3310G Series
Plug-In Electronic
Load module
Operation manual

S/N:9003310G02 REV:K

PRODIGIT
INSTRUMENT PROFESSIONAL

Material Contents Declaration

(材料含量宣称)

(Part Name) 零件名称	Hazardous Substance (有毒有害物质或元素)					
	铅(Pb)	汞(Hg)	镉(Cd)	六价铬 (Cr6+)	多溴联苯(PBB)	多溴二苯醚 (PBDE)
PCBA (印刷电路装配件)	X	○	X	○	○	○
Electrical part not on PCBA's 未在PCBA上的电子零件	X	○	X	○	○	○
Metal parts **金属零件**	○	○	○	X	○	○
Plastic parts 塑料零件	○	○	○	○	X	X
Wiring 电线	X	○	○	○	○	○
Package **封装**	X	○	○	○	○	○

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

Note(注释):

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

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

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

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

SAFETY 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.:

3310G, 3311G, 3312G, 3314G, 3315G, 3316G, 3317G, 3317G-M, 3318G, 3319G, 3319G-M, 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:

PRODIGIT INSTRUMENT PROFESSIONAL

Manufacturer/Importer
Signature:

Dean Wang

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

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.:

3310G, 3311G, 3312G, 3314G, 3315G, 3316G, 3317G, 3317G-M, 3318G, 3319G, 3319G-M, 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

SAFETYSYMOLS

 **Direct current (DC)**

 **Alternating current (AC)**

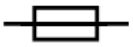
 **Both direct and alternating**

 **Three-phase alternating current**

 **Protective earth (ground)**

 On (Supply)

 **Off (Supply)**

 **Fuse**

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

 **Caution, risk of electric shock**

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

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

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

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

3310G series module load operation manual

Table of Contents

Figures

Tables

Chapter 1 Introduction

1-1. General description

The 3310G 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.

Model		3310G	3311G	3312G	3314G	3315G
Power	Turbo OFF	150W	300W	300W	300W	75W
	Turbo ON	300W	600W	600W	600W	150W
Current	Turbo OFF	30A	60A	12A	12A	15A
	Turbo ON	60A	120A	24A	24A	30A
Voltage		60V	60V	250V	500V	60V

Model		3316G	3317G	3318G	3319G
Power	Turbo OFF	400W	800W	400W	800W
	Turbo ON	800W	1600W	800W	1600W
Current	Turbo OFF	80A	160A	20A	40A
	Turbo ON	160A	320A	40A	80A
Voltage		80V	80V	500V	500V

* Turbo ON Power & Current Bootst up 2 times

The 3310G 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 3310G can sink up to 30A and 60Vdc at a maximum of 150W. So if the maximum voltage of 60Vdc is present at the load's input terminals a maximum load current of 2.5A is possible. Conversely if the 3310G is required to sink 30A the voltage must be limited to 5V.

The power contour of each load module in the 3310G series is shown in Fig 1-1, to 1-9.

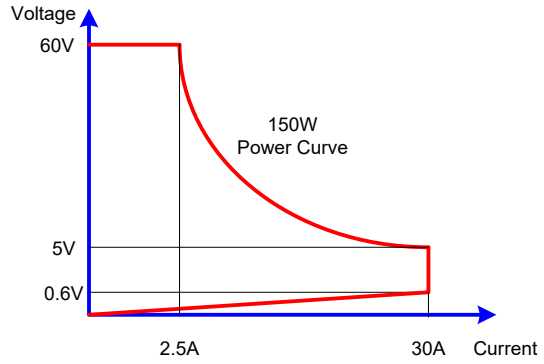


Fig 1-1 3310G 60V/30A/150W power contour

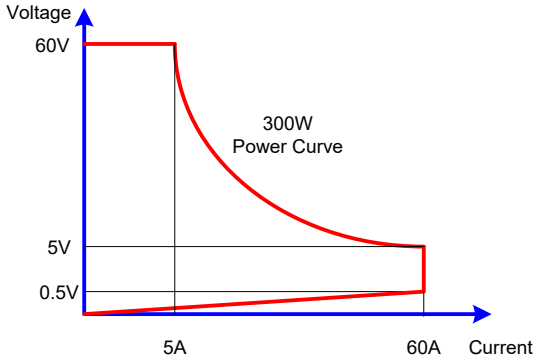


Fig 1-2 3311G 60V/60A/300W power contour

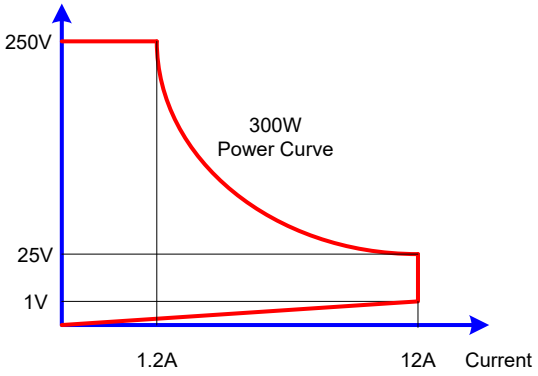


Fig 1-3 3312G 250V/12A/300W power contour

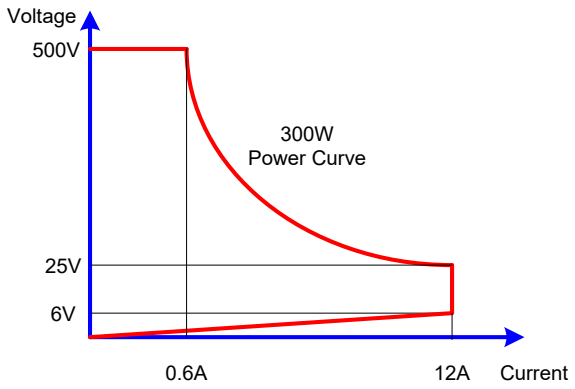


Fig 1-4 3314G 500V/12A/300W power contour

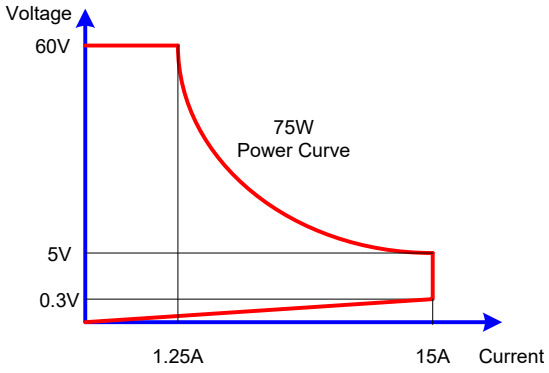


Fig 1-5 3315G 60V/15A/75W power contour

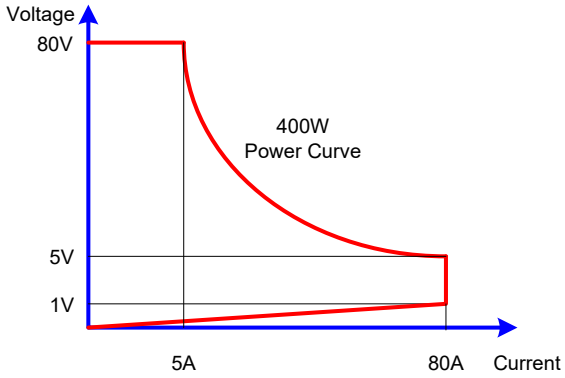


Fig 1-6 3316G 80V/80A/400W power contour

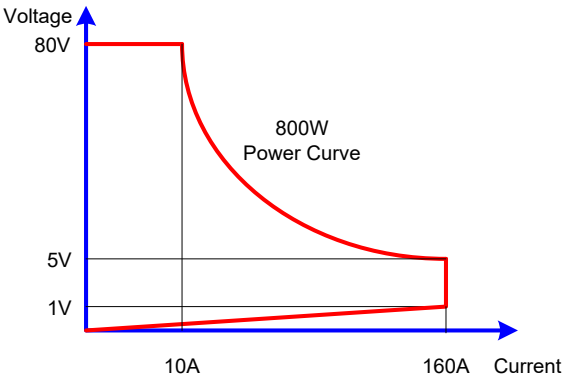


Fig 1-7 3317G 80V/160A/800W power contour

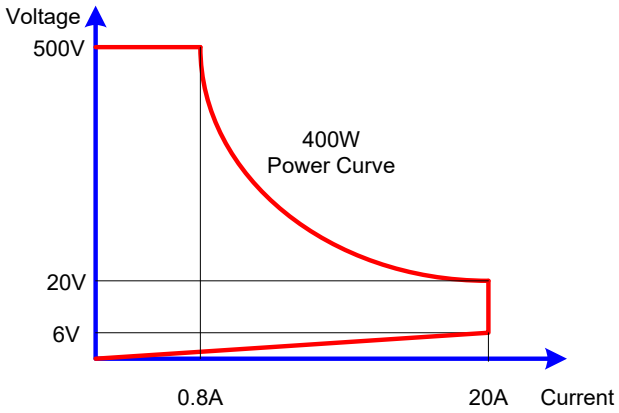


Fig 1-8 3318G 500V/20A/400W power contour

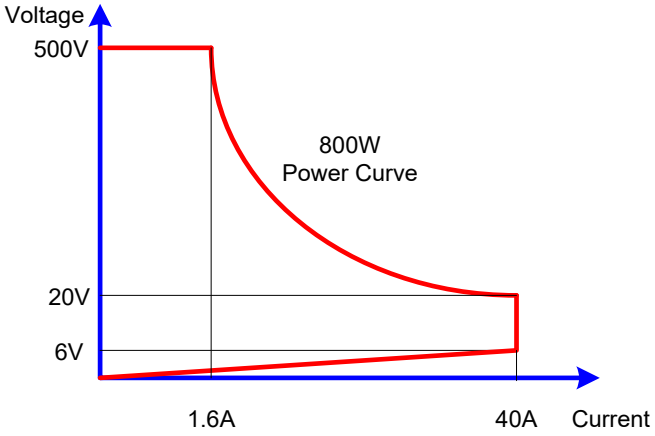


Fig 1-9 3319G 500V/40A/800W power contour

The 3310G series of electronic load modules feature 4 operating modes. These are Constant Current (CC) mode, Constant Resistance (CR) mode, Constant Voltage (CV) mode, and Constant Power (CP) mode.

Along with static operation the loads can also be programmed to operate dynamically in CC, CR or CP modes. An analogue programming input on the mainframe allows the 3310G series load module to track an external signal. For example a dynamic waveform can be set up on an external generator. The load will follow this signal assuming it is within it's range of dynamic response.

1.1.1. CC Mode

With the operating mode of Constant Current, the 3310G series electronic load will sink a current in accordance with the programmed value regardless of the input voltage (see Fig.1-10).

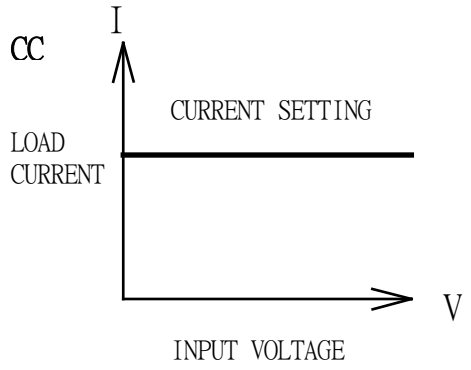


Fig 1-10 Constant Current mode

1.1.2. CR Mode:

At Constant Resistance mode, the 3310G series Electronic Load will sink a current linearly proportional to the load input voltage in accordance with the programmed resistance setting (see Fig 1-11).

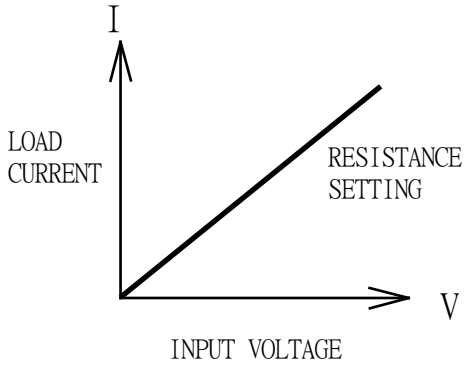


Fig 1-11 Constant Resistance mode

1.1.3. CV Mode:

At Constant Voltage mode, the 3310G series Electronic Load will attempt to sink enough current until the load input voltage reaches the programmed value (see Fig 1-12).

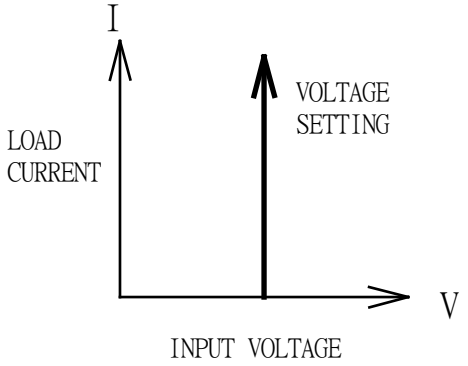


Fig 1-12 Constant Voltage mode

1.1.4. CP Mode:

At Constant Power mode, the 3310G series Electronic Load will attempt to sink load power (load voltage * load current) in accordance with the programmed power. (See Fig 1-13).

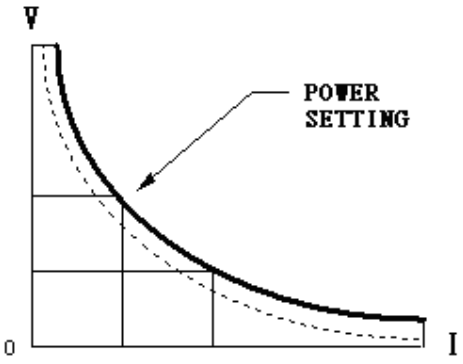


Fig 1-13 Constant Power mode

1.1.5. Dynamic Waveform Definition

Along with static operation the 3310G 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 3310G 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 1-14.

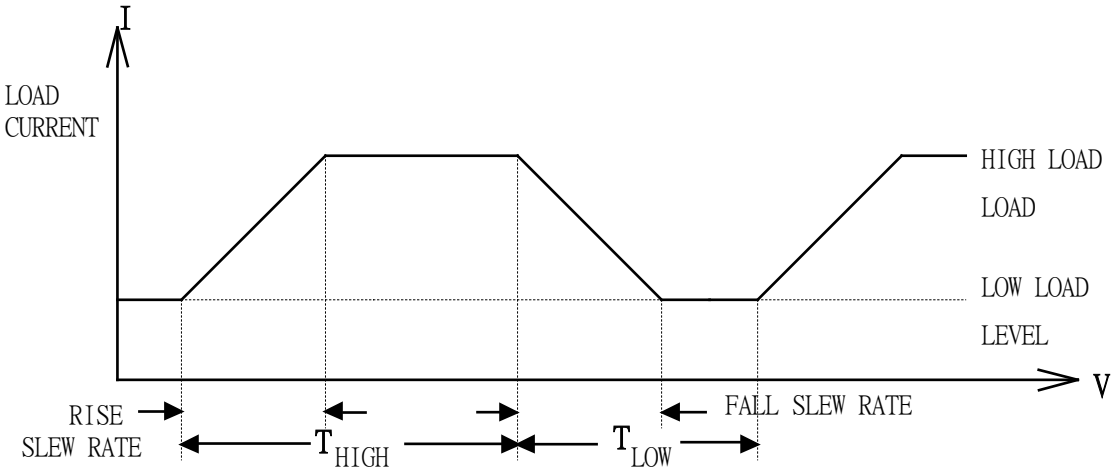


Fig 1-14 Dynamic Wave form

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 3.1.26 titled ‘Analog Programming Input’ for further information.

