button changes the middle LCD text. The Sequence and the corresponding setting value shown on the bottom Display are as follows:

- V_Hi (upper limit voltage) displays the set value in volts “V”
- V_Lo (lower limit voltage) displays the set value in volts “V”
- I_Hi (upper limit current) displays the set value in amps “A”
- I_Lo (lower limit current) displays the set value in amps “A”
- W_Hi (upper limit power) displays the set value in watts “W”
- W_Lo (lower limit power) displays the set value in watts “W”
- NG displays whether the NG flag is set to「ON」or「OFF」

3.2.7.3. CONFIG. Each press of the CONFIG button changes the middle LCD Text.
The sequence and the corresponding setting value shown on the bottom Display are as follows:

- LDon (load ON voltage) displays the set value in volts “V”
- LDoff (load OFF voltage) displays the set value in volts “V”
- POLAR (load polarity) can be set to「＋LOAD」or「－LOAD」
- BW (Bandwidth) can be set to 「Hi」or「Lo」.
- AVG (Average) can be set value 1~64.
- Rd_Io can be set to 「Rd」or「Io」.

3.2.7.4. SHORT test. This allows the parameters of the short test to be set up. Each press of the SHORT button moves the setting function. The Sequence of the short test along with the setting value is as follows:

- Short Press Start (pressing the red START/STOP button starts the test)
- TIME shows the duration of the SHORT test. “CONTI”, on the bottom display indicates continuous. Time can be adjusted in “ms”.
- V-Hi (voltage high threshold) displays the set value in volts “V”
- V-Lo (voltage low threshold) displays the set value in volts “V”

When the test is started the lower display will show RUN. When the test Has finished the lower display will show END.

3.2.7.5. OCP test. This allows the parameters of the over current protection test To be set up. Each press of the OCP button moves the setting function. The sequence of the OCP test along with the setting value is as follows:

- OCP Press Start (pressing the red START/STOP button starts the test)
- ISTAR (current start point) lower display provides setting in amps “A”
- ISTEP (current steps) lower display provides setting in amps “A”
- ISTOP (current stop point) lower display provides setting in amps “A”
- VTH (voltage threshold) lower display provides setting in volts “V”

When the test is started the lower display will show the current value being Taken by the load. If the Device Under Test is able to supply the load According to the values set then the middle display will show PASS and the

Lower display will show the maximum current taken during the OCP test. If, During the test, OTP is displayed the over temperature protection has been Engaged. Similarly if OPP is shown on the display the over power protection Has been activated.

3.2.8. MODE and CC, CR, CV, LED Indicator

There are four operating modes. These can be selected in turn by pressing the "MODE" key on the 33401G series electronic Load module. The sequence is:

- (LED) LED Mode
- (CC) Constant Current
- (CR) Constant Resistance
- (CV) Constant Voltage

The appropriate LCD will illuminate according to the operating mode is selected.

3.2.9. LOAD key and LED

The input to the 33401G Electronic Load can be switched ON/OFF by using the “LOAD” button. Indication of the ON/OFF state is provided by illumination of the Button.

LOAD button lit	= LOAD ON	(load sinks according to the preset values)
LOAD button unlit	= LOAD OFF	(the load does not sink current)

Turning the LOAD OFF does not affect the preset values. When the LOAD ON state is enabled the unit will revert to sinking according to the preset values.

3.2.9.1. When the Load ON/OFF key is operated the current taken by load will follow The RISE or FALL with time according to the preset rate. The current RISE And FALL times can be adjusted in the DYN Setting button of the front panel.

3.2.9.2. In addition to the LOAD ON/OFF function the user can also adjust the Voltage level at which the unit will automatically start or stop sinking energy. The adjustable LDon and LDoff voltage levels are found within the CONFIG Menu. Please note that the LDoff level cannot be set higher than the LDon Level.

Please refer to table 1-4 for adjustment ranges.

3.2.10. Range key and LED

The 33401G Load Module features 2 setting ranges for CC, CR, CV & LED Operation. This allows improved resolution for setting low values. When left in the Default AUTO mode the changeover between ranges is automatic depending on The setting value entered.

If desired the RANGE button can be pressed to force the unit to operate only in RANGE II. This is signaled by the accompanying LED becoming lit. Please note That it is only possible to force RANGE II in CC mode.

3.2.11. **Preset** key and LED

If the PRESET key is pressed the button will become lit indicating that the PRESET mode has been accessed. The lowest 5 digit display will change from showing the power consumption in watts to displaying the value to be preset. The value that can be programmed changes according to the operating mode that has been selected.

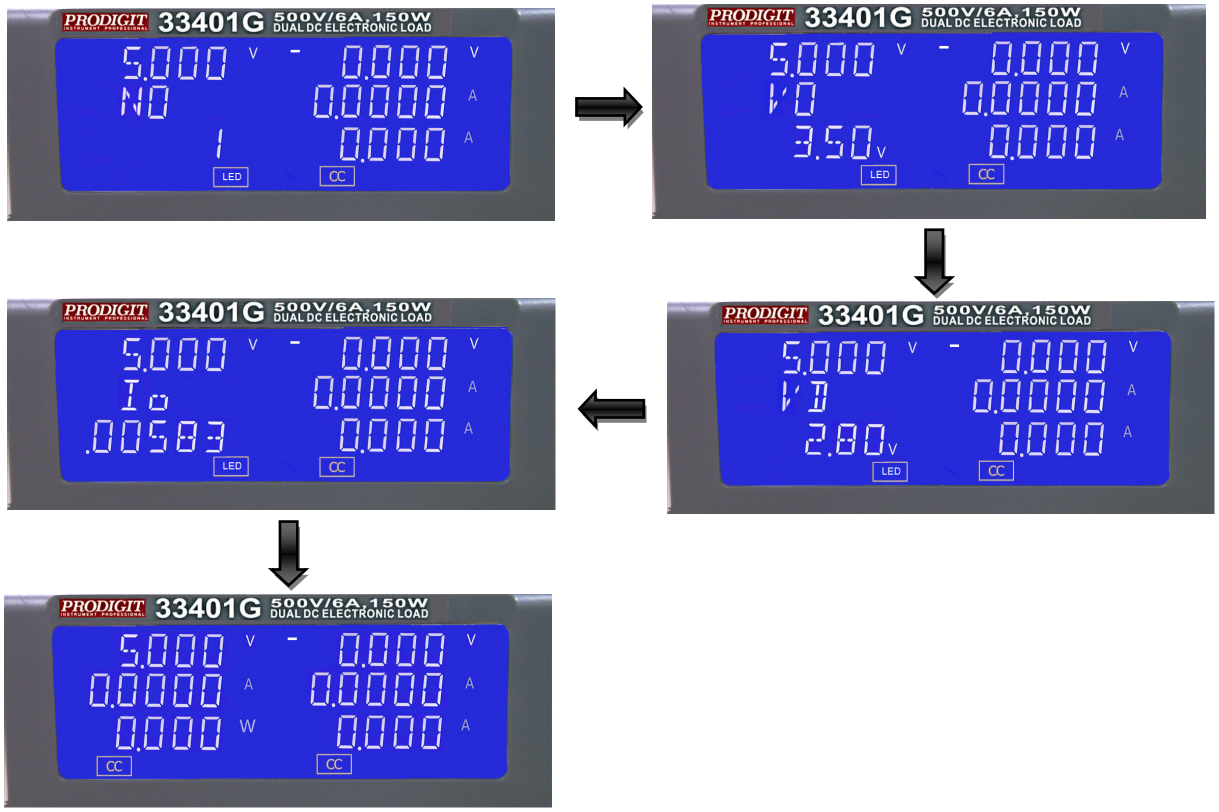
3.2.13.1. Constant Current (CC) mode:
The High and Low levels of load current can be preset at lower 5 digit LCD. The "A" LED will be lit indicating the setting value is amps.

3.2.13.2. Constant Resistance (CR) mode:
The High and Low levels of load resistance can be preset on the lower 5 Digit LCD. The "Ω" LED will be lit indicating the setting value is ohms.

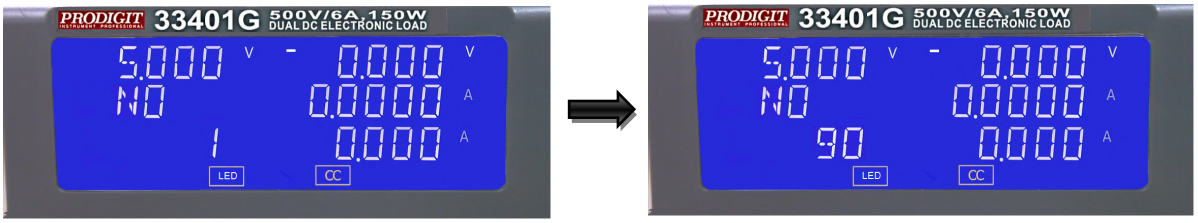
3.2.13.3. Constant Voltage (CV) mode:
The High and Low levels of load voltage can be preset on the lower 5 Digit LCD. The “V" LED will be lit indicating the setting value is volts.

3.2.13.4. LED mode:
Press MODE key 4 times to the "LED" mode, press the Preset key ON, Sequence set "No." -> "Vo" ->"Vd" -> "Io" -> Preset OFF.

Note: When the Preset OFF when you cannot change the settings, must be Set in the Preset ON.

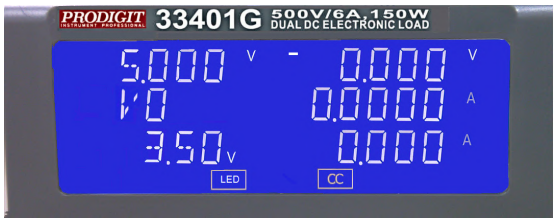


- setting LED cascading connection features a few pieces, the latter setting the specifications of LED can be set a parameter, cascading connection LED as a light Bar, to set back the settings, 33401G setting range is 1 ~ 90,

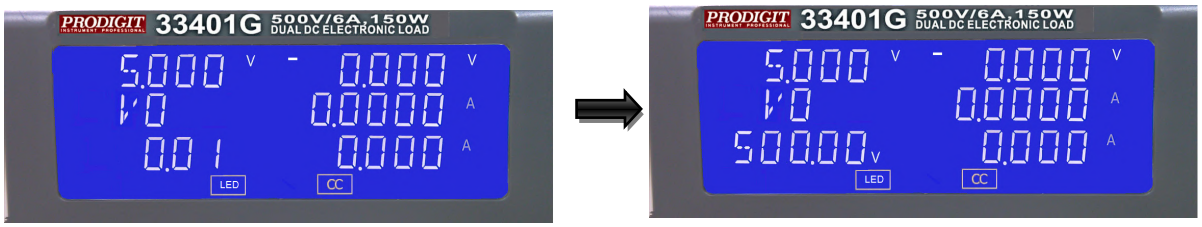


Note: Changing the quantity of possible shift caused Rd, Rd automatically switch to The original settings, if you have exceeded the value of the nearest range setting, Change the quantity of confirmed again after the settings are correct.

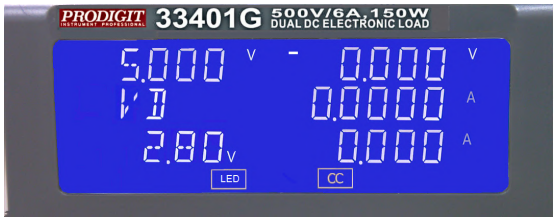
- LED Mode, Vo set the initial value of 3.5V.Vo must be less than the Specifications in addition to set quantity, Vo is a single LED of the Vo voltage.



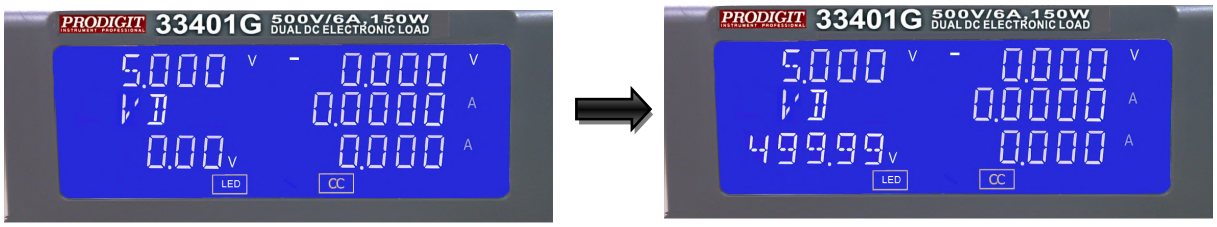
- LED Mode, setting the Vo, The LCD display shows, lower 5 digit LCD display setting value, the unit is "V", the setting range is 0.01V to the full scale of the LED mode specification. The setting is by rotating the setting knob.



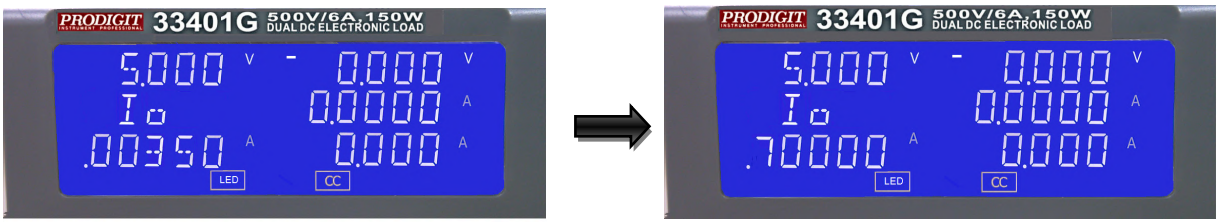
- LED Mode, Vd is 80 percent the initial value of Vo, when change Vo, When the Vo after the change, Vd will also be changed Vo 80 percent ,Vd is a simulation of a single LED of the Vd voltage, Vd initial value of 2.8V



- LED Mode, setting the Vd, The LCD display shows, lower 5 digit LCD display setting value, the unit is "V", the setting range is 0.00V to the 499.99V of the LED mode specification, The setting is by rotating the setting knob.

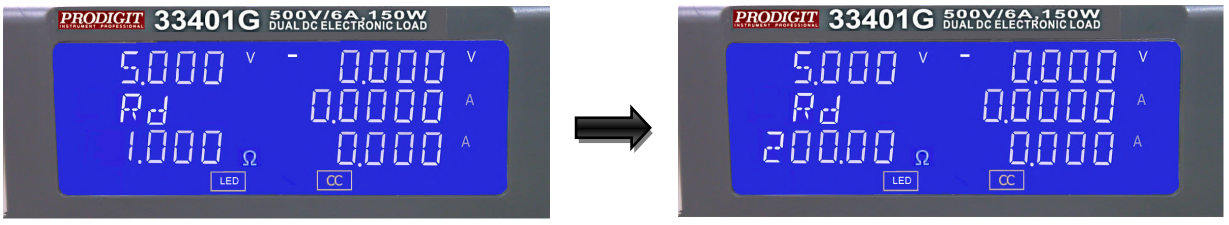


- LED Mode, Io setting, When Vo is 3.5V and Vd is 2.8V, the setting range is 0.00350A to the 0.70000A of the LED mode specification, The setting is by rotating the setting knob.
  Io= (Vo-Vd)/Rd



- LED Mode, press “Config” and switch Rd_Io.
- Rd setting the initial value of 200 ohm, according to n * (Vo-Vd) of the voltage will be three Ranges, See Specifications Table 1-1.

- LED Mode, Rd setting, The LCD display shows, lower 5 digit LCD display, the unit is "Ω", the setting range is 1.000Ω to the 200.0Ω of the LED mode specification, the setting is by rotating the setting knob.



