3341G Series Plug-In Electronic Load module Operation manual

S/N:9003341G02 REV:E

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.

EC DECLARATION OF CONFORMITY

We **Prodigit Electronics Co., Ltd.** declares under our own responsibility that the product

DC Electronic Load

(Model No.:

3341G, 3342G, 3343G, 3300G, 3302G, 3305G)

satisfies all the technical relations application to the product within the scope of council:

Directive: 2014/30/EU; 2014/35/EU; 2015/863/EU; 2012/19/EU

The above product is in conformity with the following standards or other normative documents

Harmonized Standard：

EN 61010-1: 2010+A1:2019

EN IEC 61010-2-030:2021+A11:2021

EN 61326-1:2013

EN 61326-2-1:2013

Reference Basic Standards：

Emission:

EN 55011: 2016+A1: 2020 Class A

EN 55032: 2015+A1:2020

EN 61000-3-2: 2014

EN 61000-3-3: 2013

Immunity:

EN 61000-4-2: 2009

EN 61000-4-3: 2006+A2:2010

EN 61000-4-4: 2012

EN 61000-4-5: 2014+A1:2017

EN 61000-4-6: 2014

EN 61000-4-8: 2010

EN 61000-4-11: 2020

Company Name : Prodigit Electronics Co., Ltd.

Company Address : 8F, No.88, Baojhong Rd., Sindian District, New Taipei City, Taiwan.

Person is responsible for marking this declaration:

Manufacturer/Importer

Signature:

Date: **2022/10/20** Name:

Dean Wang

Dean Wang
R&D Assistant Manager

UK Declaration of Conformity

We Prodigit Electronics Co., Ltd. declares under our own responsibility that the product

DC Electronic Load

(Model No.:

3341G, 3342G, 3343G, 3300G, 3302G, 3305G)

satisfies all the technical relations application to the product within the scope of council:

Directive: **Electromagnetic Compatibility Regulations 2016; Electrical Equipment (Safety) Regulations 2016; the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012**

The above product is in conformity with the following standards or other normative documents

Harmonized Standard：

BS EN 61010-1:2010+A1:2019 ;BS EN IEC 61010-2-030:2021+A11:2021

BS EN 61326-1: 2013 ; BS EN 61326-2-1: 2013

Reference Basic Standards：

Emission:		**Immunity:**
BS EN 55011: 2016+A1: 2020	Class A	BS EN 61000-4-2: 2009
BS EN 55032: 2015+A1:2020		BS EN 61000-4-3: 2006+A2:2010
BS EN 61000-3-2: 2014		BS EN 61000-4-4: 2012
BS EN 61000-3-3: 2013		BS EN 61000-4-5: 2014+A1:2017
		BS EN 61000-4-6: 2014
		BS EN 61000-4-8: 2010
		BS EN 61000-4-11: 2020

Company Name : Prodigit Electronics Co., Ltd

Company Address : 8F, No.88, Baojhong Rd., Sindian District, New Taipei City, Taiwan

Person is responsible for marking this declaration:

Manufacturer/Importer

Signature: Dean Wang

Date: **2022/10/20** Name: Dean Wang
R&D Assistant Manager

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.

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3341G series module load operation manual
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Chapter 1 Introduction

1-1. General description

The 3341G series 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 3341G series 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 3341G can sink up to 24A and 300Vdc at a maximum of 300W. So if the maximum voltage of 300Vdc is present at the load's input terminals a maximum load current of 0.5A is possible. Conversely if the 3341G is required to sink 24A the voltage must be limited to 12.5V.

The power contour of 3341G 300 watts Electronic Load is shown in Fig 1-1; it has an input from 0-24A, and 0-300V current and voltage operating range respectively. The power contour of 3341G (300V, 24A, 300W), 3342G (500V, 12A, 300W), 3343G (500V, 24A, 300W) Electronic Load are shown in Fig 1-1 ~1-3 respectively.

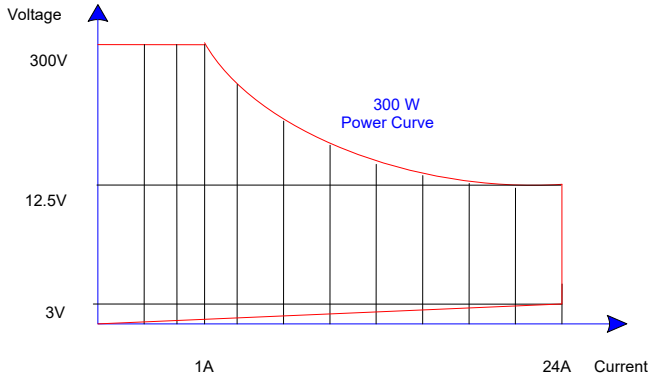


Fig 1-1 3341G 300V/24A/300W power contour

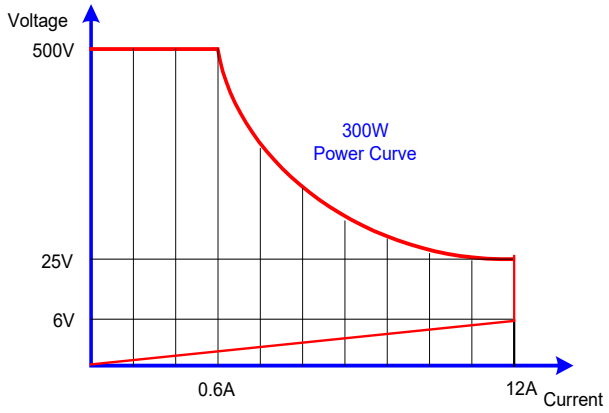


Fig 1-2 3342G 500V/12A/300W power contour

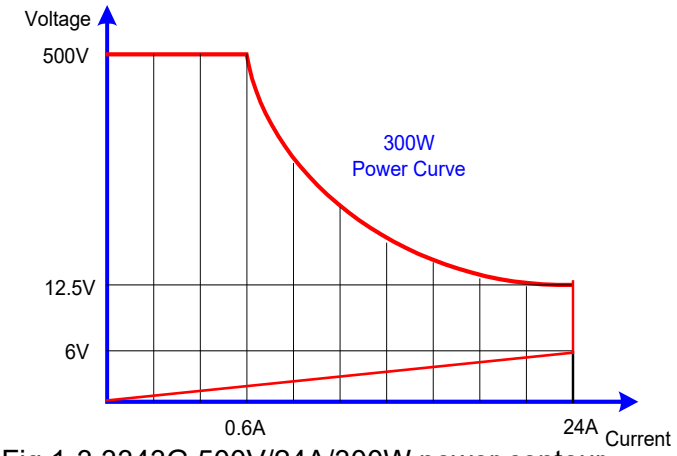


Fig 1-3 3343G 500V/24A/300W power contour

The 3341G series of electronic load modules feature 5 operating modes. These are Constant Current (CC) mode, Constant Resistance (CR) mode, Constant Voltage (CV) mode, Constant Power (CP) and(LED) mode.

1.1.1. CC Mode

With the operating mode of Constant Current, the 3341G series electronic load will sink a current in accordance with the programmed value regardless of the input voltage (see Fig.1-4).

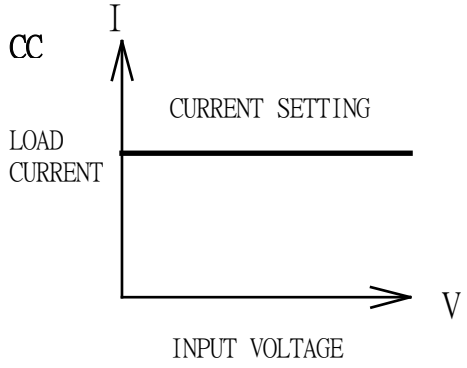


Fig 1-4 Constant Current mode

1.1.2. CR Mode:

At Constant Resistance mode, the 3341G 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).

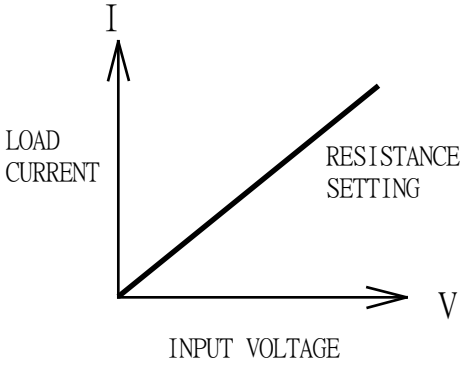


Fig 1-5 Constant Resistance mode

1.1.3. CV Mode:

At Constant Voltage mode, the 3341G series Electronic Load will attempt to sink enough current until the load input voltage reaches the programmed value (see Fig 1-6).

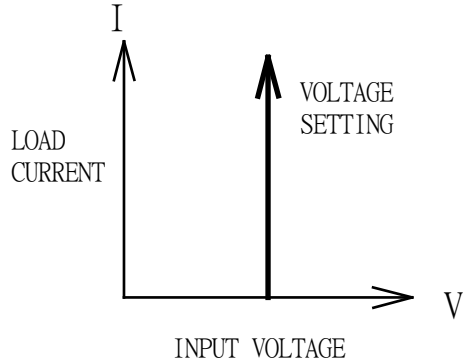


Fig 1-6 Constant Voltage mode

1.1.4. CP Mode:

At Constant Power mode, the 3341G series Electronic Load will attempt to sink load power (load voltage x load current) in accordance with the programmed power. (See Fig 1-7).

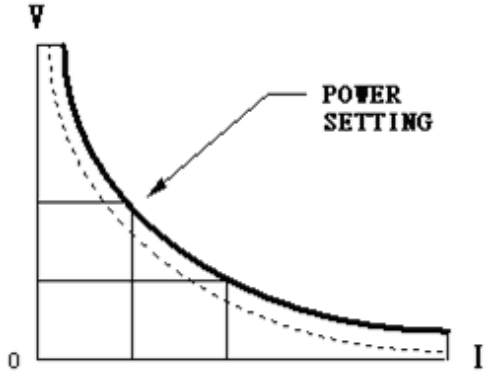


Fig 1-7 Constant Power mode

1.1.5. LED Mode

In the LED mode of operation, Voltage is applied to the 3341G 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 1-8.

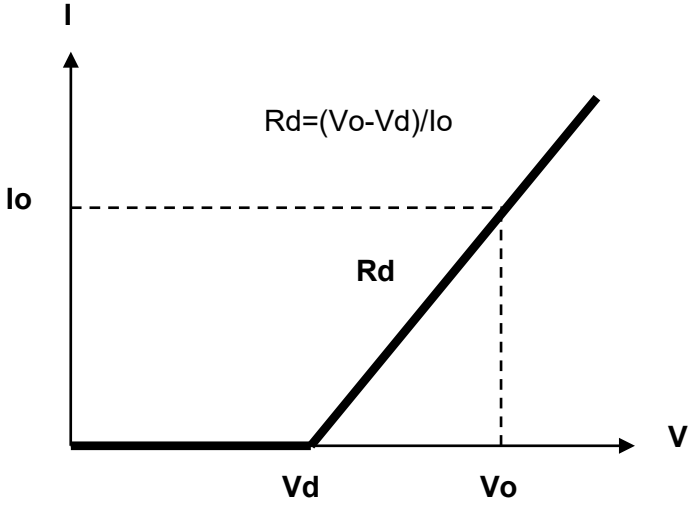


Fig 1-8 LED mode characteristics

1.1.6. Dynamic Waveform Definition

Along with static operation the 3341G series load modules are built with a Dynamic mode for operation in Constant Current (CC), Constant Resistance (CR) or Constant Power (CP). This allows the test engineer to simulate real world pulsing loads or implement a load profile that varies with time.
A dynamic waveform can be programmed from the front panel of the 3341G series load module. The user would first set a High and low value of load current using the Level button. The Dynamic Setting then allows for the rise and fall time between these 2 current values to be adjusted. The time period that the waveform is high (Thigh) along with the time period that the waveform is low (Tlow) can also be set.
The dynamic waveform is illustrated below in Fig 1-9.

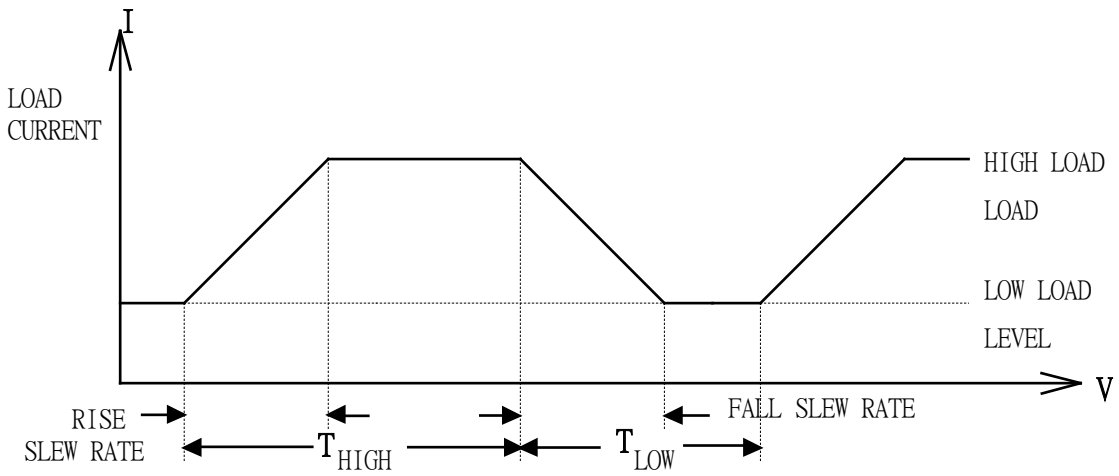


Fig 1-9 Dynamic Wave form

The dynamic waveform can also be set up via the optional computer interface. Dynamic waveform settings made from the front panel of the load module can also be saved in the memory of the mainframe. For the store/recall procedure and the computer command set please refer to the relevant operating manual for the 3300G/3302G/3305G mainframes.

Further dynamic waveform definitions are:

- The period of dynamic waveform is Thigh + Tlow
- The dynamic frequency = 1 /(Thigh + Tlow)
- The duty cycle = Thigh / (Thigh + Tlow)

The analogue programming input also provides a convenient method of implementing a dynamic waveform. Please see the section 3.1.29 titled ‘Analog Programming Input’ for further information.

1.1.7. Slew Rate

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

In cases where the transition from one setting to another is large, the actual transition time can be calculated by dividing the voltage or current transition by the slew rate. The actual transition time is defined as the time required for the input to change from 10% to 90% or from 90% to 10% of the programmed excursion.

In cases where the transition from one setting to another is small, the small signal bandwidth (of the load) limits the minimum transition time for all programmable slew rates.

Because of this limitation, the actual transition time is longer than the expected time based on the slew rate, as shown in Figure 1-10

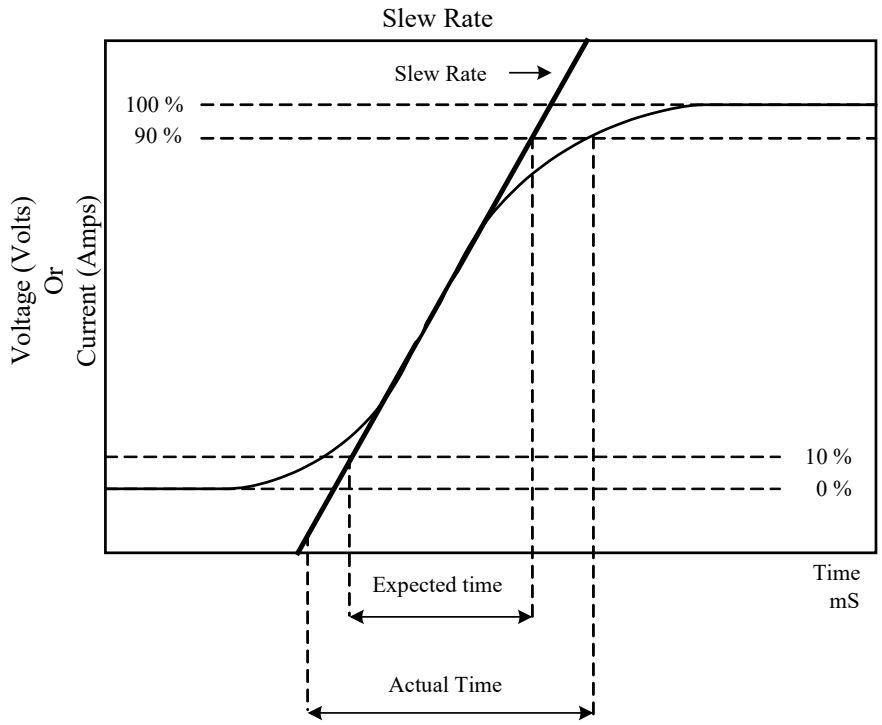


Fig 1-10 Rise Time Transition Limitation

Therefore, both minimum transition time and slew rate must be considered when determining the actual transition time.
Following detail description is exclude in operation manual.
The minimum transition time for a given slew rate as about a 30% or greater load change, The slew rate increases from the minimum transition time to the Maximum transition time at a 100% load change. The actual transition time will be either the minimum transition time, Or the total slew time (transition divided by slew rate), whichever is longer.

Use the following formula to calculate the minimum transition time for a given slew rate
Min transition time=7.2A(24*30%) / slew rate (in amps/second).
72uS (7.2A/0.1) x 0.8(10%~90%) =57.6uS

Use the following formula to calculate the maximum transition time for a given slew rate
Max transition time=24A / slew rate (in amps/second).
240uS (24A/0.1) x 0.8(10~90%) = 192uS

EX. CCH=3A, CCL=0A Slew Rate =0.1A, the expected time is 24uS but the actual Transition Time will be limited to 57.6uS
30uS(3/0.1)x 0.8(10%~90%) = 24uS

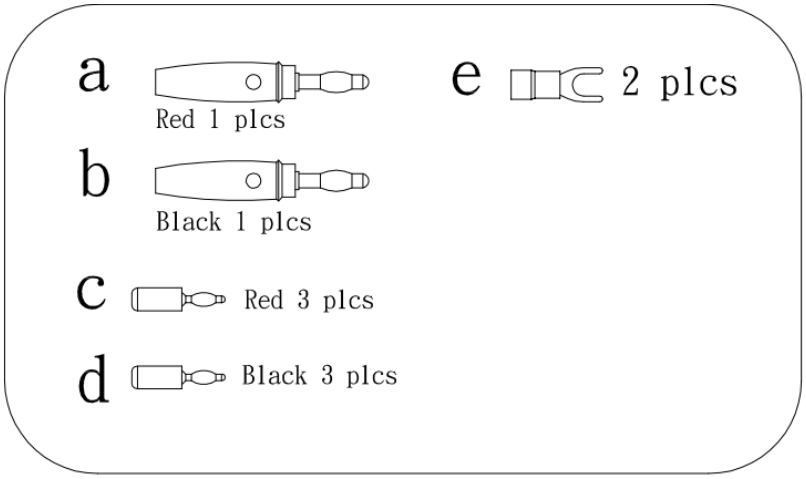
1-2. Features

The main features of the 3341G series of load modules are highlighted below.

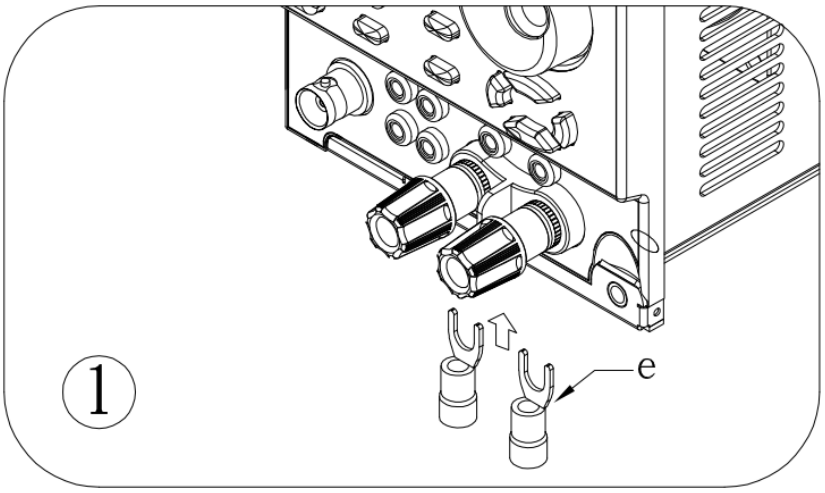
- Bench top and rack mounting flexibility with single, dual and 4 slot mainframes
- CC, CR, CV, CP, LED, Dynamic, and Short Operating Mode.
- Remote control via a choice of computer interfaces.
- High accuracy & resolution with 16 bit voltage and current meter.
- Built in pulse generators for dynamic loading.
- Independently adjustable current rise and fall times.
- Short circuit test with current measurement
- Dedicated over current and overpower protection test functions
- Programmable voltage on/off capability.
- Full protection from overpower, over-temperature, overvoltage, and reverse polarity.
- Analogue programming input for tracking an external signal
- Current Monitor with BNC (non-isolated) socket.
- 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

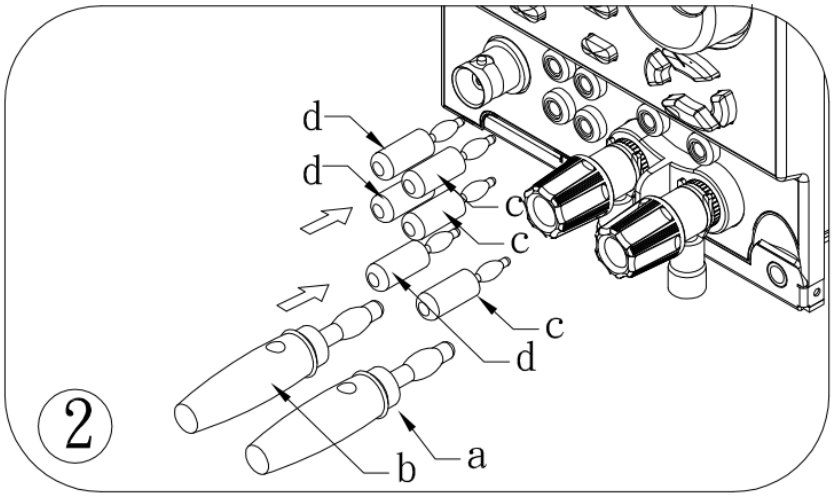
1-3. Standard Accessories

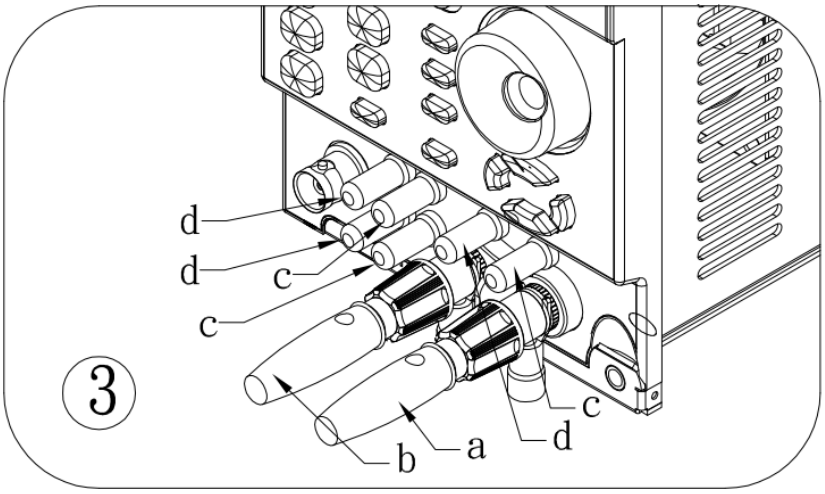
a	4mm Banana Plug (Red)	1 PC
b	4mm Banana Plug (Black)	1 PC
c	2mm Banana Plug (Red)	3 PCS
d	2mm Banana Plug (Black)	3 PCS
e	ZE090 SNB8-6 Y type terminal	4 PCS
f	3341G series operation manual	1 PC