1.1.6. 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 1-15

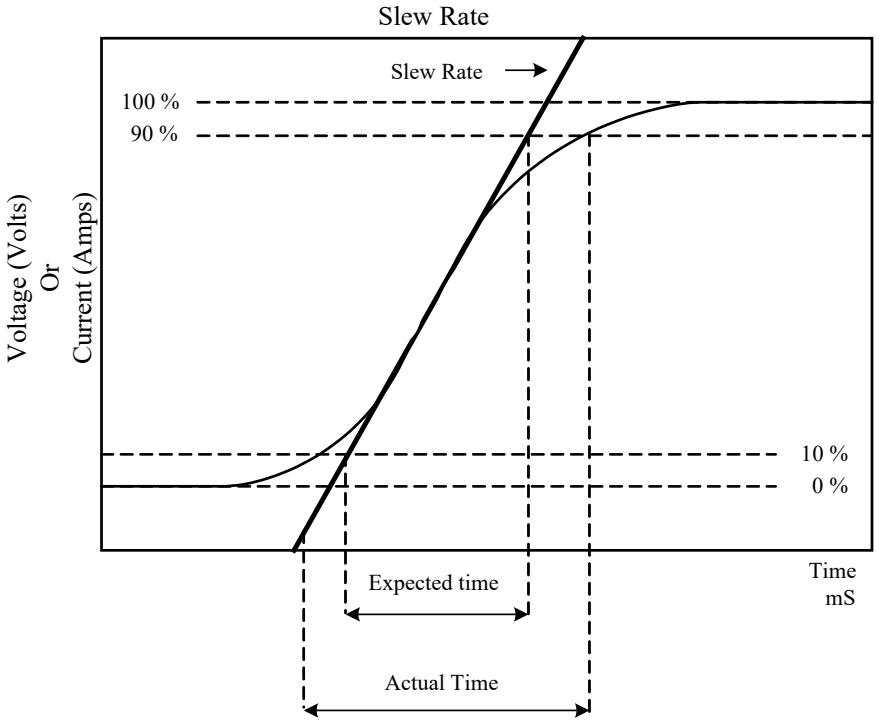


Fig 1-15 Rise Time Transition Limitation

Therefore, both minimum transition time and slew rate must be considered when determining the actual transition time.
Following detail description is excluding 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.
EX: 3311G 60V/60A/300W (CCH - CCL >60Ax 30%)

Use the following formula to calculate the minimum transition time for a given slew rate Min transition time=18A/slew rate (in amps/second).
180uS (18A/0.1) x 0.8(10%~90%) =144uS

Use the following formula to calculate the maximum transition time for a given slew rate Max transition time=60/slew rate (in amps/second).
600uS (60A/0.1) x 0.8(10~90%) = 480uS

EX. CCH=16A, CCL=0A Slew Rate =0.1A, the expected time is 128uS but the actual Transition Time will be limited to 144uS
160uS (16/0.1) x 0.8(10%~90%) = 128uS

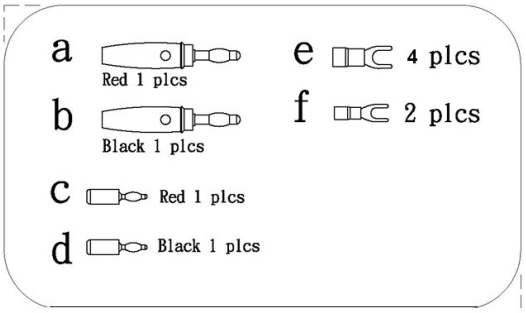
1-2. Features

The main features of the 3310G series of load modules are highlighted below.

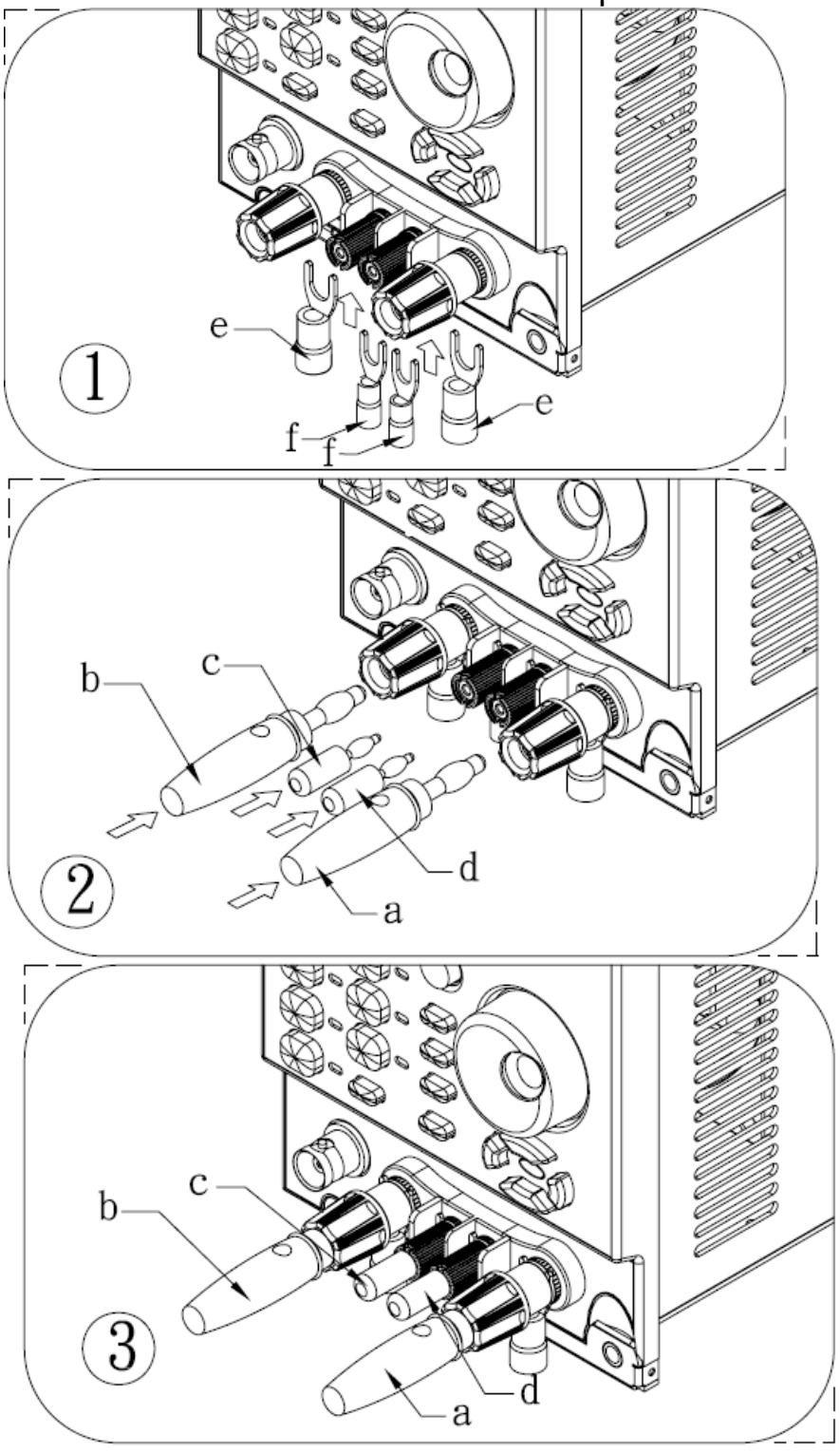
- Bench top and rack mounting flexibility with single, dual and 4 slot mainframes
- CC, CR, CV, CP, Dynamic, and Short Operating Mode.
- Remote control via a choice of computer interfaces.
- High accuracy & resolution with 16 bit voltage and current meter.
- Built in pulse generators for dynamic loading.
- Independently adjustable current rise and fall times.
- Short circuit test with current measurement
- Dedicated over current and overpower protection test functions
- Programmable voltage sense capability.
- Full protection from overpower, over-temperature, overvoltage, and reverse polarity.
- Analogue programming input for tracking an external signal
- Digital Calibration
- Advance Fan speed control
- Current Monitor with BNC (non-isolated) socket.
- 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
- With synchronous parallel execution of the function (SYNC. Load on).
- Support solar panel MPPT test.
- Provide battery BMS protection board protection function test.
- Model 9923 Current Waveform Generator (Card) provide battery real discharge current waveform simulation (Option)
- Built-in test modes include, Battery Discharge time, BMS Fuse / Breaker Trip / Non-Trip, short circuit Simulation, OCP, OPP, etc.
- Turbo mode and short time (within 2 second) more than 2 times, Fuse/Breaker, BMS, SHORT, OCP, and OPP test.
- Capacitive load and sudden load access test of power supply at power on.

1-3. Standard Accessories

3310G/3311G/3312G/3314G/3315G/3316G/ 3318G/3319G/3319G-M	Qty
4mm Banana Plug (Red)	1 PC
4mm Banana Plug (Black)	1 PC
2mm Banana Plug (Red)	1 PC
2mm Banana Plug (Black)	1 PC
Hook Terminal Y type large size terminal	4 PCs
Hook Terminal Y type small size terminal	2 PCs
3310G series operation manual	1 PC
3317G/3317G-M	**Qty**
M6 HEX HEAD CAP SCREW L=16mm	2 PCs
Nut M6	2 PCs
M6 Spring Washer	2 PCs
Gilded Washer FW6.7X12.7X1.0	4 PCs
Positive (Red) braided wire	1 PC
Negative (Black) braided wire	1 PC
WTN-1011R1 RED;BANANA PLUG 2mm	1 PC
WTN-1011R1 BLK;BANANA PLUG 2mm	1 PC
3310G series operation manual	1 PC



1.3.1 Accessories Installation Description



1-4. Specifications

Specifications

MODEL	3310G		3311G		3312G	
Power	150W, 300W max. *1		300W, 600W max. *1		300W, 600W max. *1	
Current	30A, 60A max. *1		60A, 120A max. *1		12A, 24A max. *1	
Voltage	60V		60V		250V	
Min. Operating Voltage	0.3V @ 30A		0.3V @ 60A		1V @ 12A	
PROTECTIONS						
Over Power Protection (OPP)	105%					
Over Current Protection (OCP)	105%					
Over Voltage Protection (OVP)	105%					
Over Temp Protection (OTP)	YES					
Constant Current Mode						
Range *2	0 ~ 3A	0 ~ 30A	0 ~ 6A	0 ~ 60A	0 ~ 1.2A	0 ~ 12A
Resolution	0.05mA	0.5mA	0.1mA	1mA	0.02mA	0.2mA
Accuracy *3	± 0.05% of (Setting + Range)					
Constant Resistance Mode						
Range	2~120KΩ	0.02Ω~2Ω	1Ω~60 KΩ	0.0083Ω~1Ω	25Ω~1500KΩ	0.08Ω~25Ω
Resolution	0.00833mS	0.033mΩ	0.0166mS	0.0166mΩ	0.00066mS	0.4166mΩ
Accuracy	± 0.2% of (Setting + Range)					
Constant Voltage Mode						
Range	0 ~ 6V	0 ~ 60V	0 ~ 6V	0 ~ 60V	0 ~ 30V	0 ~ 250V
Resolution	0.0001V	0.001V	0.0001V	0.001V	0.001V	0.01V
Accuracy	± 0.025% of (Setting + Range)					
Constant Power Mode						
Range	0 ~ 15W	0 ~ 150W	0 ~ 30W	0 ~ 300W	0 ~ 30W	0 ~ 300W
Resolution	0.00025W	0.0025W	0.0005W	0.005W	0.0005W	0.005W
Accuracy *4	± 0.1% of (Setting + Range)					
Constant Voltage + Current Limit Mode						
Range	60V	30A	60V	60A	250V	12A
Resolution	0.001V	0.5mA	0.001V	1mA	0.01V	0.2mA
Accuracy	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)
Constant Voltage + Power Limit Mode						
Range	60V	150W	60V	300W	250V	300W
Resolution	0.001V	0.0025W	0.001V	0.005W	0.01V	0.005W
Accuracy	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)
Turbo mode *1	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**
Short/OCP/OPP Test Function						
Maximum Current	30A	60A	60A	120A	12A	24A
Meas. Accuracy	± 1.0% of (Reading + Range)					
Short time	100ms~10 Sec. or Continue	100~2000mS	100ms~10 Sec. or Continue	100~2000mS	100ms~10 Sec. or Continue	100~2000mS
Meas. Accuracy	NA	NA	NA	NA	NA	NA
OCP Time (Tstep)	100mS	20mS	100mS	20mS	100mS	20mS
Meas. Accuracy	NA	NA	NA	NA	NA	NA
OPP Time (Tstep)	100mS	20mS	100mS	20mS	100mS	20mS
Meas. Accuracy	NA	NA	NA	NA	NA	NA

Turbo mode *5	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**
Short time	100ms~10 Sec. or Continue	0.05mS~10ms	100~1000ms	0.05mS~10ms	100ms~10 Sec. or Continue	0.05mS~10ms	100~1000ms	0.05mS~10ms	100ms~10 Sec. or Continue	0.05mS~10ms	100~1000ms	0.05mS~10ms
Meas. Accuracy	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS
OCP Time (Tstep)	100mS	0.05mS~10mS / 11~1000mS	20mS	0.05mS~10mS / 11~1000mS	100mS	0.05mS~10mS / 11~1000mS	20mS	0.05mS~10mS / 11~1000mS	100mS	0.05mS~10mS / 11~1000mS	20mS	0.05mS~10mS / 11~1000mS
Meas. Accuracy	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS

Fuse Test Mode *6						
Trip & Non-Trip Time	1~5999ms, 6~16383sec	1~2000mS	1~5999ms, 6~16383sec	1~2000mS	1~5999ms, 6~16383sec	1~2000mS
Meas. Accuracy	± 0.04mS (<200mS) , ± 20mS (>200mS)					
Repeat Time	0~255					
Surge Test Mode						
Surge current	0~60A		0~120A		0~24A	
Normal current	0~30A		0~60A		0~12A	
Surge Time	10~2000ms					
Surge Step	1~5					
MPPT Mode						
Algorithm	P & O					
Load mode	CV					
P&O interval	1000ms ~ 60000ms					
Resolution	1000mS					
Dynamic Mode (50KHz)						
Timing						
Thigh & Tlow	0.010~9.999 / 99.99 / 999.9 / 9999mS					
Resolution	0.001 / 0.01 / 0.1 / 1mS					
Slew rate	0.008 ~ 0.5A/μS	0.08 ~ 5A/μS	0.016 ~ 1A/μS	0.16 ~ 10A/μS	0.0008 ~ 0.05A/μS	0.008 ~ 0.5A/μS
Accuracy	± (5% of Setting) ±10μS					
Measurement						
Voltage Read Back						
Range (5 Digital)	6V	60V	6V	60V	30V	250V
Resolution	0.0001V	0.001V	0.0001V	0.001V	0.001V	0.01V
Accuracy	± 0.025% of (Reading + Range)					
Current Read Back						
Range (5 Digital)	3A	30A	6A	60A	1.2A	12A
Resolution	0.0001A	0.001A	0.0001A	0.001A	0.00002A	0.0002A
Accuracy	± 0.05% of (Reading + Range)					
Power Read Back						
Range (5 Digital)	15W	150W	30W	300W	30W	300W
Resolution	0.0001W	0.001W	0.001W	0.01W	0.001W	0.01W
Accuracy *7	± 0.125% of (Reading + Range)					
Current Monitor	FULL SCALE 10V					
Accuracy	0.5% of (Setting + Range)					
Current Programming Input	FULL SCALE 10V					
Programmable Short	BUILT-IN					
Load ON Voltage	0.1 ~ 25V		0.1 ~ 25V		0.2 ~ 50V	
Accuracy	1% of (Setting + Range)					
Load OFF Voltage	0 ~ 25V		0 ~ 25V		0 ~ 50V	
Accuracy	0.025% of (Setting + Range)					
Typical Short Resistance (Cont.)	0.0166Ω		0.0083 Ω		0.08 Ω	
Max. Short Current (Cont.)	30A		60A		12A	
Dimension (HxWxD)	143 x 108 x 412 mm					
Operating Temperature *8	0 ~ 40℃					