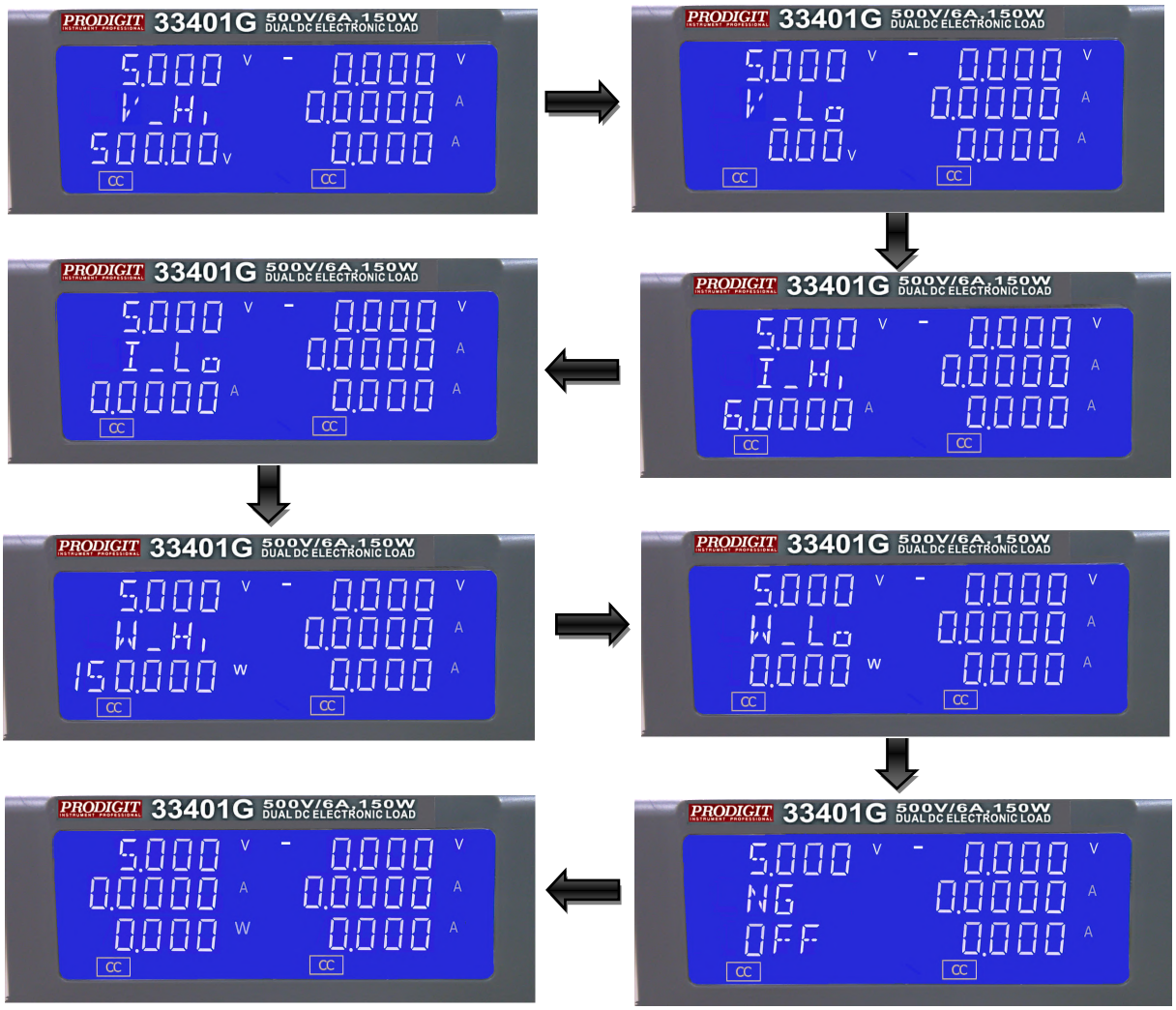
3.2.12. Limit key

The LIMIT button allows the user to set upper and lower thresholds for voltage, Current or power. These threshold settings are used in conjunction with the NG function to flag when the load is operating outside the desired limits

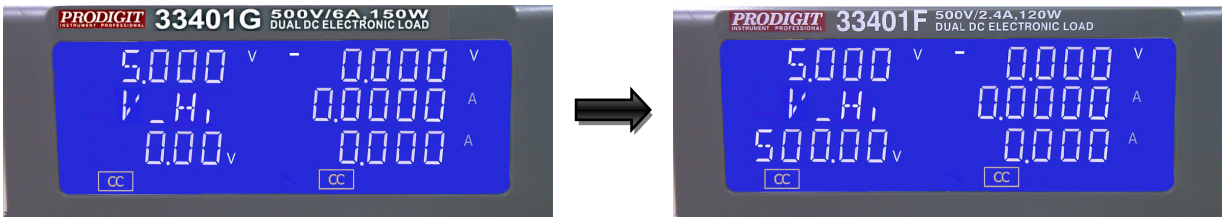
Each press of the LIMIT key enables a different value to be entered. On first press of the LIMIT key the button will illuminate and V-Hi will be displayed on the middle LCD. The setting is made with the rotary knob and can be read from the lower LCD during setting. The setting sequence is shown below:

V_Hi (DVM upper limit) →
V_Lo (DVM lower limit) →
I_Hi (DAM upper limit) →
I_Lo (DAM lower limit) →
W_Hi (DWM upper limit) →
W_Lo (DWM lower limit) →
NG OFF/ON (No Good Flag) →
LIMIT setting function OFF

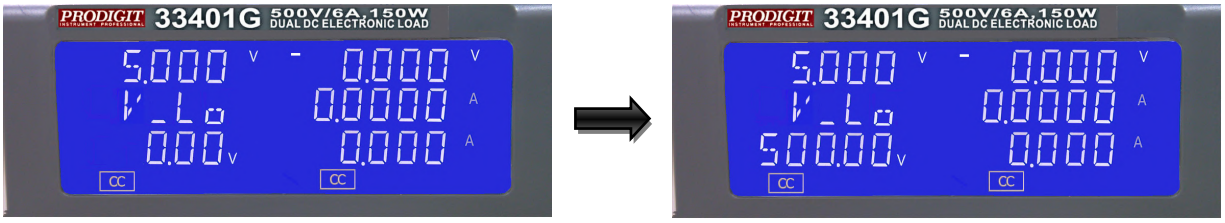
The engineering unit is “V”, “A” or “W” depending on the threshold LIMIT being set.



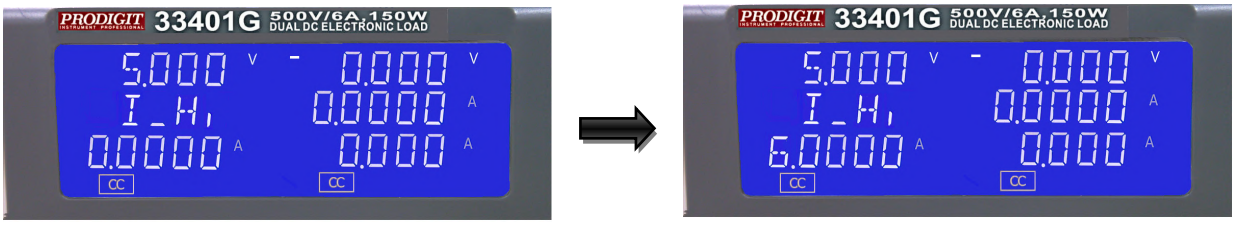
- Setting Upper limit voltage VH , Middle 5 digit LCD display「V-Hi」,lower 5 digit LCD display the unit is "V" ,The V-Hi set range from 0.00 V to 500.00V step 0.01V by rotating the Setting knob.



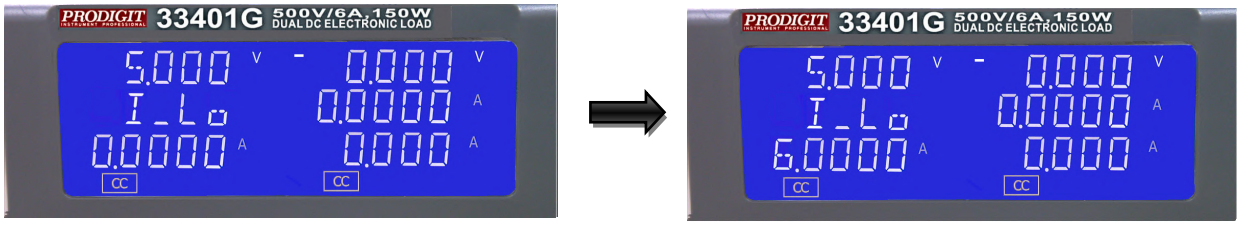
- Setting lower limit voltage VL, Middle 5 digit LCD display「V-Lo」,lower 5 digit LCD display the unit is "V",The V-Lo set range from 0.00 V to 500.00V step 0.01V by rotating the Setting knob.



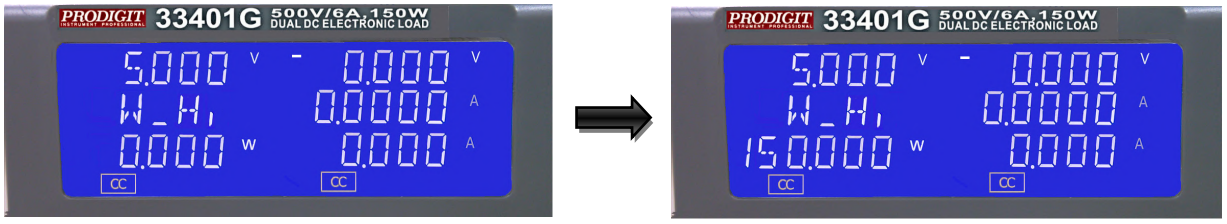
- Setting Upper limit current IH , Middle 5 digit LCD display「I-Hi」,lower 5 digit LCD display the unit is "A", The I-Hi set range from 0.0000 A to 6.0000A step 0.0001A by rotating the Setting knob.



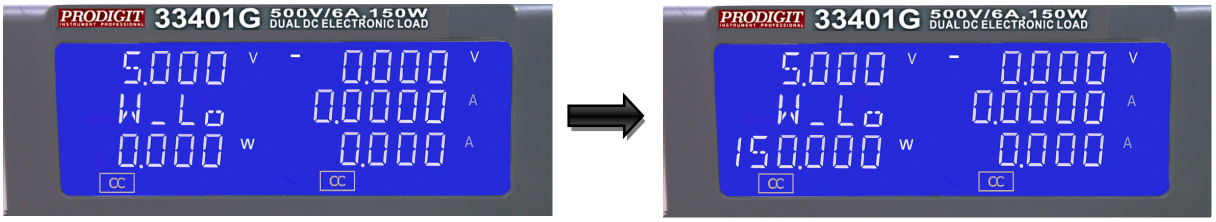
- Setting lower limit current IL , Middle 5 digit LCD display「I-Lo」,lower 5 digit LCD display the unit is "A" ,The I-Lo set range from 0.0000 A to 6.0000A step 0.001A by rotating the Setting knob.



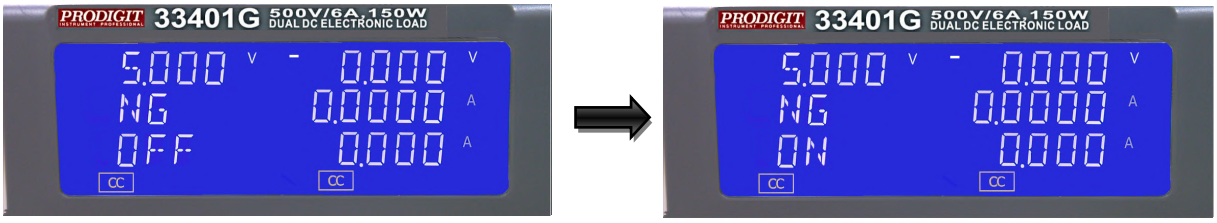
- Setting Upper limit power WH, Middle 5 digit LCD display「W-Hi」lower 5 digit LCD display the unit is "W", The W-Hi set range from 0.000 W to 150.00W step 0.001W by rotating the Setting knob.



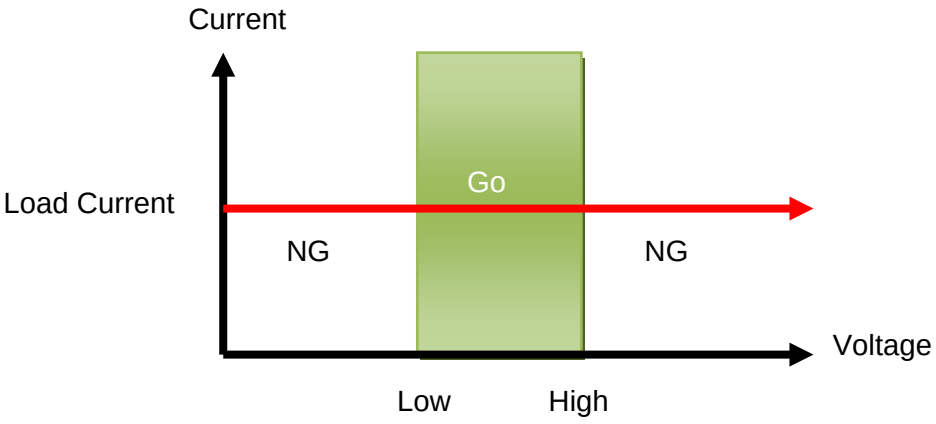
- Setting lower limit power WL, Middle 5 digit LCD display「W-Lo」lower 5 digit LCD display the unit is "W", The W-Lo set range from 0.000 W to 150.00W step 0.001W by rotating the Setting knob.



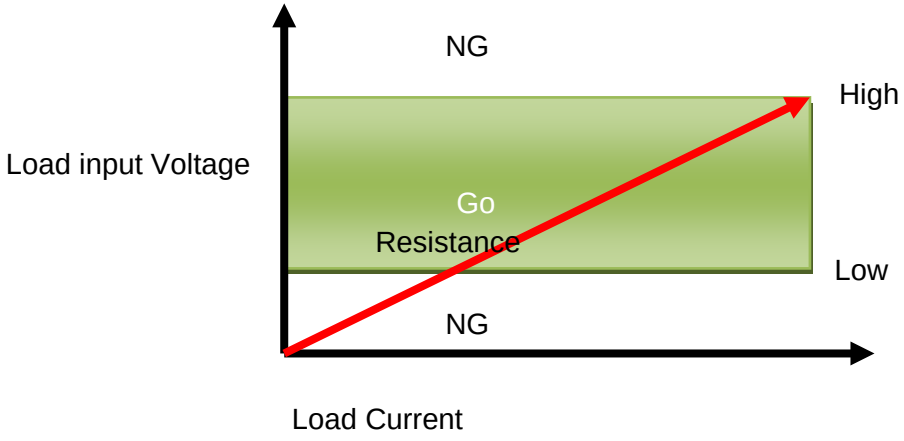
- Setting NG ON/OFF, When exceed VH、VL、IH、IL、WH、WL One of these Whether NG on LCD display.



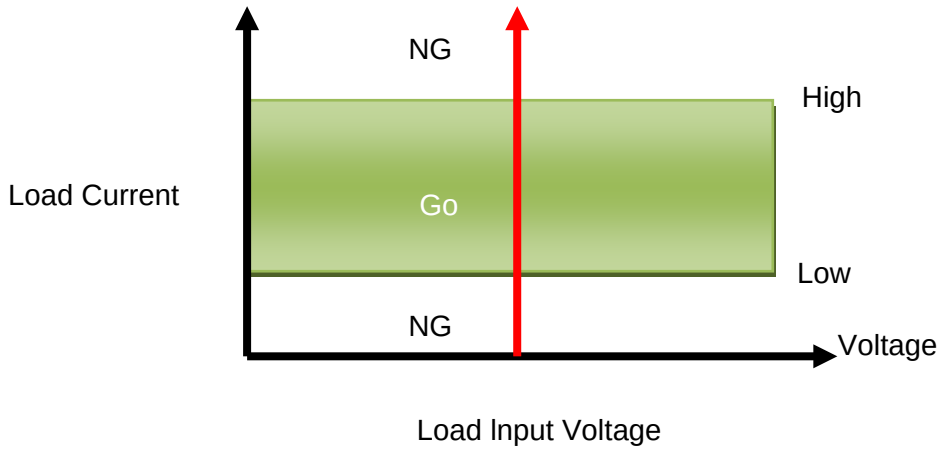
- CC mode, press limits key to set the V-Hi and V-Lo voltage upper and lower limits of the GO / NG.



- CR mode, press limits key to set the V-Hi and V-Lo voltage upper and lower limits of the GO / NG.



- CV mode, press limits key to set the I-Hi and I-Lo Current upper and lower limits of the GO / NG.