1.3.1 Accessories Installation Description







1-4. Option

a Short Relay BD 1 PC

1-5. Specifications

MODEL	3341G		3342G		3343G	
Power	300W		300W		300W	
Current	0 – 6A	0 – 24A	0 – 3A	0 – 12A	0-6A	0-24A
Voltage	0~300V		0~500V		0~500V	
Min. Operating Voltage	3V @ 24A		6V @12A		6V @ 24A	
Constant Current Mode						
Range *1	0 – 6A	0 – 24A	0 – 3A	0 – 12A	0 – 6A	0 – 24A
Resolution	0.1mA	0.4mA	0.05mA	0.2mA	0.1mA	0.4mA
Accuracy	± 0.1% OF(SETTING + RANGE)					
Constant Resistance Mode						
Range	CRL:0.125Ω ~1.5KΩ (150V)	CRH:0.25Ω ~3KΩ (300V)	CRL:0.5Ω ~1.5KΩ (300V)	CRH:1Ω ~3KΩ (500V)	CRL:0.25Ω ~3KΩ (300V)	CRH:0.5Ω ~6KΩ (500V)
Resolution	133.333uS	66.666uS	33.333uS	16.666uS	66.666uS	33.333uS
Accuracy	± 0.2% OF (SETTING + RANGE)					
Constant Voltage Mode						
Range	30V/150V/300V		60V/300V/500V		60V/300V/500V	
Resolution	0.0005V/0.0025V/0.005V		0.001V/0.005V/0.01V		0.001V/0.005V/0.01V	
Accuracy	± 0.05% OF (SETTING + RANGE)					
Constant Power Mode						
Range	0-300W		0-300W		0-300W	
Resolution	0.005W		0.005W		0.005W	
Accuracy	± 0.5% OF (SETTING + RANGE)					
LED Mode						
Vo Voltage Range	LEDL:30V / LEDM:150V / LEDH:300V		LEDL:60V / LEDM:300V / LEDH:500V		LEDL:60V / LEDM:300V / LEDH:500V	
Rd Resistance Range	LEDL : 0.125 ~ 125 Ω @ Vo-Vd = 0~3V LEDL : 1.25 ~ 1.25KΩ @ Vo-Vd = 3~30V LEDM: 0.625 ~ 625 Ω @ Vo-Vd = 0~15V LEDM: 6.25 ~ 6.25KΩ @ Vo-Vd = 15~150V LEDH: 1.25 ~ 1.25KΩ @ Vo-Vd = 0~30V LEDH: 12.5 ~ 12.5KΩ @ Vo-Vd = 30~300V		LEDL : 0.5 ~ 100Ω @ Vo-Vd = 0~6V LEDL : 5 ~ 1KΩ @ Vo-Vd = 6~60V LEDM: 2.5 ~ 500Ω @ Vo-Vd = 0~30V LEDM: 25 ~ 5KΩ @ Vo-Vd = 30~300V LEDH: 5 ~ 1KΩ @ Vo-Vd = 0~60V LEDH: 50 ~ 10KΩ @ Vo-Vd = 60~500V		LEDL : 0.25 ~ 125Ω @ Vo-Vd = 0~6V LEDL : 2.5 ~ 1.25KΩ @ Vo-Vd = 6~60V LEDM: 1.25 ~ 625Ω @ Vo-Vd = 0~30V LEDM: 12.5 ~ 6.25KΩ @ Vo-Vd = 30~300V LEDH: 2.5 ~ 1.25KΩ @ Vo-Vd = 0~60V LEDH: 25 ~ 12.5KΩ @ Vo-Vd = 60~500V	
Resolution	16Bits					
Accuracy	Vd : ± (0.05% OF SETTING + 0.1% OF RANGE), Rd : ± (0.05% OF SETTING + 0.1% OF RANGE)					
Dynamic Mode						
Timing						
THIGH & TLOW	0.050~9.999 / 99.99 / 999.9 / 9999mS					
Resolution	0.001 / 0.01 / 0.1 / 1mS					
Accuracy	1uS/10uS/100uS/1mS + 50ppm					
Slew Rate	4.8-300mA/uS	19.2-1200mA/uS	2.4-150mA/uS	9.6-600mA/uS	4.8-300mA/uS	19.2-1200mA/uS
Resolution	1.2mA/uS	4.8mA/uS	0.6mA/uS	2.4mA/uS	1.2mA/uS	4.8mA/uS
Min. Rise Time	20uS(Typical)		20uS(Typical)		20uS(Typical)	

Current						
Range	0 – 6A	0 – 24A	0 – 3A	0 – 12A	0 – 6A	0 – 24A
Resolution	0.1mA	0.4mA	0.05mA	0.2mA	0.1mA	0.4mA
Accuracy *4	± 0.1% OF(SETTING + RANGE)		± 0.1% OF(SETTING + RANGE)		± 0.1% OF(SETTING + RANGE)	
Measturement						
Voltage Read Back						
Range	30V/150V/300V		60V/300V/500V		60V/300V/500V	
Resolution	0.5mV/2.5mV/5mV		1mV/5mV/10mV		1mV/5mV/10mV	
Accuracy	± 0.025% OF (READING + RANGE)					
Current Read Back						
Range	6A	24A	3A	12A	6A	24A
Resolution	0.1mA	0.4mA	0.05mA	0.2mA	0.1mA	0.4mA
Accuracy	± 0.1% OF (READING + RANGE)					
Power Read Back						
Range	300W		300W		300W	
Accuracy *2	± 0.1% OF (READING + RANGE)					
Gernaral						
Imonitor	2.4A/V		1.2A/V		2.4A/V	
Short Signal Output	12V/100 mAmax		12V/100 mAmax		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		3.5Kg		3.5Kg	
Safety & EMC	CE					

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℃, Except as noted

Note *4 : The Slew Rate accuracy under BW=15

Table 1-1 3341G Series Specification

Chapter 2 Installation

This chapter details the installation and removal procedure of the 3341G 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 3341G series load module does not need any user adjustment after it has been plugged in to the mainframe.

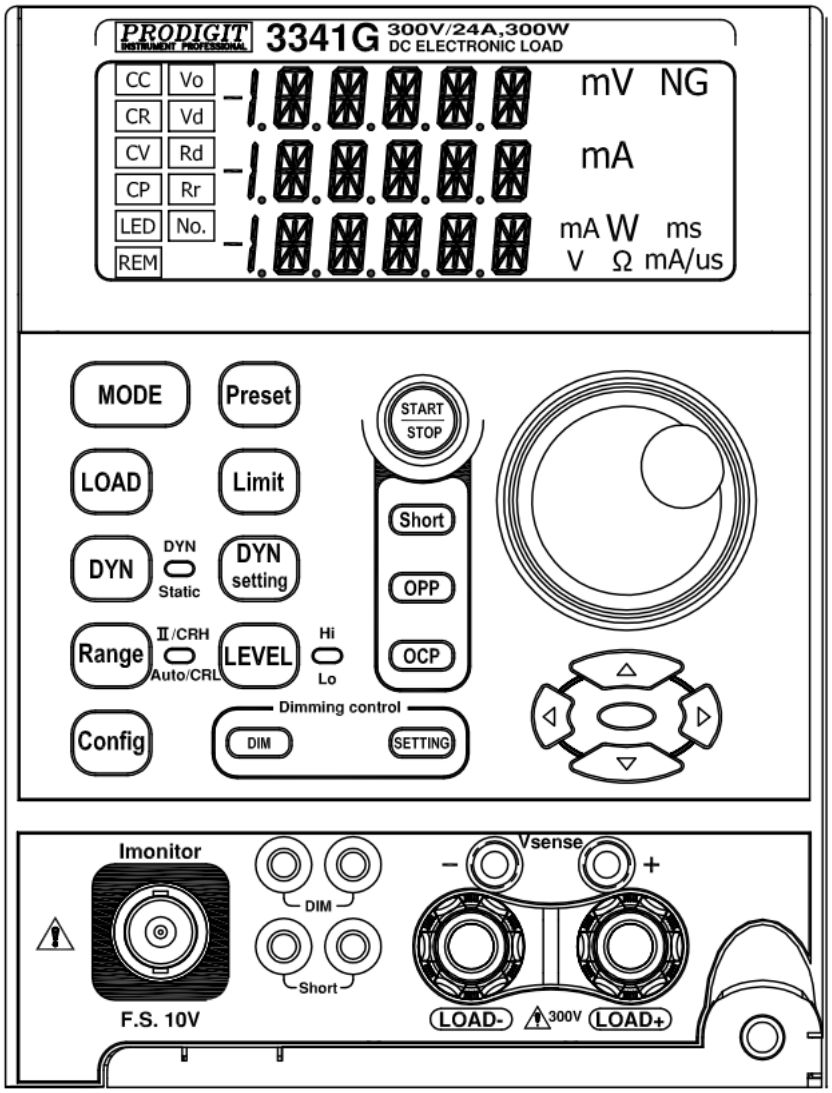


Fig 2-1
Binding post and withdraw handle on the front panel of 3341G series Plug-in load module

2-1. Installation and Removal of 3341G series plug in module

The 3341G 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 3341G series Electronic load module were purchased separately, the 3341G 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 3341G series load module in or out from the 3300G/3302G/3305G.

2.1.1. Installation of 3341G series plug-in load:

2.1.1.1 Turn the 3300G/3302G/3305G mainframe power OFF before inserting he3341G 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 3300F mainframe with the upper and Lower guides of the selected compartment.

2.1.1.3 If correctly positioned the 3341G 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 3341G 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 3341G 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.

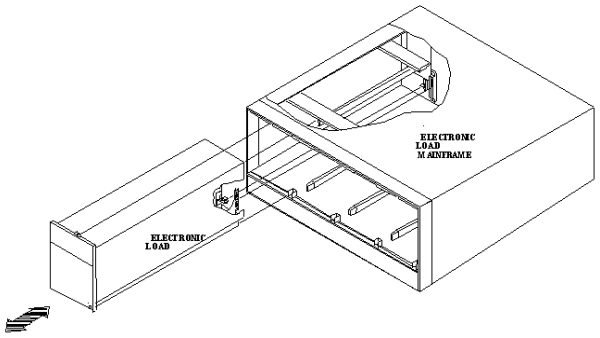


Fig 2-2 Plug-in installation and removal

2-2. Environmental requirements

- Indoor use.
- Measurement Category I.
- 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 II, 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！Refer to this manual before using the load.

2-4. Cleaning

To clean this product, use a soft or wet cloth.

Before you clean this product, power this product off and disconnect the power plug.

- Please do Not use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
- Please pay attention that any liquid should not be penetrated into this product.

2-5. Observe precautions for handling electrostatic sensitive devices

Imonitor BNC terminal is ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000V readily accumulates on the human body and Test equipment and can discharge without detection.

Although the features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges.

Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

2-6. Power Up

The following procedure should be followed before applying mains power:

2.6.1 Check that the POWER switch is in the off (O) position
2.6.2 Check the rear panel voltage selector of the 3300G/3302G/3305G mainframe is Correctly set.
2.6.3 Check that nothing is connected to the DC INPUT (load input terminals) on the Front panel of the 3341G load module.
2.6.4 Connect correct AC mains lead to the 3300G/3302G/3305G mainframe
2.6.5 Turn on (I) the POWER switch.

2-7. 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 3302F is used.

The string between "____" in the flow chart is a RS-232C or GPIB programming commends.
Please follow the flow chart sequence to have proper and effective load settings.
The load mode (CC, CR, CV, CP or LED) should be set first, where only Static mode is available for CR and CV mode, both Static and Dynamic modes are available for CC and CP mode, then choose high or Low load level and programming the load level for Static mode, or programming the six parameters for Dynamic mode.

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.

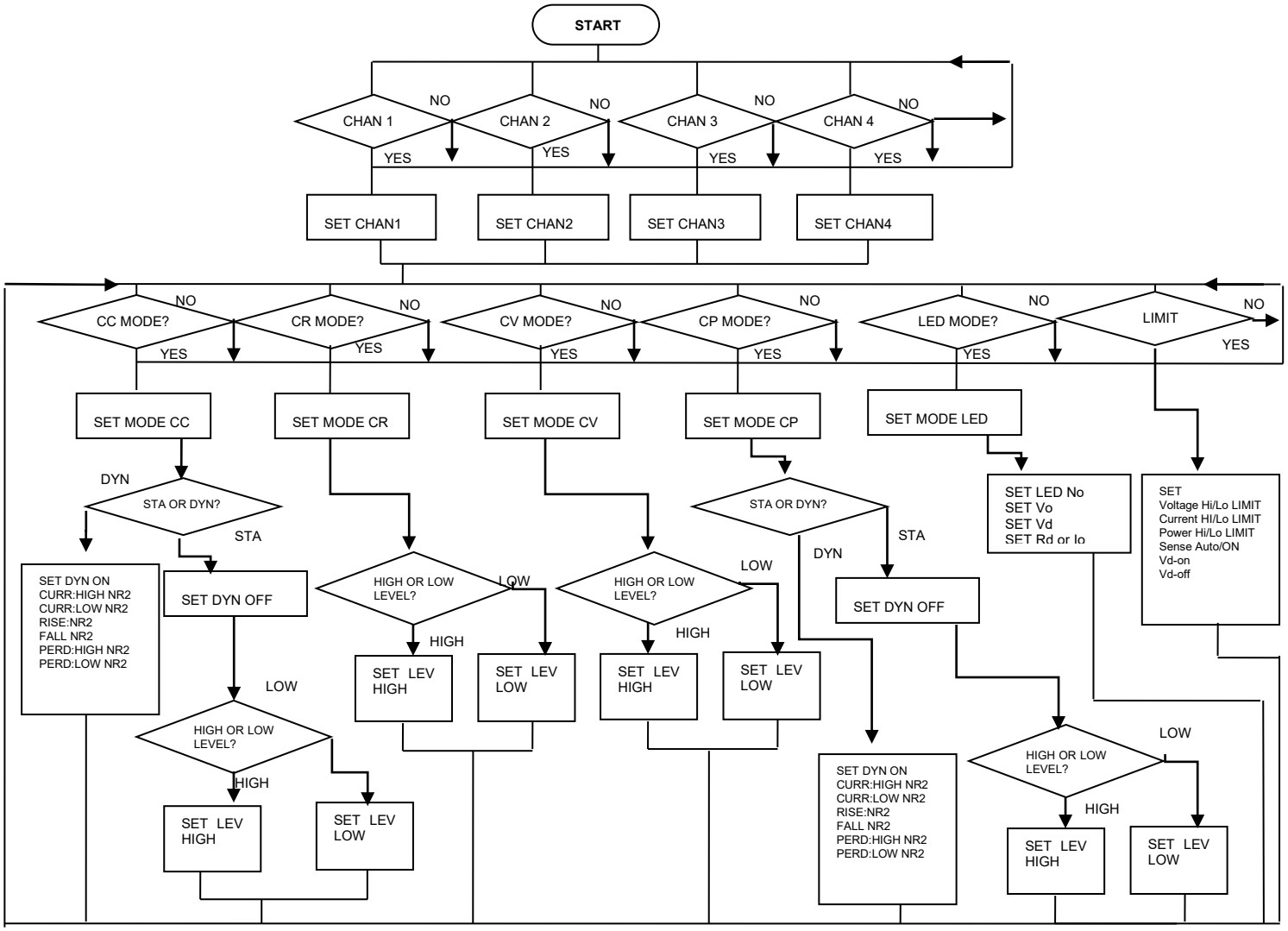
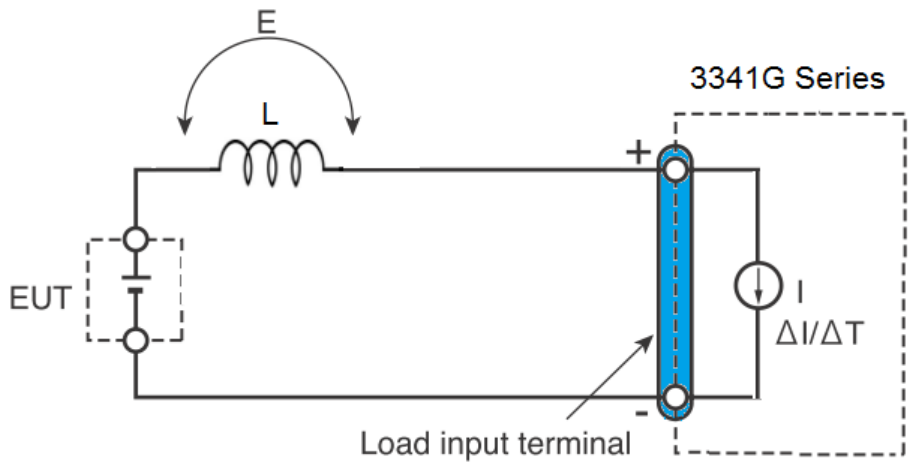


Fig 2-3 3341G series electronic load module load condition setting flow chart

2-8. Load wire inductance

The load wiring has an inductance (L). When the current (I) varies in short time period, It generates a large voltage at both ends of the wiring cable. This voltage applies to all of the load input terminals of the 3341G series when the impedance of the EUT is relatively small. The voltage generated by the load wire inductance (L) and the current variation (I) is expressed using the following equation.



$E = L \times (\Delta I / \Delta T)$
E: Voltage generated by the wire inductance
L: Load wire inductance
ΔI: Amount of Current variation
ΔT: Variation period of current

In general, the wire inductance can be measured approximately 1 μH per 1 meter. If the 10 Meters of Load wires is connected between the EUT and the electronic load (3341G Series) With the current Variation of 2 A/μs, the voltage generated by the wire inductance will be 20 V.

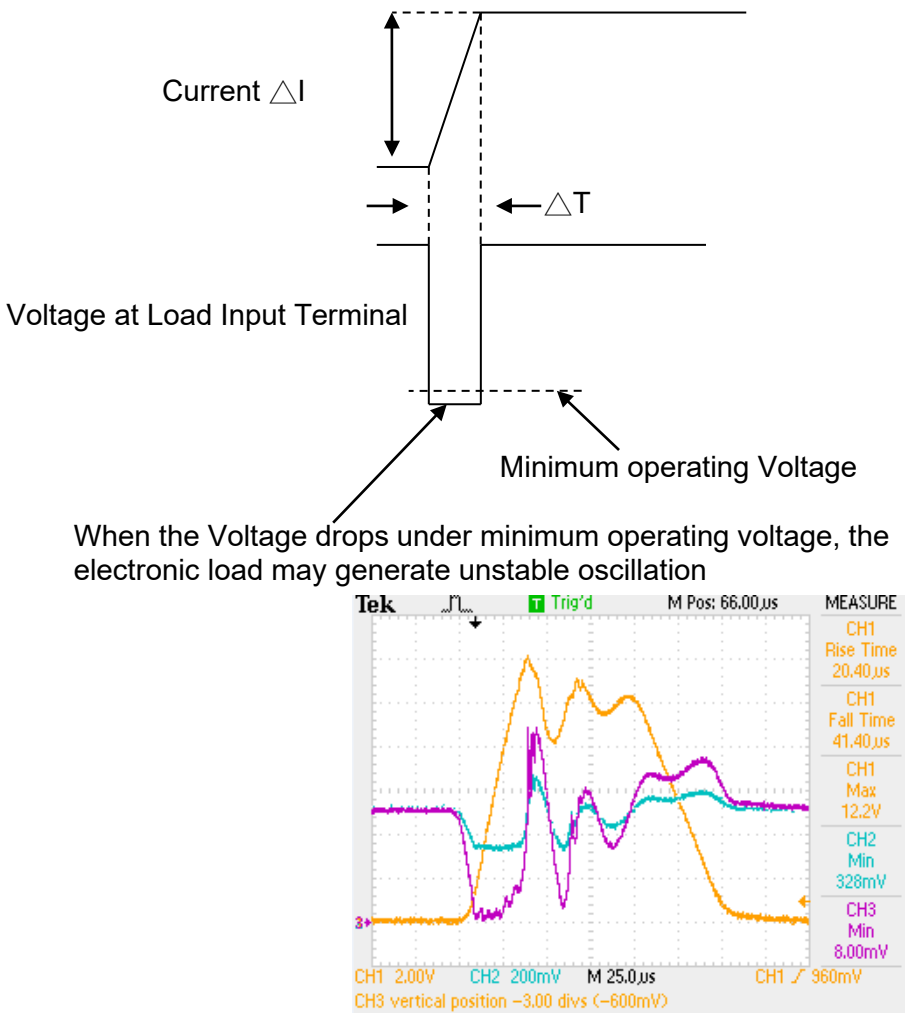
The negative polarity of the load input terminal is the reference potential of the external control Signal, Therefore, the device connected to the external control terminal may get malfunctioned.

When operating under the constant voltage (CV) mode or constant resistance (CR) mode or constant power (CP), the load current is varied by the voltage at the load input terminal, so the operation can be affected easily by the generated voltage.

The wiring to the EUT should be twisted and the shortest as possible.
If the load wire is long or has a large loop, the wire inductance is increased. Consequently, The current variation that results when switching occurs will cause a large voltage drop.

When the value of instantaneous voltage drops under the minimum operating voltage depends On the generated voltage at the load input terminal, the response of recovery will be Extensively Delayed.

In such event, the electronic load (3341G) may generate unstable oscillation.
In such condition, the input voltage may exceed the maximum input voltage and Cause Damage to the 3341G Series.



CH1=Imonitor
CH2=Power Supply output Voltage (x10)
CH3= LOAD Input Voltage (x10)

Fig 2-4 Waveform example: Generate unstable oscillation

You must be careful especially when the slew rate setting is high or switching is performed using large currents through parallel operation.

To prevent problems, connect the 3341G series and the equipment under test using the Shortest Twisted Wire possible to keep the voltage caused by inductance between the Minimum operating Voltage and the maximum input voltage range or set a low slew rate.

If the high-speed response operation is not required, decrease the slew rate setting.

In such settings, the value of DI /DT will be decreased, accordingly the generated voltage will Be Reduced even the inductance of load wiring can not be reduced.

In the case of DC operation also, the phase delay of the current may cause instability in the 3341G Series Control inducing oscillation. In this case also, connect the 3341G series and the Equipment Under test using the shortest twisted wire possible.

If only DC operation is required, a capacitor and a resistor may be connected to the load input Terminal as shown in Fig. 2-5 to alleviate oscillation. In this case, use the capacitor within its Allowable ripple current.

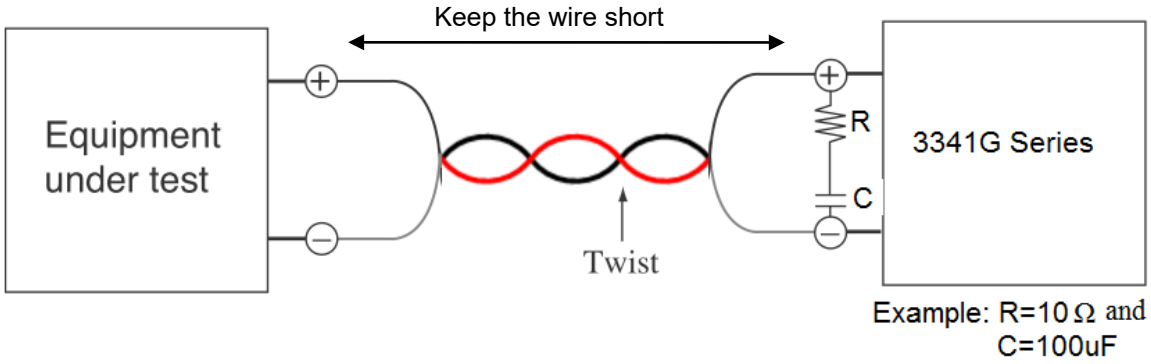


Fig 2-5 Length of wiring

Chapter 3 Operation

This chapter describes the front panel operation of each 3341G 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.

For example to understand more about the Imonitor function labeled 26 please refer to 3.1.26

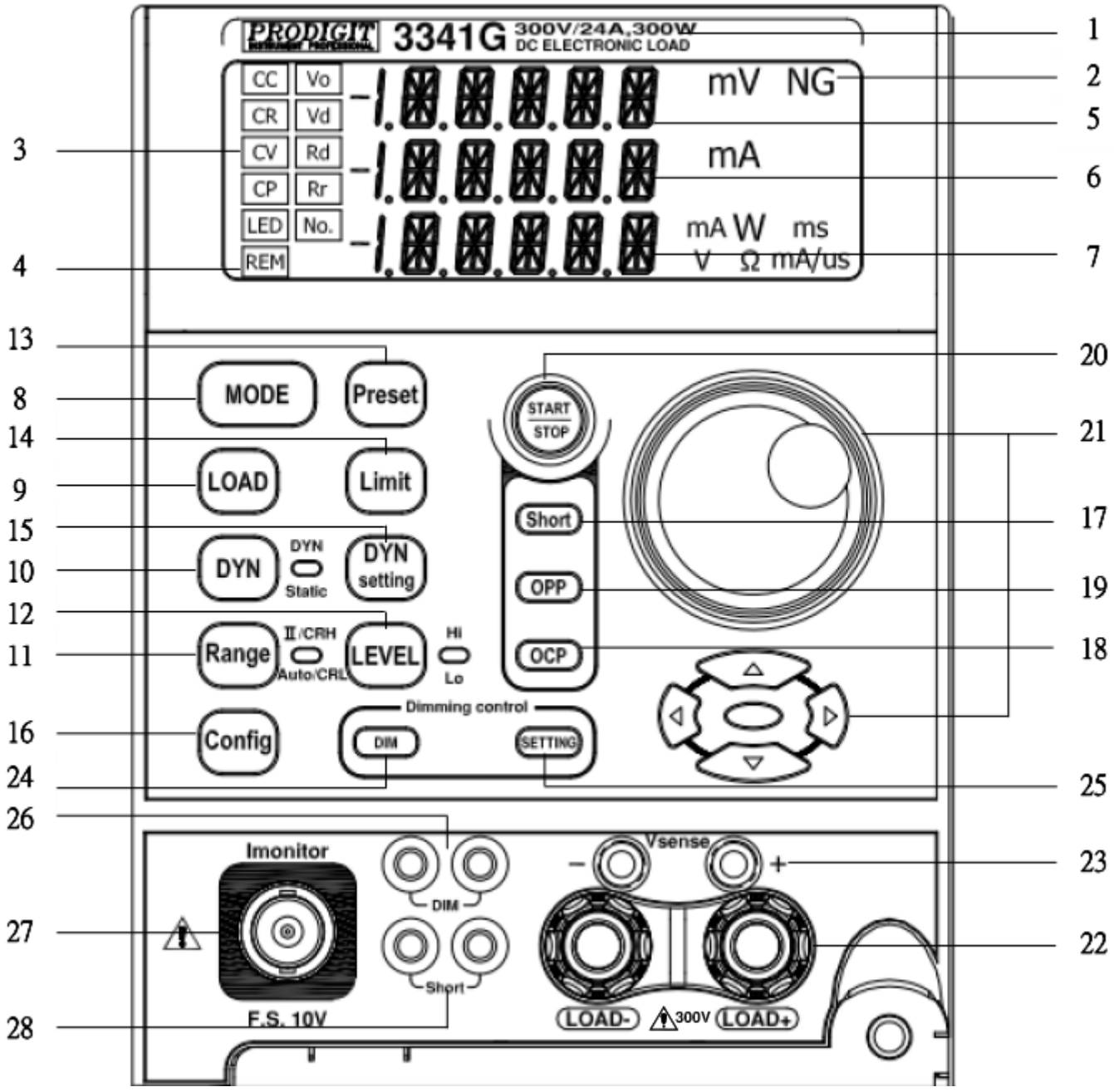


Fig 3-1 Front panel of 3341G plug-in module

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 , CP , LED mode, LCD

Indicator, There are four operating modes that can be selected by pressing the "MODE" key on the 3341G series Electronic Load module.
The sequence is Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV) , Constant Power (CP) and LED mode (LED). 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, CP and LED modes are described in Section 1-1. Common application examples for the different operating modes are described in Section 4-3 to 4-7 respectively.