*1 Turbo mode for up to 2X Current rating & Power rating support Fuse, BMS, Short/OCP/OPP test function
*2 The range is automatically or forcing to range II only in CC mode
*3 If the operating current is below range 0.1%, the accuracy specification is 0.1% F.S.
*4 If the operating power below range 2%, the accuracy specification is 0.2% of setting + range.
*5 BMS Test function for Battery Management System Board SHORT, OCCP and OCDP Test
*6 Fuse Test function for Fuse and Breaker test
*7 Power range = Vrange F.S. x Irange F.S.
*8 Operating temperature range is 0~40°C, all specification apply for 25°C±5°C, Except as noted

Order Information

DC Electronic Load

- **3310G** 60V、30A、150W
- **3311G** 60V、60A、300W
- **3312G** 250V、12A、300W

DC Electronic Load Mainframe

Optional interface : ① GPIB Card ② RS232 Card ③ USB Card ④ LAN Card

3302G
(single channel mainframe)
5.5kg / W160mm / H177mm / D452mm

3305G
(two channels mainframe)
7.5kg / W269mm / H177mm / D452mm

3300G
(four channels mainframe)
9.3kg / W440mm / H177mm / D445mm

High Slew Rate
3310G ▶ 5A/μS
3311G ▶ 10A/μS
3315G ▶ 2.5A/μS

Optional feature : NTC Simulator ①10KΩ NTC(100~500KΩ) ②100KΩ NTC(1000~5MΩ)

MODEL	3314G		3315G	
Power	300W, 600W max. *1		75W, 150W max. *1	
Current	12A, 24A max. *1		15A, 30A max. *1	
Voltage	500V		60V	
Min. Operating Voltage	6V @ 12A		0.25V @ 15A	
PROTECTIONS				
Over Power Protection (OPP)	105%			
Over Current Protection (OCP)	105%			
Over Voltage Protection (OVP)	105%			
Over Temp Protection (OTP)	YES			
Constant Current Mode				
Range *2	0 ~ 1.2A	0 ~ 12A	0 ~ 1.5A	0 ~ 15A
Resolution	0.02mA	0.2mA	0.0254mA	0.25mA
Accuracy *3	± 0.05% of (Setting + Range)			
Constant Resistance Mode				
Range	50 ~ 3000KΩ	0.5Ω ~ 50Ω	4Ω ~ 240 KΩ	0.02Ω ~ 4Ω
Resolution	0.000333mS	0.8333mΩ	0.04166mS	0.0666mΩ
Accuracy	± 0.2% of (Setting + Range)			
Constant Voltage Mode				
Range	0 ~ 60V	0 ~ 60V	0 ~ 6V	0 ~ 60V
Resolution	0.001V	0.001V	0.0001V	0.001V
Accuracy	± 0.025% of (Setting + Range)			
Constant Power Mode				
Range	0 ~ 30W	0 ~ 300W	0 ~ 7.5W	0 ~ 75W
Resolution	0.001W	0.01W	0.000125W	0.00125W
Accuracy *4	± 0.1% of (Setting + Range)			
Constant Voltage + Current Limit Mode				
Range	500V	12A	60V	15A
Resolution	0.01V	0.2mA	0.001V	0.25mA
Accuracy	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)
Constant Voltage + Power Limit Mode				
Range	500V	300W	60V	75W
Resolution	0.01V	0.01W	0.001V	0.00125W
Accuracy	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)	±0.05% of (Setting+Range)	±1.0% of (Setting+Range)
Turbo mode *1	**OFF**	**ON**	**OFF**	**ON**
Short/OCP/OPP Test Function				
Maximum Current	12A	24A	15A	30A
Meas. Accuracy	± 1.0% of (Reading + Range)			
Short time	100ms~10 Sec.	100~2000mS	100ms~10 Sec.	100~2000mS
Meas. Accuracy	NA	NA	NA	NA
OCP Time (Tstep)	100mS	20mS	100mS	20mS
Meas. Accuracy	NA	NA	NA	NA
OPP Time (Tstep)	100mS	20mS	100mS	20mS
Meas. Accuracy	NA	NA	NA	NA

Turbo mode *5	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**
Short time	100ms~10 Sec. or Continue	0.05mS~10ms	100~1000ms	0.05mS~10ms	100ms~10 Sec. or Continue	0.05mS~10ms	100~1000ms	0.05mS~10ms
Meas. Accuracy	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS	NA	±0.005mS
OCP Time (Tstep)	100mS	0.05mS~10mS / 11~1000mS	20mS	0.05mS~10mS / 11~1000mS	100mS	0.05mS~10mS / 11~1000mS	20mS	0.05mS~10mS / 11~1000mS
Meas. Accuracy	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS	NA	±0.005mS / ±0.2mS

Fuse Test Mode *6				
Trip & Non-Trip Time	1~5999ms, 6~16383sec	1~2000mS	1~5999ms, 6~16383sec	1~2000mS
Meas. Accuracy	± 0.04mS (<200mS) , ± 20mS (>200mS)			
Repeat Time	0~255			
Surge Test Mode				
Surge current	0~24A		0~30A	
Normal current	0~12A		0~15A	
Surge Time	10~2000ms			
Surge Step	1~5			
MPPT Mode				
Algorithm	P & O			
Load mode	CV			
P&O interval	1000ms ~ 60000ms			
Resolution	1000mS			
Dynamic Mode (50KHz)				
Timing				
Thigh & Tlow	0.010~9.999 / 99.99 / 999.9 / 9999mS			
Resolution	0.001 / 0.01 / 0.1 / 1mS			
Slew rate	0.0008 ~ 0.05A/μS	0.008 ~ 0.5A/μS	0.004 ~ 0.25A/μS	0.04 ~ 2.5A/μS
Accuracy	± (5% of Setting) ±10μS			
Measurement				
Voltage Read Back				
Range (5 Digital)	60V	600V	6V	60V
Resolution	0.001V	0.01V	0.0001V	0.001V
Accuracy	± 0.025% of (Reading + Range)			
Current Read Back				
Range (5 Digital)	1.2A	30A	1.5A	15A
Resolution	0.0001A	0.001A	0.00001A	0.001A
Accuracy	± 0.05% of (Reading + Range)			
Power Read Back				
Range (5 Digital)	30W	300W	7.5W	75W
Resolution	0.0001A	0.001A	0.0001W	0.001W
Accuracy *7	± 0.1% of (Reading + Range)			
Current Monitor	FULL SCALE 10V			
Accuracy	0.5% of (Setting + Range)			
Current Programming Input	FULL SCALE 10V			
Programmable Short	BUILT-IN			
Load ON Voltage	0.4 ~ 100V		0.1 ~ 25V	
Accuracy	1% of (Setting + Range)			
Load OFF Voltage	0 ~ 100V		0 ~ 25V	
Accuracy	0.025% of (Setting + Range)			
Typical Short Resistance (Cont.)	0.5 Ω		0.02 Ω	
Max. Short Current (Cont.)	12A		15A	
Dimension (HxWxD)	143 x 108 x 412 mm			
Operating Temperature *8	0 ~ 40℃			

*1 Turbo mode for up to 2X Current rating & Power rating support Fuse, BMS, Short/OCP/OPP test function
*2 The range is automatically or forcing to range II only in CC mode
*3 If the operating current is below range 0.1%, the accuracy specification is 0.1% F.S.
*4 If the operating power below range 2%, the accuracy specification is 0.2% of setting + range.
*5 BMS Test function for Battery Management System Board SHORT, OCCP and OCDP Test
*6 Fuse Test function for Fuse and Breaker test
*7 Power range = Vrange F.S. x Irange F.S.
*8 Operating temperature range is 0~40°C, all specification apply for 25°C±5°C, Except as noted

Order Information

DC Electronic Load

- **3314G** 500V、12A、300W
- **3315G** 60V、15A、 75W

DC Electronic Load Mainframe

Optional interface : ❶ GPIB Card ❷ RS232 Card ❸ USB Card ❹ LAN Card

3302G
(single channel mainframe)
5.5kg / W160mm / H177mm / D452mm

3305G
(two channels mainframe)
7.5kg / W269mm / H177mm / D452mm

3300G
(four channels mainframe)
9.3kg / W440mm / H177mm / D445mm

High Slew Rate
3310G ▶ 5A/uS
3311G ▶ 10A/uS
3315G ▶ 2.5A/uS

Optional feature : NTC Simulator ❶10KΩ NTC(100~500KΩ) ❷100KΩ NTC (1000~5MΩ)

Specifications

MODEL	3316G		3318G	
Power	400W, 800W max. *1		400W, 800W max. *1	
Current	80A /160A max. *1		20A / 40A max. *1	
Voltage	80V		500V	
Min. Operating Voltage	0.8V @ 80A		4V @ 20A	
PROTECTIONS				
Over Power Protection(OPP)	105%			
Over Current Protection(OCP)	105%			
Over Voltage Protection(OVP)	105%			
Over Temp Protection(OTP)	YES			
Constant Current Mode				
Range *2	0 ~ 8.04A	0 ~ 80A	0 ~ 2.04A	0 ~20A
Resolution	0.134mA	1.34mA	0.034mA	0.34mA
Accuracy *3	± 0.05% of (setting + Range)			
Constant Resistance Mode				
Range	1Ω~ 60KΩ	0.0083Ω ~ 1Ω	30Ω~ 1800KΩ	0.3Ω ~ 30Ω
Resolution	0.0166mS	0.0166mΩ	0.000555mS	0.5mΩ
Accuracy	± 0.2% of (Setting + Range)			
Constant Voltage Mode				
Range	0 ~ 8.04V	0 ~ 80V	60V	500V
Resolution	0.000134V	0.00134V	0.001V	0.01V
Accuracy	± 0.025% of (Setting + Range)			
Constant Power Mode				
Range	0 ~ 40.02W	0 ~ 400W	0 ~ 40.02W	0 ~ 400W
Resolution	0.667mW	6.67mW	0.667mW	6.67mW
Accuracy *4	± 0.1% of (Setting + Range)			
Constant Voltage + Current Limit Mode				
Range	80V	80A	500V	20A
Resolution	0.00134V	1.34mA	0.01V	0.34mA
Accuracy	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)
Constant Voltage + Power Limit Mode				
Range	80V	400W	500V	400W
Resolution	0.00134V	6.67mW	0.01V	6.67mW
Accuracy	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)
Turbo mode *1	**OFF**	**ON**	**OFF**	**ON**
Short/OCP/OPP Test Function				
Meas. Accuracy	± 3.0% of (Reading + Range)			
Maximum Current	80A	160A	20A	40A
Short Time	100ms~10 Sec. or Continue	100~2000ms	100ms~10 Sec. or Continue	100~2000ms
Meas. Accuracy	NA			
OCP Time (Tstep)	100ms	20ms	100ms	20ms
Meas. Accuracy	NA			
OPP Time (Tstep)	100ms	20ms	100ms	20ms
Meas. Accuracy	NA			
BMS Test Mode *5				
Short Time	0.05mS~10ms	0.05mS~10ms	0.05mS~10ms	0.05mS~10ms
Meas. Accuracy	±0.005mS			
OCP Time (Tstep)	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms
Meas. Accuracy	±0.005mS / ±0.2mS			
Fuse Test Mode *6				
Trip & Non-Trip Time	r1:1~5999ms, r2:6~16383sec	1~2000mS	r1:1~5999ms, r2:6~16383sec	1~2000mS
Meas. Accuracy	r1 : ±0.2mS(<200mS), ±20mS(>200mS), r2: ±0.5S			
Repeat Cycle	0~255			
Surge Test Mode				
Surge current	0~160A		0~40A	
Normal current	0~80A		0~20A	
Surge Time	10~2000ms			
Surge Step	1~5			
MPPT Mode				
Algorithm	P&O			
Load mode	CV			
P&O interval	1000ms ~ 60000ms			
Resolution	1000ms			
Dynamic Mode (50KHz)				
Timing				
Thigh & Tlow	0.010~9.999 / 99.99 / 999.9 / 9999mS			
Resolution	0.001 / 0.01 / 0.1 / 1mS			
Slew rate	5.4 ~ 337.5mA/μs	54~ 3375mA/μs	1.28 ~ 80mA/μs	12.8 ~ 800mA/μs
Accuracy	± (5% of Setting) ±10μS			
Measurement				
Voltage Read Back				
Range (5 Digital)	8.04V	80V	60V	500V
Resolution	0.000134V	0.00134V	0.001V	0.01V
Accuracy	± 0.025% of (Reading + Range)			
Current Read Back				
Range (5 Digital)	8.04A	80A	2.1A	20A
Resolution	0.000134A	0.00134A	0.000034A	0.00034A
Accuracy	± 0.05% of (Reading + Range)			
Power Read Back				
Range (5 Digital)	400W		400W	
Resolution	0.01W		0.01W	
Accuracy *7	± 0.1% of (Reading + Range)			
Current Monitor	FULL SCALE 10V			
Accuracy	0.5% of (Setting + Range)			
Current Programming Input	FULL SCALE 10V			
Programmable Short	BUILT-IN			
Load ON Voltage	0.1 ~ 25V		0.4~100V	
Accuracy	1% of (Setting + Range)			
Load OFF Voltage	0 ~ 24.866V		0~99V	
Accuracy	0.025% of (Setting + Range)			
Typical Short Resistance	0.009Ω		0.15Ω	
Maximum Short Current	80A		20A	
Dimension(HxWxD)	143 x 108 x 412 mm			
Operating Temperature *8	0 ~ 40℃			

*1 Turbo mode for up to 2X Current rating & Power rating support Fuse, BMS, Short/OCP/OPP test function
*2 The range is automatically or forcing to range II only in CC mode
*3 If the operating current is below range 0.1%, the accuracy specification is 0.1% F.S.
*4 If the operating power below range 2%, the accuracy specification is 0.2% of setting + range.
*5 BMS Test function for Battery Management System Board SHORT, OCCP and OCDP Test
*6 Fuse Test function for Fuse and Breaker test
*7 Power range = Vrange F.S. x Irange F.S.
*8 Operating temperature range is 0~40°C, all specification apply for 25°C±5°C, Except as noted