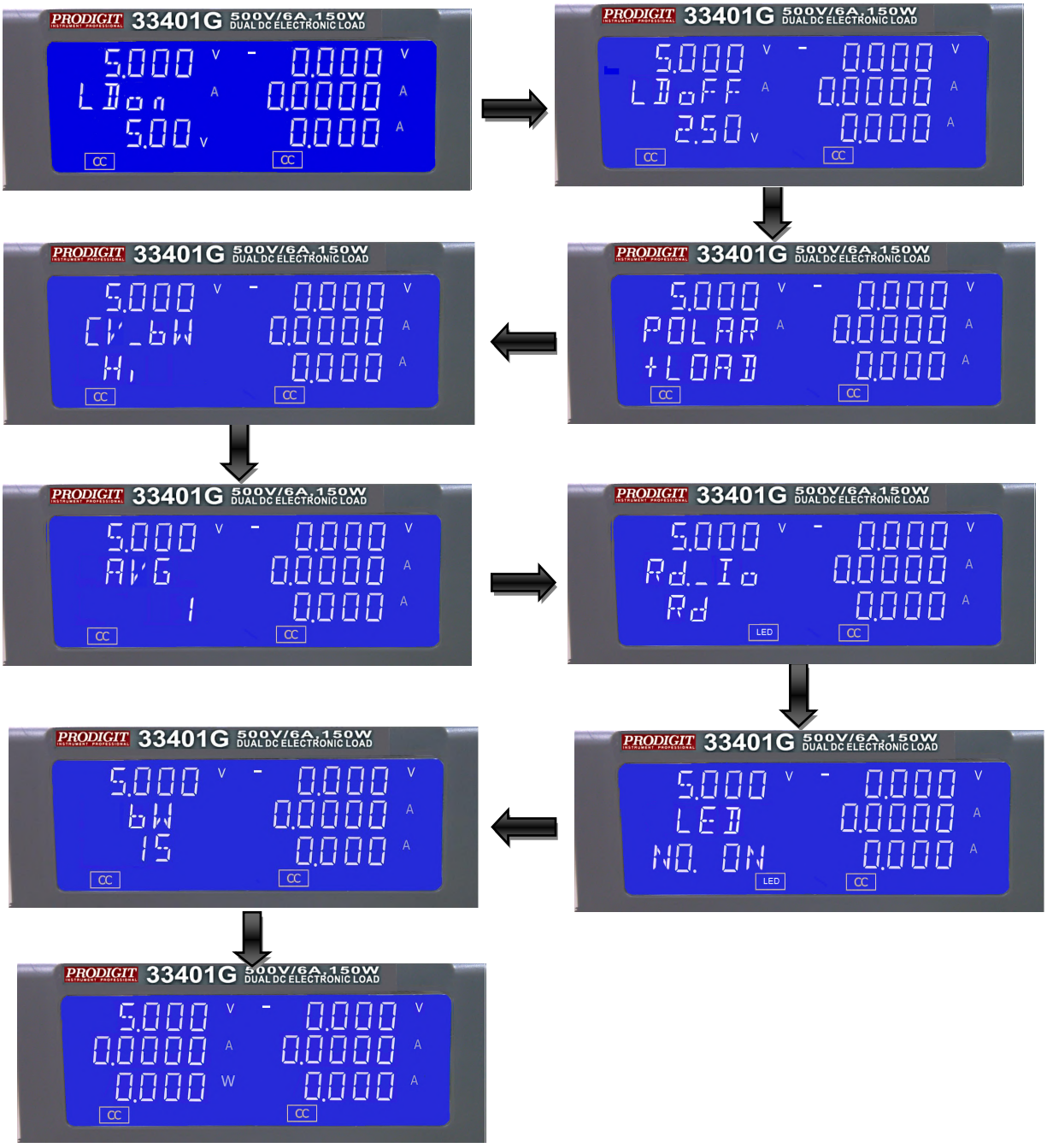


3.2.13. Config key

The CONFIG key allows the sense function to engage automatically or switched ON. The CONFIG key also enables the LOAD to automatically turn ON/OFF When a voltage level is reached. The polarity symbol can also be switched via the CONFIG menu.

Each press of the CONFIG key moves the menu on one step. On first press of the CONFIG key the button will illuminate and SENSE will be displayed on the middle LCD. The value is adjusted with the rotary knob and can be read from the lower LCD during setting. The setting sequence is shown below:

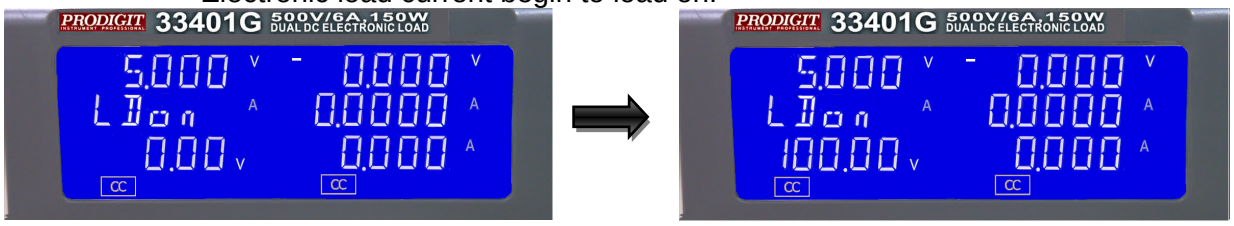
LDon (Voltage at which LOAD turns ON) →
LDoff (Voltage at which LOAD turns OFF) →
POLAR (change polarity symbol) →
bW(Bandwidth change Hi or Lo) →
AVG (Average 1~64) →
Rd _Io (change Rd or Io) →
LED NO.(ON or OFF) →
bW (Bandwidth change 0~15) →
Exit CONFIG options



Note 1: The adjustable LDon (LOAD ON) voltage is valid for CC, CR operating Modes. The adjusted LDon voltage will not operate in CV mode.

Note 2: The LDon (LOAD ON) voltage setting cannot be lower than the LDoff (LOAD OFF) voltage. If 0V is required for both LOAD ON and LOAD OFF make the LOAD OFF adjustment first.

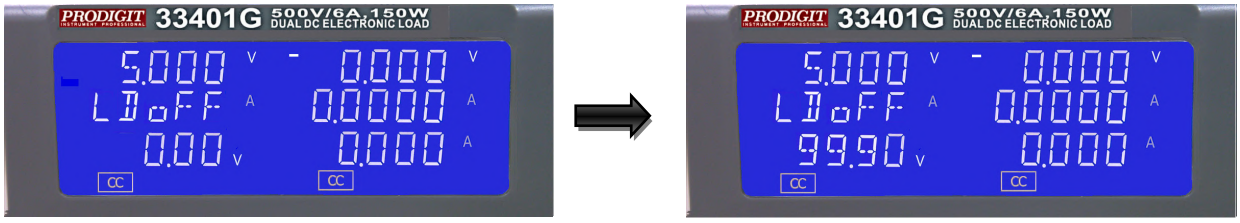
- Set Load ON voltage, the middle of the 5 digit LCD display will show "LDon", Lower 5 digit LCD display will show setting value, the units is V, The Load ON Voltage set range from 0.00V to 100.00V step 0.01V by rotating the setting knob. If the load is greater than the input voltage Load ON voltage setting, the Electronic load current begin to load on.



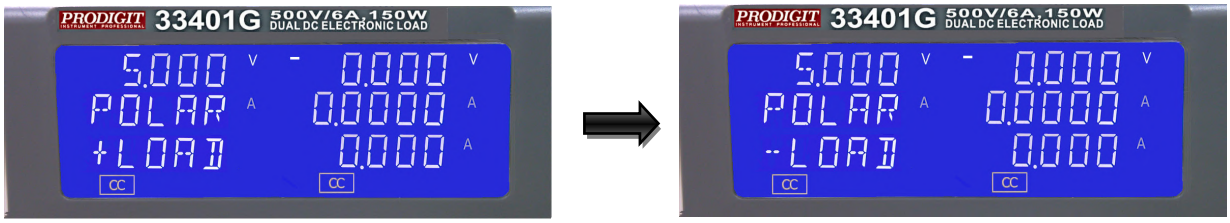
NOTE1: CC/CR MODE is controlled by Load ON voltage, CV MODE is not Controlled by Load ON voltage.

NOTE2: If Load ON voltage Setting 0V, load OFF voltage has to setting to 0V.

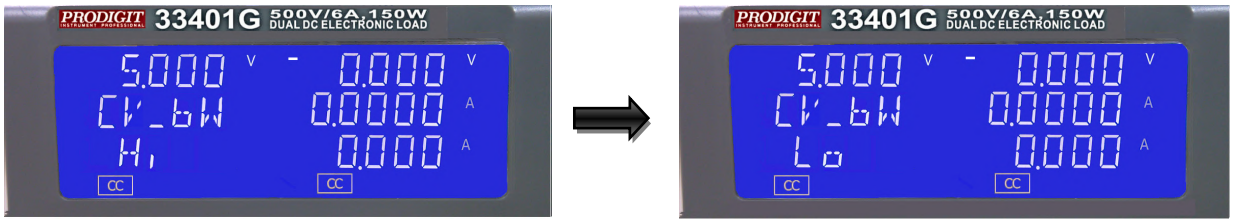
- Setting Load OFF voltage, the middle of the 5 digit LCD display will show "LDoFF", lower the 5 digit LCD display will show settings value, the units is V, The Load OFF Voltage set range from 0.00V to 99.90V step 0.01V by rotating The setting knob.
  if the load input voltage is less than Load OFF setting voltage, the electronic load to load off.



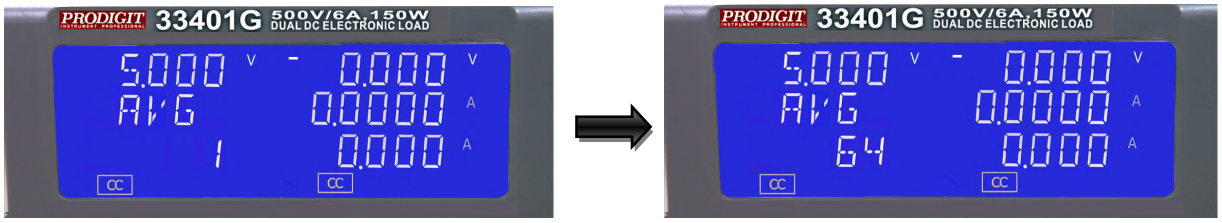
- Set Load polarity, the middle of the 5 digit LCD display will show "POLAR", lower the 5 digit LCD display "will show + LOAD" or "-LOAD", use the knobs and key settings "+ LOAD" or "-LOAD".



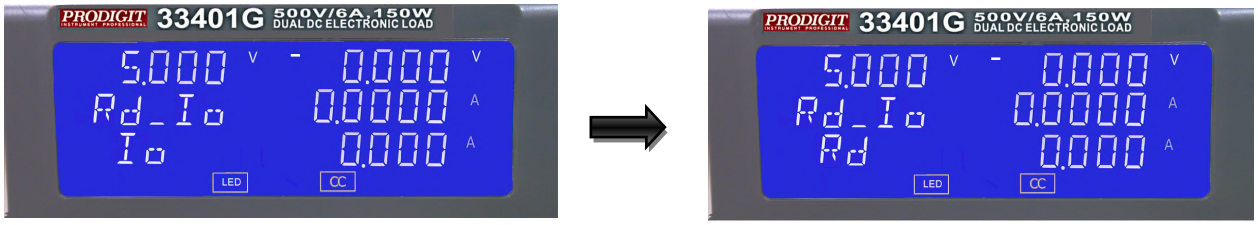
- Set bW, the middle of the 5 digit LCD display will show "CV_bW", lower the 5 digit LCD display "will show Hi" or "Lo", use the knobs and key settings "Hi" or "Lo".



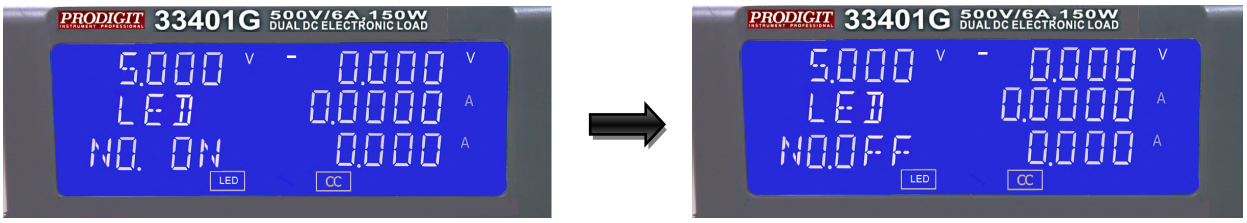
- Setting AVG , the middle of the 5 digit LCD display will show "AVGT", lower the 5 digit LCD display will show settings value,
  The AVG set range from 1 to 64 steps 1 by rotating the setting knob.



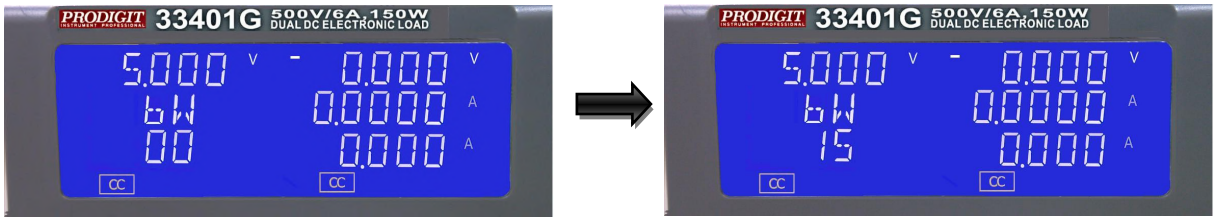
- Set RD.DSP, the middle of the 5 digit LCD display will show " Rd._Io ", lower the 5 digit LCD display will show "Rd" or "-Io". (The default mode is Io.)
  use the knobs or key to setting "Rd" or "Io".
- If setting to Rd the LED mode parameter will be include Rd.
- If setting to Io the LED mode parameter will be include Io.



- Set LED NO, the middle of the 5 digit LCD display will show "LED", lower the 5 digit LCD display "will show NO.ON" or "NO.OFF", use the knobs and key settings "ON" or "OFF", When select No. OFF display will not display LED No Quantity.



- Set bW, the middle of the 5 digit LCD display will show" bW", lower the 5 digit LCD display will show setting value, the bW values can setting from 00 to 15 by rotating the setting knob, and default value is 15(frequency response is faster), the bW setting available in CC, CR and LED mode, The bW can setting to slower when CC , CR or LED mode test have some unstable or oscillation with the UUT. User can adjust the bW setting value with the voltage and current waveform by oscilloscope to find out suitable frequency response.



3.2.14. DIM and LED

- Dimming setting mode:

  DIM ON: Press the DIM key, LED will be lit and setting control signal by setting parameters output.

  DIM OFF: Press the DIM key again, the LED will be OFF and Control signal output to zero.

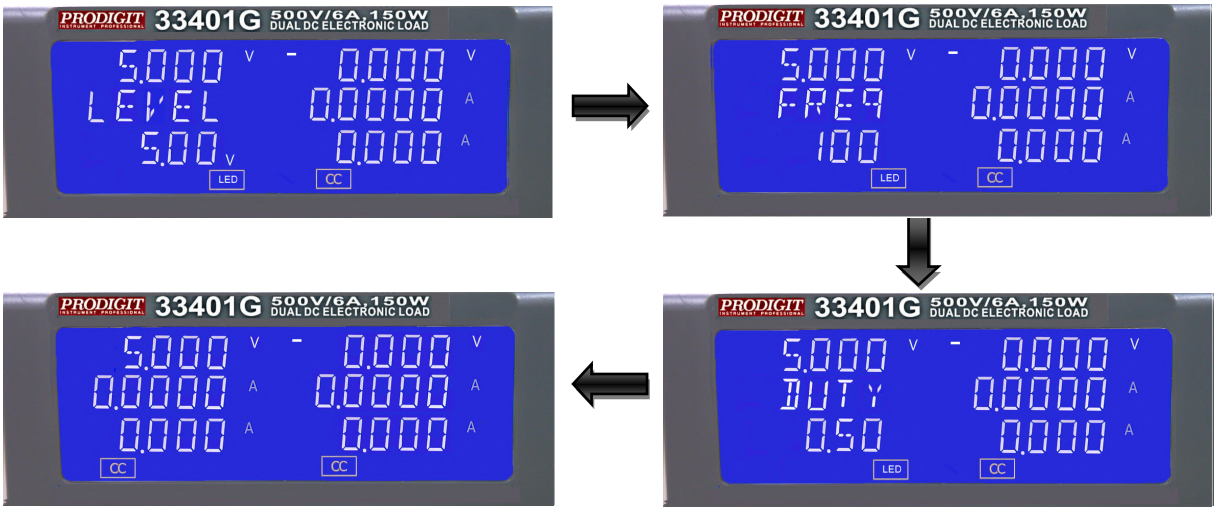
Note1: When the DIM ON and setting button is OFF, freq parameter is DC, can be Adjusted in the Level value is by rotating the setting knob.

Note2: When the DIM ON and setting button is OFF, freq parameter is 100~1000,

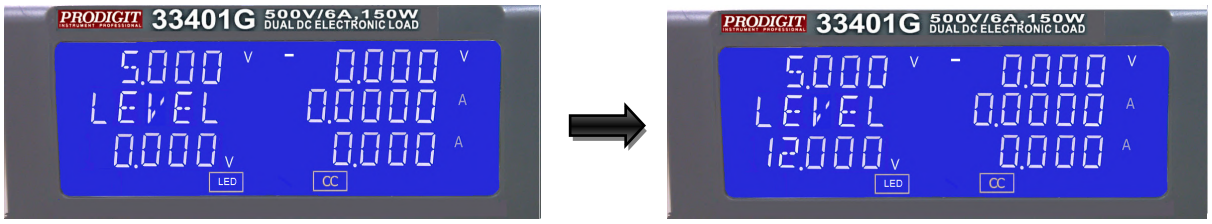
Can be adjusted in the Duty value is by rotating the setting knob.