Constant current (CC) mode provides a force Range 2 functions, mainly used when using the CC Range 1, but when they need fast Slew Rate can be set in the CC force the Range 2.

In LED mode, Vo setting the Range of third, 3341G series electronic load will be set according to Vo and Vd, automatically adjusts to the most appropriate gear.

Note: The program version 2.16 defaults the boot for the LED Mode and Rd_Io default for Io.

3.2.4. REM LCD Indicator

Remote LCD indicator can be bright by computer control.
When Remote LCD indicator goes off, indicating that manual operation.

3.2.5. 3341G 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, OPP 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)

<u>Test Mode:</u>

If the SHORT, OPP 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”.
OPP test selected: upper display will show “OPP”.
OCP test selected: upper display will show “OCP”.

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

3.2.6. 3341G Middle 5 digit LCD display

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

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, DYN, SHORT, OPP 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” → “AVG“→“Rd_Io“→“LED“→“CV_bw“→“bw“
- **LIMIT**: Sequence is ”V_Hi” → “V_Lo” → “I_Hi” → “I_Lo” → “W_Hi” → “W_Lo” → “NG”.
- **DYN setting**: Sequence is “T-Hi” → ”T-Lo” → ”RISE” → “FALL”
- **SHORT**: Sequence is “PRESS” → “TIME” → ”V_Hi” → “V_Lo”
- **OPP**: Sequence is “PSTAR” → “PSTEP” → “PSTOP” → “Vth”.
- **OCP**: Sequence is “ISTAR” → “ISTEP” → “ISTOP” → ”Vth”.

3.2.7. 3341G 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 CP mode is selected the lower display provides setting in watts “W”.
- 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 “A”
➔ W_Lo (lower limit power) displays the set value in watts “A”
➔ NG displays whether the NG flag is set to「ON」or「OFF」

3.2.7.3. DYN setting. Each press of the DYN setting button changes the text on The middle LCD. The sequence and the corresponding setting value Shown on the bottom display are as follows:

➔ T-Hi (time high) displays the set value in milliseconds “ms”
➔ T-Lo (time low) displays the set value in milliseconds “ms”
➔ Rise (current rise time/slew rate) displays the set value in “A/us” or “A/ms”

➔ Fall (current fall time/slew rate) displays the set value in “A/us” or “A/ms”

3.2.7.4. 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」
➔ AVG (Average) can be set value 1~64.
➔ Rd_Io can be set to 「Rd」or「Io」.
➔ LED No. can be set to 「ON」or「OFF」.
➔ CV_bw can be set to 「Hi」or「Lo」.
➔ bW can be set value 0~15.

3.2.7.5. 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.

3.2.7.6. OPP test. This allows the parameters of the over power protection test to Be Set up. Each press of the OPP button moves the setting function. The Sequence of the OPP test along with the setting value is as follows:

➔ OPP Press Start (pressing the red START/STOP button starts the test)
➔ PSTAR (power start point) lower display provides setting in watts “W”
➔ PSTEP (power steps) lower display provides setting in watts “W”
➔ PSTOP (power stop point) lower display provides setting in watts “W”
➔ VTH (voltage threshold) lower display provides setting in volts “V”

When the test is started the lower display will show the power 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 power taken during the OPP 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.

3.2.7.7. 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, CP, LED Indicator

3341G series electronic load MODE has five operating modes.
Select the program for the LED mode (LED)、current (CC)、resistance (CR) and Voltage (CV), fixed power (CP), switch on the LCD LED, CC, CR, CV, and CP Depending on the selected operating mode

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

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

3.2.9. LOAD key and LED

The input to the 3341G series 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. DYN /STA key and LED

The DYN button allows the user to switch between DYNAMIC operation and STATIC operation. Dynamic operation is only possible in constant current (CC) or Constant power (CP) mode only. The LED next to the DYN button will become lit When DYNAMIC operation is selected. If you are in constant resistance (CR) or Constant voltage (CV) mode pressing the DYN button will have no effect.

3.2.11. Range key and LED

The 3341G series Load Module features 2 setting ranges for CC, CR, CV, CP and 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.

3.2.12. LEVEL key and LED

The LEVEL button is used to program a High or Low load value. The setting value Changes between current, resistance, voltage or power depending whether CC, CR, CV or CP mode has been selected. If the LED is lit then the High level value setting Has been enabled. If the LED is not lit then the low load level can be set using the Rotary switch in combination with the arrow keys.

In STATIC mode the user can switch between High and low load levels during Operation.

In DYNAMIC operation (CC & CP modes only) the preset high and low levels are Used to define the dynamic waveform.

Please note that the low level setting cannot exceed the high level. The converse is Also true in that the High level cannot be set below the low level.

3.2.12.1 In Constant Current mode:
The level is initial setting on High, LEVEL High / Low has two level, Low current level setting must be lower than Level High.

3.2.12.2 In Constant Resistance mode:
The level is initial setting on High, LEVEL High / Low has two level, Low resistance level setting must be higher than Level High.
P.S.：CR Mode Level High / Low level by current perspectives.

3.2.12.3 In Constant Voltage mode:
The level is initial setting on High, LEVEL High / Low has two level, Low voltage level setting must be lower than Level High.
P.S.：CV Mode Level High / Low has "automatic push function”.

3.2.12.4 In Constant Power mode:
The level is initial setting on High, LEVEL High / Low has two level, Low power level setting must be lower than Level High.

P.S. Automatically Push Function
Level setting, Level High must be higher or equal than Level Low; When Level High equal to than LEVEL Low, it can not be adjusted anymore.

when Level High equals to lower low, the Automatic push function can push down the level Low value.
Therefore, the Level High can continue adjusting.

3.2.13. 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.

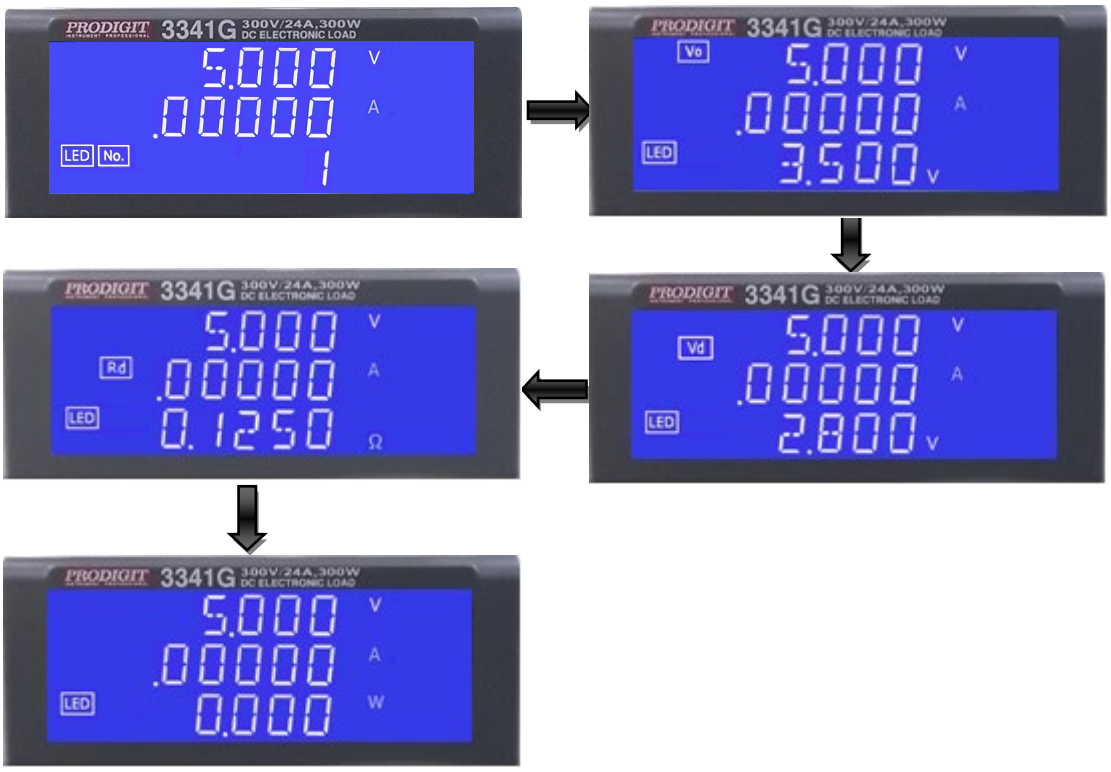
3.2.13.2. Constant Resistance (CR) mode:
The High and Low levels of load resistance can be preset on the lower 5 Digit LCD. The "Ω" LED will be lit indicating the setting value is ohms.

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:

Load the LED parameters set value is displayed on the display of below. Press the Preset key ON, sequence set "No." -> "Vo" ->"Vd" -> "Rd" -> Preset OFF.

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

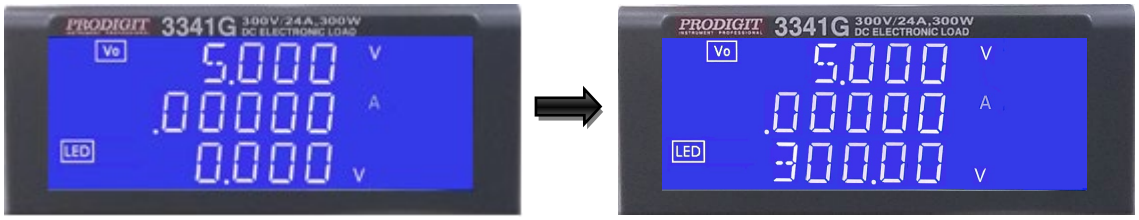


- LED Mode, LED Quantity set the initial value of 1, Simulation can change this setting LED cascading connection features a few pieces, the latter setting the specifications of LED can be set a parameter, cascading connection LED as a light Bar, to set back the settings, 3341G~ 3343G setting range is 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.

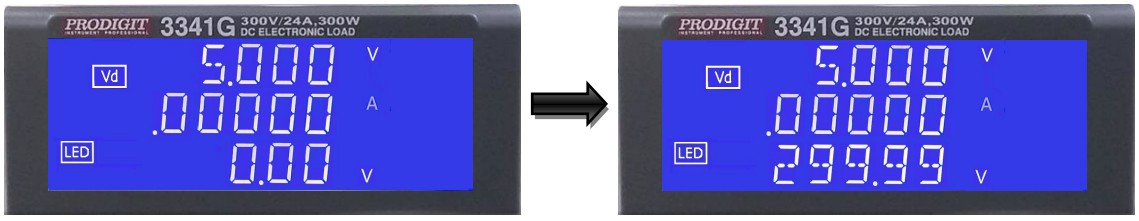
- LED Mode, Vo set the initial value of 3.5V.Vo must be less than the Specifications in addition to set quantity, Vo is a single LED of the Vo voltage.

- LED Mode, setting the Vo, The LCD display shows, lower 5 digit LCD display setting value, the unit is "V", the setting range is 0.000V to the full scale of the LED mode specification. The setting is by rotating the setting knob.

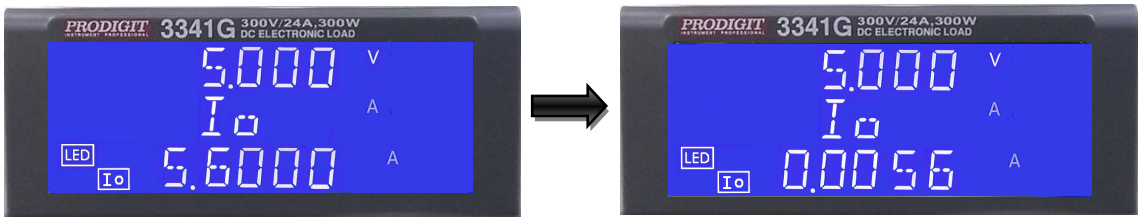


- LED Mode, Vd is 80 percent the initial value of Vo, when change Vo, When the Vo after the change, Vd will also be changed Vo 80 percent ,Vd is a simulation of a single LED of the Vd voltage, Vd initial value of 2.8V

- 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 299.99V of the LED mode specification, The setting is by rotating the setting knob.

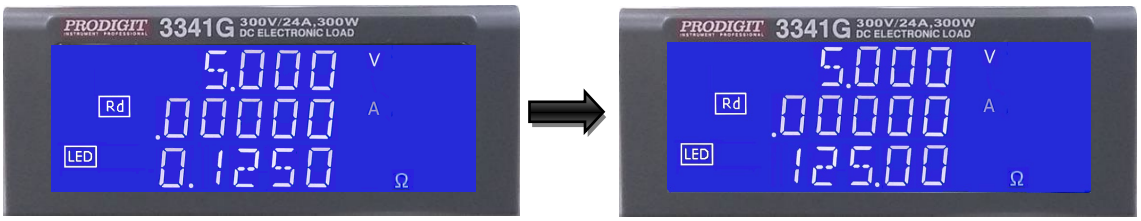


- LED Mode, Io setting, please config to uses the knobs or key setting "Io".
  When Vo is 3.5V and Vd is 2.8V, the setting range is 0.0056A to the 5.6000A of the LED mode specification, The setting is by rotating the setting knob.
  Io= (Vo-Vd)/Rd



- LED Mode, press “Config” and switch Rd_Io.
- Rd setting the initial value of 0.125 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 0.125Ω to the 125.0Ω of the LED mode specification, the setting is by rotating the setting knob.



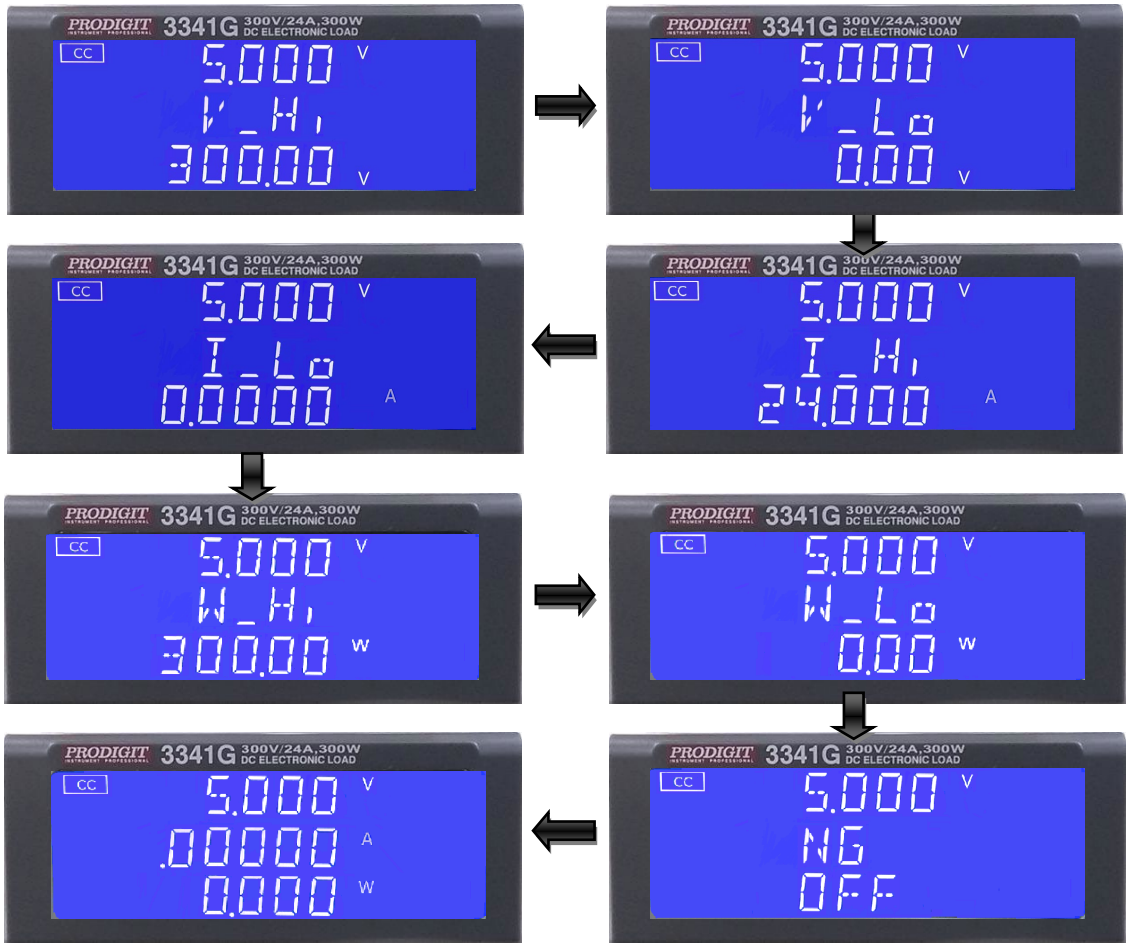
3.2.14. Limit key and LED

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

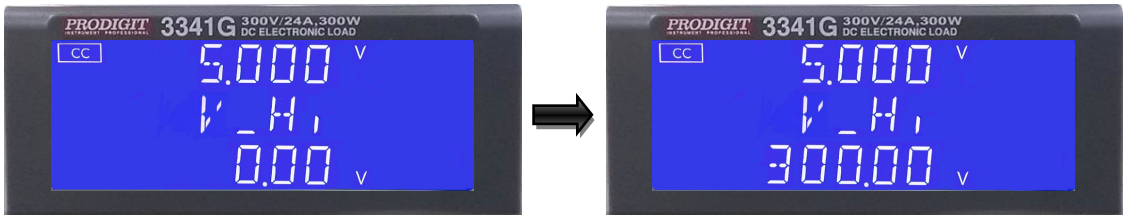
Each press of the LIMIT key enables a different value to be entered. On first press of the LIMIT key the button will illuminate and V-Hi will be displayed on the middle LCD. The setting is made with the rotary knob and can be read from the lower LCD during setting. The setting sequence is shown below:

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

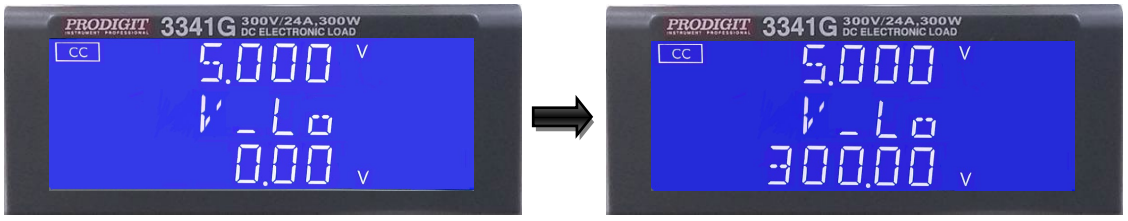
The engineering unit is “V”, “A” or “W” depending on the threshold LIMIT being set.



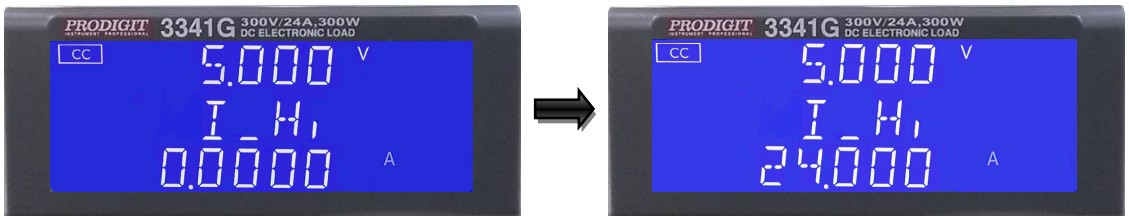
- Setting Upper limit voltage VH , Middle 5 digit LCD display「V-Hi」,lower 5 digit LCD display the unit is "V" ,The V-Hi set range from 0.00 V to 300.00V step 0.01V by rotating the Setting knob.



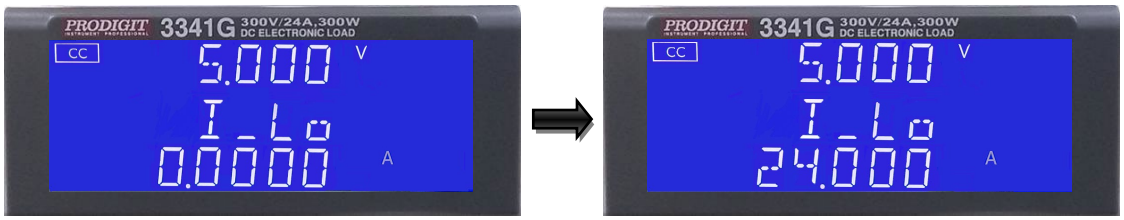
- Setting lower limit voltage VL, Middle 5 digit LCD display「V-Lo」,lower 5 digit LCD display the unit is "V",The V-Lo set range from 0.00 V to 300.00V step 0.01V by rotating the Setting knob.



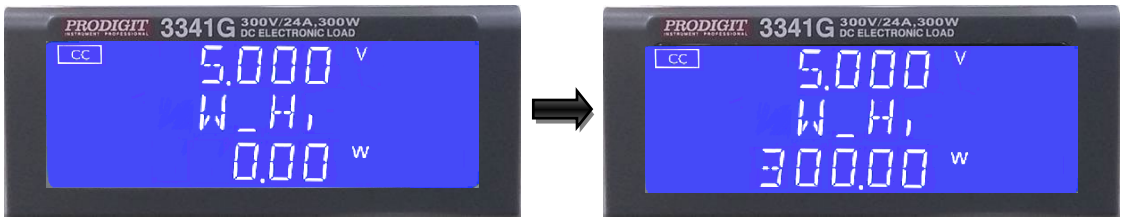
- Setting Upper limit current IH , Middle 5 digit LCD display「I-Hi」,lower 5 digit LCD display the unit is "A", The I-Hi set range from 0.0000 A to 2.4000A step 0.0001A by rotating the Setting knob.



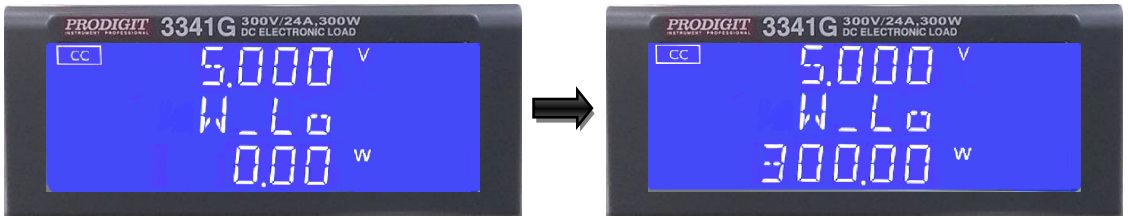
- Setting lower limit current IL , Middle 5 digit LCD display「I-Lo」,lower 5 digit LCD display the unit is "A" ,The I-Lo set range from 0.0000 A to 2.4000A step 0.0001A by rotating the Setting knob.



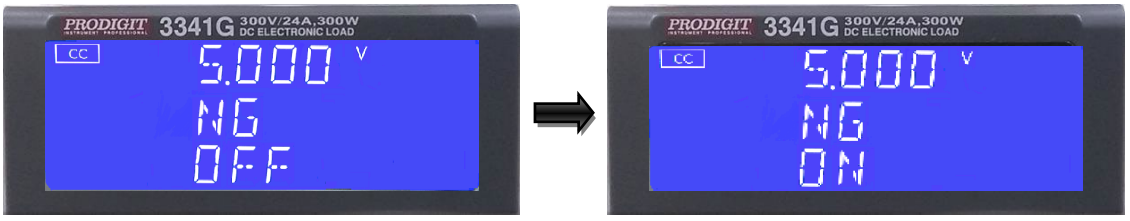
- Setting Upper limit power WH, Middle 5 digit LCD display「W-Hi」lower 5 digit LCD display the unit is "W", The W-Hi set range from 0.00 W to 300.00W step 0.01W by rotating the Setting knob.



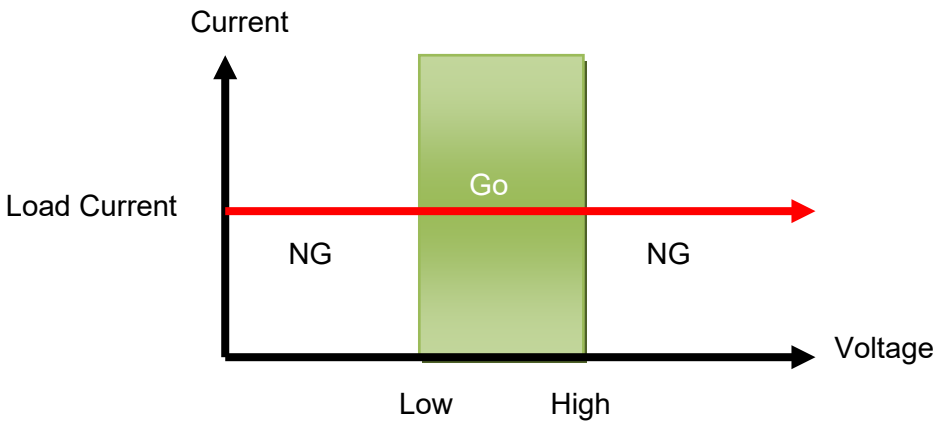
- Setting lower limit power WL, Middle 5 digit LCD display「W-Lo」lower 5 digit LCD display the unit is "W", The W-Lo set range from 0.00 W to 300.00W step 0.01W by rotating the Setting knob.