Order Information

DC Electronic Load

- **3316G**
  80V、80A、400W
- **3318G**
  500V、20A、400W

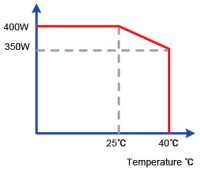
DC Electronic Load Mainframe

Optional interface：1 GPIB Card 2 RS232 Card 3 USB Card 4 LAN Card

3302G
(single channel mainframe)
5.5kg / W160mm / H177mm / D452mm

3305G
(two channels mainframe)
7.5kg / W269mm / H177mm / D452mm

3300G
(four channels mainframe)
9.3kg / W440mm / H177mm / D445mm



Power vs temperature curve

Specifications

MODEL	3317G / 3317G-M		3319G / 3319G-M	
Power	800W,1600W max. *1		800W, 1600W max. *1	
Current	160A / 320A max. *1		40A / 80A max. *1	
Voltage	80V		500V	
Min. Operating Voltage	1.0V @ 160A		4V @ 40A	
PROTECTIONS				
Over Power Protection(OPP)	105%			
Over Current Protection(OCP)	105%			
Over Voltage Protection(OVP)	105%			
Over Temp Protection(OTP)	YES			
Constant Current Mode				
Range *2	0 ~ 16.02A	0 ~ 160A	0 ~ 4.02A	0 ~ 40A
Resolution	0.267mA	26.7mA	0.067mA	0.67mA
Accuracy *6	± 0.05% of (setting + Range)			
Constant Resistance Mode				
Range	0.5Ω~ 30KΩ	0.00416Ω ~ 0.5Ω	15Ω~ 900KΩ	0.15Ω ~ 15Ω
Resolution	0.0166mS	0.0083mΩ	0.00111mS	0.25mΩ
Accuracy	± 0.2% of (Setting + Range)			
Constant Voltage Mode				
Range	0 ~ 8.04V	0 ~ 80V	0 ~ 60V	0 ~ 500V
Resolution	0.000134V	0.00134V	0.001V	0.01V
Accuracy	± 0.025% of (Setting + Range)			
Constant Power Mode				
Range	0 ~ 80.04W	0 ~ 800W	0 ~ 80.04W	0 ~ 800W
Resolution	1.334mW	13.34mW	1.334mW	13.34mW
Accuracy *4	± 0.1% of (Setting + Range)			
Constant Voltage + Current Limit Mode				
Range	80V	160A	500V	40A
Resolution	0.00134V	2.67mA	0.01V	0.67mA
Accuracy	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)
Constant Voltage + Power Limit Mode Range				
Range	80V	800W	500V	800W
Resolution	0.00134V	13.34mW	0.01V	13.34mW
Accuracy	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)	± 0.05% of (Setting + Range)	± 1.0% of (Setting + Range)
Turbo mode *1	**OFF**	**ON**	**OFF**	**ON**
Short/OCP/OPP Test Function				
Meas. Accuracy	± 3.0% of (Reading + Range)			
Maximum Current	160A	320A	40A	80A
Short Time	100ms~10 Sec. or Continue	100~2000ms	100ms~10 Sec. or Continue	100~2000ms
Meas. Accuracy	NA			
OCP Time (Tstep)	100ms	20ms	100ms	20ms
Meas. Accuracy	NA			
OPP Time (Tstep)	100ms	20ms	100ms	20ms
Meas. Accuracy	NA			
BMS Test Mode *5				
Short Time	0.05mS~10ms	0.05mS~10ms	0.05mS~10ms	0.05mS~10ms
Meas. Accuracy	±0.005mS			
OCP Time (Tstep)	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms	0.05mS~10ms / 11~1000ms
Meas. Accuracy	±0.005mS / ±0.2mS			
Fuse Test Mode *6				
Trip & Non-Trip Time	r1:1~5999ms, r2:6~16383sec	1~2000mS	r1:1~5999ms, r2:6~16383sec	1~2000mS
Meas. Accuracy	r1 : ±0.2mS(<200mS), ±20mS(>200mS), r2: ±0.5S			
Repeat Cycle	0~255			
Surge Test Mode				
Surge current	0~320A		0~80A	
Normal current	0~160A		0~40A	
Surge Time	10~2000ms			
Surge Step	1~5			
MPPT Mode				
Algorithm	P&O			
Load mode	CV			
P&O interval	1000ms ~ 60000ms			
Resolution	1000ms			
Dynamic Mode (50KHz)				
Timing				
Thigh & Tlow	0.010~9.999 / 99.99 / 999.9 / 9999mS			
Resolution	0.001 / 0.01 / 0.1 / 1mS			
Slew rate	10.8 ~ 675mA/μs	10.8 ~ 6750mA/μs	2.56 ~ 160mA/μs	25.6 ~ 1600mA/μs
Accuracy	± (5% of Setting) ±10μS			
Measurement				
Voltage Read Back				
Range (5 Digital)	8.04V	80V	60V	500V
Resolution	0.000134V	0.00134V	0.001V	0.01V
Accuracy	± 0.025% of (Reading + Range)			
Current Read Back				
Range (5 Digital)	16.02A	160A	4.02A	40A
Resolution	0.000267A	0.00267A	0.000067A	0.00067A
Accuracy	± 0.05% of (Reading + Range)			
Power Read Back				
Range (5 Digital)	800W		800W	
Resolution	0.01W		0.01W	
Accuracy *7	± 0.1% of (Reading + Range)			
Current Monitor	FULL SCALE 10V			
Accuracy	0.5% of (Setting + Range)			
Current Programming Input	FULL SCALE 10V			
Programmable Short	BUILT-IN			
Load ON Voltage	0.1 ~ 25V		0.4~100V	
Accuracy	1% of (Setting + Range)			
Load OFF Voltage	0 ~ 24.866V		0~99V	
Accuracy	0.025% of (Setting + Range)			
Typical Short Resistance	0.006Ω		0.15Ω	
Maximum Short Current	160A		40A	
Dimension(HxWxD)	3317G / 3319G (187 x 269 x 486 mm / 14.5kg)		3317G-M / 3319G-M (143 x 216.4 x 418.8 mm / 7kg)	
Operating Temperature *8	0 ~ 40℃			

*1 Turbo mode for up to 2X Current rating & Power rating support Fuse, BMS, Short/OCP/OPP test function
*2 The range is automatically or forcing to range II only in CC mode
*3 If the operating current is below range 0.1%, the accuracy specification is 0.1% F.S.
*4 If the operating power below range 2%, the accuracy specification is 0.2% of setting + range.
*5 BMS Test function for Battery Management System Board SHORT, OCCP and OCDP Test
*6 Fuse Test function for Fuse and Breaker test
*7 Power range = Vrange F.S. x Irange F.S.
*8 Operating temperature range is 0~40°C, all specification apply for 25°C±5°C, Except as noted

Order Information

3317G
80V, 160A , 800W

3319G
500V, 40A , 800W

3317G-M
80V, 160A , 800W

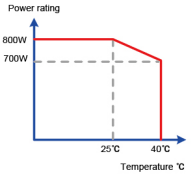
3319G-M
500V, 40A , 800W

Optional interface : 1 GPIB Card 2 RS232 Card 3 USB Card 4 LAN Card

3317G-M / 3319G-M DC Electronic Load Mainframe（Option）

3305G
(two channels mainframe)
7.5kg / W269mm / H177mm / D452mm

3300G
(four channels mainframe)
9.3kg / W440mm / H177mm / D445mm



Power vs temperature curve

Table 1-1 3310G Series Specification

Chapter 2 Installation

This chapter details the installation and removal procedure of the 3310G 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 3310G 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 3310G series Plug-in load module

2-1. Installation and removal of 3310G series plug-in load module

The 3310G 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 3310G series Electronic load module were purchased separately, the 3310G 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 3310G series load module in or out from the 3300G /3302G/3305G.

2.1.1. Installation of 3310G series plug-in load:

2.1.1.1 Turn the 3300G/3302G/3305G mainframe power OFF before inserting the 3310G Series load module. Failure to switch the mains power off may result in damage To the plug-in module's circuitry.

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

2.1.1.3 If correctly positioned the 3310G 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 3310G 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 3310G 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 ! Carefully read and understand the guidance in the operating manual Before performing any action.

2-4. Cleaning

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

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

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

2-5. Observe precautions for handling electrostatic sensitive devices

Imonitor BNC terminal is ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V 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 3310G 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.

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

2-7. 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 3302G is used.

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

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

The load mode (CC, CR, CV, CP) 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.
Note:
3310G series electronic load Dynamic mode, when in CR Mode Range I only have This feature.

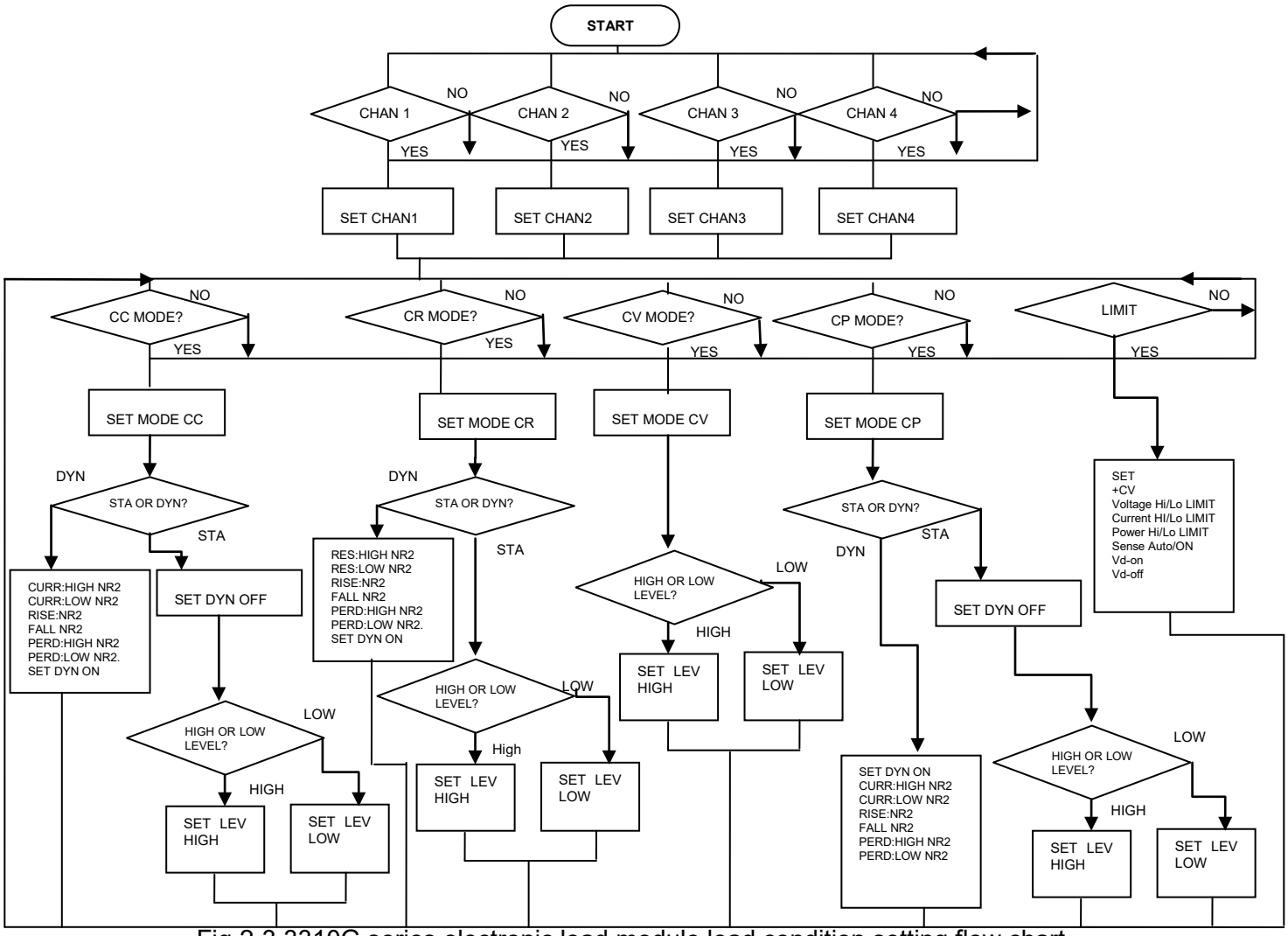


Fig 2-3 3310G series electronic load module load condition setting flow chart

Chapter 3 Operation

This chapter describes the front panel operation of each 3310G 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 LCD description

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

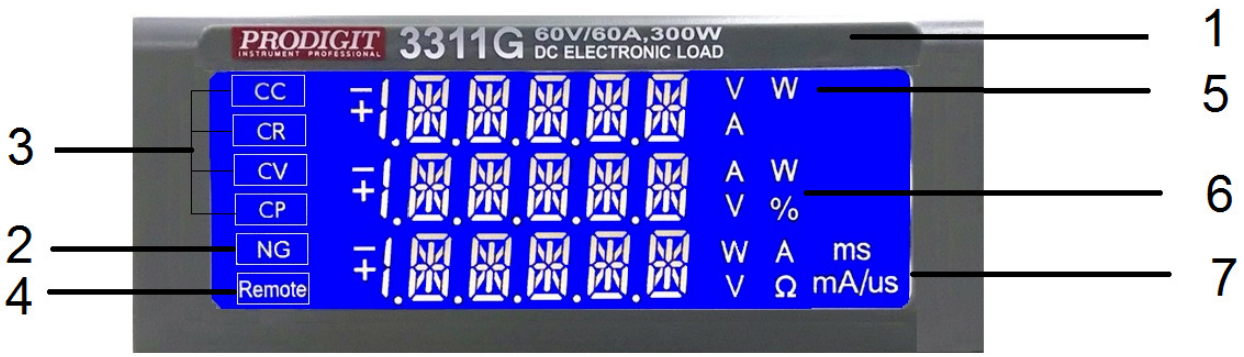


Fig 3-1 Front panel of 3310G Series LCD

3.1.1. 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.

3.1.2. 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.

3.1.3. MODE and CC , CR , CV , CP mode, LCD Indicator

There are four operating modes that can be selected by pressing the "MODE" key on the 3310G series Electronic Load module.

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

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

3.1.4. Remote LCD Indicator

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

3.1.5. Upper 5 digit LCD display

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

Normal mode:

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)

Please note that if V-sense is set to 'AUTO' and the sense leads are connected to The DUT the losses need to be approx. 600~800mV (3310G, 3311G & 3315G) or 3~4V (3312G), 6~8V(3314G) before the display compensates for the voltage loss.

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

Test Mode:

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.

3.1.6. Middle 5 digit LCD display

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

Normal mode:

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

Setting Mode:

If CONFIG, LIMIT, DYN, FUSE, BMS, SHORT, OPP or OCP buttons are pressed The middle LCD shows 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 “SENSE” → “LDon” → “LDoff” → “POLAR” →“MPPT” →“AVG” →“TURBO” →”BATT1” → “BATT2” →”EXTIN” → “CV_bW”.
- **LIMIT**: Sequence is ”+CV”→ ”V_Hi” → “V_Lo” → “I_Hi” → “I_Lo” → “W_Hi” → “W_Lo” → “NG”.
- **DYN setting**: Sequence is “T-Hi” → ”T-Lo” → ”RISE” → “FALL” →“SUR._I” →”NOR.I” →”S.TIME” →”S.STEP”.
- **FUSE**: Sequence is “CC” → ”TIME” → ”ITH” → “REP.”
- **BMS**:
  BMS SHORT Sequence is “PRESS” → ”TIME” → ”ITH”.
  BMS OPP Sequence is “PRESS” → “PSTAR”→ ” PSTEP” → ”PSTOP” → “Vth”.
  BMS OCP Sequence is “PRESS” →”ISTAR ” →”TSTEP” →”ISTEP” → ”ISTOP” →ITH”→ “Vth”.
- **SHORT**: Sequence is “PRESS” → “TIME” → ”V_Hi” → “V_Lo”
- **OPP**: Sequence is “PSTAR” → “PSTEP” → “PSTOP” → “Vth”.
- **OCP**: Sequence is “ISTAR” → “ISTEP” → “ISTOP” → ”Vth”.

3.1.7. Lower 5 digit LCD display

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

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

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

3.1.7.1. **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”.

3.1.7.2. **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:

➔ +CV (upper limit voltage) displays the set value in volts “V”
➔ 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」

3.1.7.3. 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”
➔ SUR._I (surge current) setting value in A.
➔ NOR._I (Normal current) setting value in A.
➔ S.TIME (rush time) setting value, the unit is ms.
➔ S.STEP setting value.

3.1.7.4. 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:

➔ SENSE can be set to「AUTO」or 「ON」
➔ 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」
➔ MPPT (load maximum power point tracking) .
➔ AVG (load Measuring V.I Average)can be set 1 to 64.
➔ TURBO can be set to「ON」or「OFF」.
➔ BATT1 can be set to 0~60V，the set value in volts “V”
➔ BATT2 can be set to 0~99999.
➔ EXTIN can be set to「ON」or「OFF」.
➔ CV_bW can be set to 1~4.