3.2.15. SETTING and LED

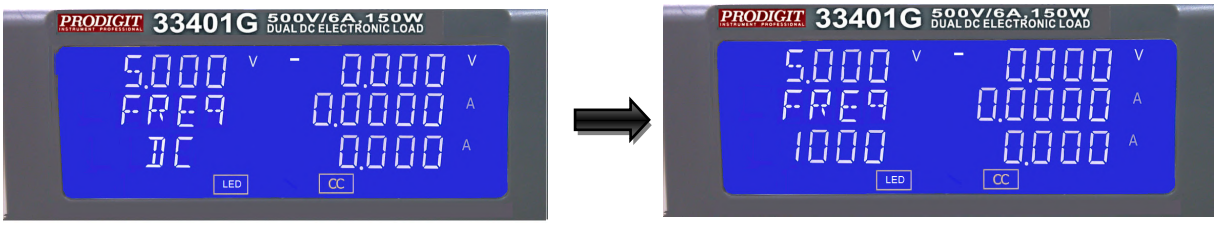
- DIM SETTING function for the 3 parameters, as LEVEL, FREQ and DUTY parameters.
  Press the dim setting key, the next parameter sequence LEVEL, FREQ, DUTY, and Disable press another and will leave and save settings, Setting test parameters as follows:



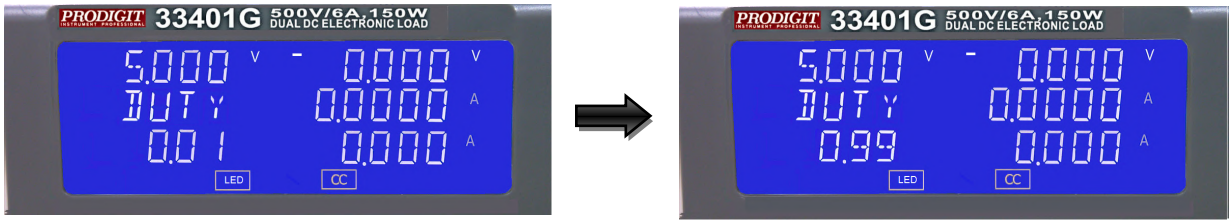
- LEVEL setting, The LCD display shows, lower 5 digit LCD display, the unit is "V", the setting range is 0.00V to the 12.00V of the LED mode specification, Step 0.04V by rotating the setting knob.



- FREQ setting, The LCD display shows, lower 5 digit LCD display, the unit is "Hz", the setting range is DC to the 1000 Hz of the LED mode specification, Step 10 Hz by rotating the setting knob.



- Duty setting, The LCD display shows, lower 5 digit LCD display, the setting range is 0.01 to the 0.99 of the LED mode specification, Step 0.01 by rotating the setting knob.



- 33401G Electronic Load DIM Description:

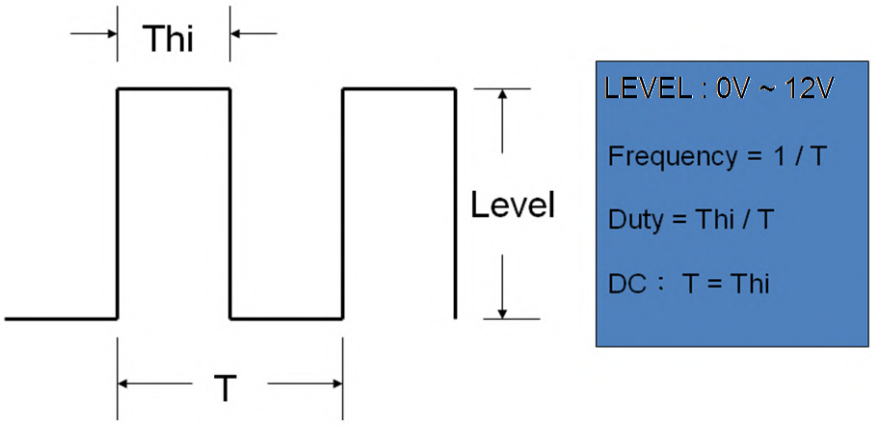


Fig 3-2 33401G Electronic Load DIM

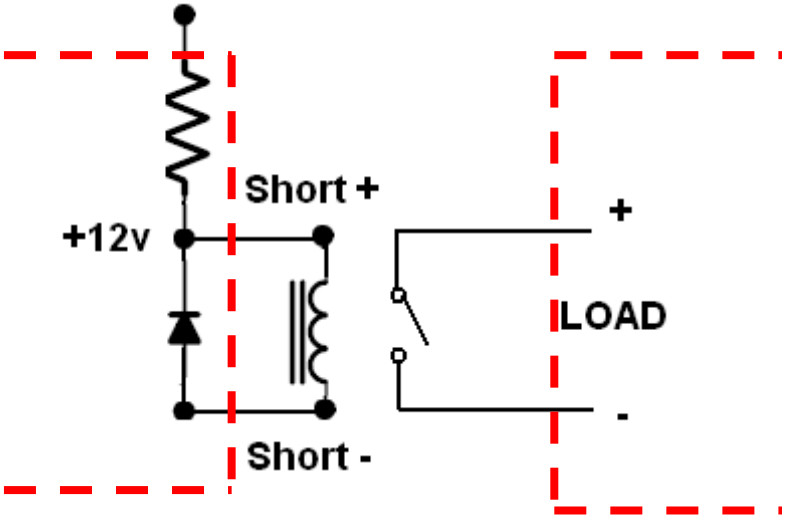
3.2.16. CHAN A Key and LED, CHAN B Key and LED

- CHAN A Key and CHAN B key to change CHAN A mode or CHAN B mode.

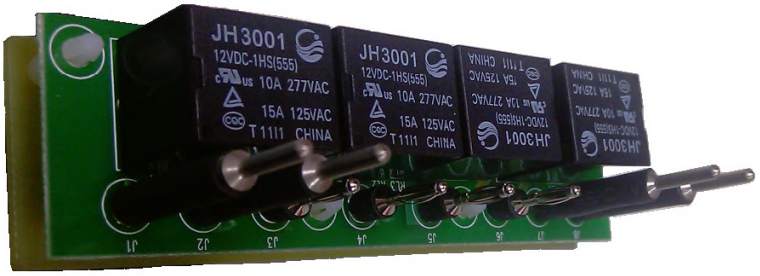
3.2.17. Short key

- Short Test Description:
  33401G of internal circuit

33401G of internal circuit



- LED Driver Short Test



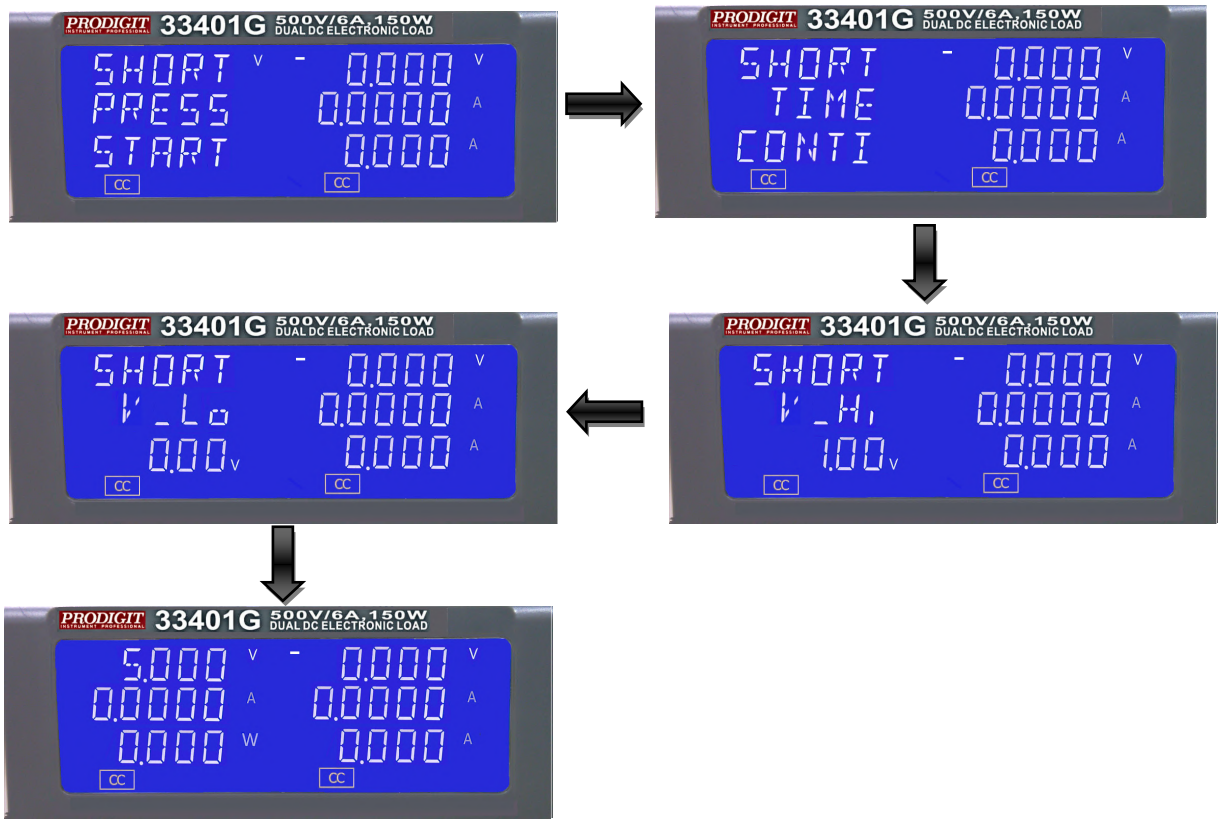
The SHORT key allows the parameters of a SHORT circuit test to be entered. The SHORT test will attempt to sink high current up to the 33401G series load module's maximum current in order to check the power source's protection and behavior. The test time can be adjusted and threshold values for the High and low voltage limits set.

Pressing the SHORT key once will cause the button to illuminate. The Message "SHORT PRESS START" will be shown across the 3 displays.

Each press of the SHORT key moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during Setting.

The setting sequence is shown below:

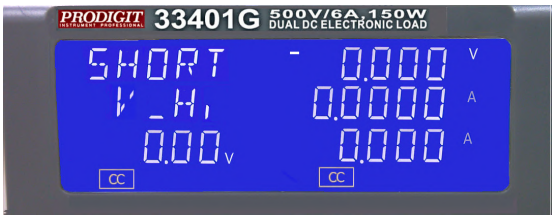
SHORT PRESS START (pressing the red start/stop key starts test) →
SHORT TIME (CONTI = Continuous or 100ms to 10,000ms possible) →
SHORT V_Hi (High voltage threshold setting) →
SHORT V_Lo (Low voltage threshold setting →
Exit SHORT test set-up

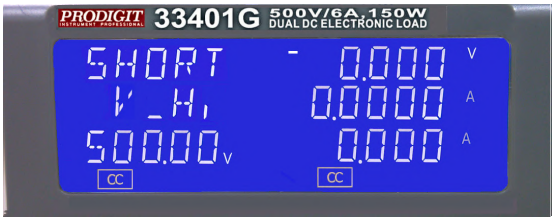


- setting the short test time，The LCD display show 「SHORT」 on upper 5 digits LCD display，shows 「TIME」on middle 5 digits LCD display，lower 5 digit LCD display 「CONTI」, the unit is "ms".

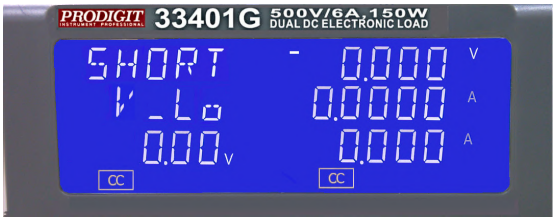
- TIME: setting the short test time, The LCD display show 「SHORT」 on upper 5 digits LCD display, shows 「TIME」on middle 5 digits LCD display the unit is “ms” ,and shows 「CONTI」 on lower 5 digits LCD display, the Setting range is “CONTI” means continue, 100mS to 10000mS step 100mS by clockwise rotate the setting knob.
  The short test will be no time limitation when setting to CONTI until press “START/STOP” key to stop the short test.

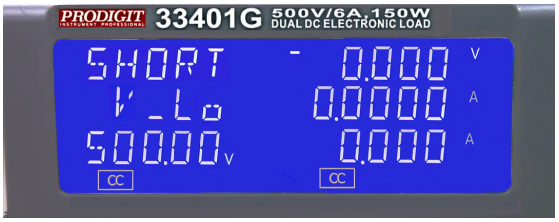
- V-Hi : Short test voltage check upper limitation setting, The LCD display shows 「SHORT」on upper 5 digit LCD display, Middle 5 digit LCD display 「V-Hi」,lower 5 digit LCD display setting value, the unit is "V", The V-Hi setting range from 0.00V to 500.00V step 0.01V by rotating the setting knob.





- V-Lo : Short test voltage check lower limitation setting, The LCD display shows 「SHORT」on upper 5 digit LCD display, Middle 5 digit LCD display 「V-Lo」,lower 5 digit LCD display setting value, the unit is "V", the V-Hi setting range from 0.00V to 500.00V step 0.01V by rotating the setting knob.





Once the test parameters have been entered the test is started by pressing The red START/STOP button while the SHORT PRESS START text is Displayed. During the test the bottom LCD will show run and the actual short Current will be displayed on the middle LCD.

Note 1: The message PASS END will be displayed if the measured voltage levels stays within the V_Hi and V_Lo threshold levels during the test

Note 2: The message FAIL END will be displayed if the measured voltage levels falls outside the V_Hi and V_Lo threshold levels during the test. The NG flag will also illuminate.

Note 3: If continuous short time is selected the test is ended by pressing the red START/STOP button.

3.2.18. OCP key

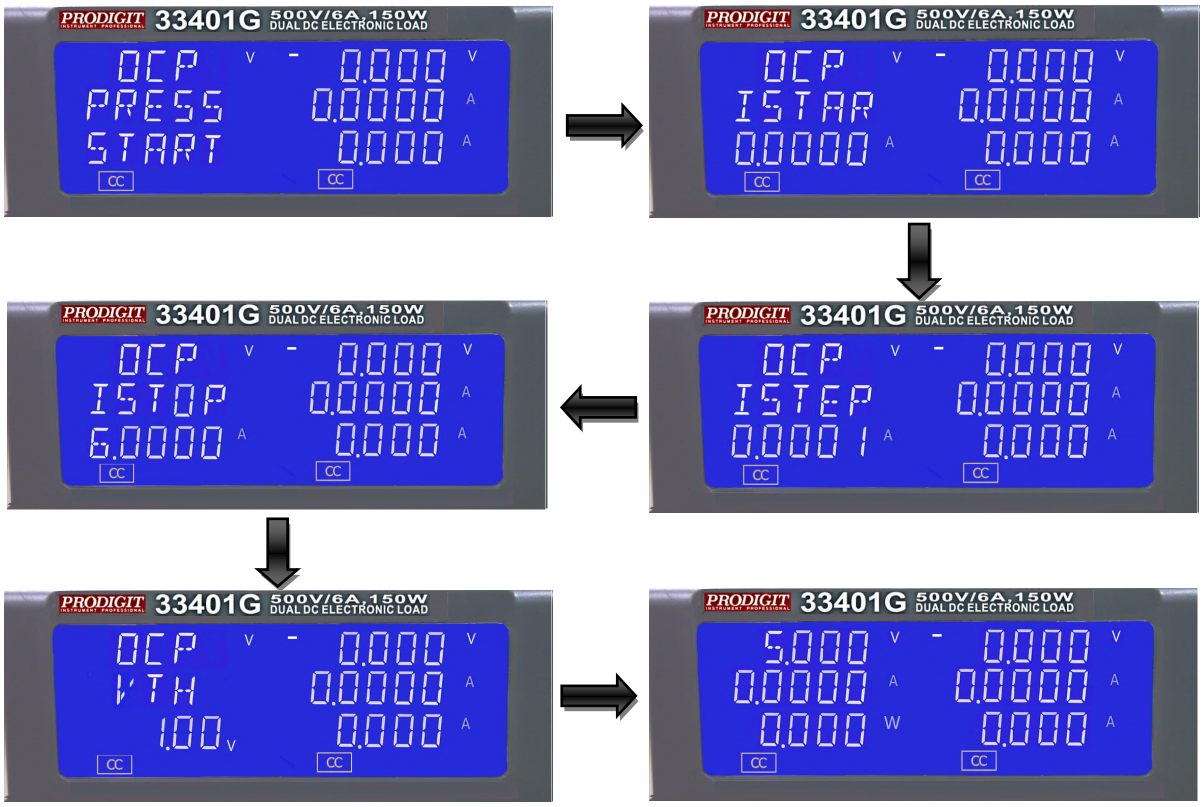
The OCP key allows the parameters of an Over Current Protection test to be entered. The OCP test will ramp up the load current in steps to validate the Device Under test's (DUT) protection and behavior. A voltage threshold level can be set. If the voltage measured during the test is lower than the set Threshold voltage then the test will fail and the display will signal OCP ERROR. Similarly a current Threshold (I STOP) can be set. If the measured Current reaches the I STOP Threshold the test will be discontinued and the OCP ERROR message will be displayed.