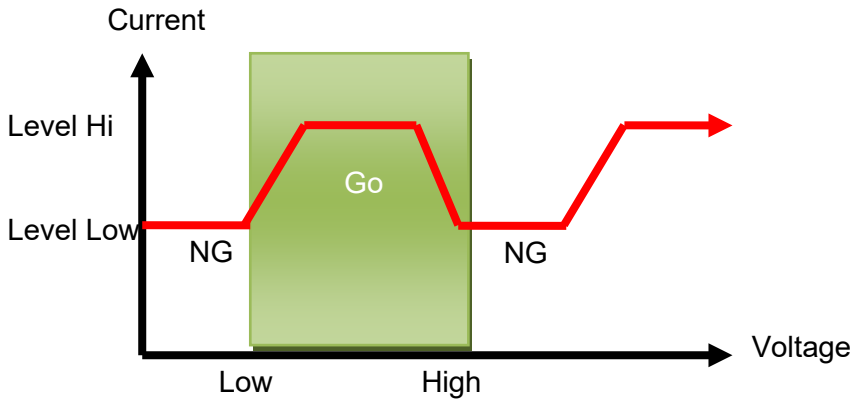
- Setting NG ON/OFF, When exceed VH、VL、IH、IL、WH、WL One of these Whether NG on LCD display.



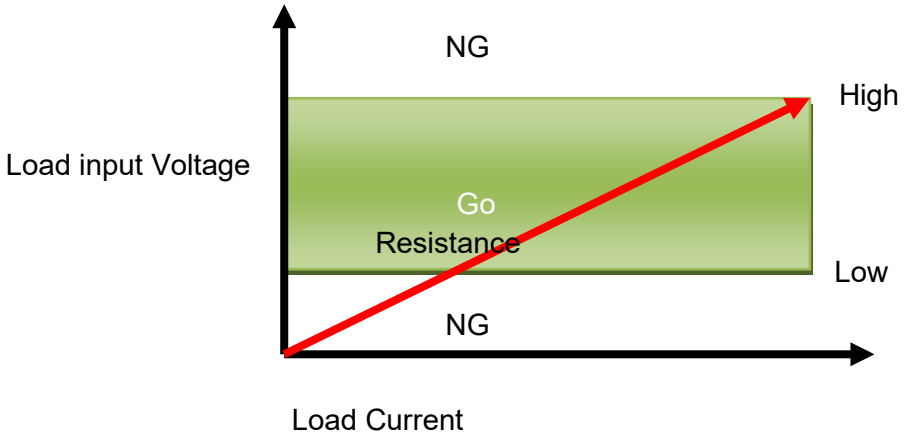
- CC mode, press limits key to set the V-Hi and V-Lo voltage upper and lower limits of the GO / NG.



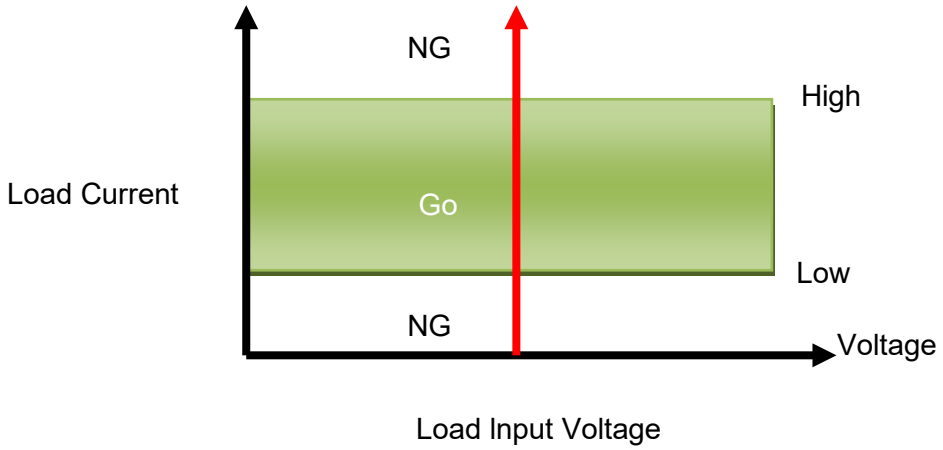
- CC Dynamic Mode, press key to set the Level Hi and Level Low voltage upper and lower limits of the GO / NG.



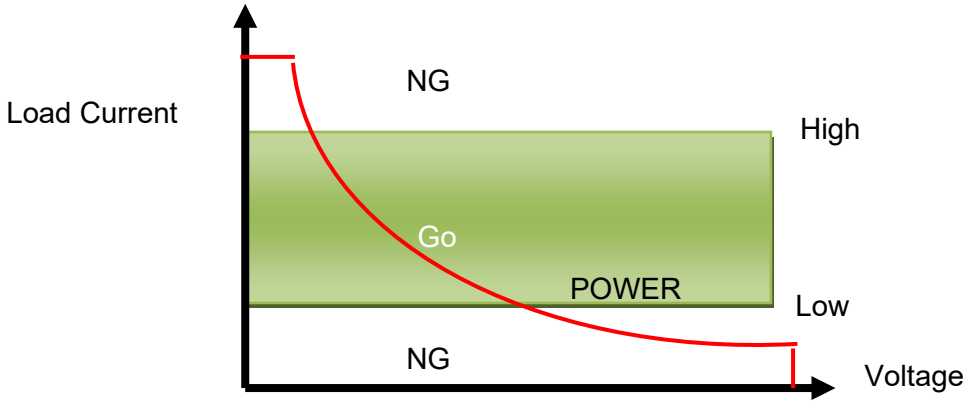
- CR mode, press limits key to set the V-Hi and V-Lo voltage upper and lower limits of the GO / NG.



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



- CP mode, press limits key to set the W-Hi and W-Lo power upper and lower limits of the GO / NG.



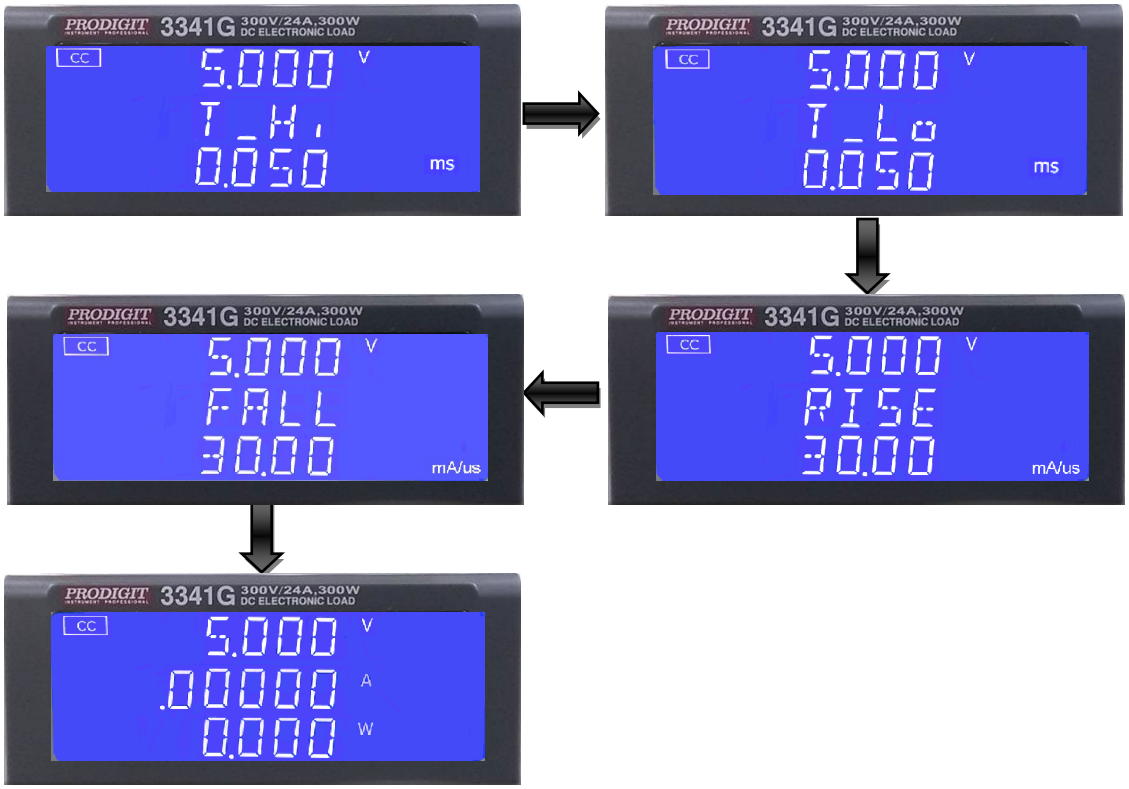
3.2.15. DYN setting and LED

The DYN button allows the user to define the timings of the dynamic load Waveform. Firstly the high and low levels of load current will need to be set via the LEVEL switch. The RISE and FALL times between the low load current and the high load current along with the TIME the waveform is HIGH and the TIME LOW Can be set via the DYN menu.

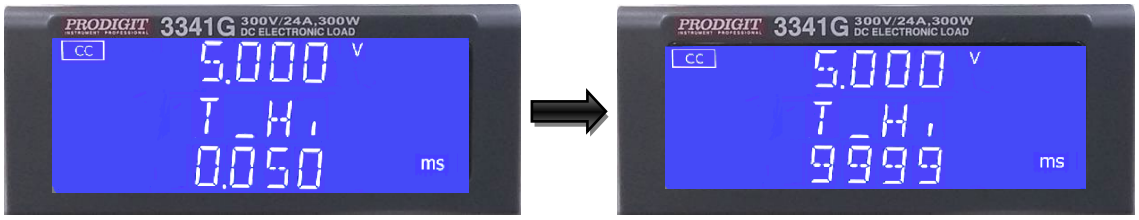
Each press of the DYN key enables a section of the DYNAMIC waveform to be set. On first press of the DYN key the button will illuminate and T-Hi will be displayed On the middle LCD. The value is adjusted with the rotary knob and can be read From the lower LCD during setting. The setting sequence is shown below:

T_Hi (time the waveform is high) →
T_Lo (time the waveform is low) →
RISE (rise time) →
FALL (fall time) →
DYN setting function OFF

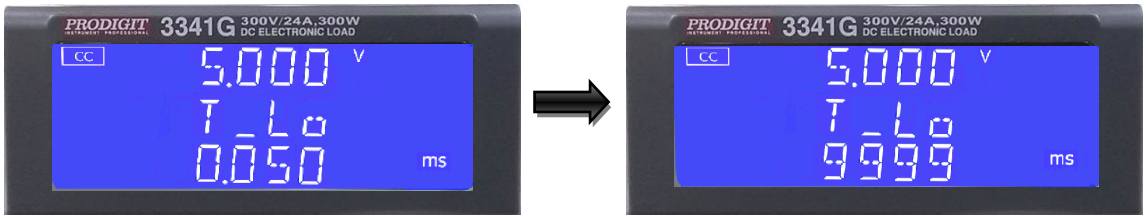
The time that the waveform is high includes the rise time and is set in “ms”
The time that the waveform is low includes the fall time and is set in “ms”
The RISE and FALL time is set in “mA/μs” or “A/μs”. The actual engineering unit is Shown on the right of the lower 5 digit display



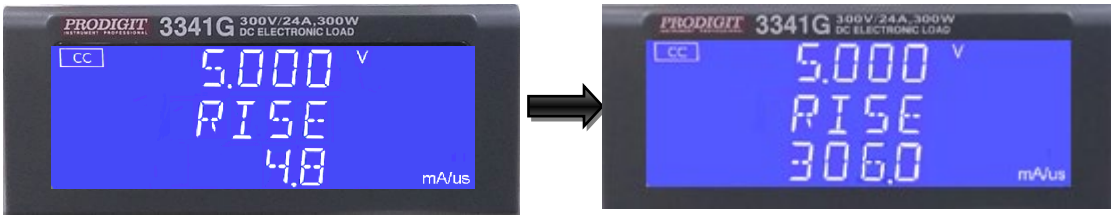
- Press DYN setting key, LED will ON
  Setting level High Period, Middle 5 digit LCD display will show 「T-Hi」
  Lower 5 digit LCD display will show setting value, the unit is “ms” , The T-Hi Set range from 0.050 ms to 9999 ms step 0.001ms by rotating the setting Knob.



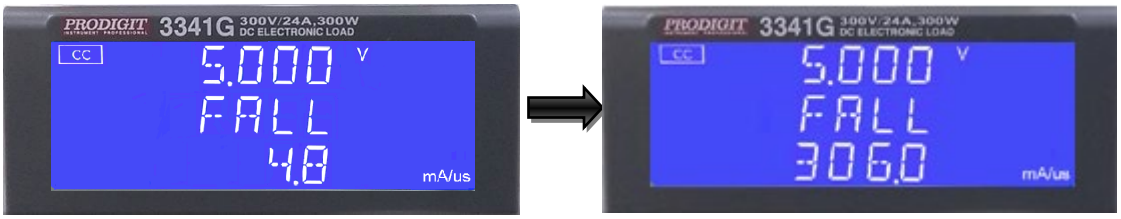
- Setting level Low period, Middle 5 digit LCD display will show 「T-Lo」, Lower 5 digit LCD display will show setting value, the unit is “ms” , The T-Lo set range from 0.050 ms to 9999 ms step 0.001ms by rotating the Setting knob.



- Setting rise time, Middle 5 digit LCD display will show 「RISE」, Lower 5 digit LCD display will show setting value, the unit is “mA/μs” , The RISE time set range from 4.8 mA/us to 306 mA/us step 0.12mA/us by rotating the Setting knob.



- Setting fall time, Middle 5 digit LCD display will show 「FALL」, Lower 5 digit LCD display will show setting value, the unit is “mA/μs” , The FALL time set range from 4.8 mA/us to 306 mA/us step 0.12mA/us by rotating the Setting knob.



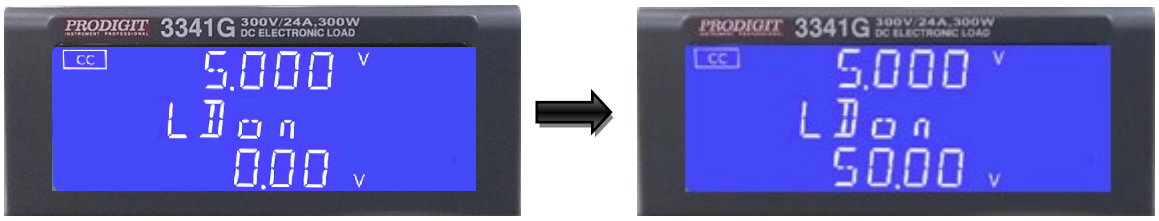
3.2.16. Config key and LED

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.

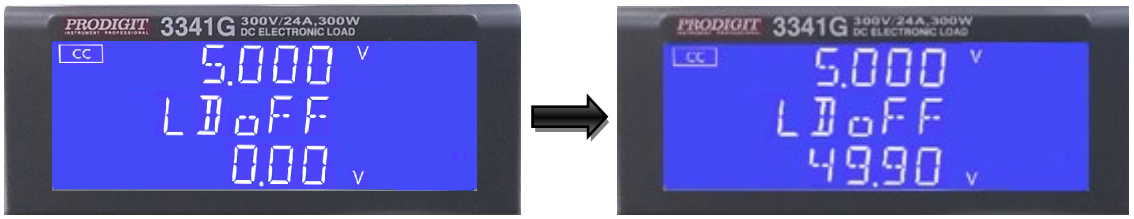
Each press of the CONFIG key moves the menu on one step. On first press of the CONFIG key the button will illuminate and SENSE will be displayed on the middle LCD. The value is adjusted with the rotary knob and can be read from the lower LCD during setting. The setting sequence is shown below:

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

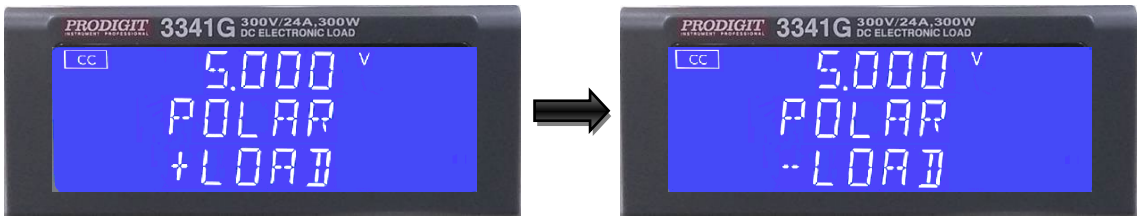
- Set Load ON voltage, the middle of the 5 digit LCD display will show "LDon", Lower 5 digit LCD display will show setting value, the units is V, The Load ON Voltage set range from 0.00V to 50.00V step 0.01V by rotating the setting knob. If the load is greater than the input voltage Load ON voltage setting, the Electronic load current begin to load on.



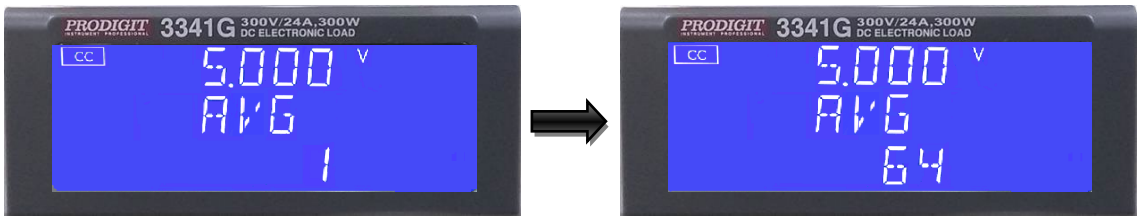
- Setting Load OFF voltage, the middle of the 5 digit LCD display will show "LDoFF", lower the 5 digit LCD display will show settings value, the units is V, The Load OFF Voltage set range from 0.00V to 49.90V step 0.01V by rotating The setting knob.
  if the load input voltage is less than Load OFF setting voltage, the electronic load to load off.



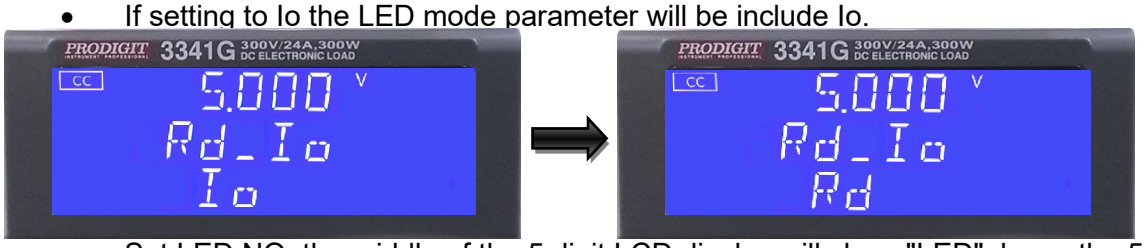
- Set Load polarity, the middle of the 5 digit LCD display will show "POLAR", lower the 5 digit LCD display "will show + LOAD" or "-LOAD", use the knobs and key settings "+ LOAD" or "-LOAD".



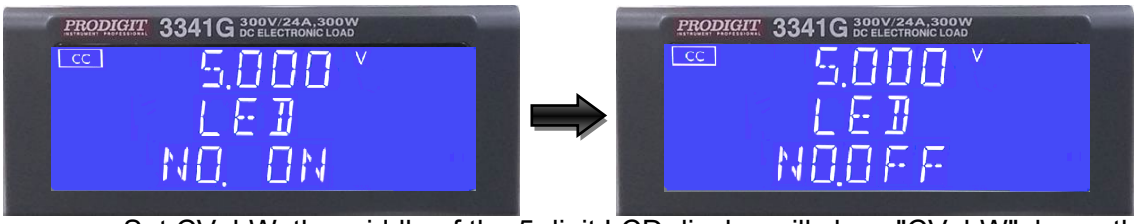
- Setting AVG , the middle of the 5 digit LCD display will show "AVG", lower the 5 digit LCD display will show settings value, the AVG set range from 1 to 64 steps 1 by rotating the setting knob.



- 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.

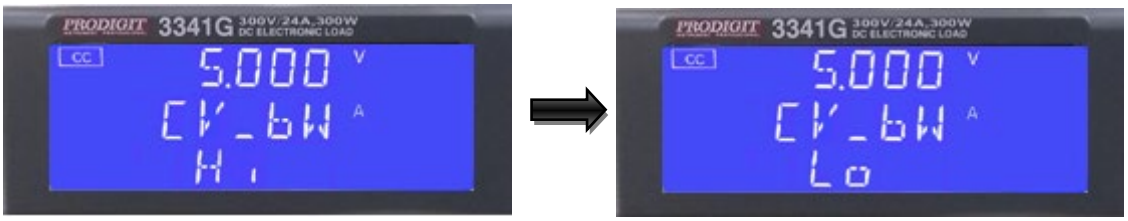


- Set LED NO, the middle of the 5 digit LCD display will show "LED", lower the 5 digit LCD display "will show NO.ON" or "NO.OFF", use the knobs and key settings "ON" or "OFF", When select No. OFF display will not display LED No Quantity.

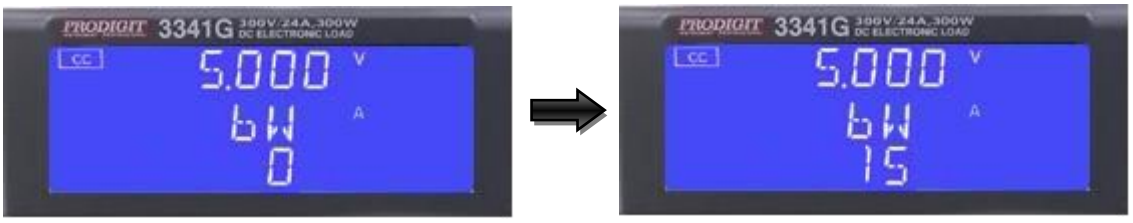


- Set CV_bW, the middle of the 5 digit LCD display will show "CV_bW", lower the 5 digit LCD display "will show Hi" or "Lo", use the knobs and key settings "Hi" or "Lo".

  the CV_bW setting available in CV mode, The CV_bW can setting to Lo when CV mode test have some unstable or oscillation with the UUT. User can adjust the CV_bW setting value with the voltage and current waveform by oscilloscope to find out suitable frequency response.



- 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 0 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.



3.2.17. Short Key and LED

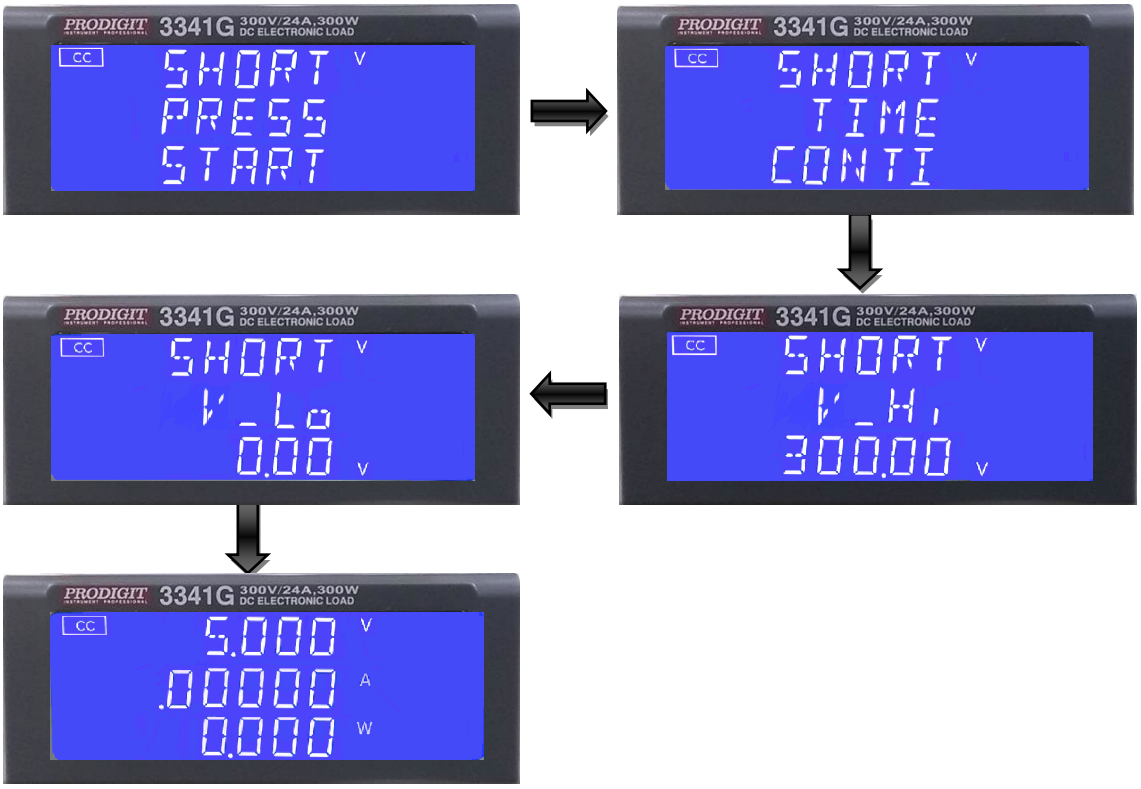
The SHORT key allows the parameters of a SHORT circuit test to be entered. The SHORT test will attempt to sink high current up to the 3341G load module's maximum current in order to check the power source's protection and behavior. The test time can be adjusted and threshold values for the High and low 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.