3.1.7.5. 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.

3.1.7.6. 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”

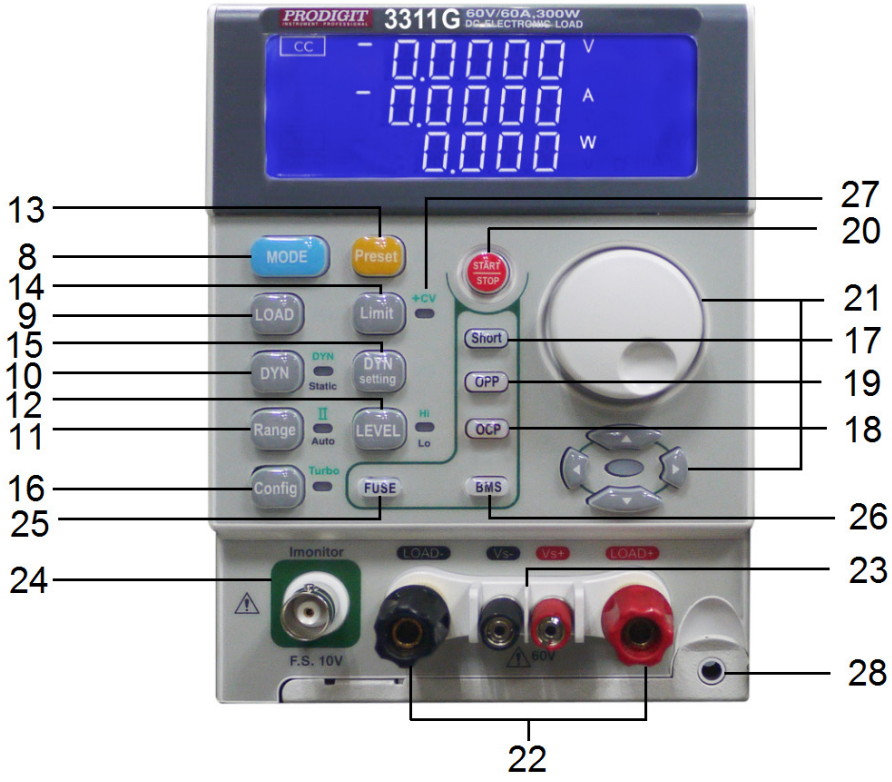
When the test is started the lower display will show the power value Being taken by the load. If the Device Under Test is able to supply the Load according to the values set then the middle display will show PASS And the lower display will show the maximum power taken during the OPP test. If, during 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.

3.1.7.7. 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.

3310G Series Panel instructions



3.1.8. MODE and CC, CR, CV, CP Indicator

There are four operating modes. These can be selected in turn by pressing the "MODE" key on the 3310G series Electronic Load module. The sequence is:

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

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

3.1.9. LOAD key and LED

The input to the 3310G 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.

3.1.9.1. 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.

3.1.9.2. 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.

3.1.10. 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.

3.1.11. Range key and LED

The 3310G series Load Module features 2 setting ranges for CC, CR, CV & CP 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.

3.1.12. 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.

3.1.12.1. 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.

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

3.1.12.3. In Constant Voltage mode:
IF Low level load voltage value greater than High level load voltage value or opposite status，the load voltage value is equal.
P.S.：CV Mode Level High / Low has "automatic push function".

3.1.12.4. 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.

3.1.13. 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.

3.1.13.1. 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.

3.1.13.2. 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.

3.1.13.3. 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.

3.1.13.4. Constant Power (CP) mode:
The High and Low levels of load power can be preset on the lower 5 digit LCD. The "W" LED will be lit indicating the setting value is watts.

3.1.13.5. Dynamic mode (CC, CR or CP modes only):
Each press of the DYN button cycles through the dynamic load settings. The DYN settings are used in conjunction with the High and Low levels Of load current to define the dynamic waveform. Each press of the DYN Button switches from T_Hi (time high), to T_Lo (time low), to Rise time And then to fall time. The middle LCD shows the section of the dynamic Waveform which is programmed with the rotary knob and read from the Lower display. The “ms” LED shows that the settings are programmed in Milliseconds.

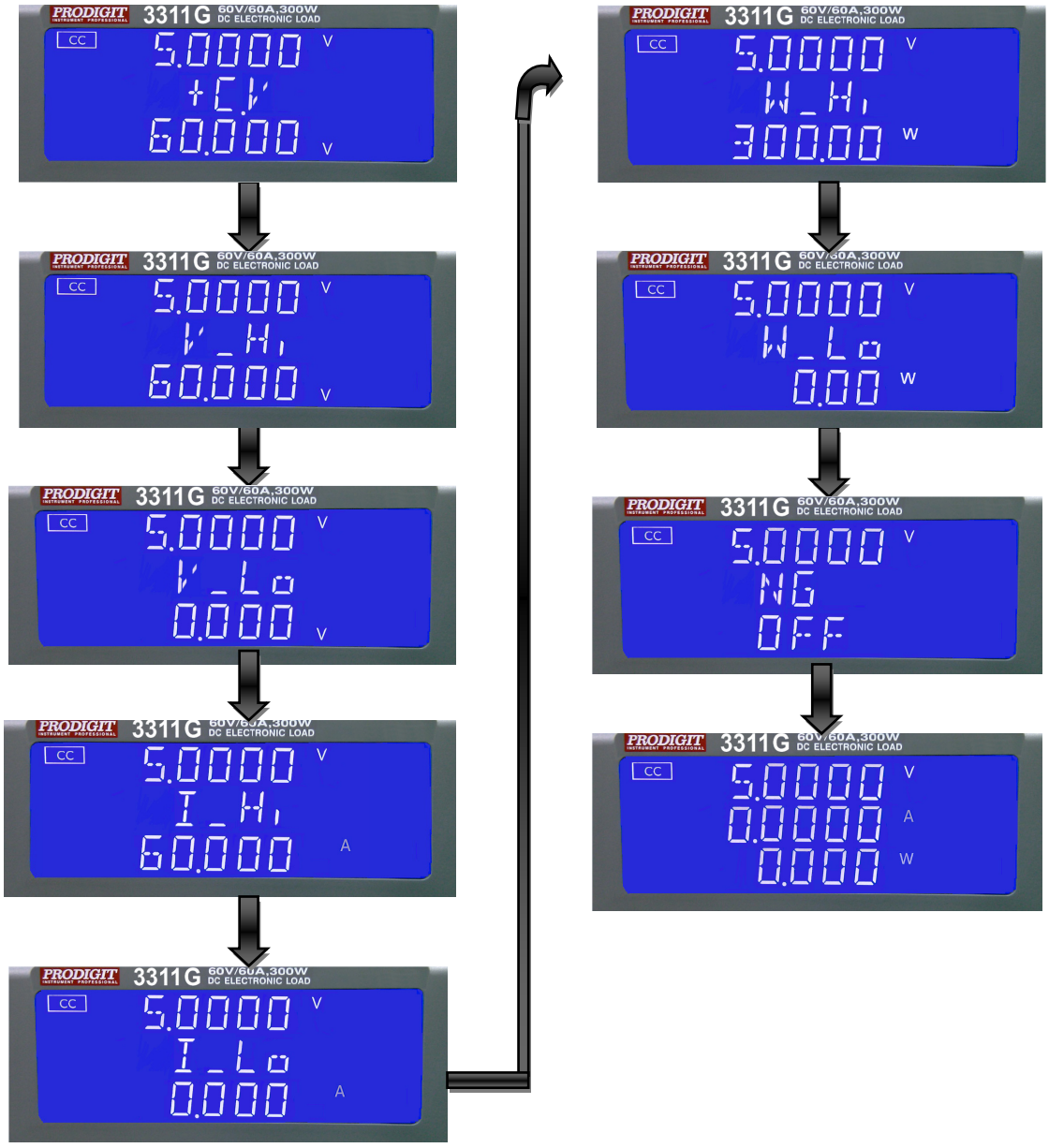
3.1.14. 

key

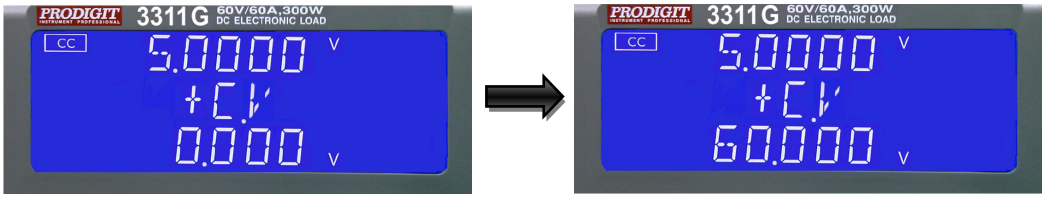
The LIMIT button allows the user to set upper and lower thresholds for voltage, Current or power. These threshold settings are used in conjunction with the NG function to flag when the load is operating outside the desired limits
Each press of the LIMIT key enables a different value to be entered. On first press of the LIMIT key the button will illuminate and +CV 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:

+CV (DVM upper limit) →
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

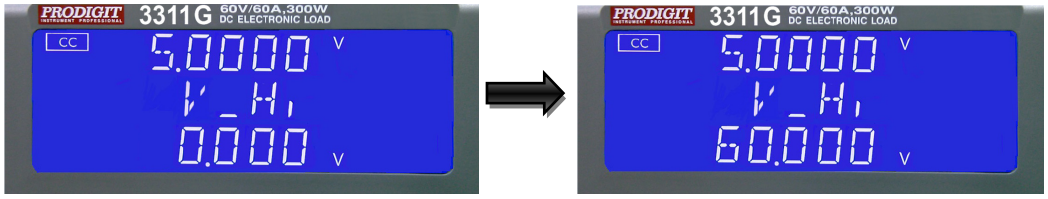
The engineering unit is “V”, “A” or “W” depending on the threshold LIMIT being set.


PRODIGIT 3311G 60V/60A,300W DC ELECTRONIC LOAD
CC
5.0000 V
+CV
60.000 V
V_H,
V_Lo
I_H,
I_Lo
W_H,
300.00 W
W_Lo
0.00 W
NG
OFF
0.0000 A
0.000 W

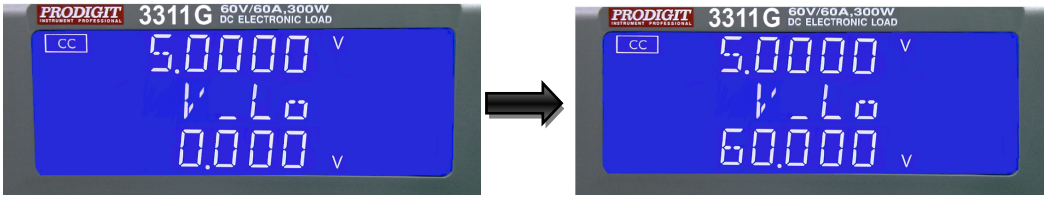
- Setting Upper limit voltage VH , Middle 5 digit LCD display「+CV」,lower 5 Digit LCD display the unit is "V", the +CV set range from 0.000 V to 60.000V step 0.001V by rotating the Setting knob.



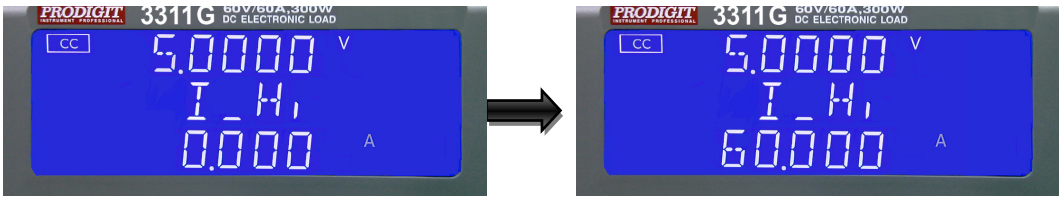
- Setting Upper limit voltage VH , Middle 5 digit LCD display「V-Hi」,lower 5 Digit LCD display the unit is "V", the V-Hi set range from 0.000 V to 60.000V step 0.001V by rotating the Setting knob.



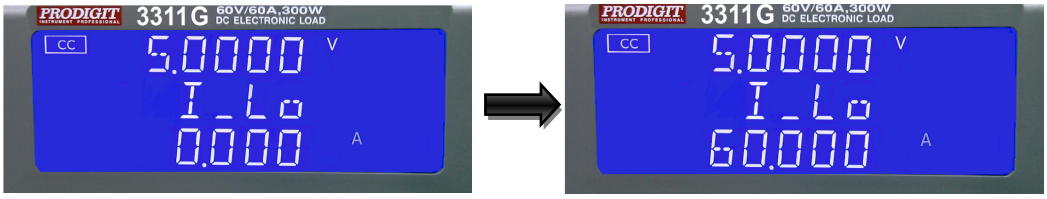
- Setting lower limit voltage VL, Middle 5 digit LCD display「V-Lo」,lower 5 Digit LCD display the unit is "V", the V-Lo set range from 0.000 V to 60.000V step 0.001V by rotating the Setting knob.



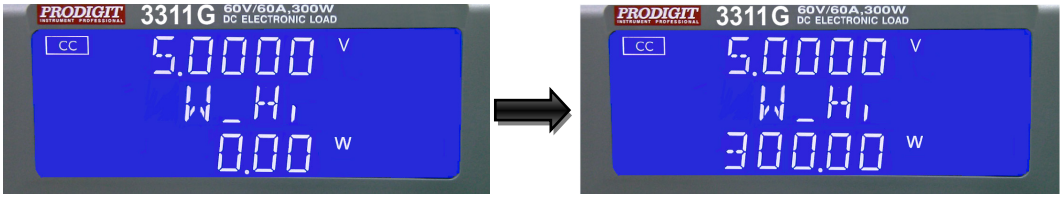
- Setting Upper limit current IH , Middle 5 digit LCD display「I-Hi」,lower 5 Digit LCD display the unit is "A", the I-Hi set range from 0.000 A to 60.000A Step 0.001A by rotating the Setting knob.



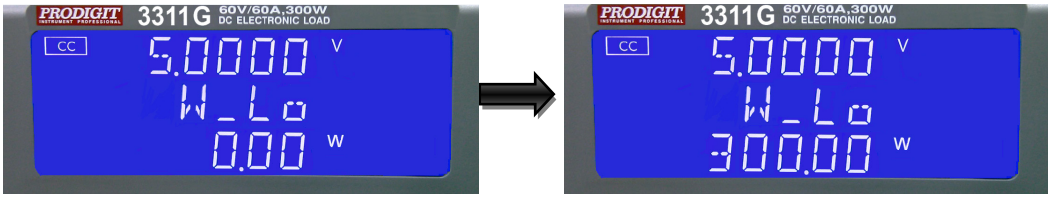
- Setting lower limit current IL , Middle 5 digit LCD display「I-Lo」,lower 5 Digit LCD display the unit is "A", the I-Lo set range from 0.000 A to 60.000A step 0.001A by rotating the Setting knob.



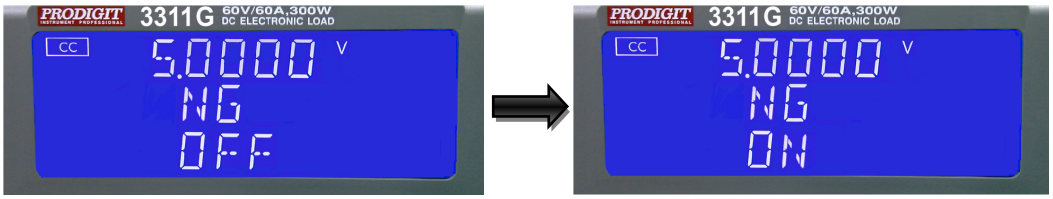
- Setting Upper limit power WH, Middle 5 digit LCD display「W-Hi」lower 5 Digit LCD display the unit is "W", the W-Hi set range from 0.00 W to 300.00W step 0.01W by rotating the Setting knob.