Pressing the OCP key once will cause the button to illuminate. The message "OCP PRESS START" will be shown across the 3 displays.

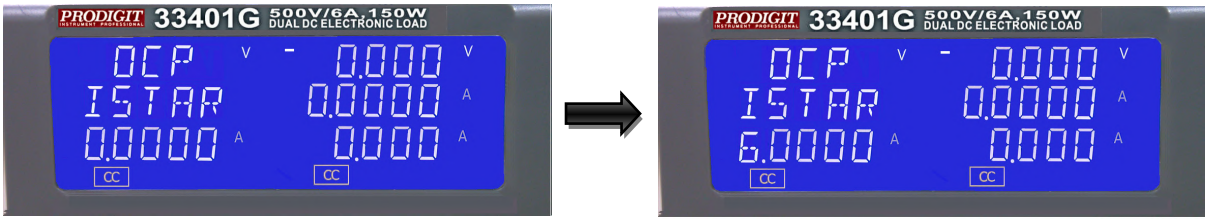
Each press of the OCP button moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during Setting.

The setting sequence is shown below:

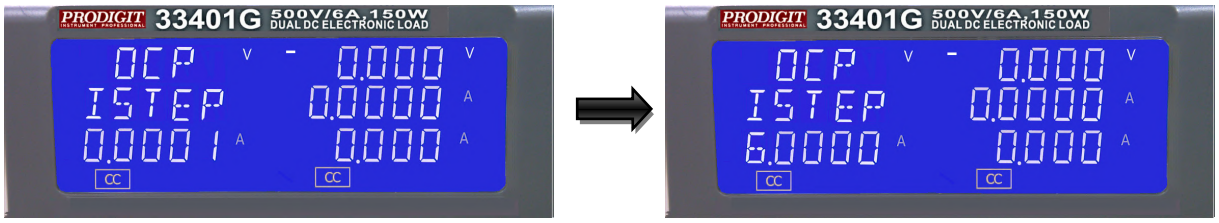
OCP PRESS START (pressing the red start/stop key starts test) →
OCP I STAR (current starting point of the OCP test) →
OCP I STEP (value of incremental current steps from I START) →
OCP I STOP (the OCP test's upper current threshold →
OCP Vth (the voltage threshold setting) →
Exit OCP test set-up



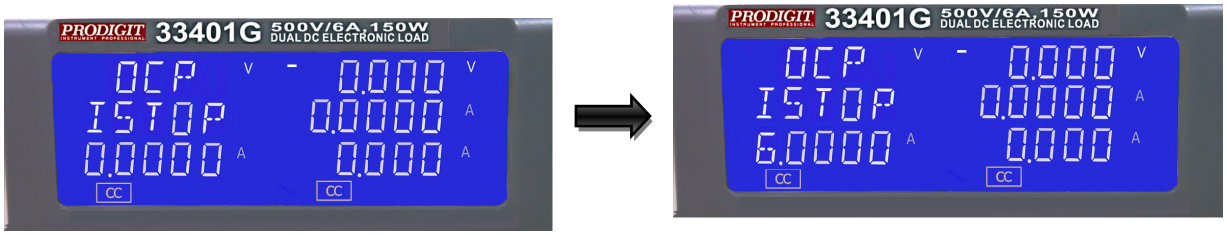
- ISTAR: setting the start current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTAR」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.0000A to the full scale of the CC mode specification.
  The setting is by rotating the setting knob.



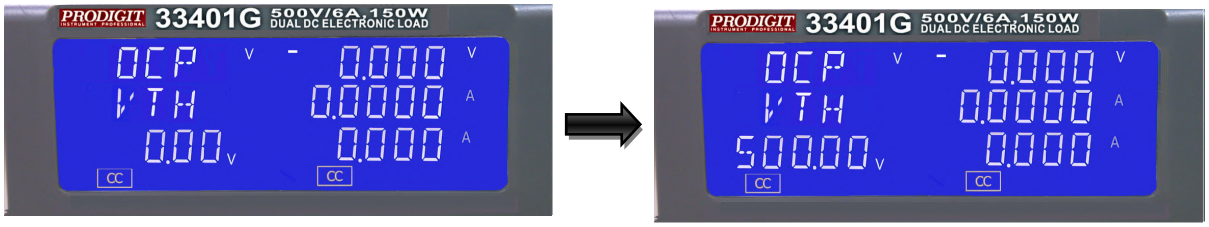
- ISTEP: setting the increment step current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTEP」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.0001A to the full scale of the CC mode specification.
  The setting is by rotating the setting knob.



- ISTOP: setting the stop current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTOP」,lower 5 digit LCD display setting value, the unit is "A", the setting range is 0.000A to the full scale of the CC mode specification. The setting is by rotating the setting knob.



- Vth: Setting threshold voltage; The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「Vth」,lower 5 digit LCD display setting value, the unit is "V", the setting range is 0.00V to the full scale of the Voltage specification. The setting is by rotating the setting knob.



Once the test parameters have been entered the test is started by pressing the red START/STOP button while the OCP PRESS START text is displayed. During the Test the middle LCD will show run and the actual current being Taken will be Displayed on the lower LCD

Note 1: The message OCP ERROR will be displayed if the DUT fails the test. The reasons for failure are due to one of the following conditions:

(a) the voltage level of the DUT falls below the set voltage threshold (OCP Vth) during the test
(b) The current taken from the DUT reaches the OCP I STOP setting.

Note 2: The message PASS will be displayed if the DUTs voltage stays above The set threshold. Also to PASS the OCP test the current taken from the DUT cannot equal the I STOP setting.

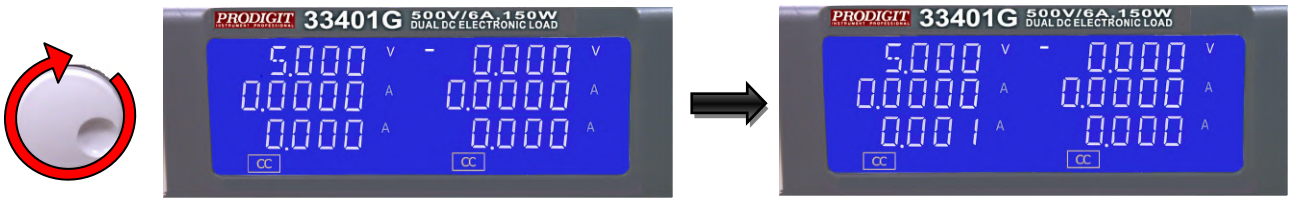
Note 3: If the DUT passes the OCP test the maximum current taken during the Test is displayed on the lower LCD.

Upon PASS or OCP ERROR the test will automatically stop. The red START/STOP button can be used during the test to immediately cease operation.

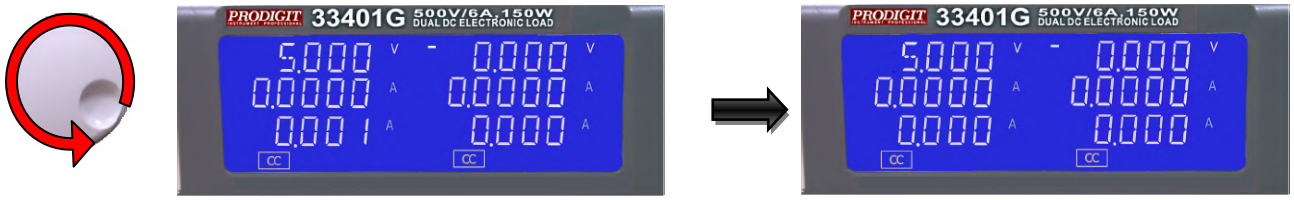
3.2.19. ROTARY Knob and ARROW Keys

The ROTARY knob and ARROW keys are used to increase or decrease the set values.

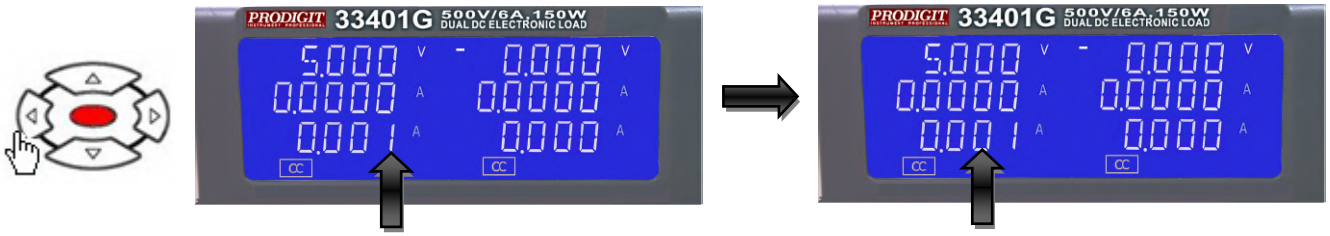
- CLOCKWISE operation of the ROTARY Knob increases the setting value.



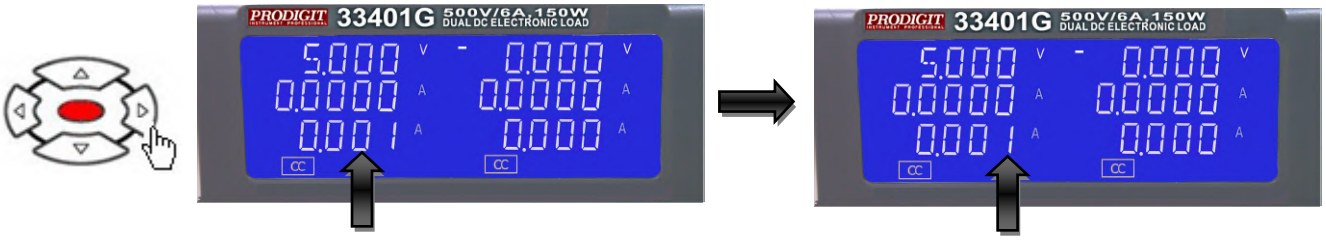
- ANTI-CLOCKWISE operation of the ROTARY Knob decreases the setting value.



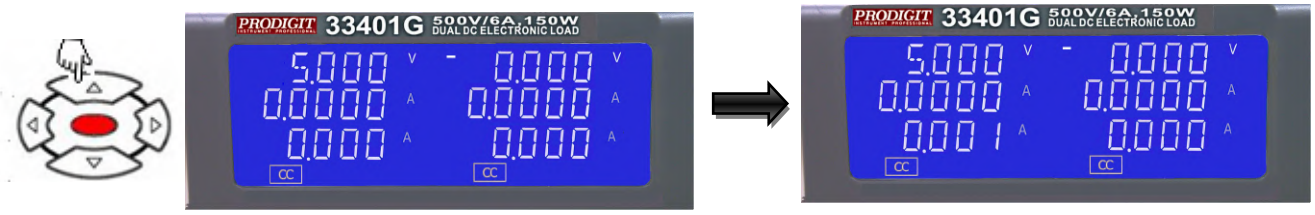
- LEFT ARROW key: Moves the setting selection one digit to the left.



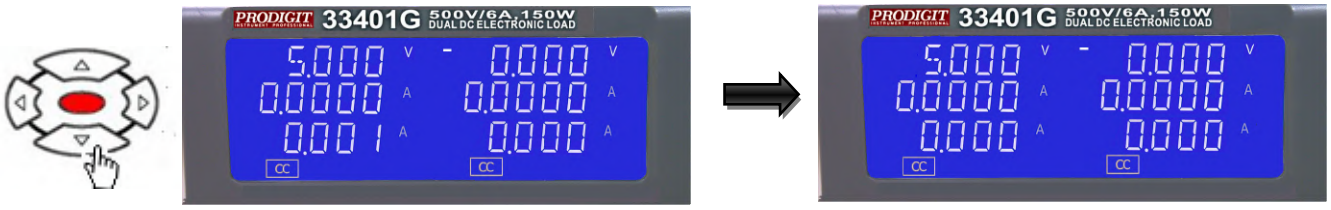
- RIGHT ARROW key moves the setting selection one digit to the right.



- UP ARROW key increases the setting value.



- DOWN ARROW key reduces the setting value.



Note 1: In CR MODE the UP ARROW key and CLOCKWISE operation of The ROTARY Knob reduces the resistance.

Note 2: In CR MODE the DOWN ARROW key & ANTI-CLOCKWISE Operation of the ROTARY Knob increases the resistance.

3.2.20. DC INPUT Terminal.

The positive (LOAD +) and negative (LOAD -) power input terminals are clearly marked. DO NOT confuse them with the smaller SENSE terminals.

Please ensure that the voltage and current rating of the DUT do not exceed the maximum rating of the 33401G load module being used. Please also check the output polarity of the DUT prior to connection and testing.

The negative load terminal should be connected to ground if testing a positive output power supply. This is normally achieved when the negative output of the power supply is grounded.

Similarly if a power supply with a negative output is to be tested then the positive Load terminal should be grounded. This is normally achieved when the positive Output of the power supply under test is grounded.

3.2.21. V-sense input terminal

The V-sense terminals can be used to compensate for a voltage drop in the load lines between the power supply and the 33401G series electronic Load. This is a useful feature useful when the load current is relatively high.

If remote sense is required the V-sense terminals are connected to the appropriate positive and negative terminals of the power supply as shown in Fig 3-3.

If V-sense is set to ‘ON’ and the sense terminals are connected to the DUT the load will check and compensate for all voltage drops.

The maximum voltage sense compensation is the same as the rating of the 33401G series electronic load module. For example the 33401G is capable of sinking current at up to 500Vdc. Therefore the maximum V-sense is also 500Vdc.

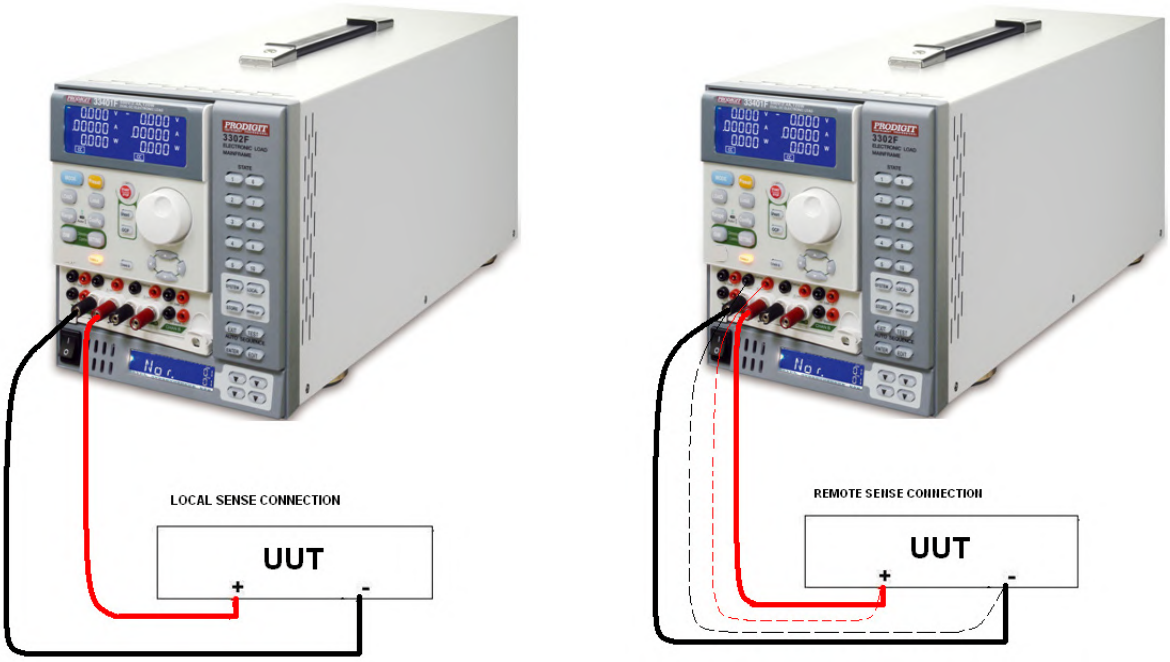


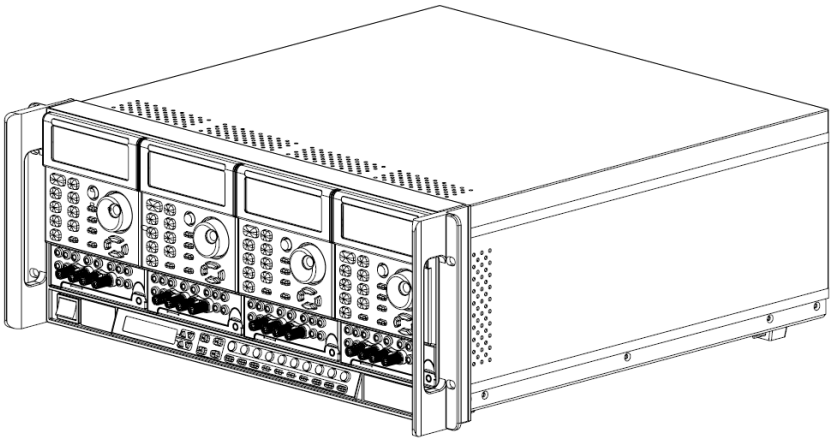
Fig 3-3 typical connection of 33401G load module

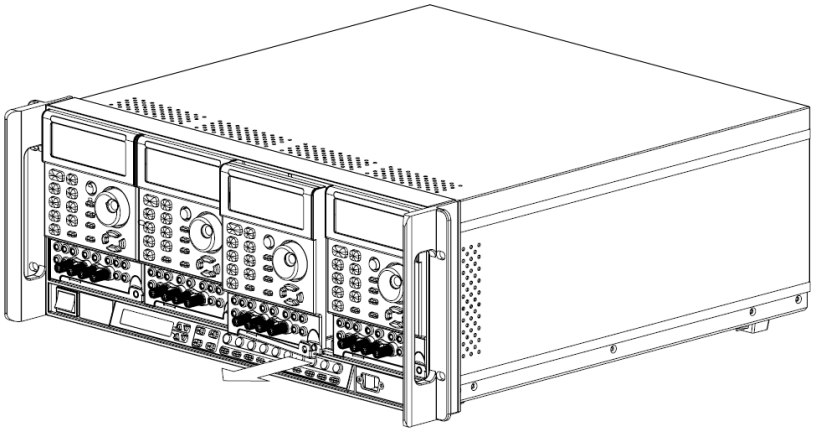
3.2.22. The withdraw handle

The following procedure details how to remove the 33401G series load Module from the mainframe.