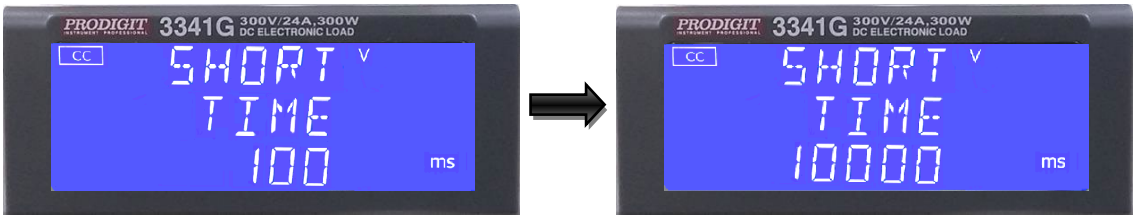
The setting sequence is shown below:

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

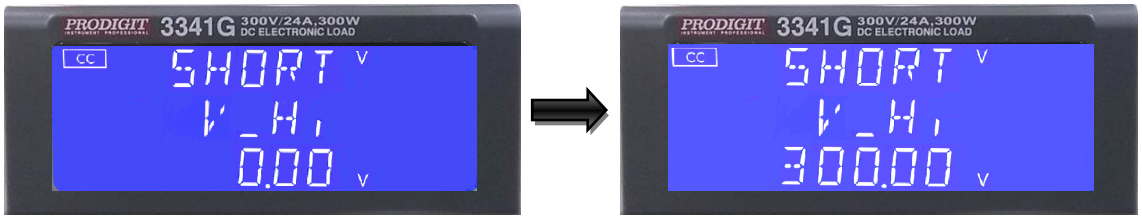


- setting the short test time，The LCD display show 「SHORT」 on upper 5 digits LCD display，shows 「TIME」on middle 5 digits LCD display，lower 5 digit LCD display 「CONTI」, the unit is "ms".

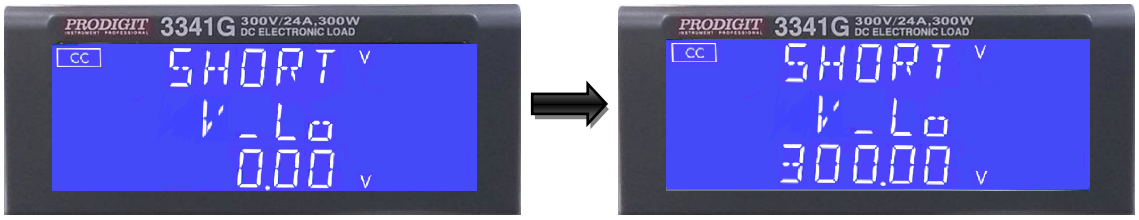
- TIME: setting the short test time, The LCD display show 「SHORT」 on upper 5 digits LCD display, shows 「TIME」on middle 5 digits LCD display the unit is “ms” ,and shows 「CONTI」 on lower 5 digits LCD display, the Setting range is “CONTI” means continue, 100mS to 10000mS step 100mS by clockwise rotate the 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 0.000V 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 0.000V to 300.00V step 0.01V by rotating the setting knob.



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

3.2.18. OCP key and LED

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.

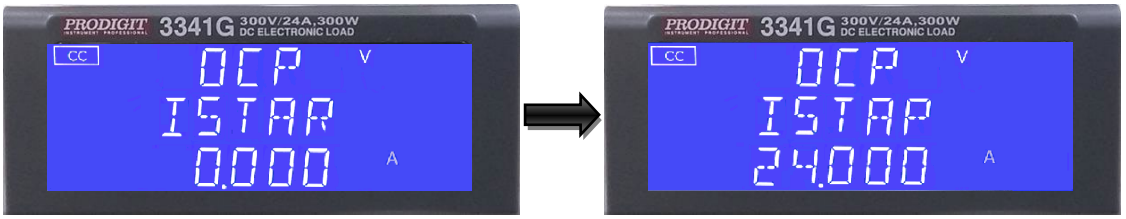
Each press of the OCP button moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during

Setting.

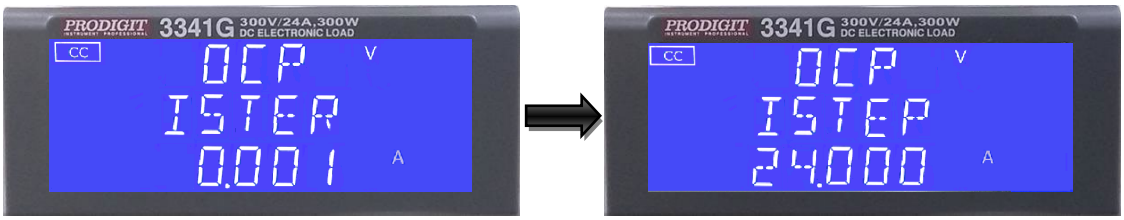
The setting sequence is shown below:

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

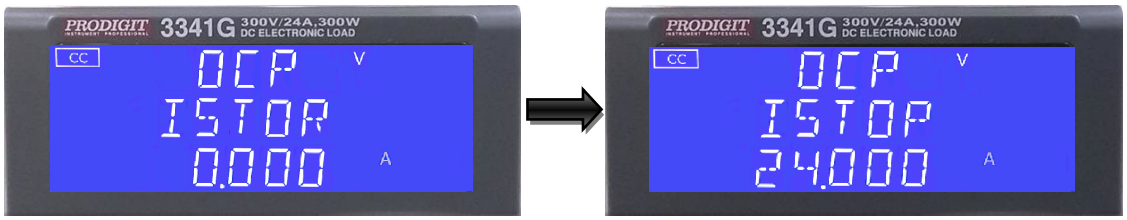
- ISTAR: setting the start current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTAR」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.000A to the full scale of the CC mode specification.
  The setting is by rotating the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



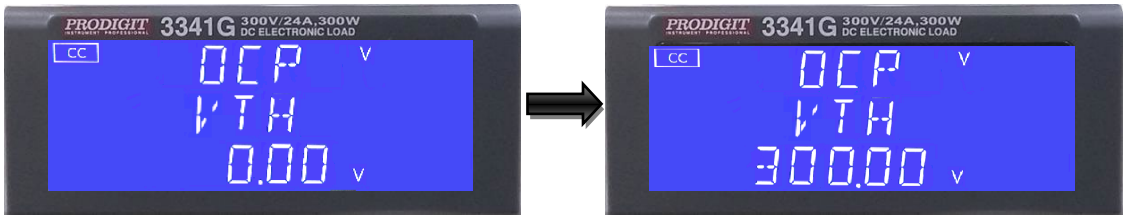
- ISTEP: setting the increment step current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTEP」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.0001A to the full scale of the CC mode specification.
  The setting is by rotating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

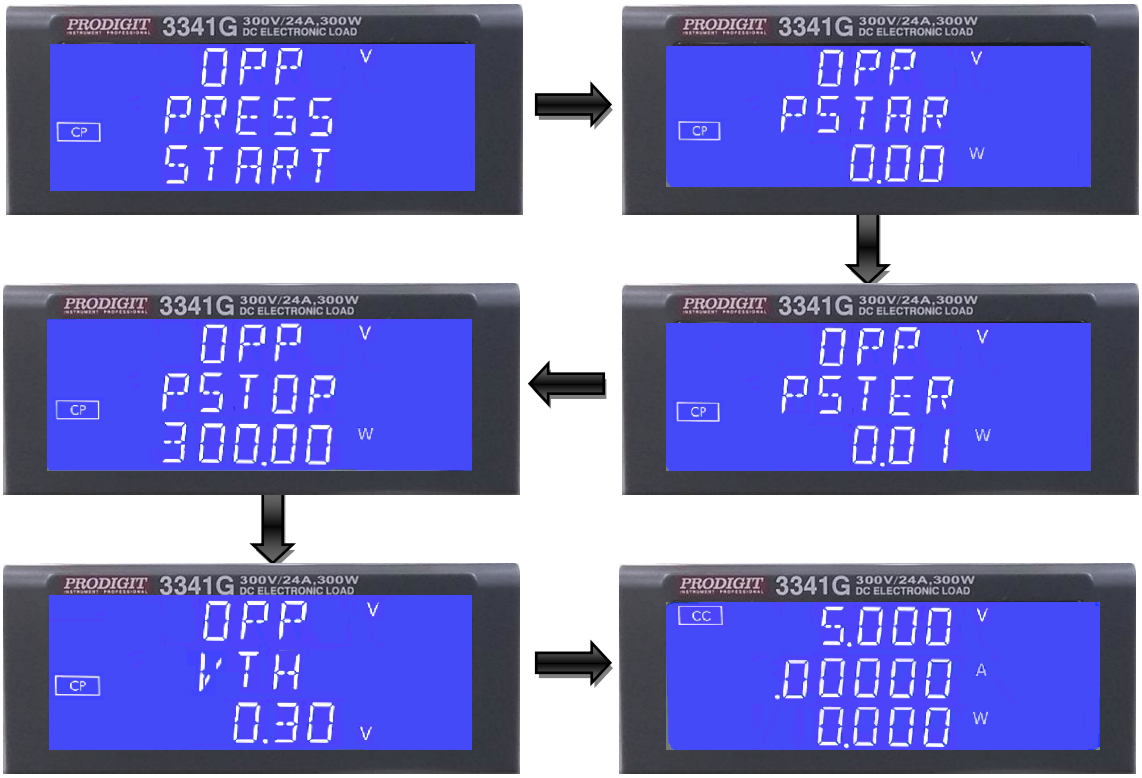
The OPP key allows the parameters of an Over Power Protection test to be entered. The OPP test will ramp up the load power in steps to validate the Device under Test's (DUT) protection and behavior. A voltage threshold level can be set. If the voltage measured during the test is lower than the set Threshold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

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

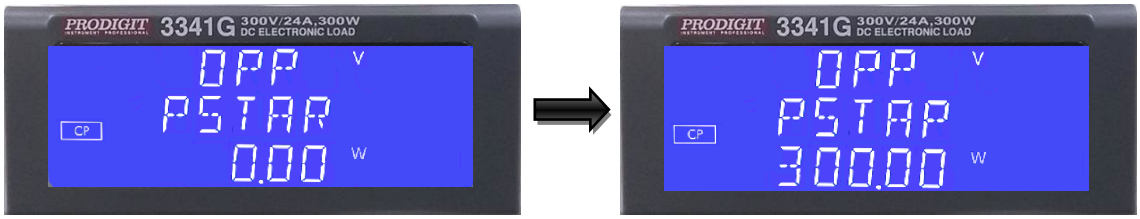
Each press of the OPP button moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during Setting.

The setting sequence is shown below:

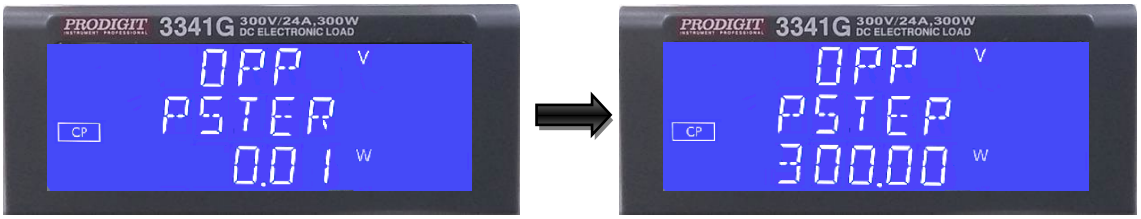
OPP PRESS START (pressing the red start/stop key starts test) →
OPP P STAR (power starting point of the OPP test) →
OPP P STEP (value of incremental current steps from P START) →
OPP P STOP (the OPP test's upper threshold power limit) →
OPP Vth (the voltage threshold setting) →
Exit OPP test set-up



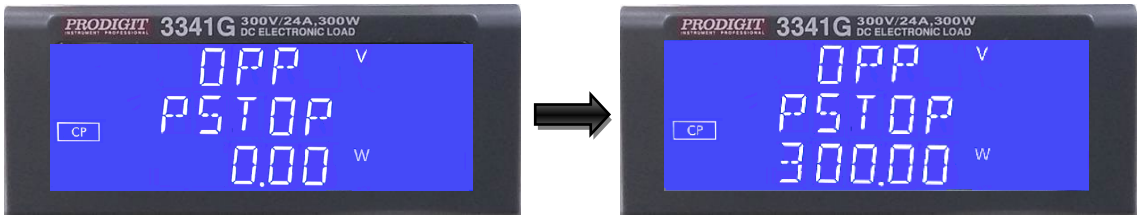
- PSTAR: setting the start power, The LCD display shows 「OPP」on upper 5 digit LCD display, Middle 5 digit LCD display「PSTAR」,lower 5 digit LCD display setting value, the unit is "W", the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.



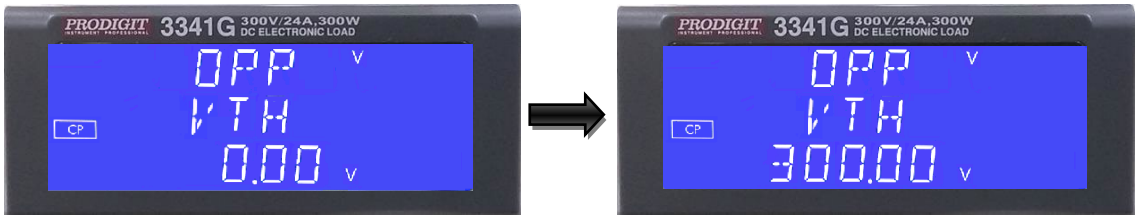
- PSTEP: setting the increment step power, The LCD display shows 「OPP」on upper 5 digit LCD display, Middle 5 digit LCD display「PSTEP」,lower 5 digit LCD display setting value, the unit is "W", the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.



- PSTOP: setting the stop power, The LCD display shows 「OPP」on upper 5 digit LCD display, Middle 5 digit LCD display「PSTOP」,lower 5 digit LCD display setting value, the unit is "W", the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.



- Vth : Setting threshold voltage; The LCD display shows 「OPP」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.



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

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

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

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

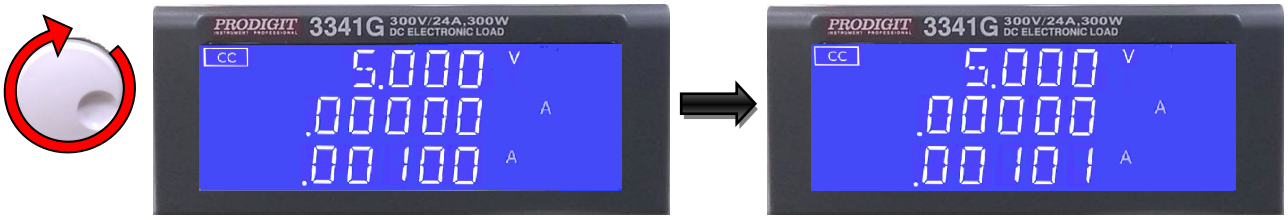
3.2.20.

key

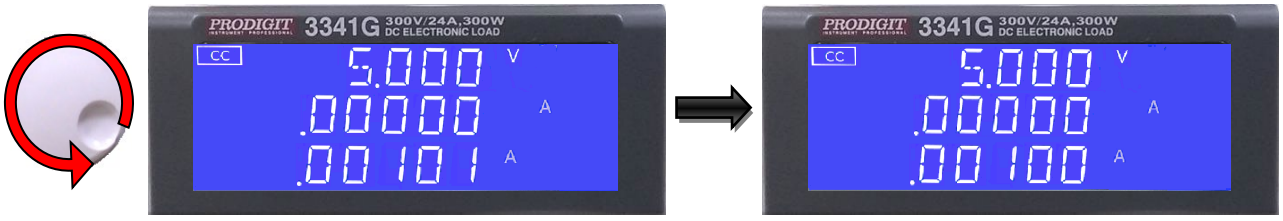
The red START/STOP key is used in conjunction with the SHORT, OCP or OPP test functions. It is used to START a test according to the set parameters or to STOP a test before PASS or FAIL is signaled. Please refer to the preceding sections for more information on the SHORT, OCP & OPP tests.

3.2.21. Knob and Knob key

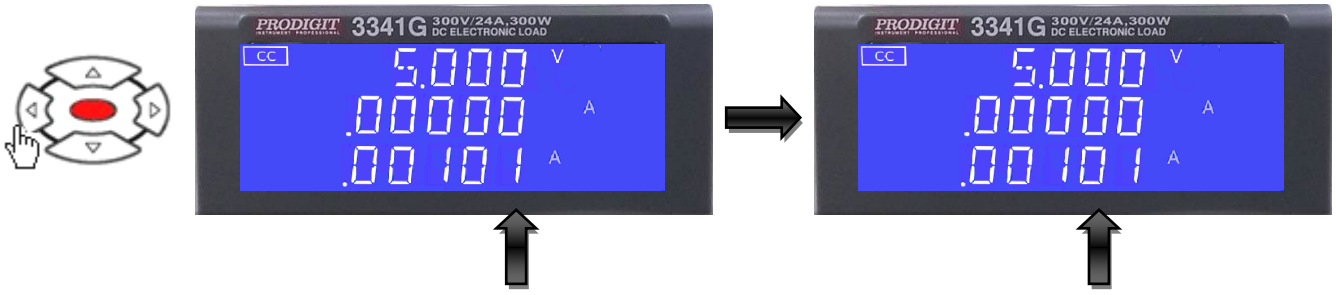
- Right Knob: Setting digit can flash clockwise add setting value.



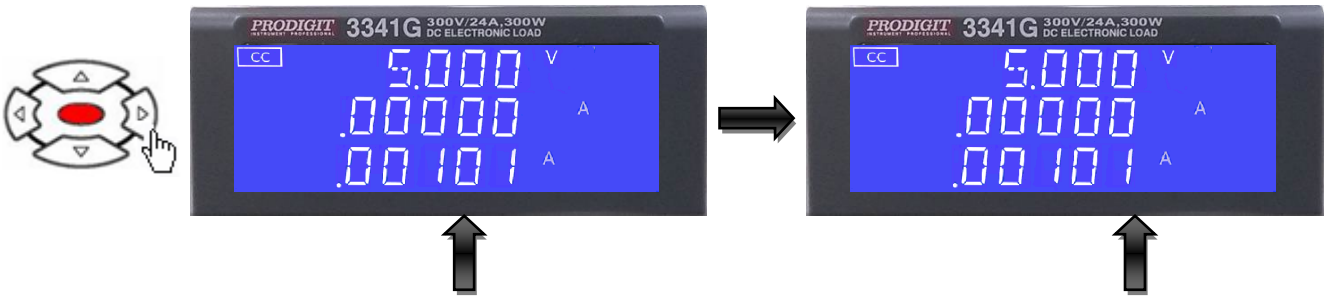
- Left Knob: Setting digit can flash Anti-clockwise to decrease setting value.



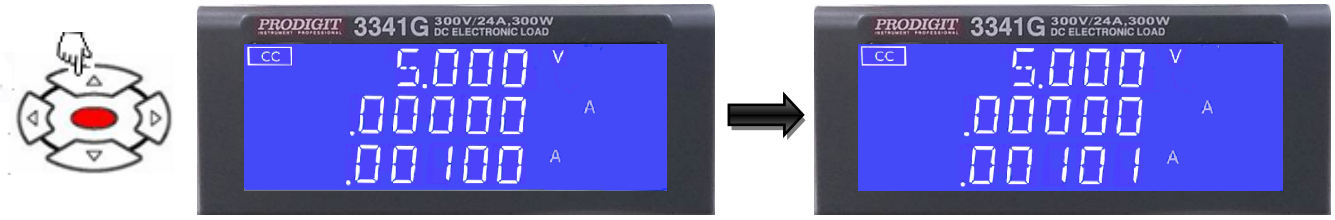
- Knob Left key: Setting digit can flash Left Knob key to push down setting value move left one-digit.



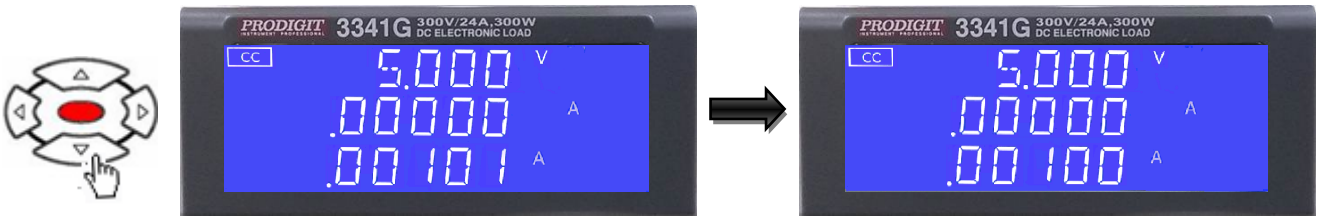
- Knob Right key: Setting digit can flash Knob Right key to push down setting value move Right one-digit.



- Knob up key: Setting digit can flash Knob UP KEY to push down add setting value.



- Knob down key: Setting digit can flash Knob down key to push down to decrease setting value.



NOTE: ON CR MODE Right Knob and Knob UP KEY to push down decrease setting value.
ON CR MODE LEFT Knob DOWN KEY to push down add setting value.

3.2.22. +/- DC INPUT Terminal.

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

Please take care of the voltage and current rating not to excess the maximum rating of each 3341G series load module. Please check the polarity of DC input connection also before testing.

3.2.23. V-sense input terminal

To measure the specific voltage points through the V-sense input terminal, refer Fig 3-2 for detail application information.

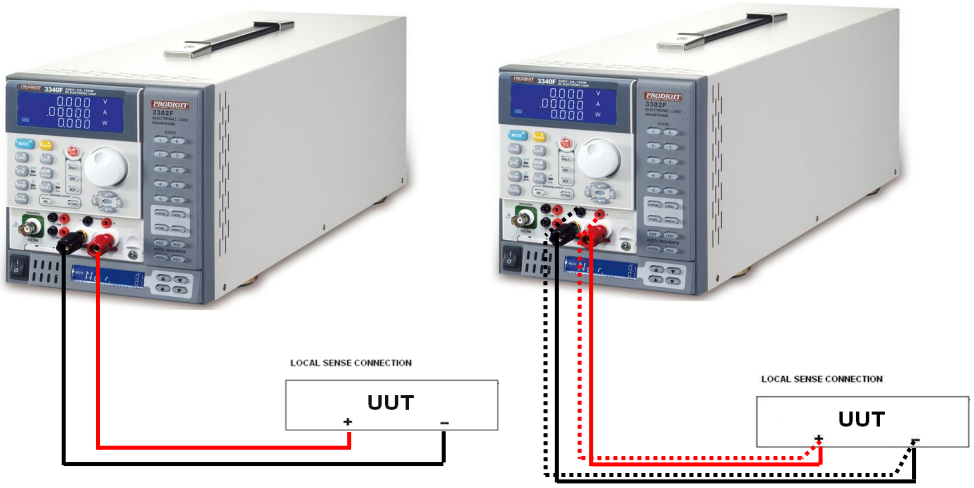


Fig 3-2 typical connection of 3341G series load module

3.2.24. DIM and LED

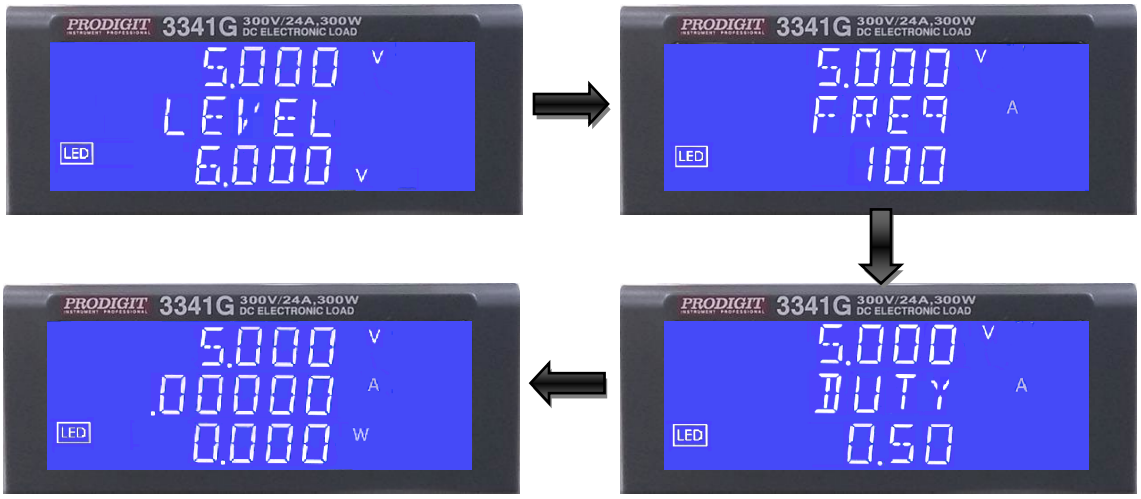
- Dimming setting mode:
  DIM ON: Press the DIM key, LED will be lit and setting control signal by setting parameters output.
  DIM OFF: Press the DIM key again, the LED will be OFF and Control signal output to zero

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.

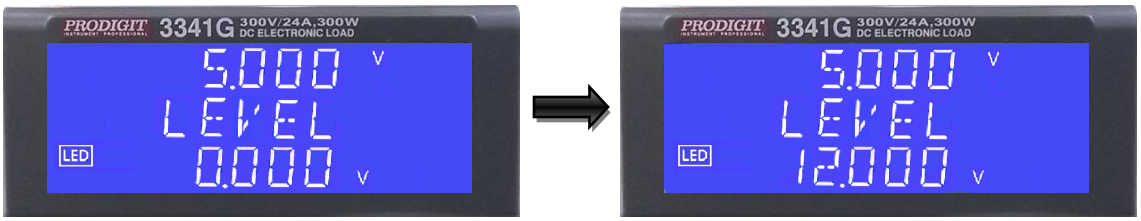
Note2: When the DIM ON and setting button is OFF, freq parameter is 100~1000, Can be adjusted in the Duty value is by rotating the setting knob.