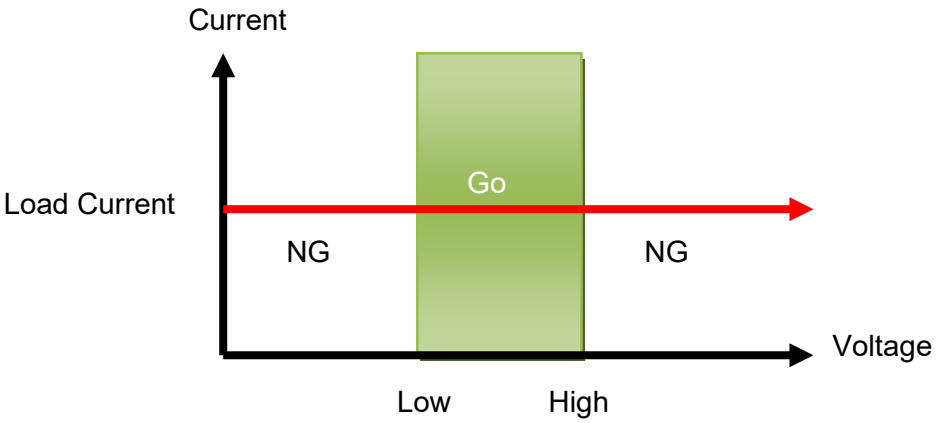
- Setting lower limit power WL, Middle 5 digit LCD display「W-Lo」lower 5 Digit LCD display the unit is "W", the W-Lo set range from 0.00 W to 300.00W step 0.01W by rotating the Setting knob.



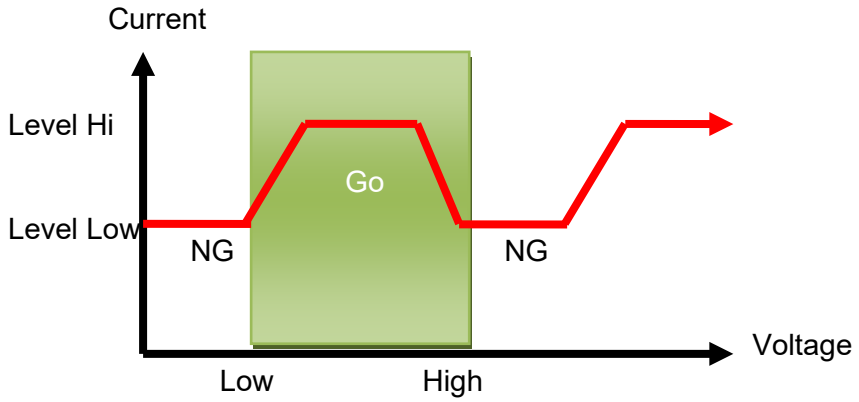
- Setting NG ON/OFF, When exceed VH、VL、IH、IL、WH、WL One of These Whether NG on LCD display.



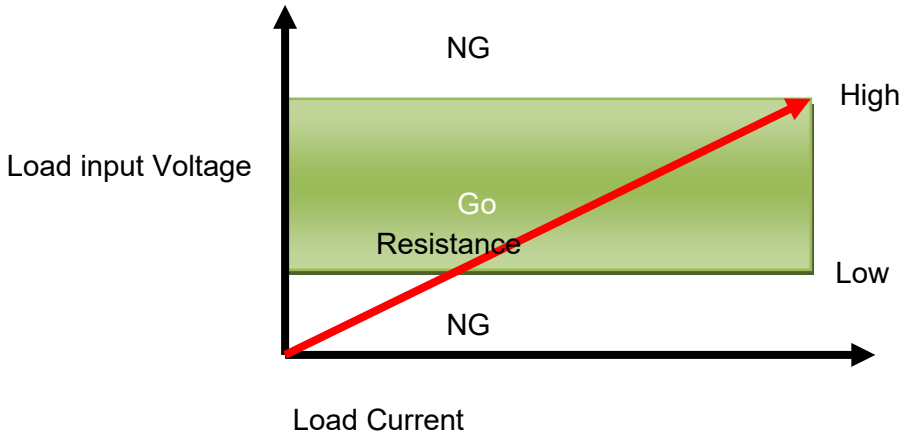
- CC mode, press limits key to set the V-Hi and V-Lo voltage upper and lower Limits of the GO / NG.



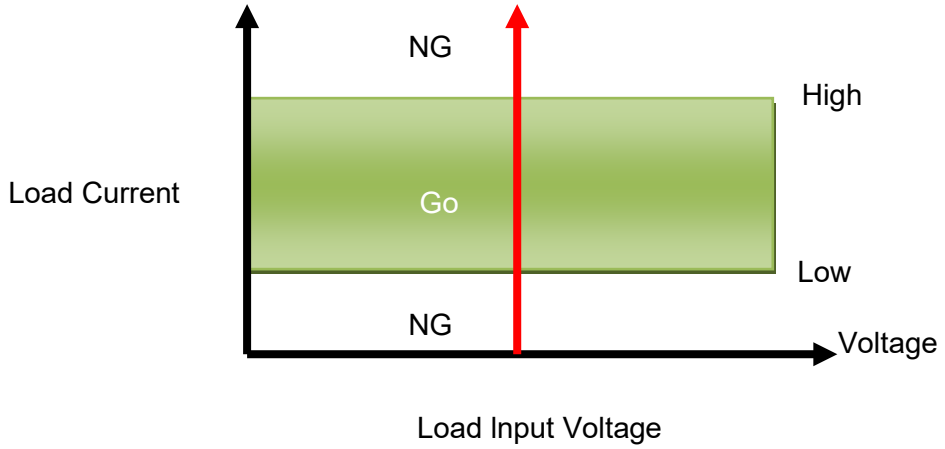
- CC Dynamic Mode, press key to set the Level Hi and Level Low voltage Upper and lower limits of the GO / NG.



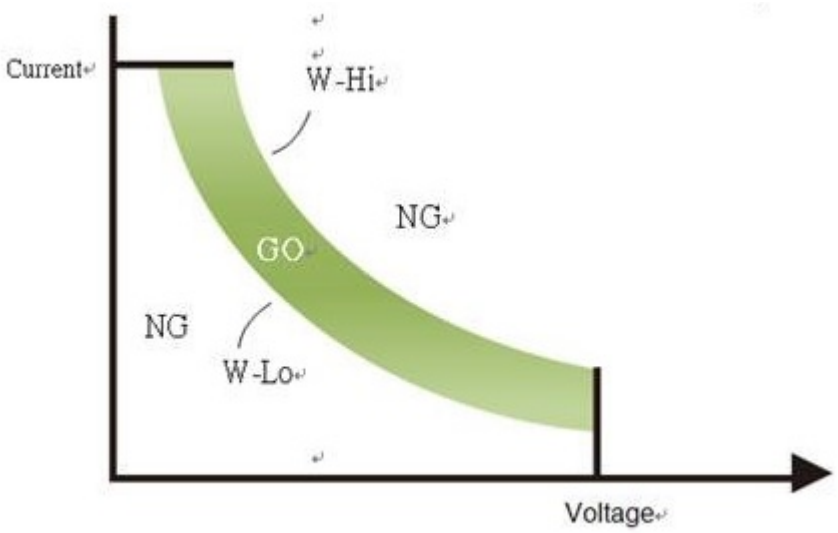
- CR mode, press limits key to set the V-Hi and V-Lo voltage upper and lower Limits of the GO / NG.



- 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.



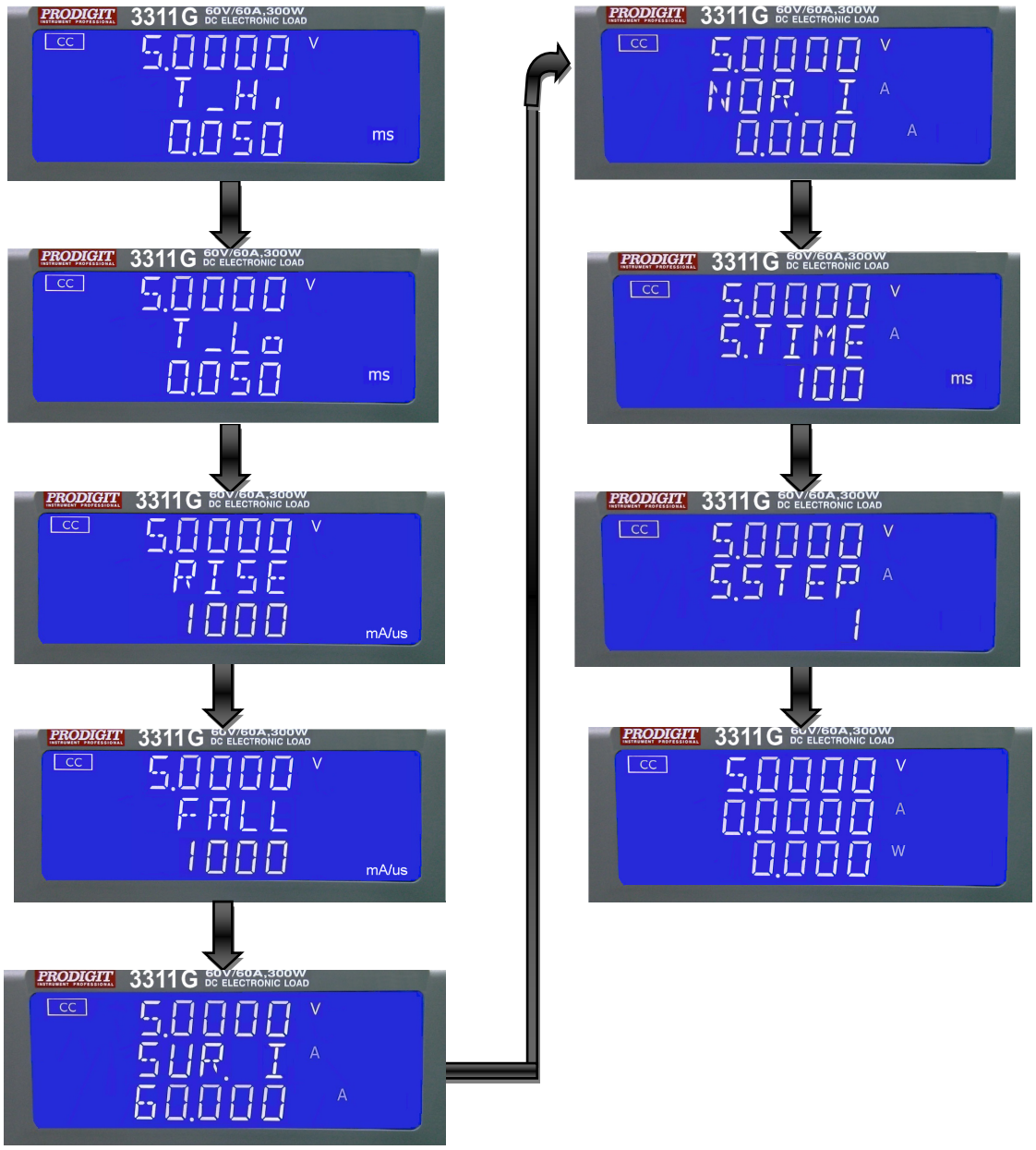
3.1.15. DYN setting Key

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.

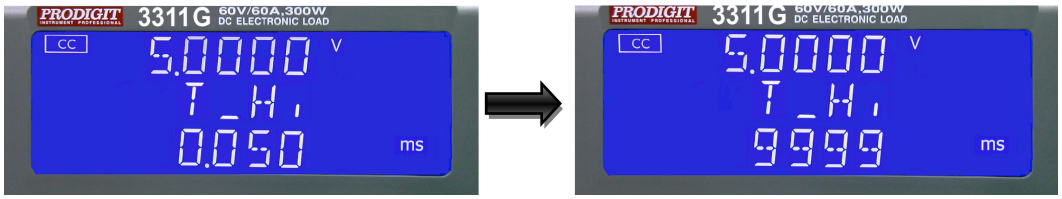
Each press of the DYN key enables a section of the DYNAMIC waveform to be set. On first press of the DYN key the button will illuminate and T-Hi will be displayed On the middle LCD. The value is adjusted with the rotary knob and can be read From the lower LCD during setting. The setting sequence is shown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

T_Hi (time the waveform is high) →
T_Lo (time the waveform is low) →
RISE (rise time) →
FALL (fall time) →
SUR._I →
NOR._I →
S.TIME →
S.STEP →
DYN setting function OFF →

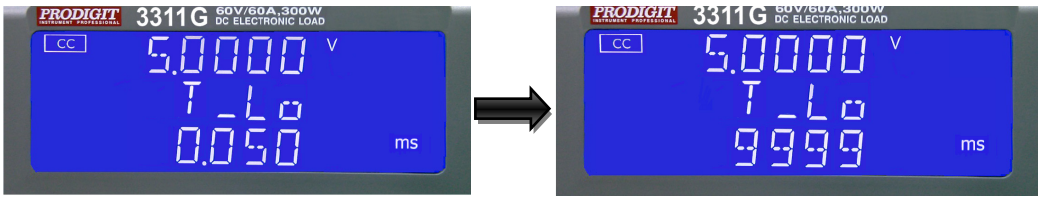
The time that the waveform is high includes the rise time and is set in “ms”
The time that the waveform is low includes the fall time and is set in “ms”
The RISE and FALL time is set in “mA/μs” or “A/μs”. The actual engineering unit is Shown on the right of the lower 5 digit display.


PRODIGIT 3311G 60V/60A,300W DC ELECTRONIC LOAD
CC
5.0000 V
T_H.
0.050 ms
T_Lo
RISE
1000 mA/us
FALL
SUR. I
60.000 A
NOR. I
0.000 A
S.TIME
100 ms
S.STEP
1
0.0000 A
0.000 W

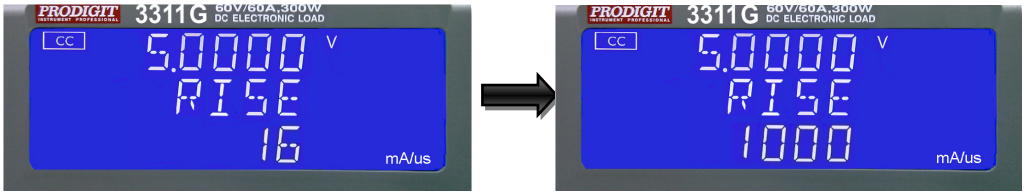
- Press DYN setting key, LED will ON
  Setting level High Period, Middle 5 digit LCD display will show 「T-Hi」 Lower 5 digit LCD display will show setting value, the unit is “ms” , The T-Hi Set range from 0.050 ms to 9999 ms step 0.001ms by rotating the setting Knob.



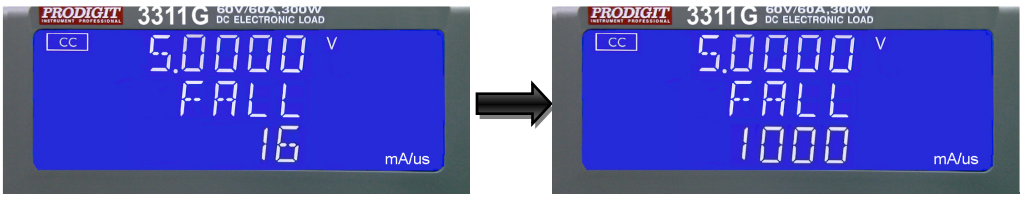
- Setting level Low period, Middle 5 digit LCD display will show 「T-Lo」, Lower 5 digit LCD display will show setting value, the unit is “ms”, The T-Lo Set range from 0.050 ms to 9999 ms step 0.001ms by rotating the Setting Knob.