- Firstly ensure that the mains power to the 3300G/3302G/3305G mainframe is Switched off. Failure to do so may result in damage to the load module.
- Take the screw out of the withdraw handle in the lower right corner of the Module.
- After removal of the screw the handle can be pulled towards you to lever the Module out of the mainframe.

The picture below illustrates the handle operation in the 3300G. The procedure is the same for the 3302G and 3305G mainframes.





3-3 Initial setting of 33401G series load module

Tables 3-1 to 3-2 were described 33401G series electronic load module's initialization parameters.

Item		Initial value	Item		Initial value
CC +Preset		0.0000 A	LIMIT	V_Hi	500.00 V
CR +Preset		6000.0 Ω		V_Lo	0.00 V
CV +Preset		500.00 V		I_Hi	6.0000A
LED No+Preset		1		I_Lo	0.0000 A
LED Vo+Preset		3.500V		W_Hi	150.000 W
LED VD+Preset		2.800V		W_Lo	0.000 W
LED Io+Preset		0.70000A	CONFIG	LD-ON	5.00 V
SHORT		Disable		LD-OFF	2.50 V
OCP		Disable		POLAR	+LOAD
SETTING	LEVEL	6.000V		CV_bW	Hi
	FREQ	100		AVG	1
	DUTY	0.50		bW	15
				RD_Io	Io
				LED NO	ON

Table 3-1 33401G initialize

項 目		起始值	項 目		起始值
CC +Preset		0.00000 A	LIMIT	V_Hi	120.000 V
CR +Preset		3000.0Ω		V_Lo	0.000 V
CV +Preset		120.000 V		I_Hi	2.0000A
LED No+Preset		1		I_Lo	0.0000 A
LED Vo+Preset		1.750V		W_Hi	75.000 W
LED VD+Preset		1.400V		W_Lo	0.000 W
LED Io+Preset		0.28000A	CONFIG	LD-ON	1.000 V
SHORT		Disable		LD-OFF	0.500 V
OCP		Disable		POLAR	+LOAD
SETTING	LEVEL	6.000V		CV_bW	Hi
	FREQ	100		AVG	1
	DUTY	0.50		RD_Io	Io
				LED NO.	ON
				bw	15

Table 3-2 33402G initialize

項 目		起始值	項 目		起始值
CC +Preset		0.00000 A	LIMIT	V_Hi	120.000 V
CR +Preset		1200.0Ω		V_Lo	0.000 V
CV +Preset		120.000 V		I_Hi	6.0000A
LED No+Preset		1		I_Lo	0.0000 A
LED Vo+Preset		0.700V		W_Hi	150.00 W
LED VD+Preset		0.5600V		W_Lo	0.000 W
LED Io+Preset		0.70000A	CONFIG	LD-ON	1.00 V
SHORT		Disable		LD-OFF	0.500 V
OCP		Disable		POLAR	+LOAD
SETTING	LEVEL	6.000V		CV_bW	Hi
	FREQ	100		AVG	1
	DUTY	0.50		RD_Io	Io
				LED NO.	ON
				bw	15

Table 3-3 33403G initialize

3-4 Input terminal and wire consideration

The Load input terminals are rated at 63A. Please note that the banana plug and spade/hook connectors provided in the accessory pack have a current rating of 20A. Please be sure to use the correct connection method if sinking high currents. There are five ways to connect the Device under Test (DUT) to the Electronic Load as detailed below.

3.4.1 Plug connectors: This is the most popular way to connect the input of electronic load to the device under test. It is recommended that the load current is less than 20A to keep within the current rating of the plug. A maximum wire gauge of AWG14 can be used in this application.

3.4.2 Spade/Hook terminals: The spade terminals provide a good contact to the binding posts. The spade terminals provided in the accessory pack are rated at 20A. The maximum wire gauge of AWG10 can be used for this connection method.

3.4.3 Insert the wire into the input terminal: Unscrewing the binding post will reveal a hole. The wire from the output of the DUT can be pushed into this hole and the binding post tightened to clamp the wire. The Maximum wire gauge is AWG14.

3.4.4 Both plug connectors and spade terminals:
It is recommended to use this method when input current is greater than 20A or if long load wires are used between the DUT and the load module.

3.4.5 Both plug connectors and Insert the wire into the input terminal.
It is recommended to use this method when the input current is greater than 20A or long wires are needed to connect the DUT to the load module.

A major consideration in making the 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.

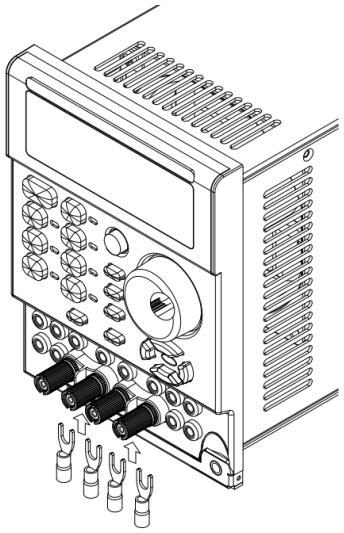


Fig 3-4 Hook Terminal Y type large size terminal connections

3.4.6 Wire/Cable Guide

The following table provides a guide to the current carrying capability (ampacity) of Both Metric and AWG sizes. Metric sizes are expressed as a cross sectional areas (CSA). If in any doubt of a cables ampacity it is recommended that you ask your Cable supplier.

Wire Size AWG	**Ampacity (A)**	**CSA (mm^2)**	**Notes:** Ratings for AWG-sized wires derived from MIL-W-5088B. Ratings for metric-sized wires derived from IEC Publication
22	**5.0**	**-----**	Ampacity of aluminium wire is approximately 84% of that listed for copper wire.
20	**8.33**	**-----**	
---	**10**	**0.75**	When two or more wires are bundled together, ampacity for each wire must be reduced to the following percentages:
18	**15.4**	**-----**	
---	**13.5**	**1**	
16		**------**	
---	**16**	**1.5**	2 conductors 94%
14	**31.2**	**-------**	3 conductors 89%
---	**25**	**2.5**	4 conductors 83%
12	**40**	**-------**	5 conductors 76%
---	**32**	**4**	
10	**55**	**------**	
---	**40**	**6**	4. Maximum temperatures:
8	**75**	**------**	Ambient = 50° C
---	**63**	**10**	Conductor = 105° C
6	**100**	**------**	
4	**135**	**------**	

Table 3-4 Stranded Copper Wire Ampere Capacity

3-5 . Protection features

The protection features of the 33401G series electronic load modules are as follows:

3.5.1. **Overvoltage protection:** The Electronic Load input will turn OFF if the overvoltage circuit is tripped. The message OVP will be displayed on the LCD. When the OVP fault has been removed the load can be set to sink power again. While the unit will attempt to protect itself given an OVP state it is strongly advised to guard against any potential OVP fault state by using external protection and the correctly rated electronic load.

The Overvoltage protection circuit is set at a predetermined voltage and cannot be adjusted. The OVP level is 105% of the 33401G series nominal voltage rating.

CAUTION: Never apply an AC voltage to the input of the 33401G series load. Do not apply a DC voltage that is higher than 33401G series load Module's rating. If this advice is ignored it is likely that damage will be caused to the electronic load module. This damage will not be covered by the warranty.

3.5.2. Over current protection (OCP): The OCP protection will engage if the current being taken by the load reaches 105% of the load module's maximum current. The message OCP will be displayed on the front panel and the unit will switch to its LOAD OFF state. Once the source of the over current has been removed the load can be switched on again.

3.5.3. Over temperature protection (OTP): The load module's internal temperature at the heat sink is monitored. If the temperature reaches approximately 90°C the OTP message will be displayed and the unit will automatically switch to the LOAD OFF state. If an OTP error occurs please check the ambient temperature is between 0 to 40°C. Also ensure that the front and rear air vents of the mainframe are not obstructed. The air flow is taken from the front of the mainframe and exhausted from the rear. Therefore a suitable gap needs to be left at the rear of the mainframe. A minimum of 15cm is recommended. After a suitable cooling period the load can be switched.

3.5.4. Reverse Polarity: The 33401G series load module will tolerate a reverse current up to the maximum current rating of the load module. The '-' symbol will be shown on the voltage and current displays.

Please note that damage will occur if the reverse current is higher than the load module's maximum rating. If a reverse current is noticed turn off and disconnect the dc power source and turn the load off. The connections between the DC Source and the Load Module can now be correctly made.

If a reverse polarity situation occurs the load will sink power even if the LOAD button is OFF. No current will be displayed on the 33401G series load module. Current up to the load's maximum current rating will be tolerated in reverse polarity. However there is no OVP OCP and protection. It is strongly recommended that the load lines be fused if it is likely that the load could be subject to reverse polarity. These fuses should be fast acting and rated at the maximum current of the load module +5%.

Chapter 4 Applications

This chapter details the basic operating modes along with some common applications in which the 33401G series electronic Load modules are used.

4-1 .Local sense connections

Local sensing is used in applications where the lead lengths are relatively short, or where load regulation is not critical. When connected in local sense mode the 5 digit voltage meter of the 33401G series electronic load measures the voltage at its DC input terminals. The connecting leads between the DUT and the Electronic Load should be bundled or tie wrapped together to minimize inductance.

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

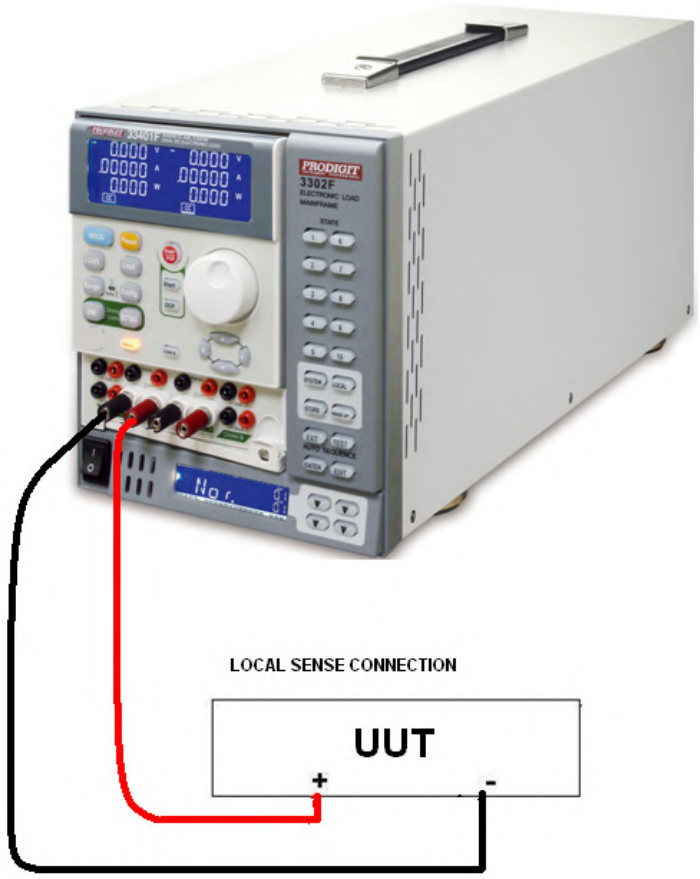


Fig 4-1 Local voltage sense connections

4-2 Remote sense connections

Remote sensing compensates for the voltage drop in applications that require long lead lengths. It is useful under low voltage high current conditions. The remote voltage sense terminals (Vs+) and (Vs-) of the load are connected to (+) and (-) output of the DC Source. Be sure to observe the correct polarity or damage may occur. The power and sense cables should be bundled or tie wrapped together to minimize inductance.

Fig 4-2 illustrates a typical set up with the electronic load connected for remote sense operation.

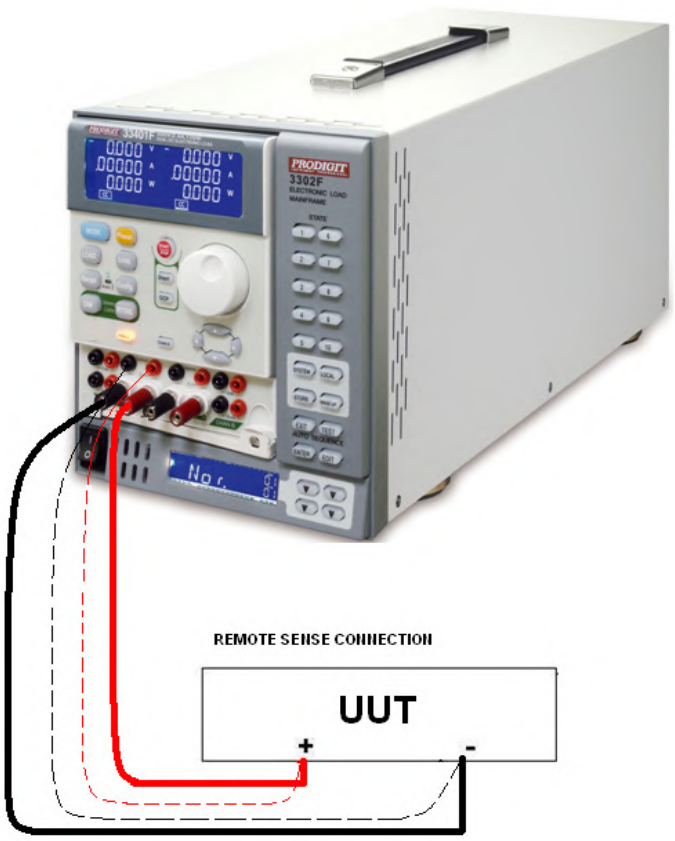
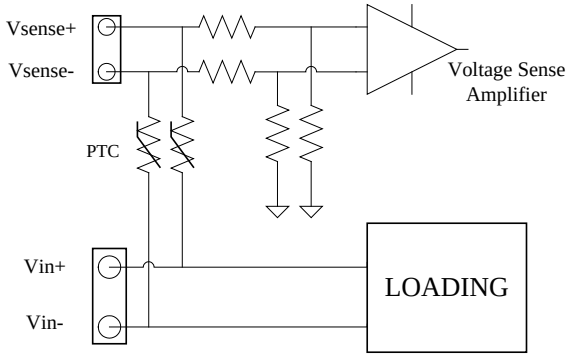


Fig 4-2 Remote voltage sense connections

※Local and remote voltage detector detecting the voltage of the voltage detection circuit,



4-3 Constant Current mode application

The Constant Current (CC) mode is ideal for testing the Load Regulation, Cross Regulation, and Output Voltage Regulation of the power supply under test. The CC mode can also be used to test the Discharge Characteristics and the Life Cycle of cells and battery packs. In CC operation the 33401G can operate as a static load with switchable high and low current levels.