3.2.25. 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:

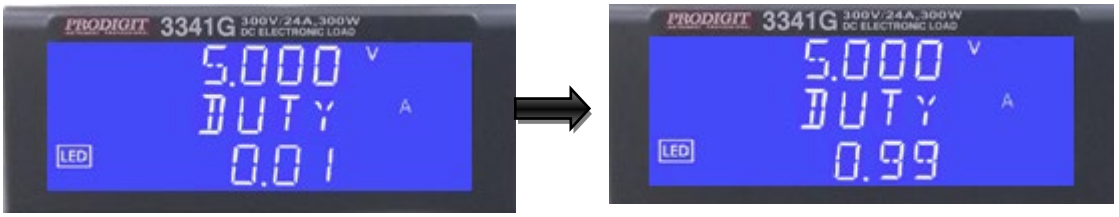


- LEVEL setting, The LCD display shows, lower 5 digit LCD display, the unit is "V", the setting range is 0.000V to the 12.000V of the LED mode specification, Step 0.04V by rotating the setting knob.



- 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.

- ows, lo
range is 0.01 to the 0.99 of the LED mode specification, Step 0.01 by rotating the setting knob.



- 3341G Series Electronic Load DIM Description:

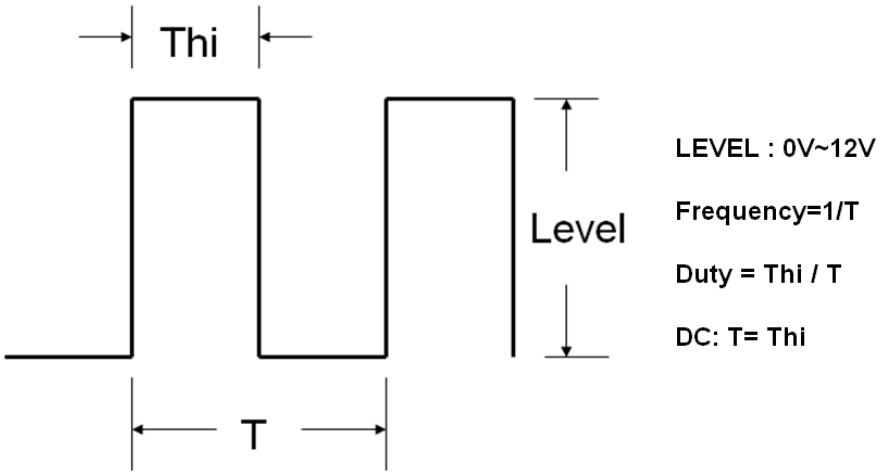
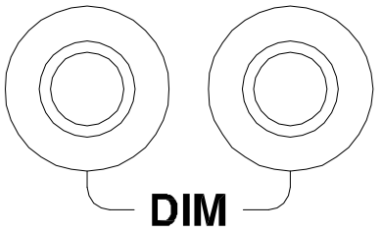
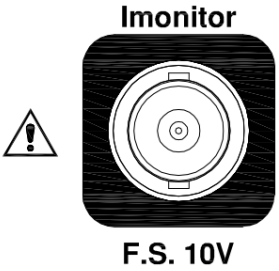


Fig 3-3 3341G Series Electronic Load DIM

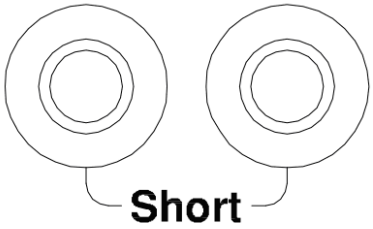
3.2.26. DIM Terminal Description



3.2.27. I-monitor Terminal Description

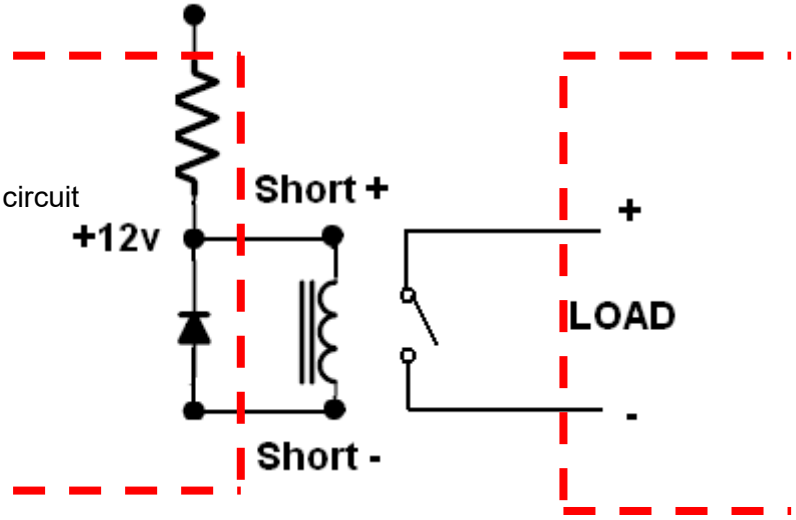


3.2.28. Short Terminal Description



- Short Test Description:
  3341G series of internal circuit

3341G series of internal circuit



- I-monitor

  The I-monitor is designed to monitor the Electronic load's input current or short current and non-isolated amplifier output 0V to 10V full scale signal indicates the zero to full scale current for each Electronic load.
  Please refer chapter 1, Table 1-1B for voltage /current relationship of each 3341G series.

  The I-monitor analog signal is proportional to the load current flow through the electronic load.
  I-monitor provides the load current waveform output to an oscilloscope to evaluate
  The voltage and current waveform of a power supply under test.

  The non-isolated I-monitor provides for power supply testing, it is designed to the ground problem while connect I-monitor and measure power supply output Voltage to oscilloscope simultaneously, because the two or more input terminals in oscilloscope are not isolated.

CAUTION! 3341G series I-monitor not isolated, don‘t use I-monitor with different channel to avoid common ground problem.

Note:
1. The CURRENT MONITER of this unit is NOT isolated. Please be careful When you connect to an oscilloscope. Improper connections would cause Damage.
2. Monitor output volt : 10V , Output impedance : 1K

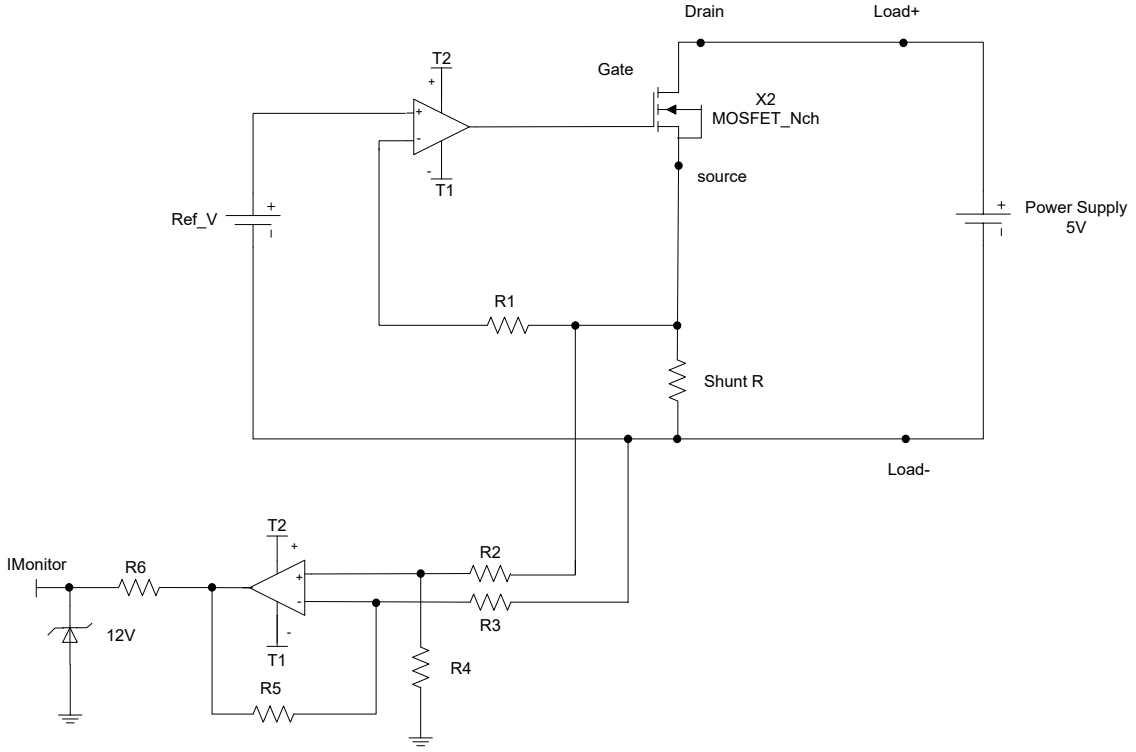


Fig 3-4 An equivalent circuit in terms of the current monitor

Note:

Connection to an oscilloscope
When you connect this product to an oscilloscope, please be careful about the polarities of the probes of the oscilloscope as shown in Fig 3-5.

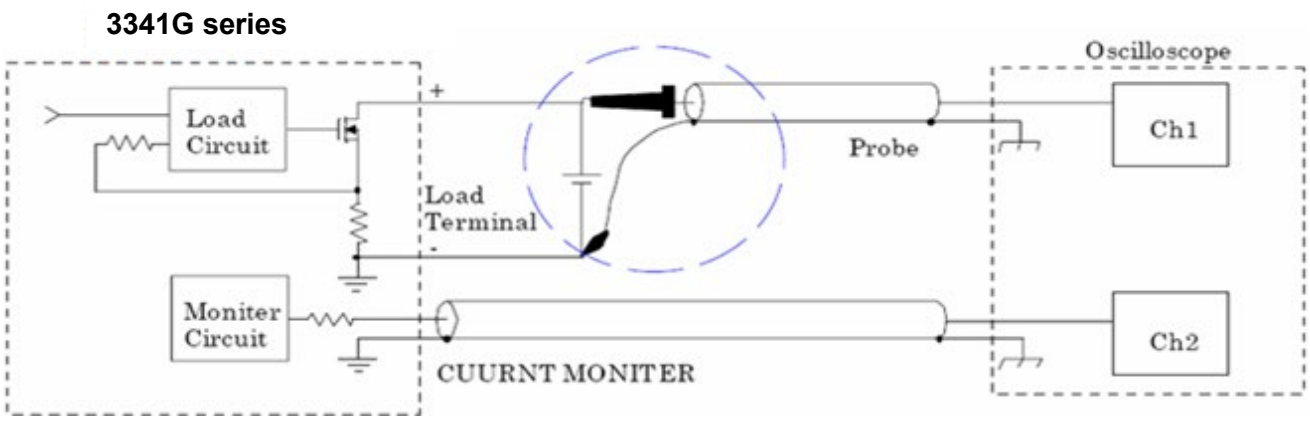
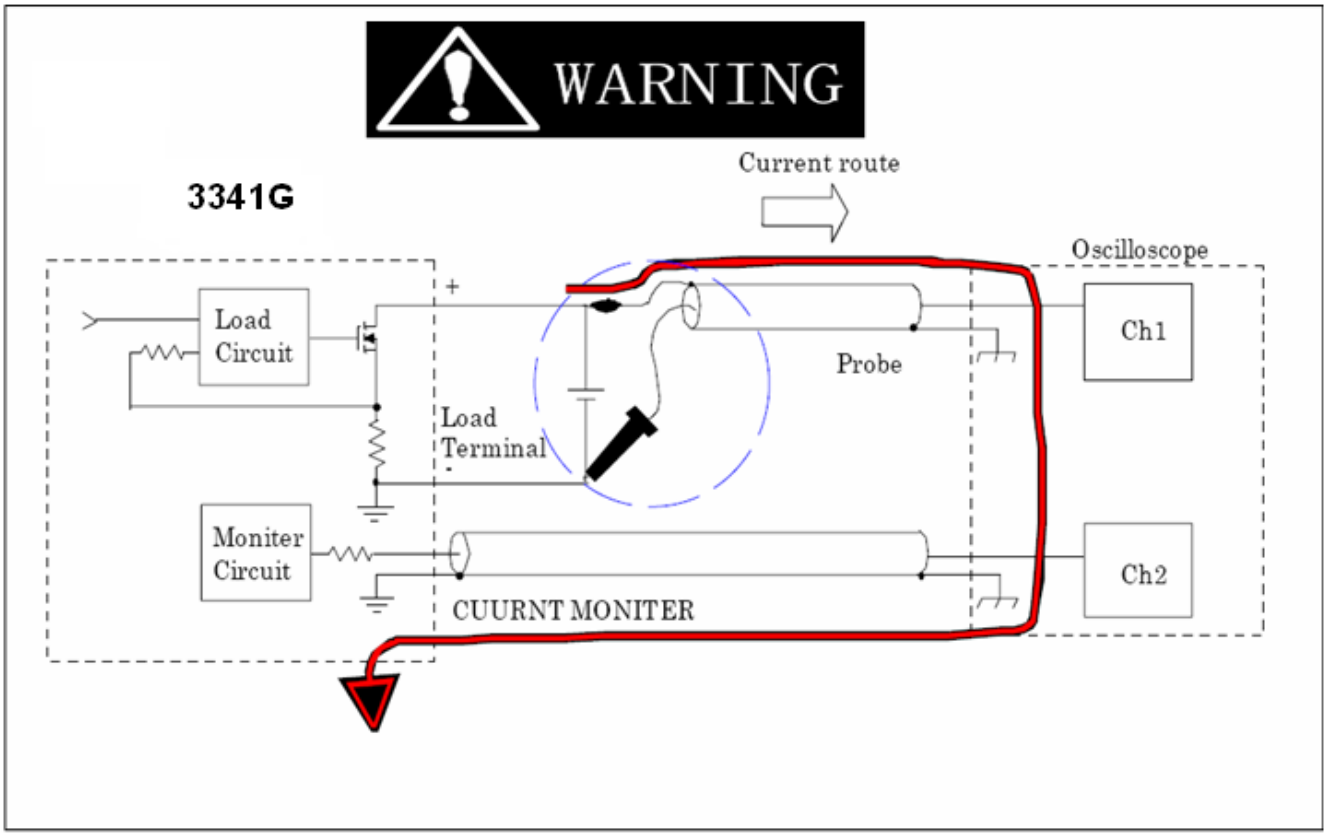


Fig 3-5 (Correct) Connections to an oscilloscope

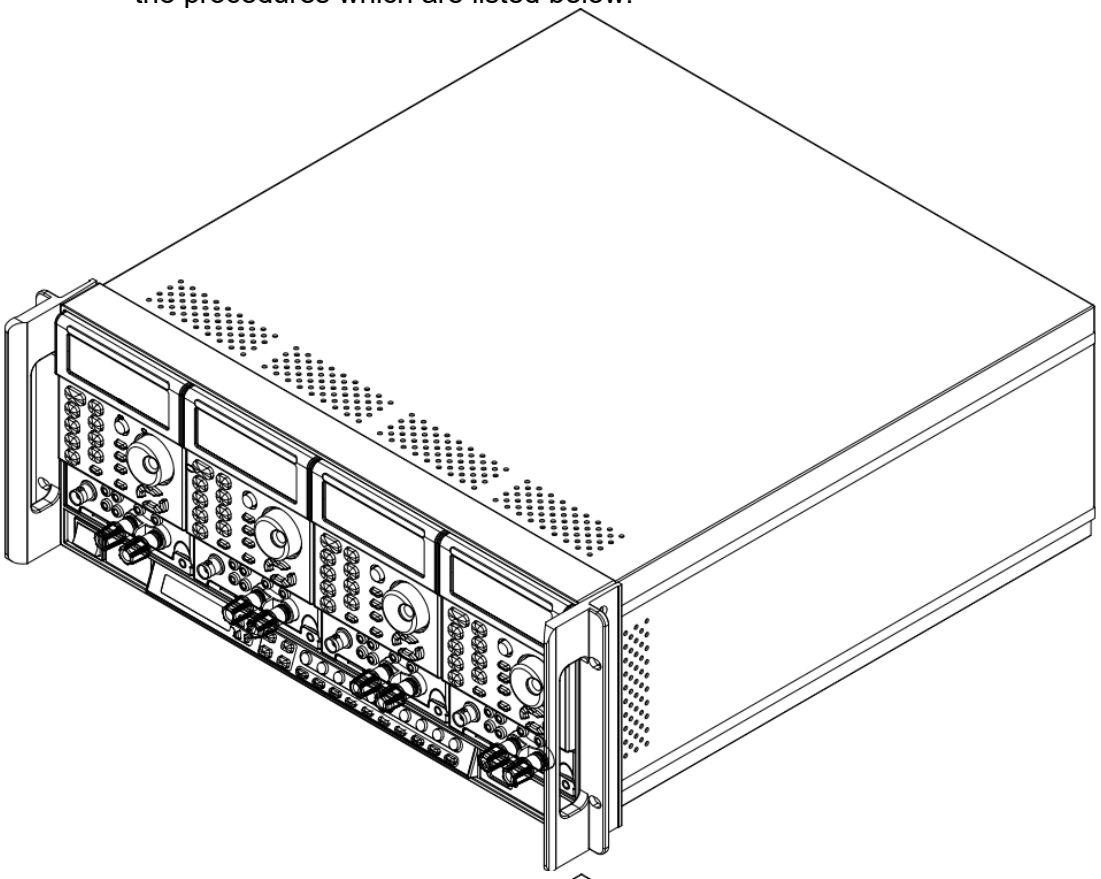


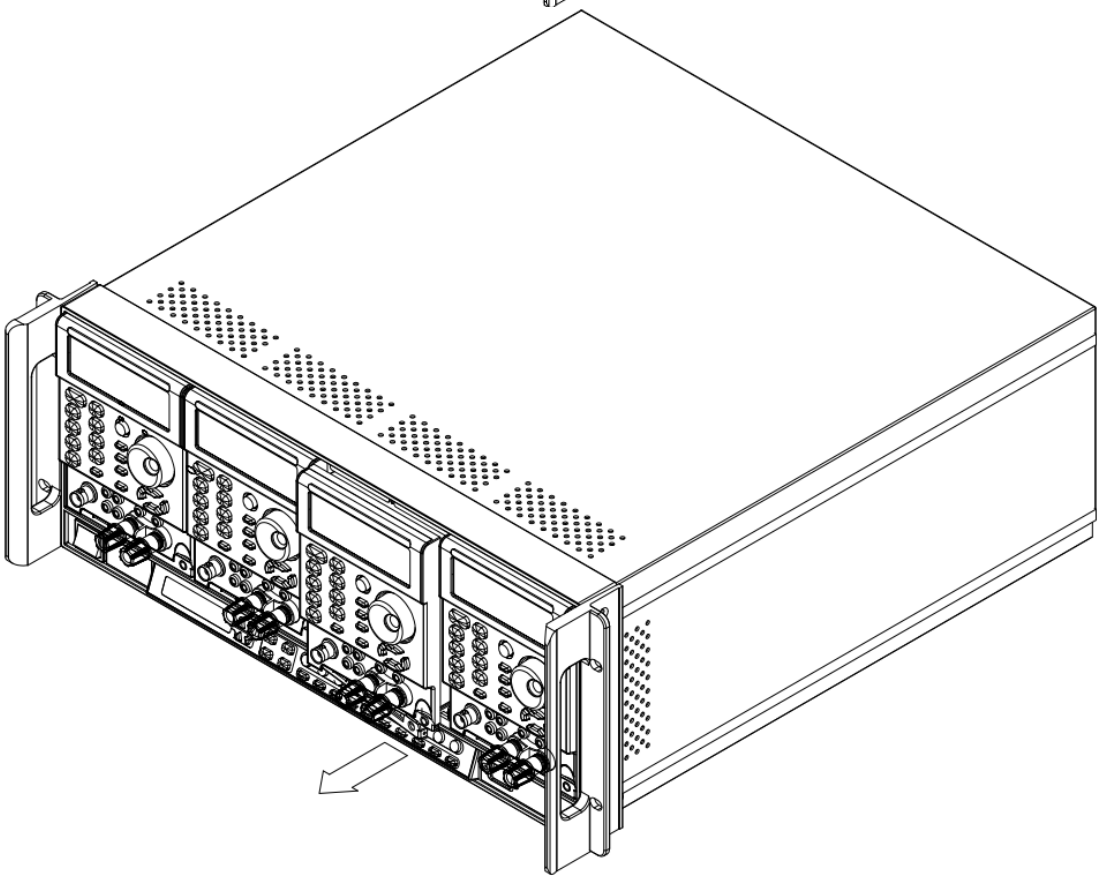
If you should connect in reverse connection as shown in Fig 3-6, large current would flow through the Probe and the internal of the oscilloscope causing a damage.

Fig 3-6 (Wrong) Connections to an oscilloscope

3.2.29. The withdraw handle

When you want to remove the 3341G series load module out from the 3300G/ 3302G/3305G mainframe for configuration reconfiguration purpose, please follow the procedures which are listed below.





3.2.30. Analog programming input

The Electronic Load has an analog programming input on the rear panel of 3300G mainframe labeled CH1, CH2, CH3, and CH4 respectively. The CC and CP modes can be programmed with a 0 to 10V analog signal (ac or ac + dc) connected to the analog programming input.

The 0 to 10V Analog signal can program the 0 to full scale input range in the CC mode, please setting range II (0 to 6A range when load current setting is less than 6A, or 0 to 24A range when load current setting is higher than 6A) . The analog programming signal can act alone or it can be summed with the programmed value via GPIB, RS-232, or the front panel. Fig 3-7 shows the analog programming signal (4 Vac, 500Hz) is summed with the 6A programmed setting in CC mode range II of 3341G, 300V/24A/300W Load module.

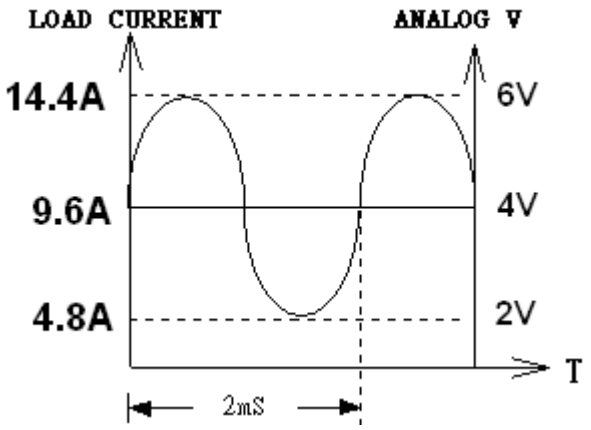


Fig 3-7 Analog programming load current in CC mode operation

3-3 Initial setting of 3341G series load module

Tables 3-1 to 3-3 were described 3341G series electronic load module's initialization parameters.

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	300.00 V
CC H+Preset		0.0000 A		V_Lo	0.000 V
CR H+Preset		3000Ω		I_Hi	24.000 A
CR L+Preset		3000Ω		I_Lo	0.000 A
CV H+Preset		300.00 V		W_Hi	300.00 W
CV L+Preset		300.00 V		W_Lo	0.00 W
CP L+Preset		0.00W	CONFIG	LD-ON	1.00 V
CP H+Preset		0.00W		LD-OFF	0.50V
DYN	T HI	0.050 mS		POLAR	+LOAD
	T L0	0.050 mS		AVG	1
	RISE	300.0mA/uS		Rd_Io	Io
	FALL	300.0mA/uS		LED NO.	ON
LED.No+Preset		1		CV_bW	Hi
LED+Preset Vo		3.50V		bW	15
LED+Preset Io		5.6000 A	LED+Preset Vd		2.800V
SHORT		Disable	SETTING (DIM)	LEVEL	6.000V
OPP		Disable		FREQ	100 Hz
OCP		Disable		DUTY	0.50

Table 3-1 3341G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	500.00 V
CC H+Preset		0.0000 A		V_Lo	0.00 V
CR H+Preset		3000 Ω		I_Hi	12.000 A
CR L+Preset		3000 Ω		I_Lo	0.0000 A
CV H+Preset		500.00 V		W_Hi	300.00 W
CV L+Preset		500.00 V		W_Lo	0.00 W
CP L+Preset		0.00W	CONFIG	LD-ON	5.00 V
CP H+Preset		0.00W		LD-OFF	2.50V
DYN	T HI	0.050 mS		POLAR	+LOAD
	T L0	0.050 mS		AVG	1
	RISE	150mA/us		Rd_Io	Io
	FALL	150mA/us		LED NO.	ON
LED.No+Preset		1		CV_bW	Hi
LED+Preset Vo		3.500V		bW	15
LED+Preset Io		A	LED+Preset Vd		2.80 V
SHORT		Disable	SETTING (DIM)	LEVEL	6.000 V
OPP		Disable		FREQ	100 Hz
OCP		Disable		DUTY	0.50

Table 3-2 3342G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	500.00 V
CC H+Preset		0.0000 A		V_Lo	0.00 V
CR H+Preset		6000 Ω		I_Hi	2.4000 A
CR L+Preset		6000 Ω		I_Lo	0.0000 A
CV H+Preset		500.00 V		W_Hi	300.00 W
CV L+Preset		500.00 V		W_Lo	0.00 W
CP L+Preset		0.00W	CONFIG	LD-ON	5.00 V
CP H+Preset		0.00W		LD-OFF	2.50V
DYN	T HI	0.050 mS		POLAR	+LOAD
	T L0	0.050 mS		AVG	1
	RISE	300mA/us		Rd_Io	Io
	FALL	300mA/us		LED NO.	ON
LED.No+Preset		1		CV_bW	Hi
LED+Preset Vo		3.500V		bW	15
LED+Preset Io		A	LED+Preset Vd		2.80 V
SHORT		Disable	SETTING (DIM)	LEVEL	6.000 V
OPP		Disable		FREQ	100 Hz
OCP		Disable		DUTY	0.50

Table 3-3 3343G initialize

3-4 Input terminal and wire consideration

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

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

3.4.2 Spade terminals: The spade terminal provides a good contact to the binding post, It is recommended to use anytime. The maximum wire gage 10 can be used in this Application as show Fig 3-8 and Table 3-5.