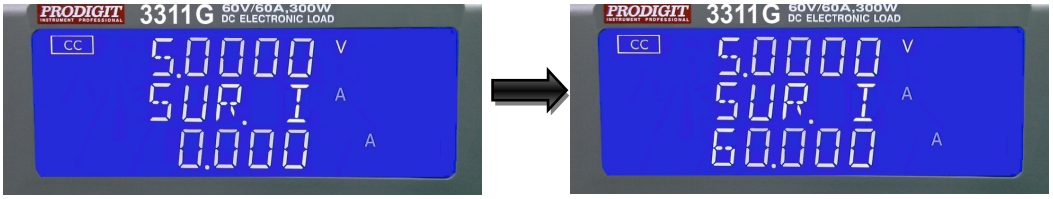
- Setting rise time, Middle 5 digit LCD display will show 「RISE」, Lower 5 Digit LCD display will show setting value, the unit is “mA/μs”, The RISE Time set range from 16 mA/us to 1000 mA/us step 1mA/us by rotating the Setting knob.



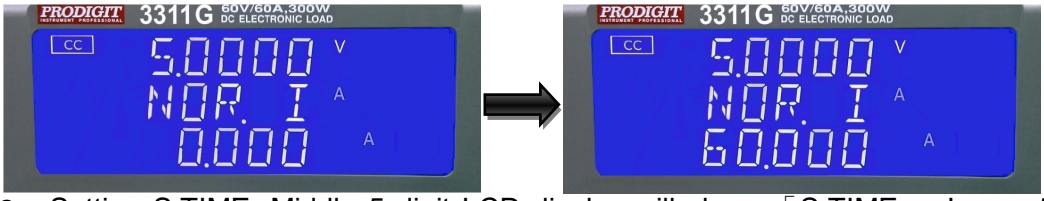
- Setting fall time, Middle 5 digit LCD display will show 「FALL」, Lower 5 Digit LCD display will show setting value, the unit is “mA/μs”, The FALL Time set range from 16 mA/us to 1000 mA/us step 1mA/us by rotating the Setting knob.



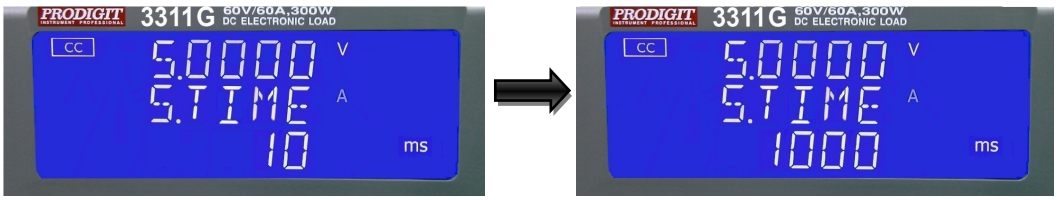
- Setting Surge current, Middle 5 digit LCD display will show 「SUR_I」, Lower 5 Digit LCD display will show setting value, the unit is “A”, the surge current set range from 0.000 A to 60.000A step 0.003A by rotating the setting knob.



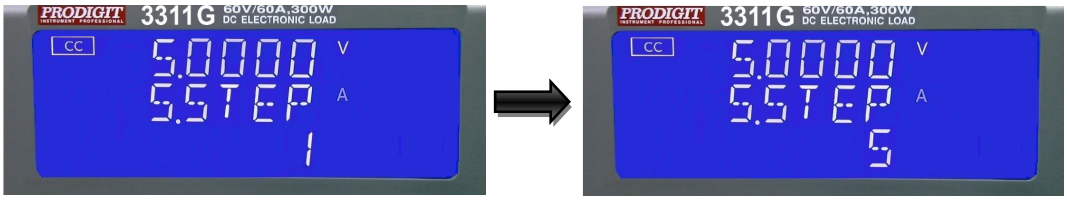
- Setting normal current, Middle 5 digit LCD display will show 「NOR_I」, Lower 5 Digit LCD display will show setting value, the unit is “A”, The Normal current set range from 0.000 A to 60.000A step 0.003A by rotating the setting knob.



- Setting S.TIME, Middle 5 digit LCD display will show 「S.TIME」, Lower 5 Digit LCD display will show setting value, the unit is “ms”, the surge current time set range from 10 to 1000ms step 10ms by rotating the setting knob.



- Setting S.STEP, Middle 5 digit LCD display will show 「S.STEP」, Lower 5 Digit LCD display will show setting value, the S.STEP set range from 1 to 5, Press the START key to start the test.

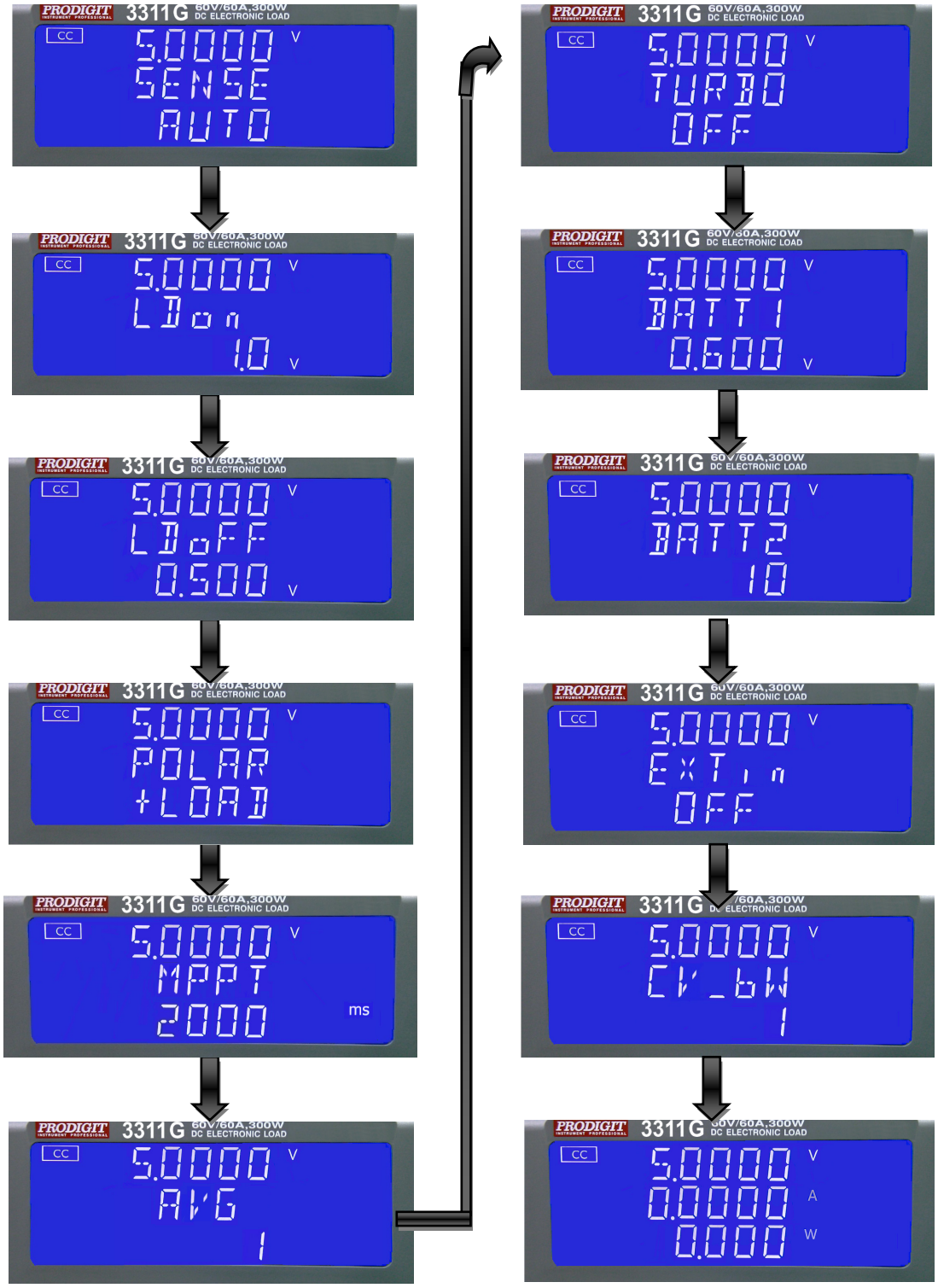


3.1.16. Config key

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

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

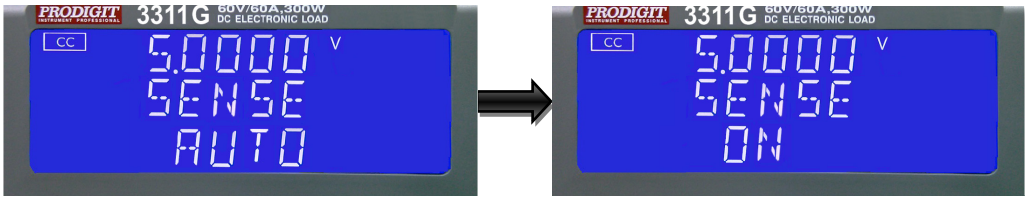
SENSE (AUTO or ON) →
LDon (Voltage at which LOAD turns ON) →
LDoff (Voltage at which LOAD turns OFF) →
POLAR (change polarity symbol) →
MPPT (maximum power point tracking) →
AVG (Measuring V.I of Average) →
TURBO (OFF or ON) →
BATT1 →
BATT2 (0~99999) →
EXTIN (OFF or ON) →
CV_bW (1~4) →
Exit CONFIG options


PRODIGIT 3311G 60V/60A,300W DC ELECTRONIC LOAD
CC
5.0000 V
SENSE
AUTO
5.0000 V
LDon
1.0 V
5.0000 V
LDoFF
0.500 V
5.0000 V
POLAR
+LOAD
5.0000 V
MPPT
2000 ms
5.0000 V
AVG
1
5.0000 V
TURBO
OFF
5.0000 V
BATT1
0.600 V
5.0000 V
BATT2
10
5.0000 V
EXTon
OFF
5.0000 V
CV_bW
1
5.0000 V
0.0000 A
0.000 W

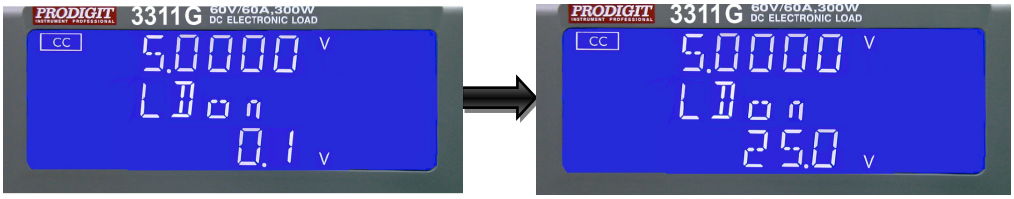
Note 1: The adjustable LDon (LOAD ON) voltage is valid for CC, CR & CP operating Modes. The adjusted LDon voltage will not operate in CV mode.

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

- Setting Vsense and load input switching methods, the middle of the 5 digit LCD Display will show "SENSE", Lower 5 digit LCD display will show "AUTO" or "ON".



- 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 0.0V to 25.0V step 0.1V by rotating the setting knob. If the load is greater than the input voltage Load ON voltage setting, the Electronic load current begin to load on.

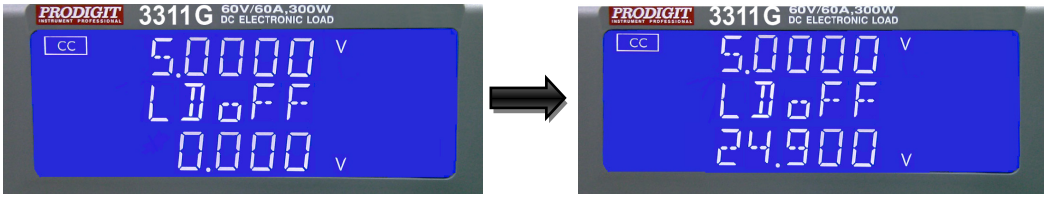


NOTE1: CC/CR/CP MODE is controlled by Load ON voltage, CV MODE is not Controlled by Load ON voltage.

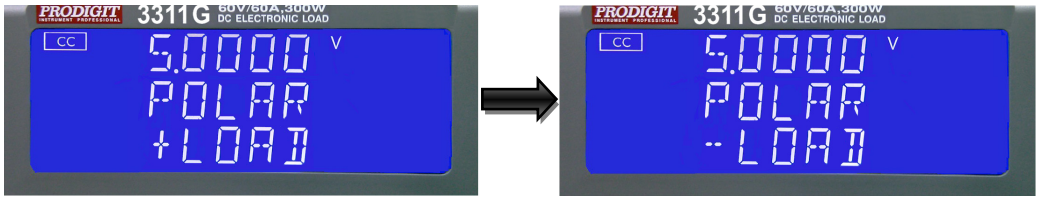
NOTE2: If Load ON voltage Setting 0V, load OFF voltage has to setting to 0V.

NOTE3: The programmed load ON voltage for model 3310G, 3311G, 3315G, 3316G, 3317G, 3317G-M Load module is from 0 to 25V, Model 3312G is from 0 to 50V, and Model 3314G, 3318G, 3319G, 3319G-M is from 0 to 100V.

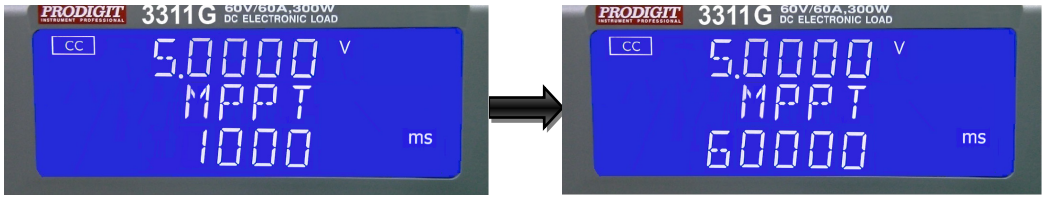
- Setting Load OFF voltage, the middle of the 5 digit LCD display will show "LDoFF", lower the 5 digit LCD display will show settings value, the units is V, The Load OFF Voltage set range from 0.0V to 24.9V step 0.1V by rotating the Setting knob.
  If the load input voltage is less than Load OFF setting 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 MPPT , the middle of the 5 digit LCD display will show "MPPT", lower The 5 digit LCD display will show settings value, The MPPT set range from 1000ms to 60000ms step 1000ms by rotating the Setting knob, Default is 2000ms.



- **The MPPT algorithm for 3310G series DC Load**

  Many photovoltaic (PV) devices, such as PV panels and concentrated photovoltaic (CPV) modules, require outdoor testing for design verification, durability, and safety. A low cost means of testing the output power of PV devices outdoors is to use DC electronic load; it provides high power-handling capability at a low cost.

  Often one of the main functions of outdoor PV testing is maximum power-point tracking (MPPT). But because eloads are general-purpose instruments, it is up to the PV test engineer to implement an algorithm in test software to perform MPPT.