4.3.1 Static mode: (Fig 4-3)

Major application areas include:

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

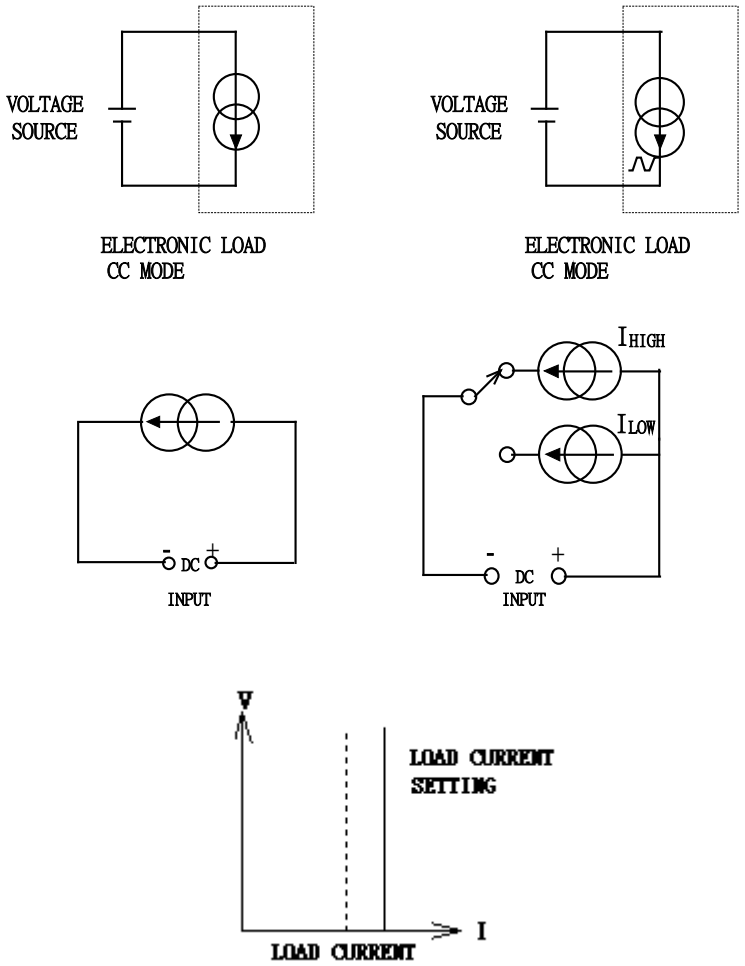


Fig 4-3 constant CURRENT mode application

4-4 . Constant Voltage mode application

In Constant Voltage (CV) operation the load will attempt to sink as much current as required in order to reach the set voltage value. CV operation is useful in checking the load regulation of dc current sources. The CV mode is also ideal for characterizing the current limit of dc power supplies. These application areas are explained a little more below.

4.4.1 Current source testing.

A common application for a dc current source is as a battery charger. Most battery chargers are designed to automatically adjust their charging current according to the battery voltage. In CV mode the electronic load will sink the current that is needed to reach the desired voltage. The CV mode is therefore ideal for checking the charge current at a particular voltage level.

If the battery charger is tested at a number of different voltage levels in CV mode a current curve can be recorded. Thus the battery charger's load regulation can be checked during development, production and batch testing.

4.4.2 Power supply current limit characterization

The current limit is a necessary function for power supplies. The fold back current limit curve is very common for fixed output switching power supplies. The constant current limit curve is more popular for adjustable laboratory power supplies.

It is very difficult or impossible to find the current limit curve by CC or CR mode. However it becomes simple by using CV mode. The user sets the CV voltage and Records the output current. Plotting the current measurements against the voltage Settings result in the output current limit curve of a power supply (Figure 4-4).

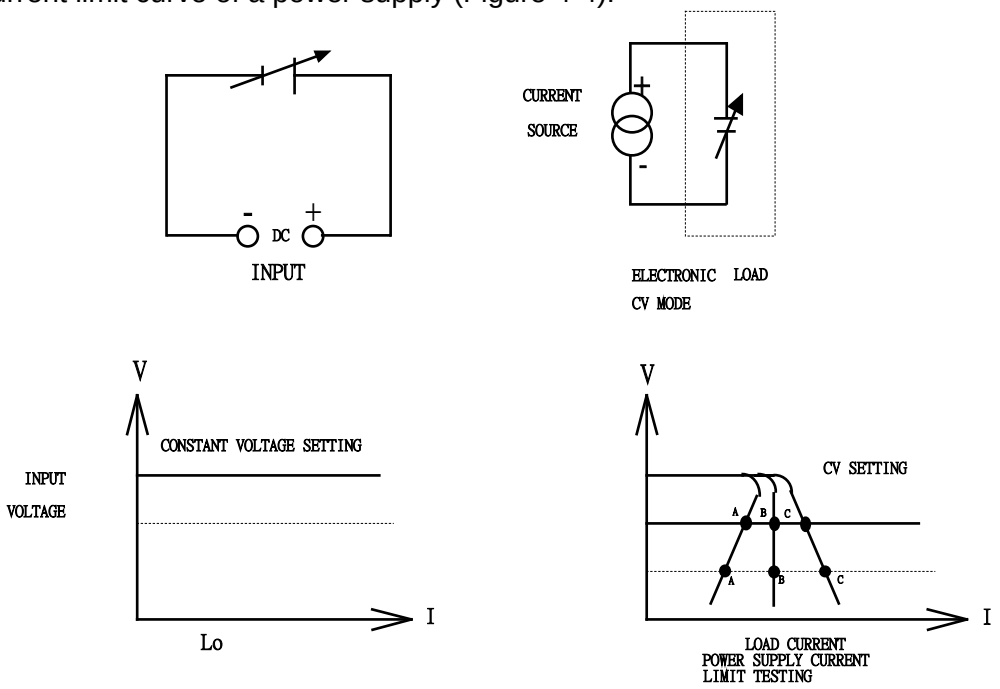


Fig 4-4 Constant Voltage mode application

4-5 . Constant Resistance mode application

Operating in Constant Resistance mode is useful for testing both voltage and current sources. The CR mode is particularly suited for the ‘soft start’ of power supplies.
This is explained in more detail below.

4.5.1 Power supply power up sequence

In constant current mode the demand at initial ‘Load ON’ of the preset current value is almost instantaneous. This might cause the Device under Test (DUT) problems meeting the relatively high current demand at initial switch on. .

For example: A 5V/50A output power supply may not be able to deliver 50A over its entire start-up range of 0-5 volts. In many cases the power supply’s short circuit or over current protection circuit cause the power supply to shut down. This is because the power supply is trying to deliver the 50A at a voltage level that is too low.

The answer to this problem is not to use CC mode but to use CR mode instead. This is because in CR mode the current and voltage ramp up together providing a ‘soft start’ when compared to standard CC mode.

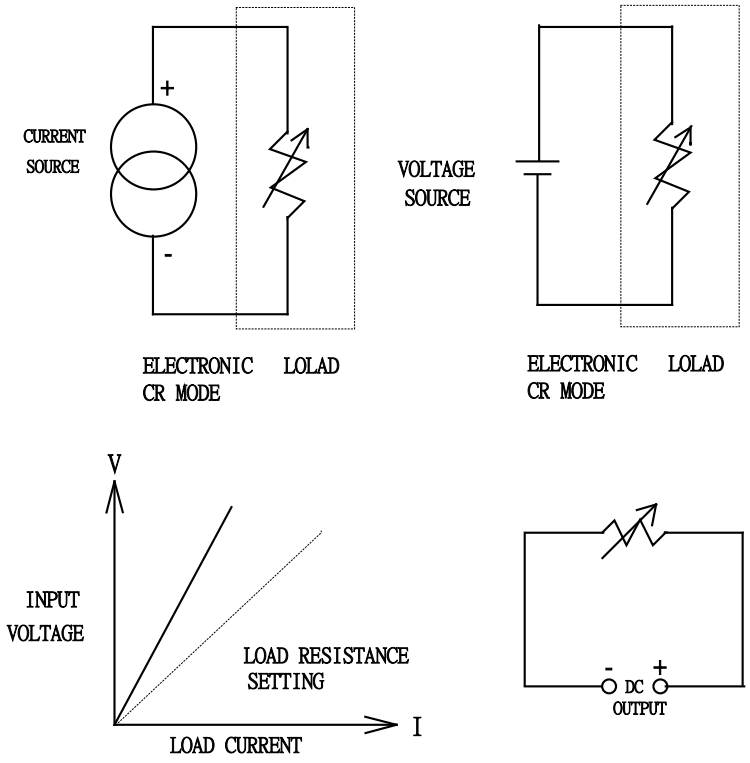


Fig 4-5 Constant Resistance mode Application

4-6 LED mode applications

As the actual connection to the LED Driver of the LED will be by brand,size,cascading , in parallel and then various different load conditions, if each test is required should be get the expensive cost of testing, the use of electronic load to simulate various combinations of LED to test can achieve fast and low cost.

1 LED Characteristic

Figure 4-6 and Figure 4-7 shows LED's equivalent circuit, there is a forward resistance Series a forward Voltage Vd,the exponential V-I characteristic curve as Figure 4-8 When Voltage across of LED larger than forward voltage Vd,then LED current Io is (Vo-Vd)/Rd.

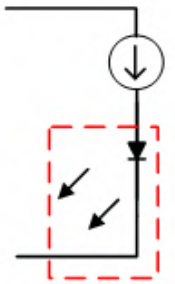


Fig 4-6

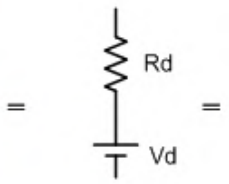


Fig 4-7

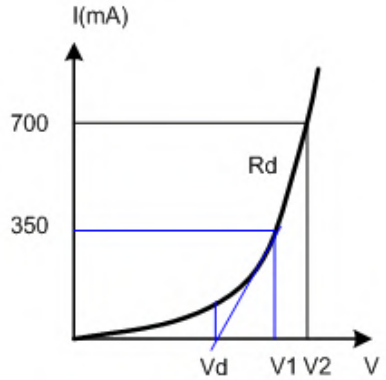
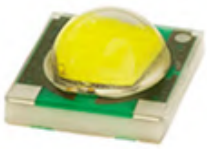


Fig 4-8



1.1 When LED driver is constant current type, the voltage across of LED is Vd+(I*Rd)=Vo, Actually the Vd have a negative temperature coefficient (NTC-2mV/℃-4 mV/℃) With respect to voltage ,e.g. the LED forward voltage Vd decreases as the LED gets Warmer, causing the Vo voltage decreases as temperature goes up.

1.2 Figure 4-9 show LED driver constant current output Io has a current ripple, the Voltage across of LED also got a Io*Rd voltage ripple (Normally is a high frequency Triangle waveform).

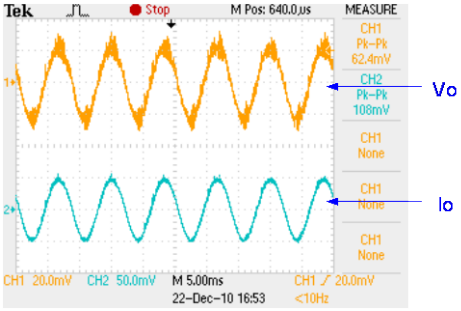


Fig 4-9

1.3 Several LED cascading connection:

Several LED cascading connection can get more output brightness, Vd and Rd also Will increase as series. Fig 4-10 shows 3 LED series, Fig 4-11 and Fig 4-12 are the LED's equivalent circuit, Fig 4-13. Shows exponential V-I characteristic curve.

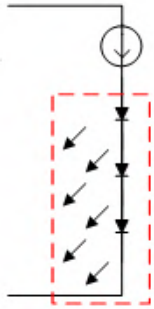


Fig 4-10

Fig 4-11

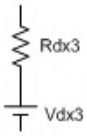


Fig 4-12

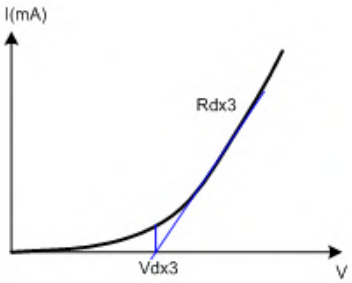


Fig 4-13

1.4 In parallel connection stacks of LED: Several LED stacks in parallel connection is also Can get more output brightness, Vd also will increase as series Rd is according to the Cascade and parallel. Fig 4-14 is 2 stacks LED to parallel, Fig 4-15 to Fig 4-17.are the LED's equivalent circuit, Fig 4-18 shows exponential V-I characteristic curve.

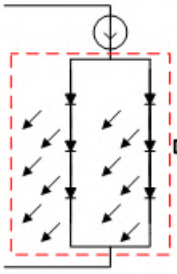


Fig 4-14

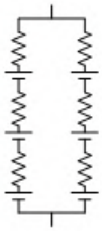


Fig 4-15

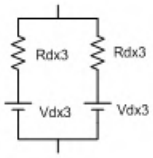


Fig 4-16

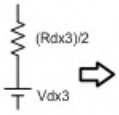


Fig 4-17

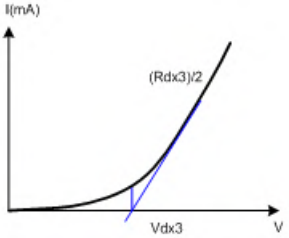


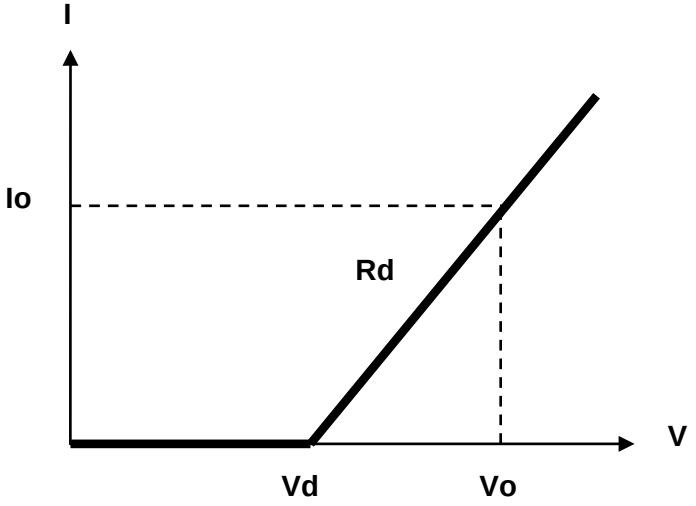
Fig 4-18

2 How to setting Vd,Rd and Vo parameters for LED mode Electronic Load.
If the LED lamp's brand, part no, and specifications is available then follow the LED data To setting the parameters.

Vd voltage LED for different value of different materials, usually about one a LED Vd Voltage, GaAs is 1V, the red GaAsP to 1.2V, GaP to 1.8V, GaN is 2.5V.
If the LED lamp's data information is not available, normally, you can use the LED driver's Specifications to setting the parameters, Vo is the LED driver output voltage Specifications,Vd can predict 70~90 percent of Vo(initial setting to 80%),Rd=(Vo-Vd)/Io ,Io Is the LED driver output current specifications

33401G LED mode

1. V-I curve as shown
2. Rd=(Vo-Vd)/Io
3. Parameter definition:
4. Vd: LED forward voltage
5. Rd: LED operating impedance
6. Vo: LED Operating Voltage
7. Io: LED operating current



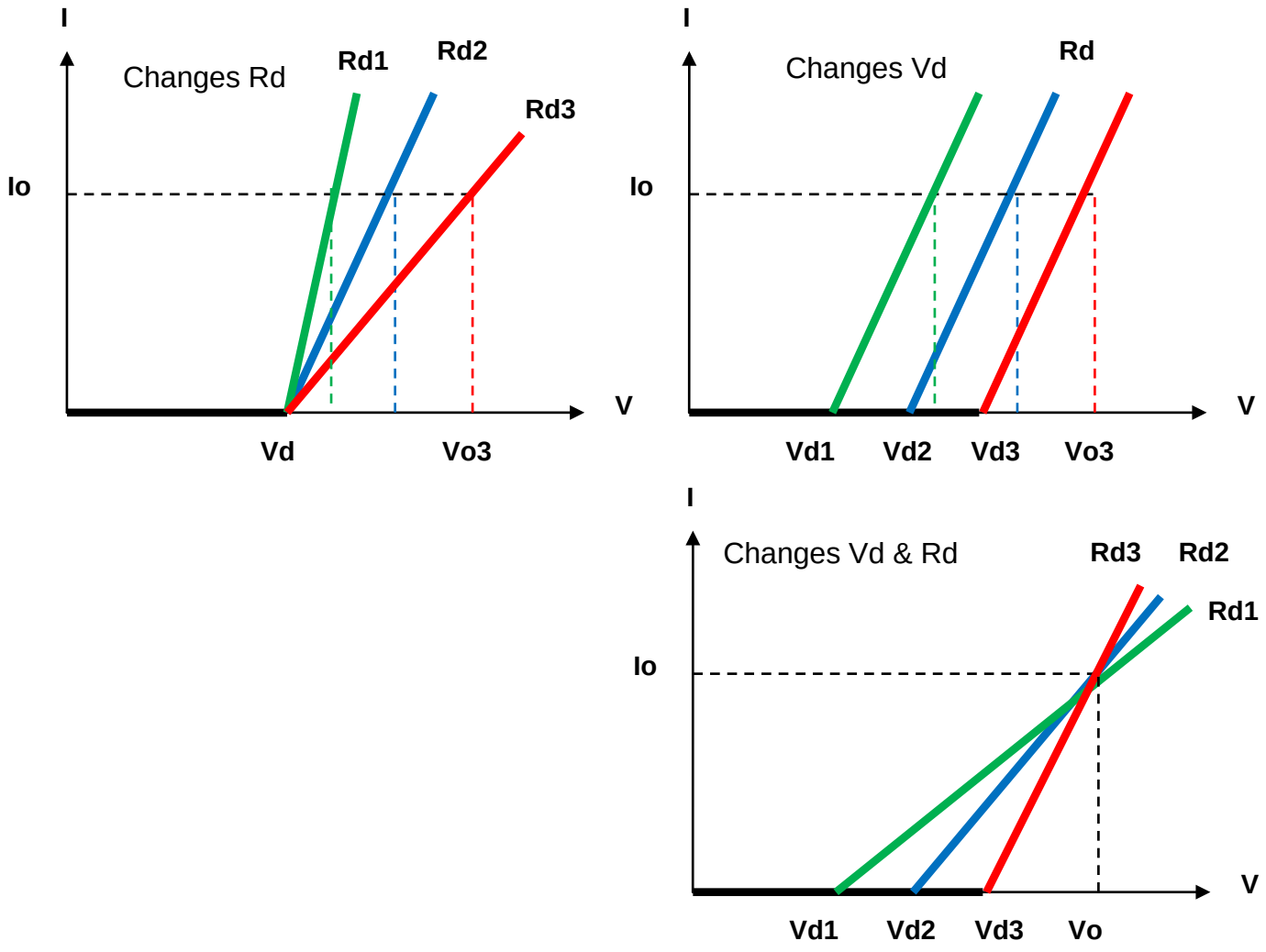


Fig 4-19 LED MODE operation mode of the application

4-7 . The connection of a multiple output power supply

The following is a rule for a multiple output power supply connects to the 33401G Electronic Loads.