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

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

3.4.5 Both plug connectors and Insert the wire into the input terminal.
It is recommended to use when input current is greater than 20A or long lead wires. A major consideration in making input connection is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires should be large enough to limit the voltage drop to less than 0.5V per lead.

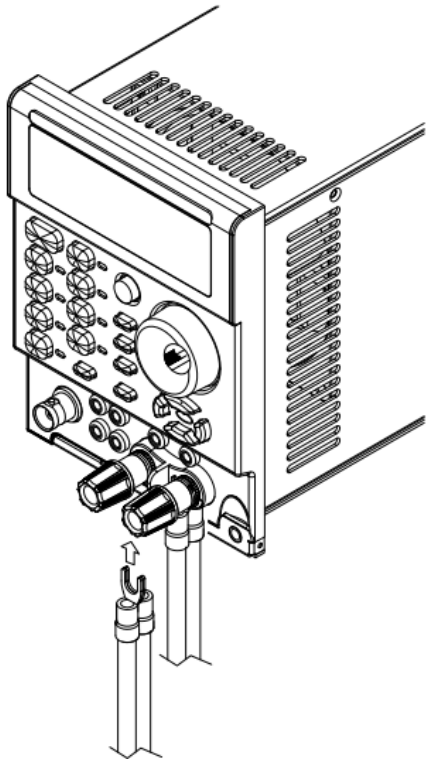


Fig 3-8 Hook Terminal Y type large size terminal connections

Wire Size AWG	Cross Section Area in mm^2	Ampacity	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 aluminum wire is approximately 84% of that
20		8.33	listed for copper wire.
	0.75	10	
18		15.4	When two or more wires are bundled together, ampacity
	1	13.5	for each wire must be reduced to the following
16			percentages:
	1.5	16	
14		31.2	2 conductors 94%
	2.5	25	3 conductors 89%
12		40	4 conductors 83%
	4	32	5 conductors 76%
10		55	
	6	40	
8		75	4. Maximum temperatures:
	10	63	Ambient = 50° C
6		100	Conductor = 105° C
4		135	

Table 3-4 Stranded Copper Wire Ampere Capacity

3-5 . Protection features

The 3341G series Electronic load modules include the following protection features:

3.5.1. Voltage
3.5.2. Over current
3.5.3. Over power
3.5.4. Over temperature
3.5.5. Reverse Polarity

The Over voltage protection circuit is set at a predetermined voltage (315V for 3341G, , 525V for 3342G and 3343G) which cannot be changed. If the Over voltage circuit has tripped, it Electronic load input turns OFF immediately to protect the abnormal condition.

When the Over voltage condition is occurred, the Digital Current Meter's seven segment LED display will indicate " oVP ".

CAUTION: Please do not add on AC line voltage or DC input load exceeds the input voltage specifications of any voltage added to 3341G Series DC Electronic Load input load, otherwise it will cause damage to 3341G series electronic load.

The 3341G series Electronic load can monitor the power dissipation of the load module, when the power dissipation is greater than 105% of rate power input, the load module will turn load to OFF state internally.

When the Over power condition is occurred, the Digital Current Meter's seven segment LED display will indicate " oPP ".

As soon as the temperature of 3341G series module's heat sink greater than 90 degree, the Over temperature protection is occurred, the Digital Current Meter's seven segment LED display will indicate " otP " at same time, the 3341G series Electronic Load will turn load to OFF state internally.

Please check the environment condition such as the ambient temperature and distance between the rear panel of Electronic load mainframe and wall is greater than 15cm.

The 3341G series Electronic load can reset the Over voltage, Over correct, Overpower and over temperature protection if the protection condition is removed and press the " LOAD " key to " ON " state.

The 3341G series electronic load conducts reverse current when the polarity of the DC source connection is incorrect. The maximum reverse current is 12A for 3342G, 24A for 3341G and 3343G. If the reverse current excess the maximum reverse current, it may cause damage of the 3341G series Electronic Load.

When the reverse condition ，the reverse current is displayed on the 5 digit Current Meter on the front panel, and the 5 digit DCM indicates negative current reading, whenever the reverse current is displayed on the current meter, turn OFF power to the DC source and make the correct connections.

Chapter 4 Applications

This chapter describes the application information of 3341G series Electronic Load module.

4-1 .Local sense connections

Fig 4-1 illustrates a typical set up with the electronic load connected to the DC power supply. Local sensing is used in application where lead lengths are relatively short, or where load regulation is not critical.

The 5 digit voltage Meter of 3341G series Electronic load measures the voltage of DC INPUT Terminal automatically; load leads should be bundled or tie-wrapped together to minimize inductance.

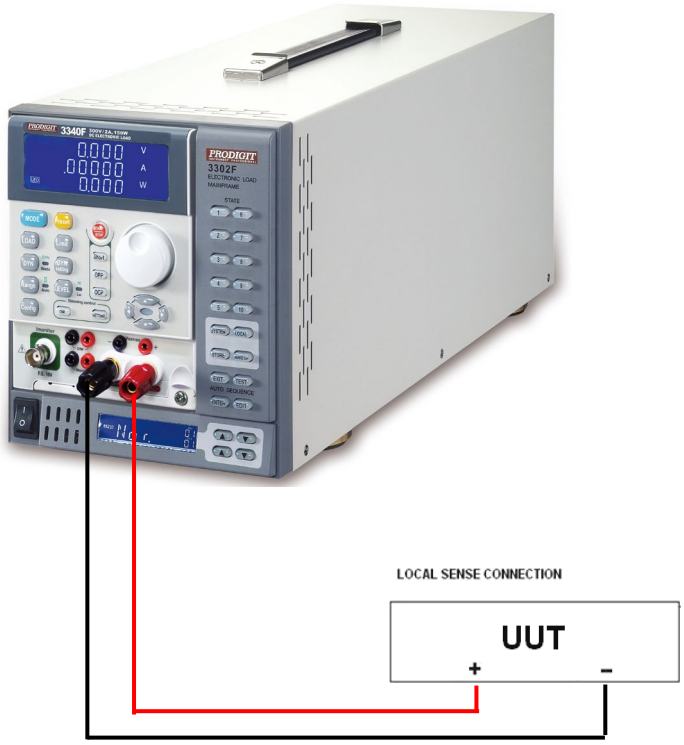


Fig 4-1 Local voltage sense connections

4-2 Remote sense connections

Fig 4-2 illustrates a typical set up with the electronic load connected for remote sense Operation. (Vsense should be set to ON)

The remote V-sense cables of the electronic load are connected to the output of the power supply. Remote sensing compensates for the voltage drop in applications that require long lead lengths.

The 5 digit voltage Meter of 3341G series Electronic load measures the voltage of V-sense input Terminal, so the high accuracy 5 digit voltage Meter can measure the specific points voltage of the power supply's output voltage.
Load leads should be bundled or tie wrapped together to minimize inductance.

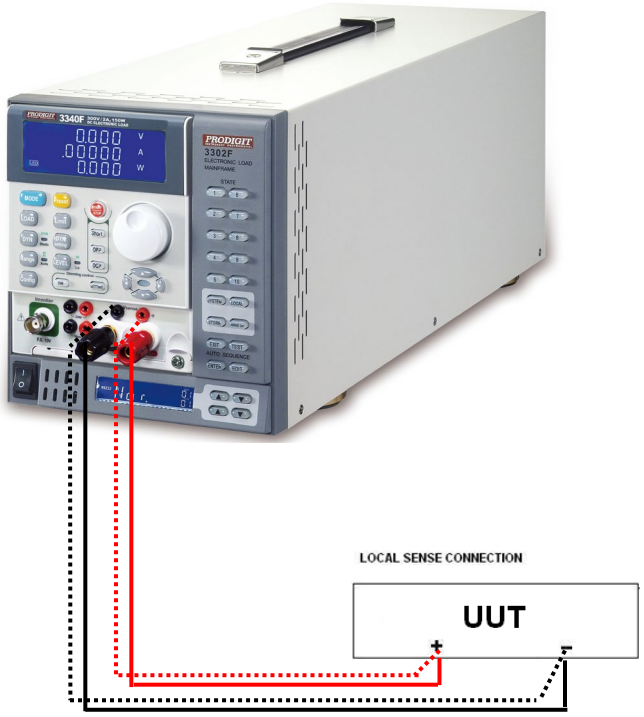
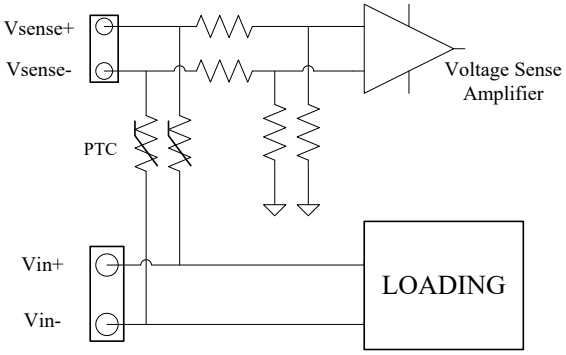


Fig 4-2 Remote voltage sense connections

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



4-3 Constant Current mode application

The Constant Current mode is very suitable to test the Load Regulation, Cross Regulation, Output Voltage and Dynamic Regulation of the power supply testing, and test the Discharge Characteristic and Life cycle of the Battery testing.

4.3.1 Static mode: (Fig 4-3)
Major application:
4.3.1.1 Source testing
4.3.1.2 Power supply load regulation testing
4.3.1.3 Battery discharge testing

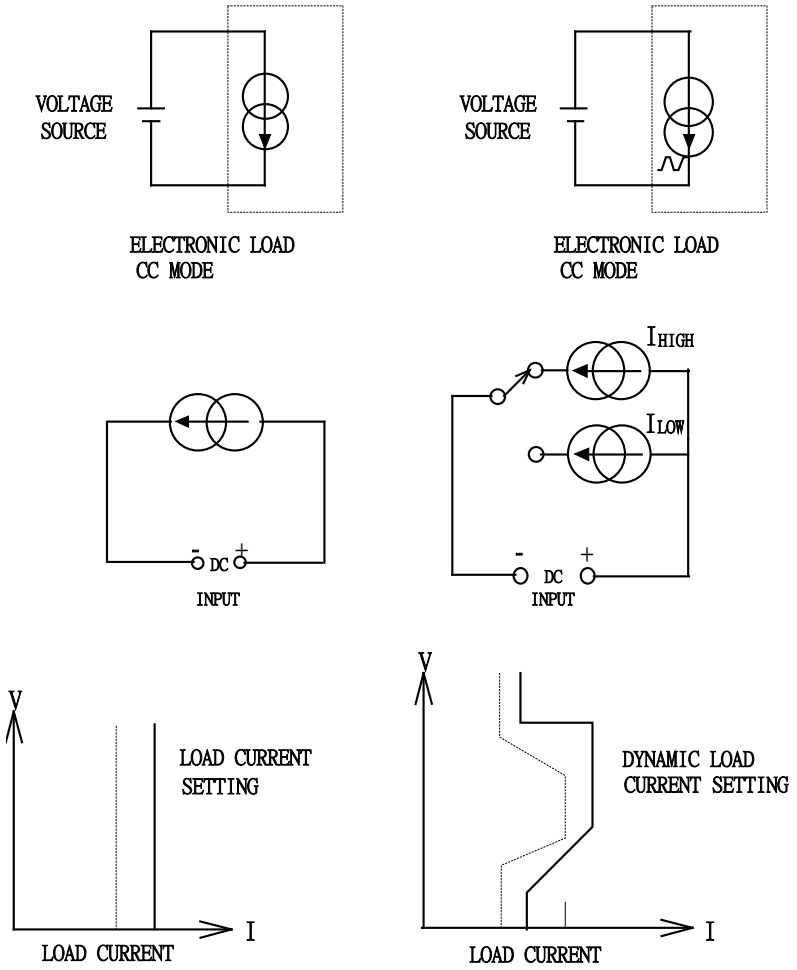


Fig 4-3 constant CURRENT mode application

4.3.2 Dynamic mode:

4.3.2.1 Built-in Pulse generator: (Fig 4-4)

Major application:

4.3.2.1.1 Power supply load transient response testing
4.3.2.1.2 Power recovery time testing
4.3.2.1.3 Pulse load simulation
4.3.2.1.4 Power component testing

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

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

4.3.2.2 Analog programming input: (Fig 4-4) (Please use the CC Mode Range II)

Major application:

4.3.2.2.1 Simulate real load condition
4.3.2.2.2 Battery discharge testing

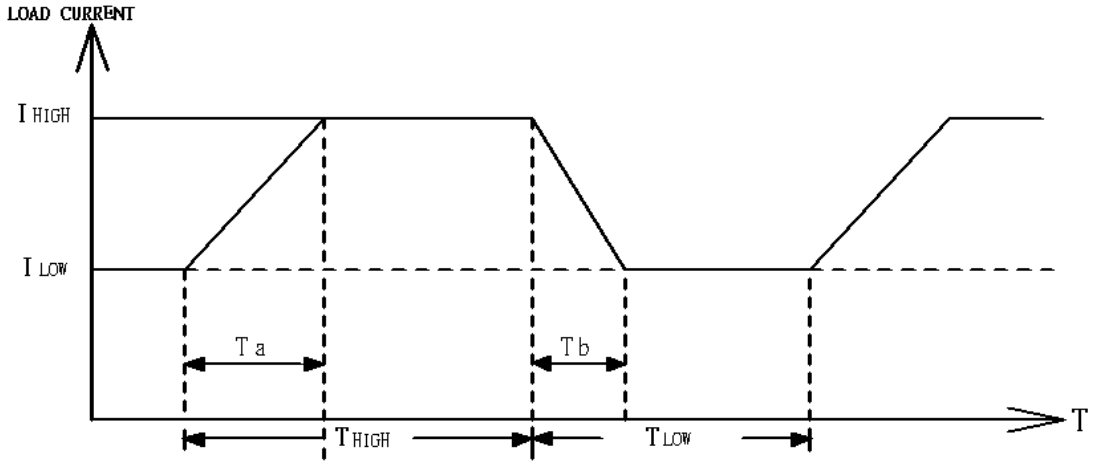


Fig 4-4 Dynamic load current with independent programmed Rise/Fall slew rate

4-4 Constant Voltage mode application

Major application:

4.4.1 Current source testing

The battery charger is a current source to charge current into a re-chargeable battery, the CV mode of electronic load can be used to simulate the terminal voltage of re-chargeable battery, it is designed to test the charge current from battery charger.

The Battery charger of notebook PC and Mobile phone is the most popular products for the current source in the real world, user can use CV mode to set voltage say 6.0V (example), then read charge current from the current meter on the load, next then set CV voltage to 5V (example), then read the charge current again, this method is used to test the load regulation of a current source.

4.4.2 Power supply current limit characteristic testing

The current limit is a necessary function for a power supply; the Fold-back current limit curve is very common for a switching power supply, where the constant current limit curve is very popular for a lab power supply.

It is very difficult or impossible to find out the above current limit curve by CC or CR mode, however, it becomes easy by using CV mode. User can set CV voltage, record the output current, then makes a series voltage and current to result a output current limit curve (Figure 4-5) of a power supply.

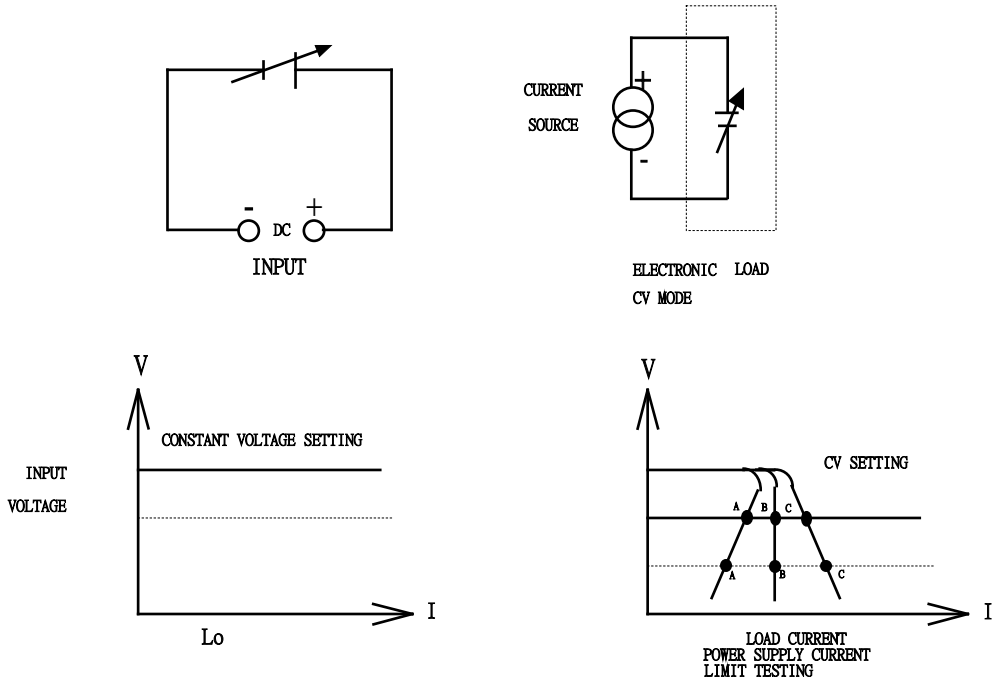


Fig 4-5 Constant Voltage mode application

4-5 Constant Resistance mode application

Major application:

4.5.1 Voltage source or Current source testing

4.5.2 Power supply power-up sequence

The constant current and constant resistance modes are used in conjunction for testing switching power supplies.

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

As a result, when testing a power supply, the CR mode should be used to allow the power supply voltage and current to ramp up together. After this has occurred the CC mode should be used to complete testing.

It has eliminated the need for manually switching from the CR to the CC mode with 3341G series Electronic Loads. They can be programmed with proper current and slew rate in the CC mode which allows a power supply to reach its specified output condition in the CC load mode.

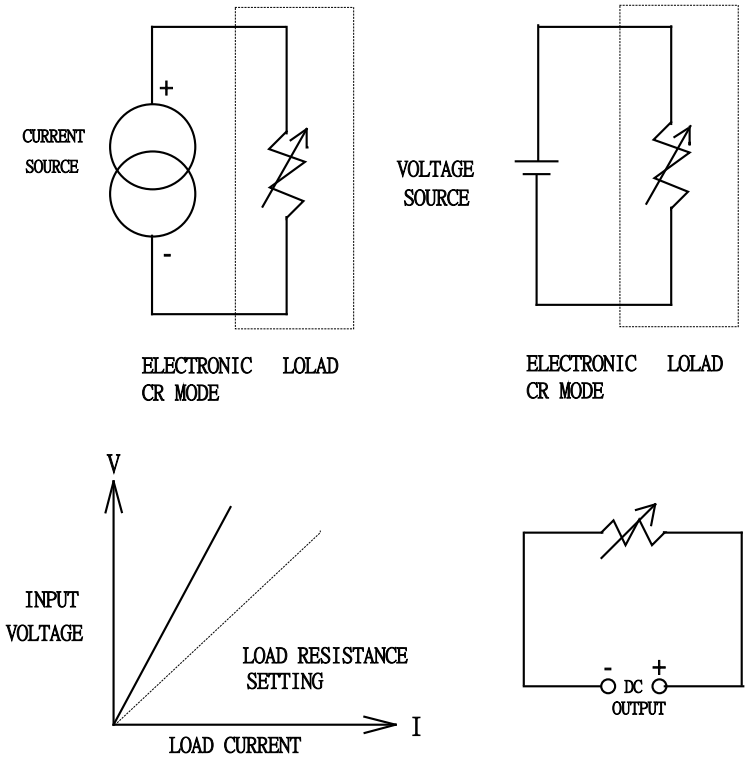


Fig 4-6 Constant Resistance mode Application

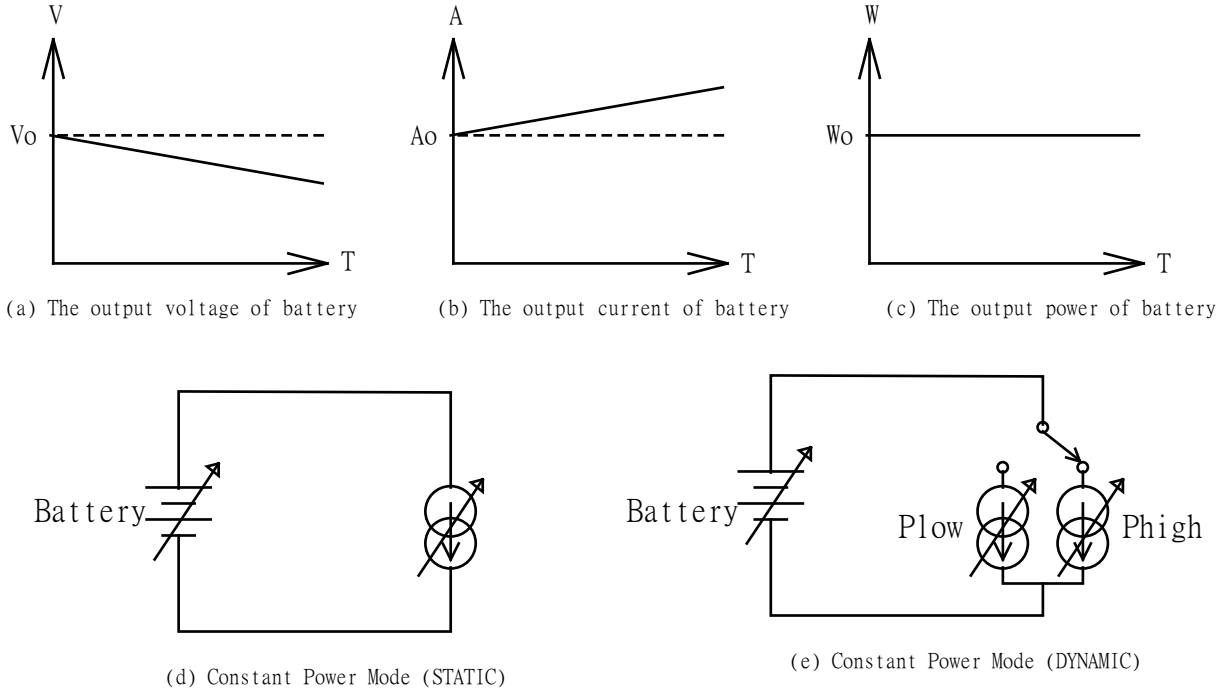
4-6 Constant Power mode application

The Constant Power mode is designed for Battery's energy capacity evaluation and testing.

Primary or secondary battery is the power source for every portable electronics products, such as notebook computer, video camera, etc. The output voltage of battery will start to drop (Fig 4-7a) according to the output current and usage duration time (Fig 4-7b), however, it should provide a stable power output regardless of output voltage (Fig 4-7c), therefore, the energy capacity (output power x time) is one of the most important factor to evaluate a battery.

The CP mode of 3341G series electronic load is designed to test the above characteristics of a battery, it can sink constant power load for a battery, the load current will increase automatically in accordance to the output voltage drop of battery, the load power will be the same to the load power setting of CP mode (Fig 4-7d), the 3341G series CP mode electronic load with time record can be used to evaluate the energy capacity or discharge life time of a battery.

Moreover, the real power could be a dynamic loading condition, the 3341G series CP mode can be operated in Dynamic power load as well, setting the STA/DYN to DYN on the front panel or remote programming, 3341G series can sink dynamic power waveform to test the dynamic characteristics of battery (Fig 4-7e).



(a) The output voltage of battery (b) The output current of battery (c) The output power of battery

(d) Constant Power Mode (STATIC)

(e) Constant Power Mode (DYNAMIC)

Fig 4-7 CONSTANT POWER MODE APPLICATION

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

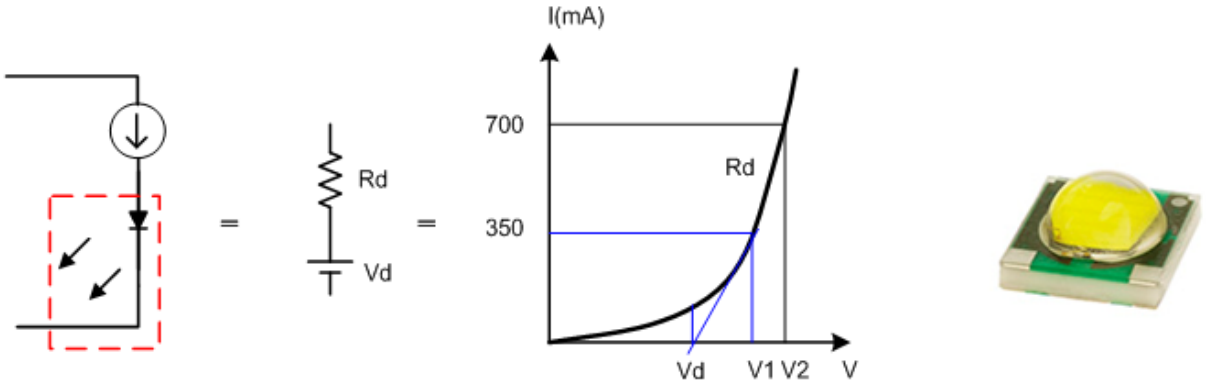


Fig 4-8 LED's equivalent circuit and characteristic curve

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).