Rule: The potential of positive input (Red binding post) must be higher than the potential of negative input (Black binding post) of 33401G Electronic load.

Here is an example of +5V, +5V, +12V and +12V four outputs power supply connected to a 33401G electronic load

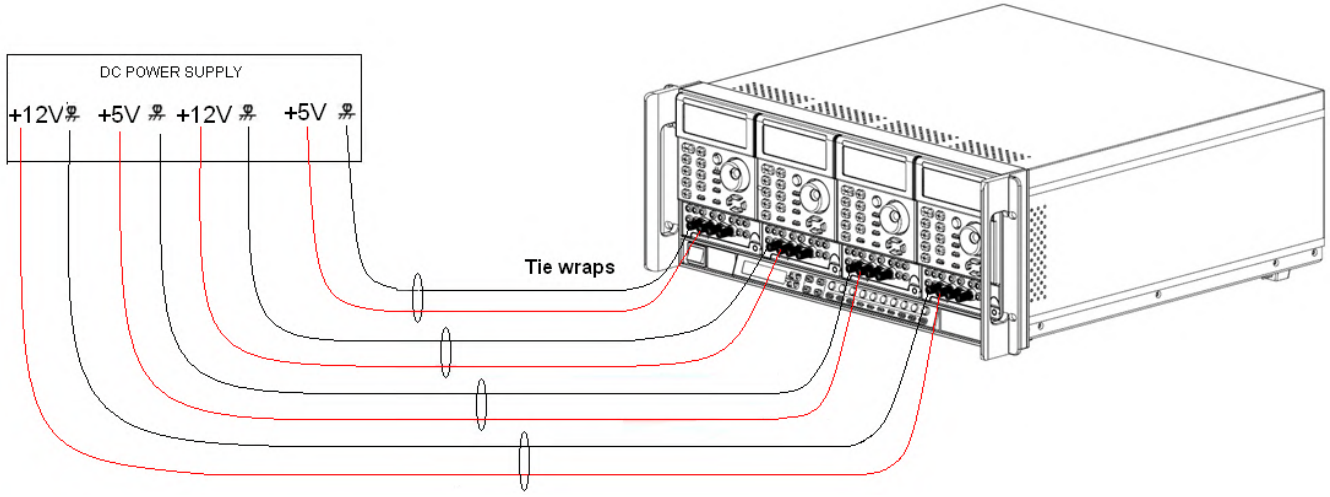


Fig 4-20 Connection between 33401G plug-in load and multiple output power supply

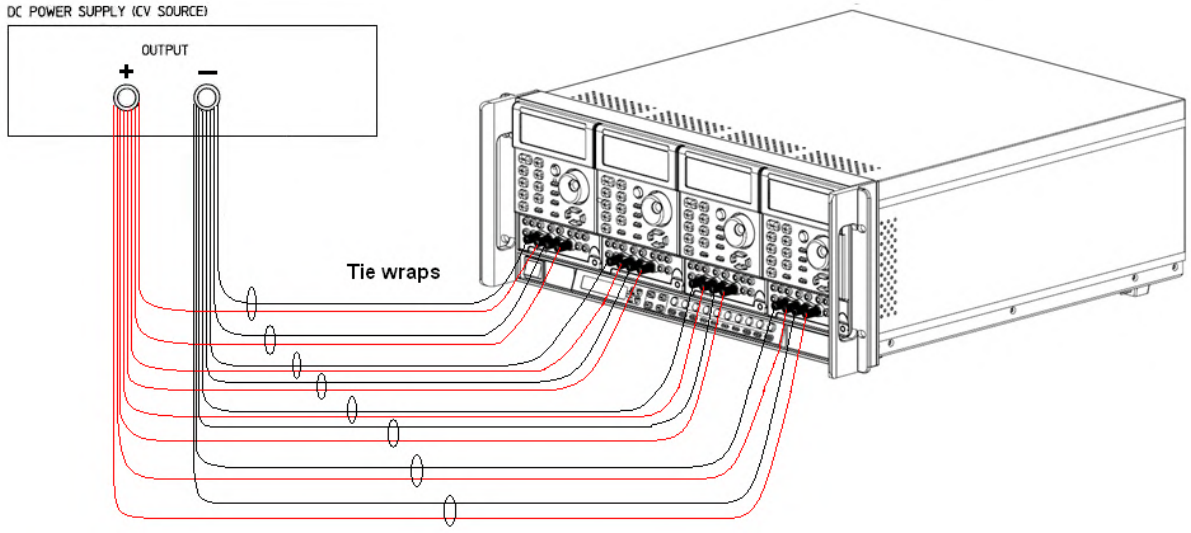
4-8 . Parallel operation

It is possible to operate load modules in parallel if the power and/or current capability of a single 33401G load module is not sufficient.

The positive and negative outputs of the power supply are connected individually to each load module as shown in the Fig 4-21 below. The setting is made at each individual load module. The total load current is the sum of the load currents being taken by each module.

It is permitted to operate 'F' series load modules with different voltage, current and power ratings to sink in parallel. For example the 4 loads modules shown in Fig 4-21 could be a mixture of 3311G, 3314G, 3332F, 3341G and 33401G.

Note: 1. the electronic load only may carry on the parallel operation under the fixed electric current pattern.
2. The electronic load do not use under series connection.



I=I1+I2+I3+I4+I5+I6+I7+I8

Fig 4-21 33401G plug-in module parallel operation

4-9 . Zero-Volt loading application

As shown in Fig 4-22, the Electronic load can be connected in series with a DC voltage source which output voltage greater than 6V (33401G), 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 6V (33401G), operating voltage required by the Electronic load. This application is suitable for low voltage Battery cell with high discharge current testing.

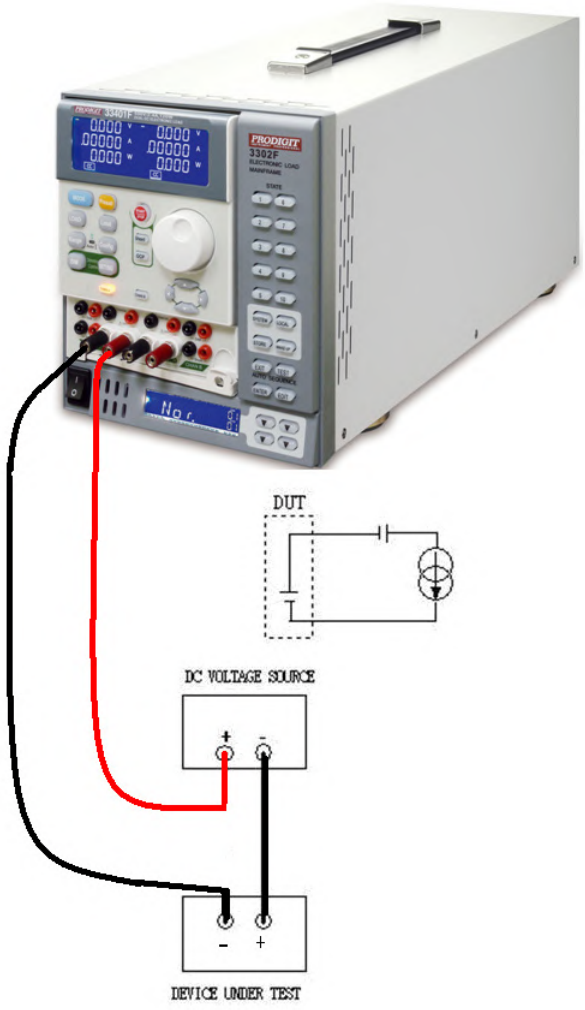


Fig 4-22 Zero-Volt loading connection

4-10 .33401G series electronic load OCP, SHORT operation flow chart

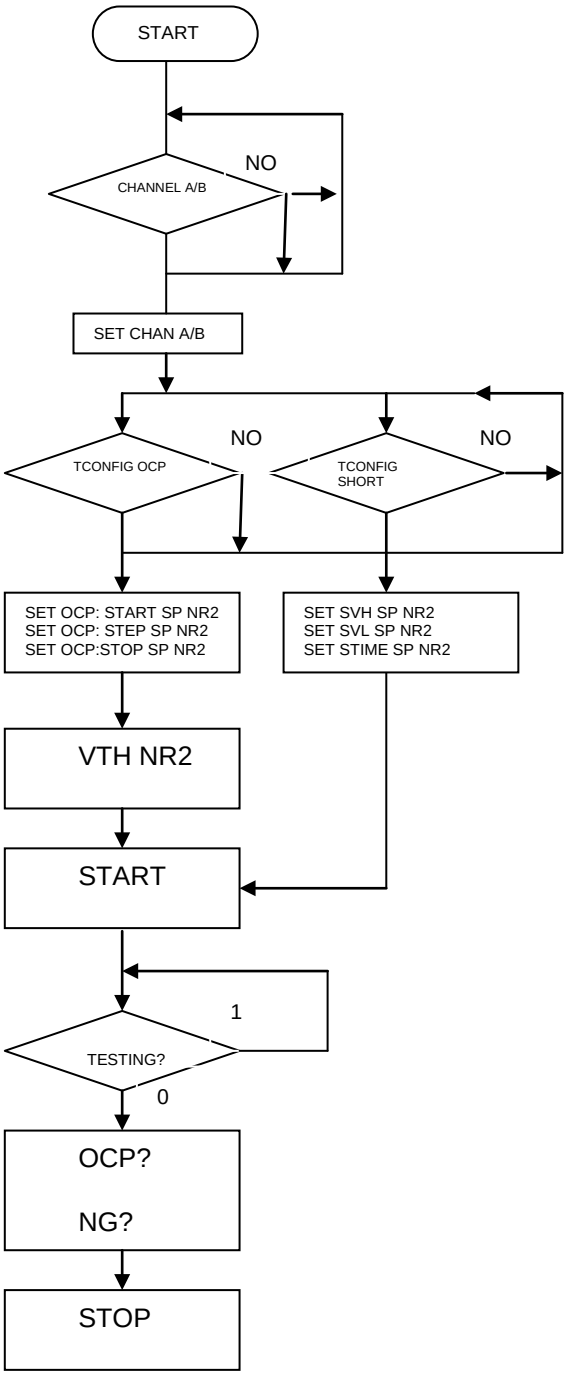


Fig 4-23 33401G series electronic load OCP, SHORT operation flow chart

4-11 . Power Supply OCP testing

4.11.1 OCP Manual control

Example:

4.11.1.1. First, press Limit Key function to setting I_Hi 2A.

4.11.1.2. Press Limit Key function to setting I_Lo 0A.

4.11.1.3. Setting OCP test, press OCP key to the next step.

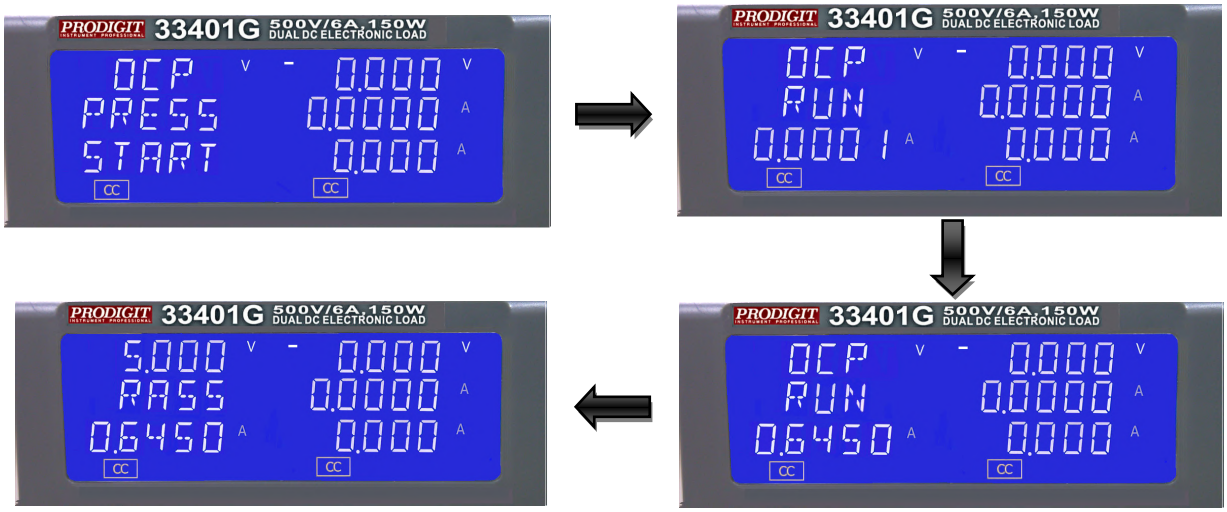
4.11.1.4. Setting start load current 0A, press OCP key to the next step.

4.11.1.5. Setting step load current 0.001A, press OCP key to the next step.

4.11.1.6. Setting stop load current 0.65A, press OCP key to the next step.

4.11.1.7. Setting OCP VTH 1.00V, press OCP key to the next step.

4.11.1.8. Press START/STOP test key.



4.11.1.9. the UUT's output voltage drop-out lower than the threshold voltage(V-th Setting), and the OCP trip point is between I_Hi and I_Lo limitation, then Middle 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

4.11.2 Remote control OCP

EX :

REMOTE	(Set Remote)
TCONFIG OCP	(Set OCP test)
OCP:START 0.1	(Set start load current 0.1A)
OCP:STEP 0.01	(Set step load current 0.01A)
OCP:STOP 2	(Set stop load current 2A)
VTH 3.0	(Set OCP VTH 3.0V)
IL 0	(Set current low limit 0A)
IH 2	(Set current high limit 2A)
NGENABLE ON	(Set NG Enable ON)
START	(Start OCP testing)
TESTING?	(Ask Testing? 1：Testing，0：Testing End)
NG?	(Ask PASS/FAIL?，0：PASS，1：FAIL)
OCP?	(Ask OCP current value)
STOP	(Stop OCP testing)

4-12 SHORT testing

4.12.1. SHORT Manual control

Example:

4.12.1.1. Setting SHORT test, press Short key to the next step.

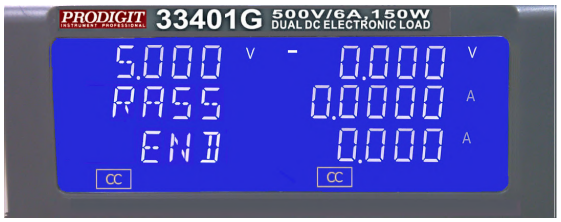
4.12.1.2. Press UP key, setting Short time to 10000ms, press Short key to The next Step.

4.12.1.3. Press down key, setting V-Hi voltage to 1.00V, press Short key To the next Step.

4.12.1.4. Press down key, setting V-Lo voltage to 0V, press Short key to the Next Step.

4.12.1.5. Press START/STOP test key.

4.12.1.6. Short test finish, the UUT's drop voltage is between V_Hi and V_Lo limitation, then middle 5 digits LCD display will shows "PASS"



4.12.1.7. The UUT's not drop voltage is between V_Hi and V_Lo limitation, LCD display will shows FAIL.

4.12.2. Remote control SHORT

EX :

REMOTE	(Set Remote)
TCONFIG SHORT	(Set SHORT test)
STIME 1	(Set short time 1ms)
START	(Start SHORT testing)
TESTING?	(Ask Testing? 1: Testing, 0: Testing End)
STOP	(Stop SHORT testing)