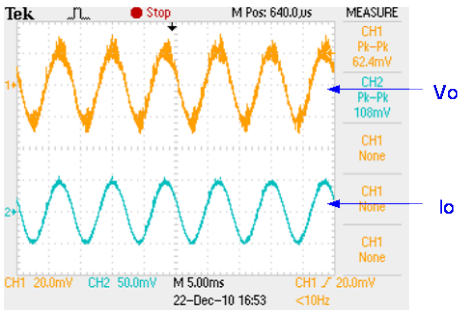


Fig 4-9 LED Driver ripple

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 cascading connection equivalent circuit And characteristic curve

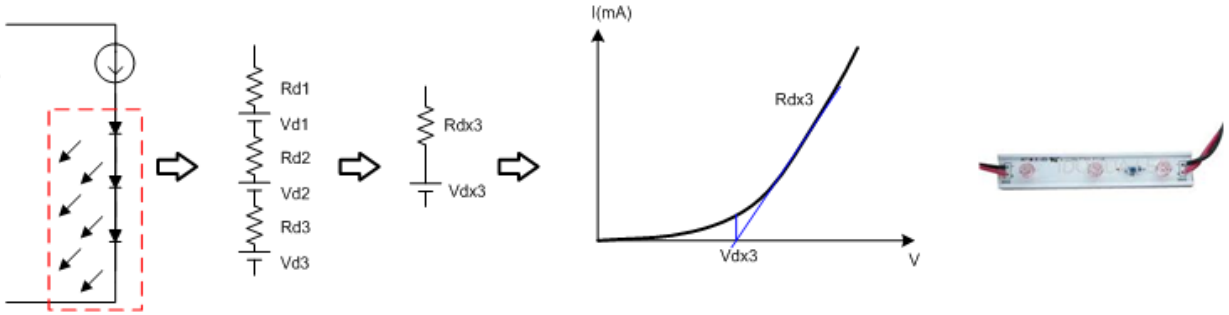


Fig 4-10 3 LED cascading connection equivalent circuit and characteristic curve

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 4-11 is 2 stacks LED to parallel, are the LED's equivalent Circuit and exponential V-I characteristic curve.

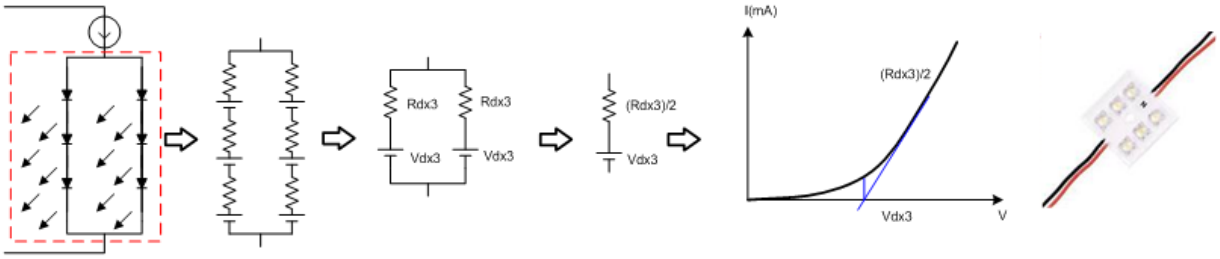


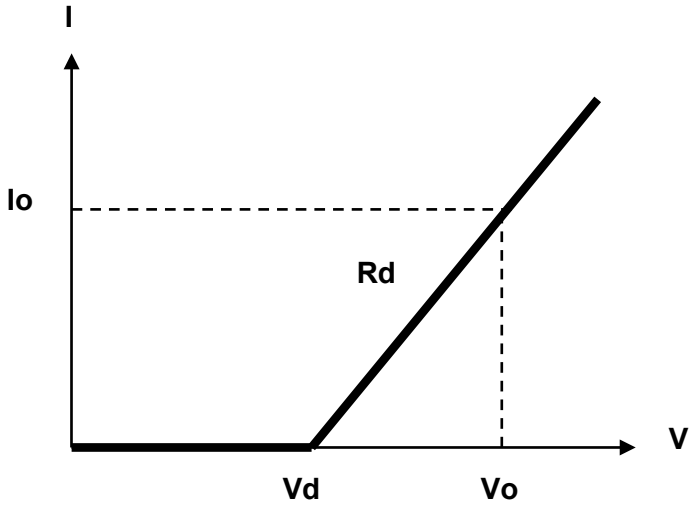
Fig 4-11 Several LED cascading and parallel connection and characteristic curve

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

3341G Series 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



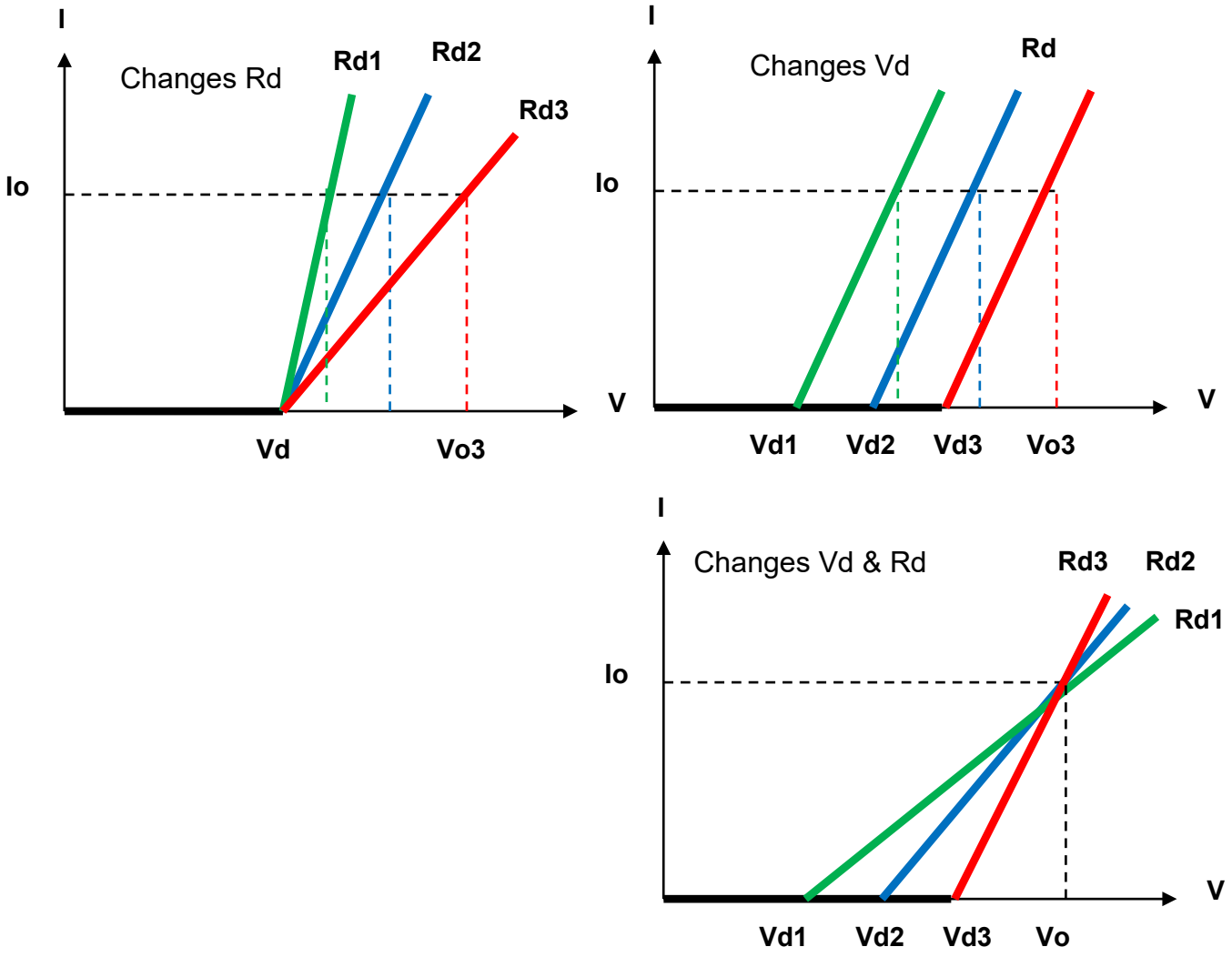


Fig 4-12 LED MODE operation mode of the application

4-8 The connection of a multiple output power supply

The following is a rule for a multiple output power supply connects to the 3341G series Electronic Loads.

Rule: The potential of positive input (Red binding post) must be higher than the potential of negative input (Black binding post) of 3341G series Electronic load.

Here is an example of +5V, -5V, +12V and -12V four outputs power supply connected to a 3341G series electronic load

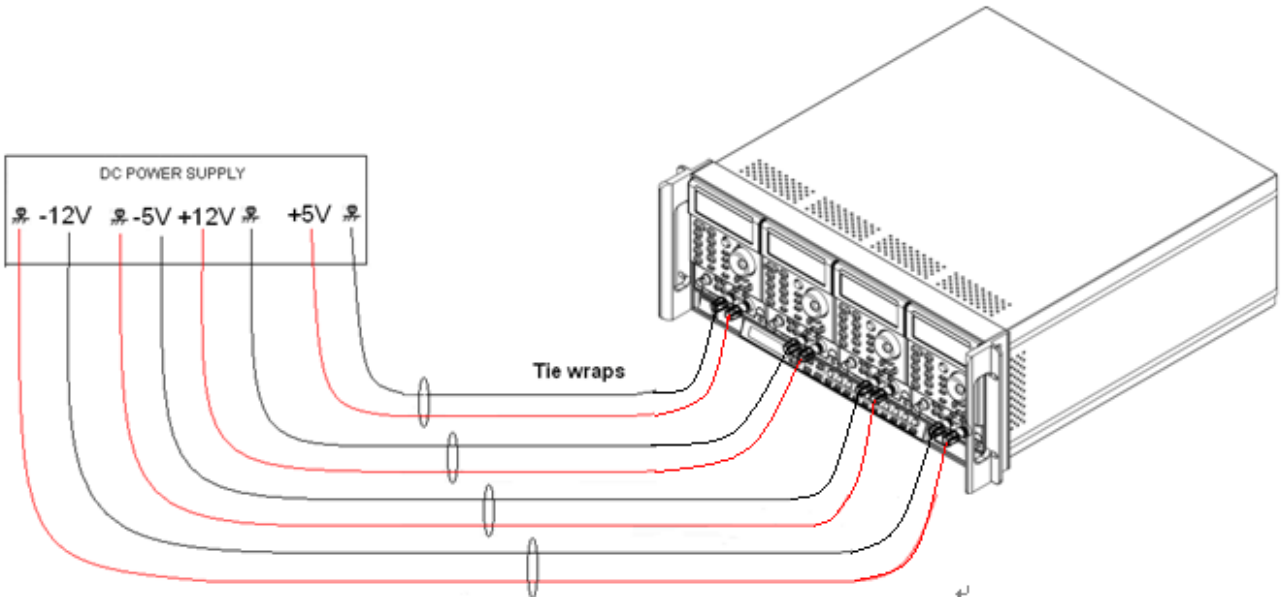
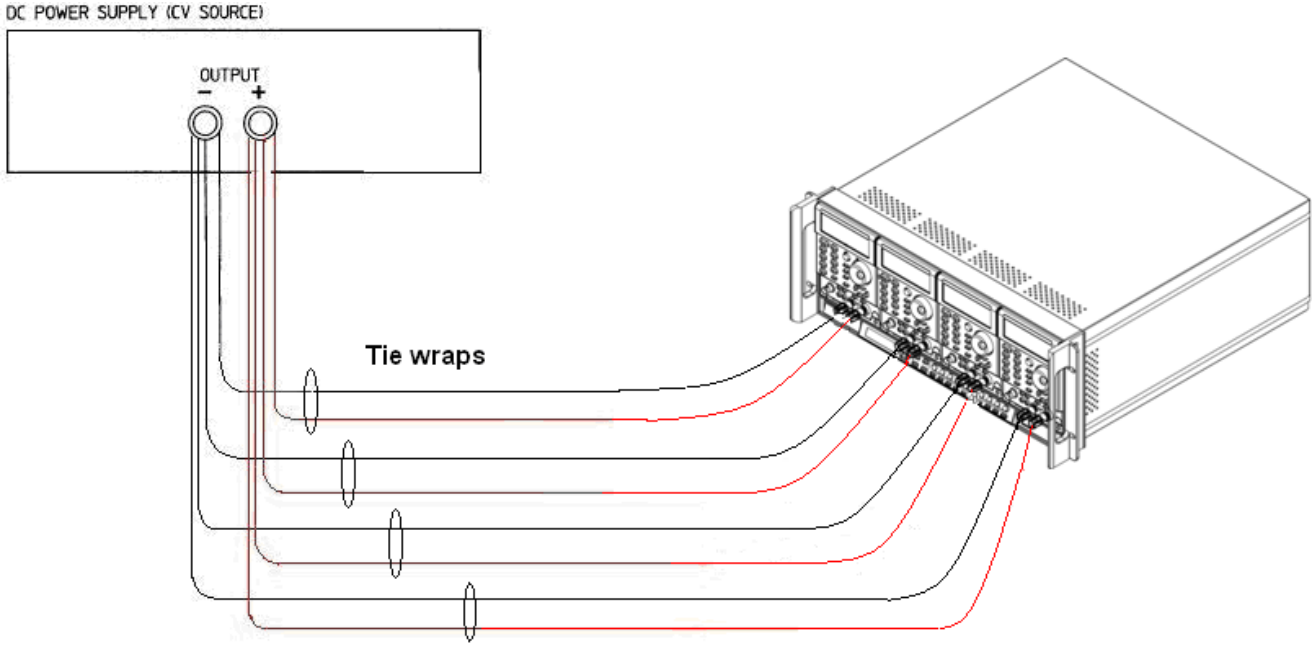


Fig 4-13 Connection between 3341G series plug-in load and multiple output power supply

4-9 Parallel operation

When the power or current rating is not enough on the electronic load module, up to eight modules in one mainframe can be directly paralleled in CC or in CR or in CP mode, modules cannot be paralleled in CV mode. At this time, the total load current and power is the sum of the two or more load modules also. This connection can extend the electronic load module to a higher power and current rating.

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.



$$I = I_1 + I_2 + I_3 + I_4$$

Fig 4-14 3341G series plug-in module parallel operation

4-10 Zero-Volt loading application

As shown in Fig 4-15, the Electronic load can be connected in series with a DC voltage source which output voltage greater than 6V 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 operating voltage required by the Electronic load. This application is suitable for low voltage Battery cell with high discharge current testing.

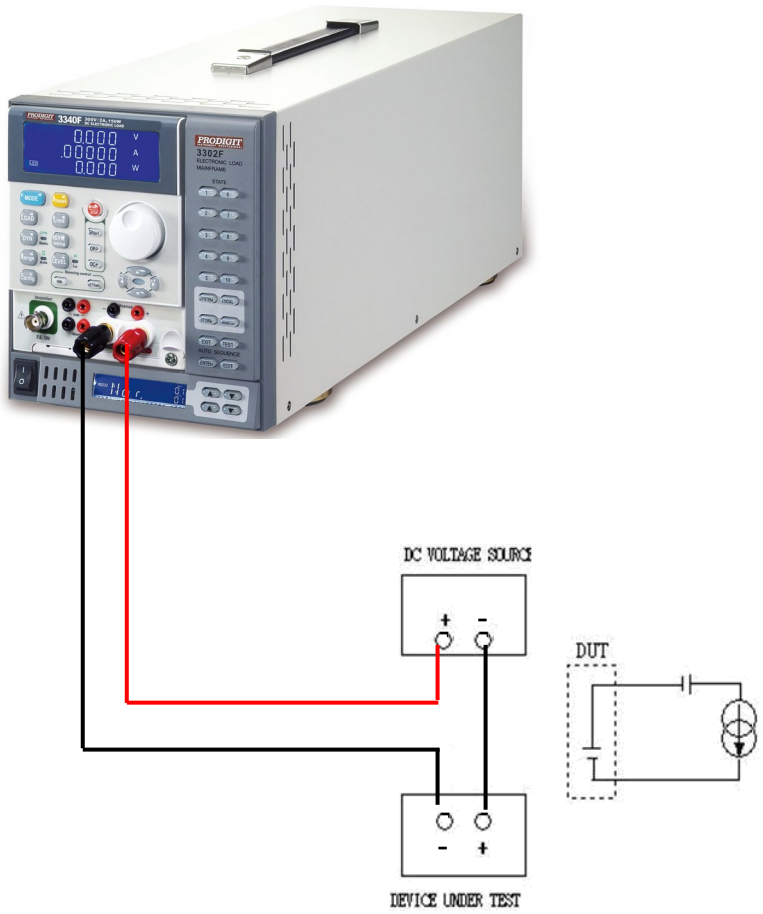


Fig 4-15 Zero-Volt loading connection

4-11 3341G series electronic load OCP, OPP, SHORT operation flow Chart

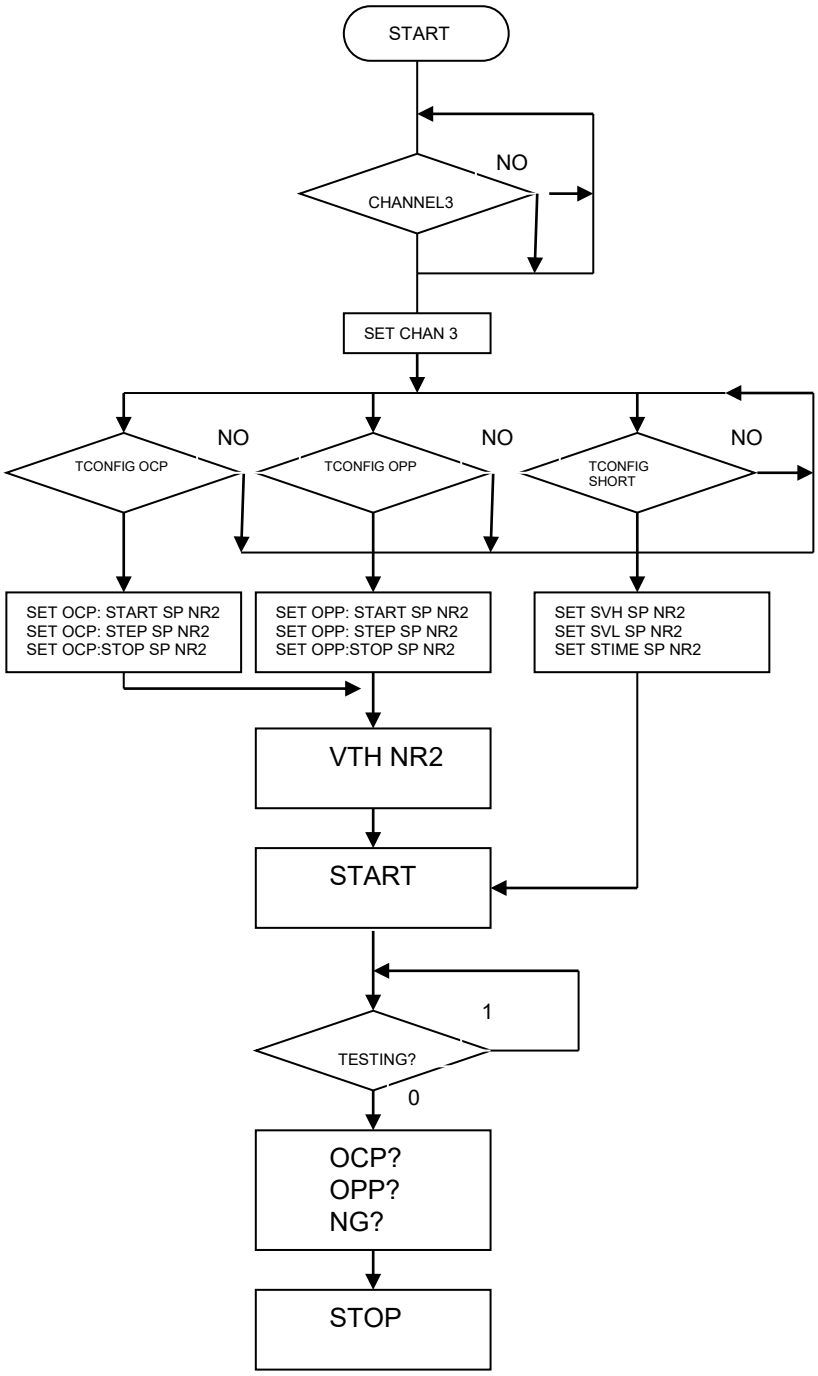


Fig 4-16 3341G series electronic load OCP, OPP, SHORT operation flow chart

4-12 Power Supply OCP testing

4.12.1 OCP Manual control

Example:

4.12.1.1. First, press Limit Key function to setting I_Hi and I_Lo.

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

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

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

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

4.12.1.6. Setting OCP VTH 3.00V, press OCP key to the next step.

4.12.1.7. Press START/STOP test key.

4.12.1.8. 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 "ERROR".

4.12.2 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 2.4A)
VTH 3.0	(Set OCP VTH 3.0V)
IL 0	(Set current low limit 0A)
IH 2	(Set current high limit 2.4A)
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)

4-13 Power Supply OPP testing

4.13.1 OPP Manual control

Example:

4.13.1.1. First, press Limit Key function to setting W_Hi and W_Lo.

4.13.1.2. Setting OPP test, press OPP key to the next step.

4.13.1.3. Setting start load watt 0W, press OPP key to the next step.

4.13.1.4. Press up key, set step load watt 0.02W, press OPP key to the next step.

4.13.1.5. Press up key, set stop load watt 3.25W, press OPP key to the next step.

4.13.1.6. Setting OPP VTH 3.00V，press OPP key to the next step.

4.13.1.7. Press START/STOP Test key.

4.13.1.8. the UUT's output voltage drop-out lower than the threshold voltage (V-th setting), and the OPP trip point is between W_Hi and W_Lo limitation, then lower 5 digits LCD display will shows "PASS", otherwise shows "FAIL".

4.13.2 Remote control OPP

EX：

REMOTE	（Set Remote）
TCONFIG OPP	（Set OCP test）
OPP:START 3	（Set start load watt 3W）
OPP:STEP 1	（Set step load watt 1W）
OPP:STOP 5	（Set stop load watt 5W）
VTH 3.0	（Set OPP VTH 3.0V）
WL 0	（Set watt low limit 0W）
WH 5	（Set watt high limit 5W）
NGENABLE ON	（Set NG Enable ON）
START	（Start OPP testing）
TESTING?	（Ask Testing? 1：Testing，0：Testing End）
NG?	（Ask PASS/FAIL?，0：PASS，1：FAIL）
OPP?	（Ask OPP watt value）
STOP	（Stop OPP testing）

4-14 LED Driver SHORT testing

4.14.1 Set output current LED DRIVER General Electronic LOAD cannot be short circuit Test.

4.14.2 3341G Series LED mode Load provides +12 V power supply and Short Relay output interface to control external +12 V RELAY to short-circuit test.

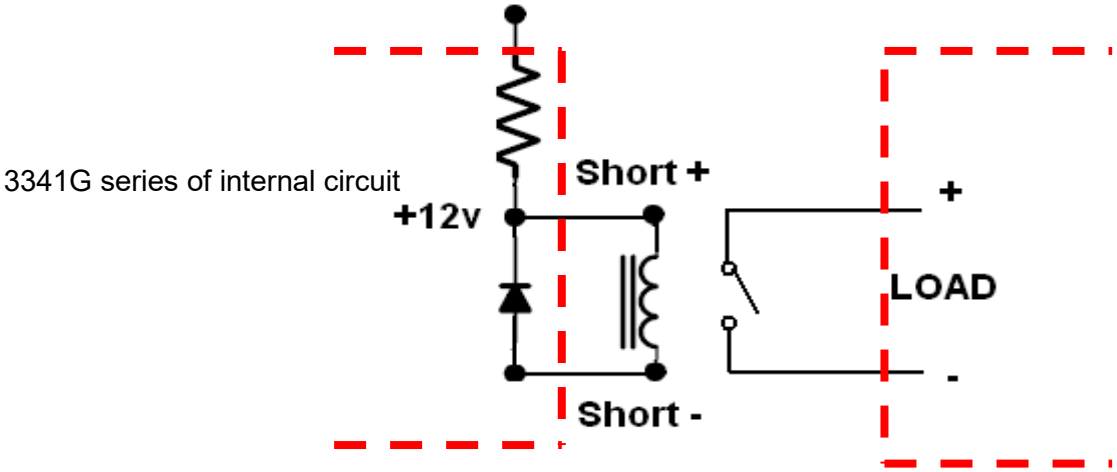


Fig 4-17 short test connection

4.14.3 Short-circuit impedance test method:

3341G maximum short circuit current models for the maximum current value.

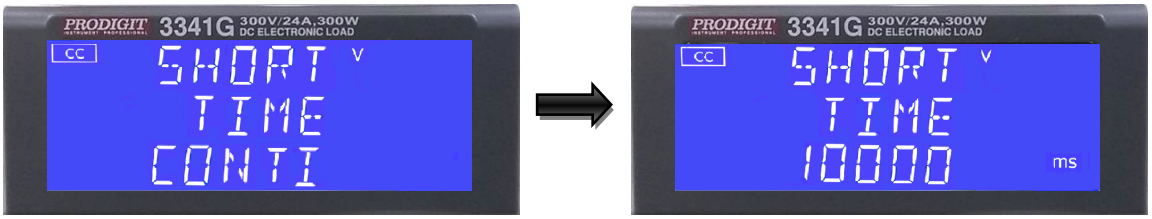
Example: 3341G maximum short circuit current is 20A

4.14.4 SHORT Manual control

Example:

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

4.14.4.2. Press UP key, setting Short time to 10000ms, press Short key to the next Step.



4.14.4.3. Press down key, setting V-Hi voltage to 1V, press Short key to the next Step.

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

4.14.4.5. Press START/STOP test key.

4.14.4.6. 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"

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

4.14.5 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）