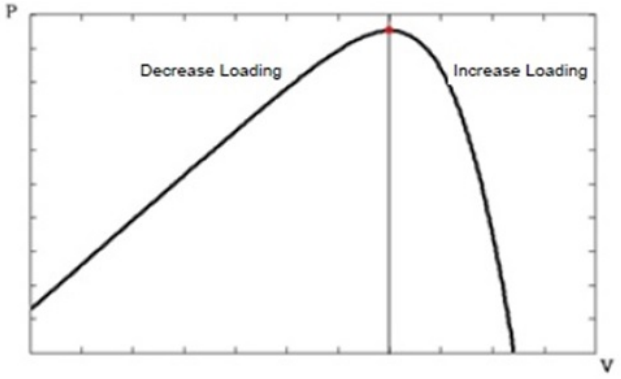
  Fortunately, there are a lot of MPPT algorithm you can choose from, with more than 19 published papers on the implementation and performance of different MPPT algorithm. However, these algorithms were designed for solar inverters. Inverter are different for test systems, so a MPPT algorithm that performs well in an inverter may not necessarily perform well in a PV test system. This article introduces a MPPT algorithm that is a good fit for PV testing with an eload. We discuss how the algorithm is implemented and why it's a good fit for MPPT in outdoor PV test systems.

  The main difference between implementing a given MPPT algorithm in an inverter and an eload is in the I/O latency. In inverters, the MPPT algorithm runs on an internal microprocessor that can measure and compute and make load adjustments in microseconds. To perform the same set of operations with custom software and an eload could easily take tens of milliseconds due to the unavoidable I/O latency between the computer and the eload. This I/O latency is the main bottleneck affecting tracking speed. With that in mind, we chose and modified the MPPT algorithm discussed in this article to meet the needs of a PV test system using the 3310G series eload.

An eload is an instrument that can sink and measure the output power of a power source, such as a power supply or a PV device. Like a variable resistor, an eload can be adjusted to control the amount of power it is sinking. Eloads can measure the voltage drop across them and the current they are sinking. Eloads typically have four modes of operation: constant current, constant resistance, constant voltage and constant power. The eload will maintain its mode setting even when the power output of the source it is connected to changes. For instance, if the eload is connected to the output of a PV panel and has a constant-voltage (CV) mode setting of 30V, it will adjust its internal resistance to remain at 30V as the I-V curve of the panel varies. If the maximum voltage of the panel (Voc) drop below 30V, the eload will act like an open and the voltage across it will be whatever Voc is. In photovoltaic test, eloads are typically used in CV mode, so we will use this mode for defining the algorithm.

- 3310G series ELOAD MPPT algorithm
  The algorithm that will be used for performing MPPT with the 3310G series eload is a modified version of the Perturbation and Observation (P&O) algorithm, which we will refer to as the Perturbation and Observation for 3310G series load MPPT algorithm. The 3310G series load MPPT algorithm works by comparing the small perturbation values and sampling of instantaneous values of a PV device's output. These values give us the measuring change in the V-P curve to tell us if we are already at the MPP. If we are not at the MPP, it tells us which way to go on the curve to find it.

  The mathematical relationships of voltage and power that 3310G series uses to track the MPP can be expressed as:
  At MPP: $P_n-P_{n-1}=0$
  Right of MPP : $P_n-P_{n-1}>0$ and $V_n-V_{n-1}<0$, $P_n-P_{n-1}\leqq 0$ and $V_n-V_{n-1}\geqq 0$
  Left of MPP : $P_n-P_{n-1}\leqq 0$ and $V_n-V_{n-1}<0$, $P_n-P_{n-1}>0$ and $V_n-V_{n-1}\geqq 0$



$P_n-P_{n-1}>0$	$V_n-V_{n-1}\geqq 0$	Location	Tracking Load
False	False	Left	Decrease
False	True	Right	Increase
True	False	Right	Increase
True	True	Left	Decrease

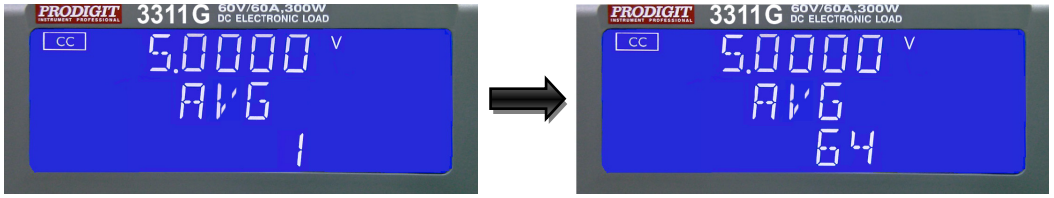
- How to operating MPPT in 3310G series load
  Manual Operation:
  Press "Config" key 5 times to MPPT function and the initial tracking interval time is 2000mS than press "Start/Stop" key to going to track the MPP (The operation mode will be goes to CV mode and Load ON automatically.)
  1. Power ON 3310G series Load
  2. Connecting UUT (PV panel) to load input terminal
  3. Press "Config" 5 times to MPPT function
  4. Adjust the interval time (Initial is 2000mS) by knob switch or adjust key

(every 2000mS record a voltage, current and power data in the internal memory, that can be record about 720 data, The MPP tracking will be stop when memory is full. The memory data will be clear when power OFF)

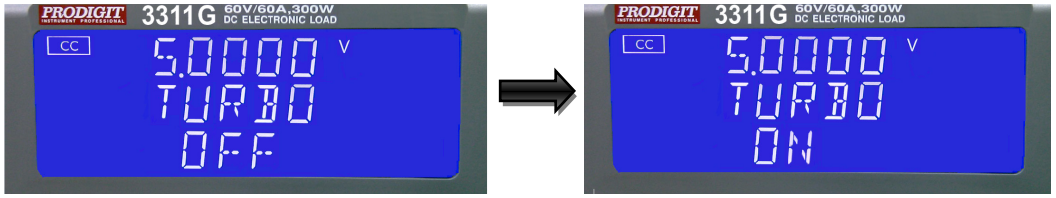
5. Press Start/Stop to start tracking MPP of UUT
6. The voltage, current and power (MPP) will display on the meter of 3310G series load.
7. Press Start/Stop to stop to tracking the MPP of UUT. Or the record memory is full.

- **Remote Operation with remote command:**
  1. Power ON 3310G series Load
  2. Connecting UUT (PV panel) to load input terminal
  3. Sent MPPTIME interval time (MPPTIME{sp} NR2, MPPTIME 1000, the range is 1000 to 60000 mS), the record data is no limitation in 3310G series internal memory.
  4. Sent command MPPT ON to start tracking MPP of UUT
  5. Sent MPP? command to read back the voltage, current and power (MPP)
  6. Sent MPPT OFF to stop tracking the MPP of UUT

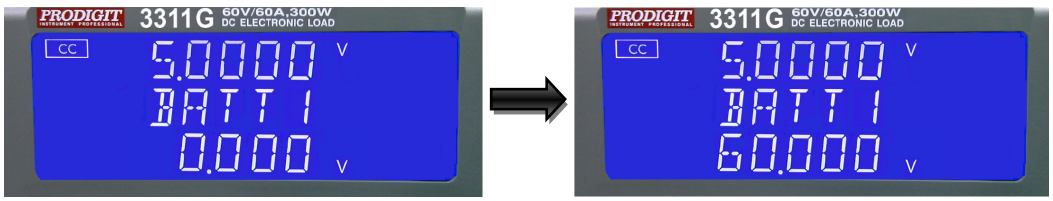
- Setting AVG , the middle of the 5 digit LCD display will show "AVG", lower the 5 digit LCD display will show settings value, the AVG set range from 1 to 64 steps 1 by rotating the setting knob.



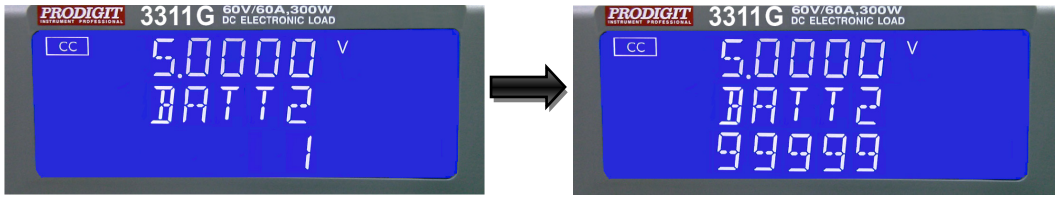
- Setting TURBO , the middle of the 5 digit LCD display will show "TURBO", Lower the 5 digit LCD display will show "OFF" or "ON".



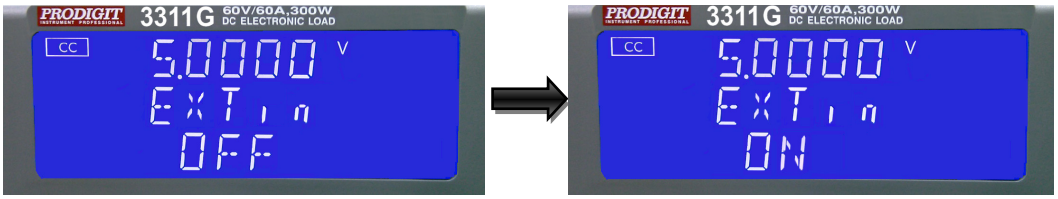
- Setting BATT1 voltage , Middle 5 digit LCD display「BATT1」,lower 5 digit LCD display the unit is "V" ,The BATT1 set range from 0.000 V to 60.000V step 0.001V by rotating the Setting knob, Default is 0.6V.



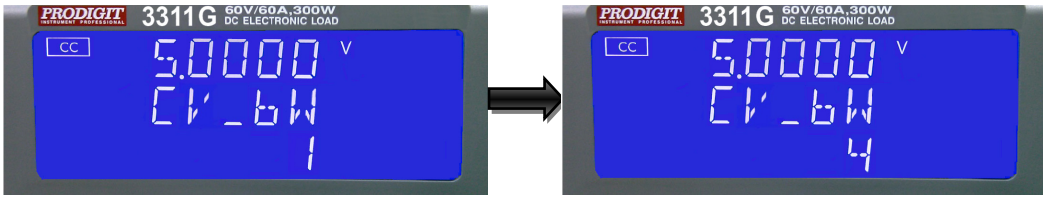
- Setting BATT2 , Middle 5 digit LCD display「BATT2」,lower 5 digit LCD Display, The BATT2 set range from 1 to 99999 step 1 by rotating the Setting knob.



- The Middle 5 digit monitor display the EXTIN and lower monitor display OFF or ON for 3310G Series external input disable or enable. Default is OFF.



- The Middle 5 digits monitor display the “CV_bW” and lower monitor display for different bandwidth. The range is 1~4, Default is 1.

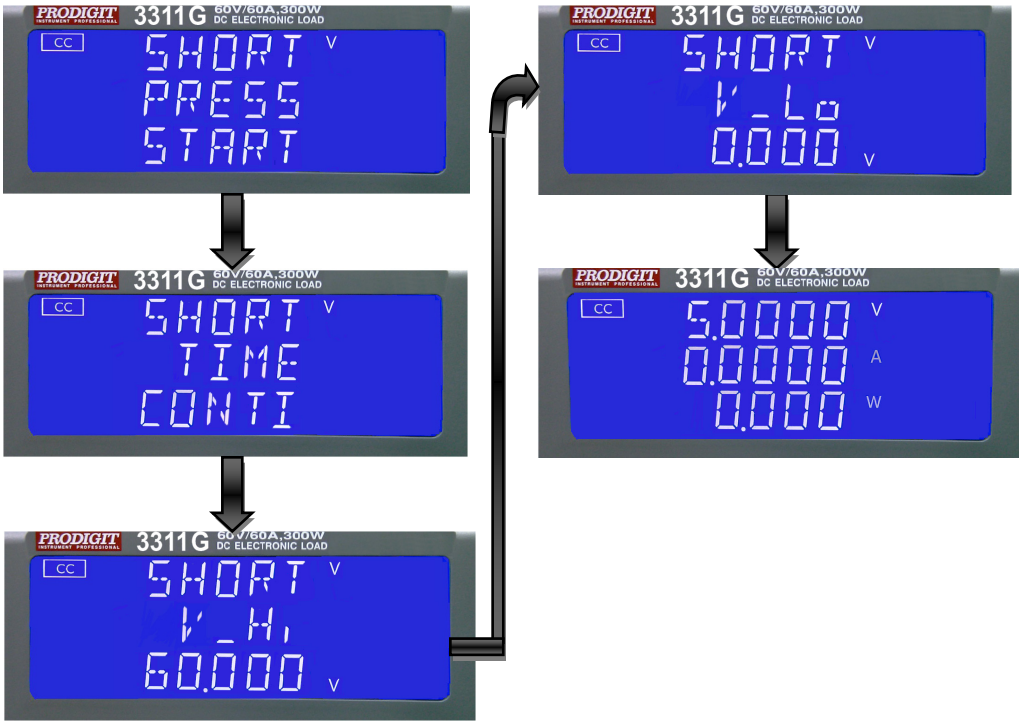


3.1.17. **Short** key

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 3310G 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.

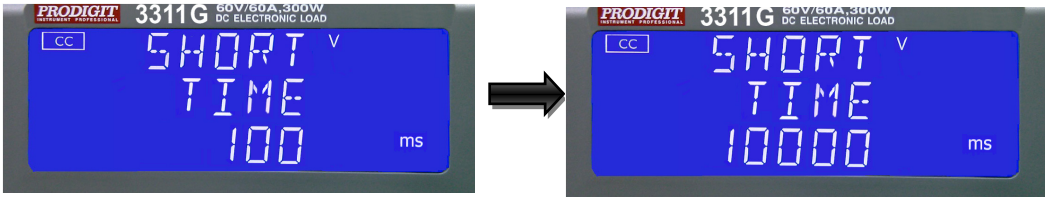
Pressing the SHORT key once will cause the button to illuminate. The Message “SHORT PRESS START” will be shown across the 3 displays.
Each press of the SHORT key moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary 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

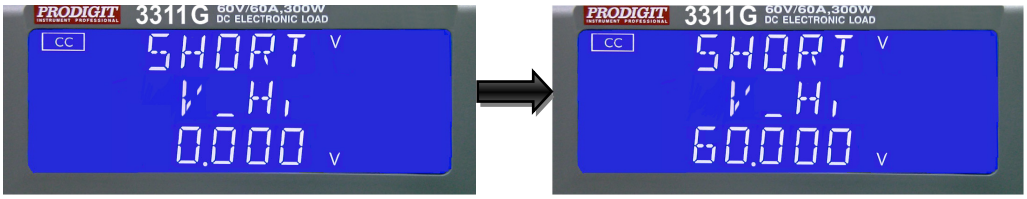


- setting the short test time，The LCD display show 「SHORT」 on upper 5 digits LCD display，shows 「TIME」on middle 5 digits LCD display，lower 5 digit LCD display 「CONTI」, the unit is "ms".

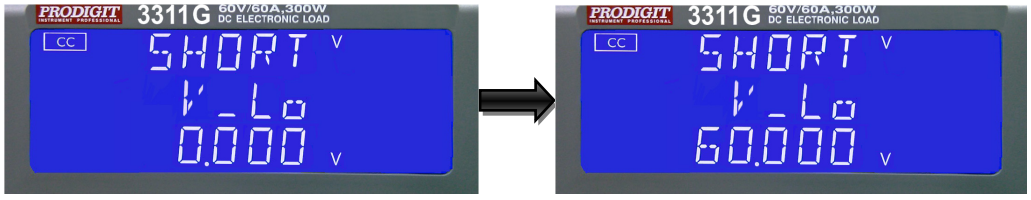
- TIME: setting the short test time, The LCD display show 「SHORT」 on upper 5 digits LCD display, shows 「TIME」on middle 5 digits LCD display the unit is “ms” ,and shows 「CONTI」 on lower 5 digits LCD display, the Setting range is “CONTI” means continue, 100mS to 10000mS step 100mS By clockwise rotate the 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 60.000V step 0.001V 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 60.000V step 0.001V by rotating the setting knob.



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

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

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

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

3.1.18. OCP key

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

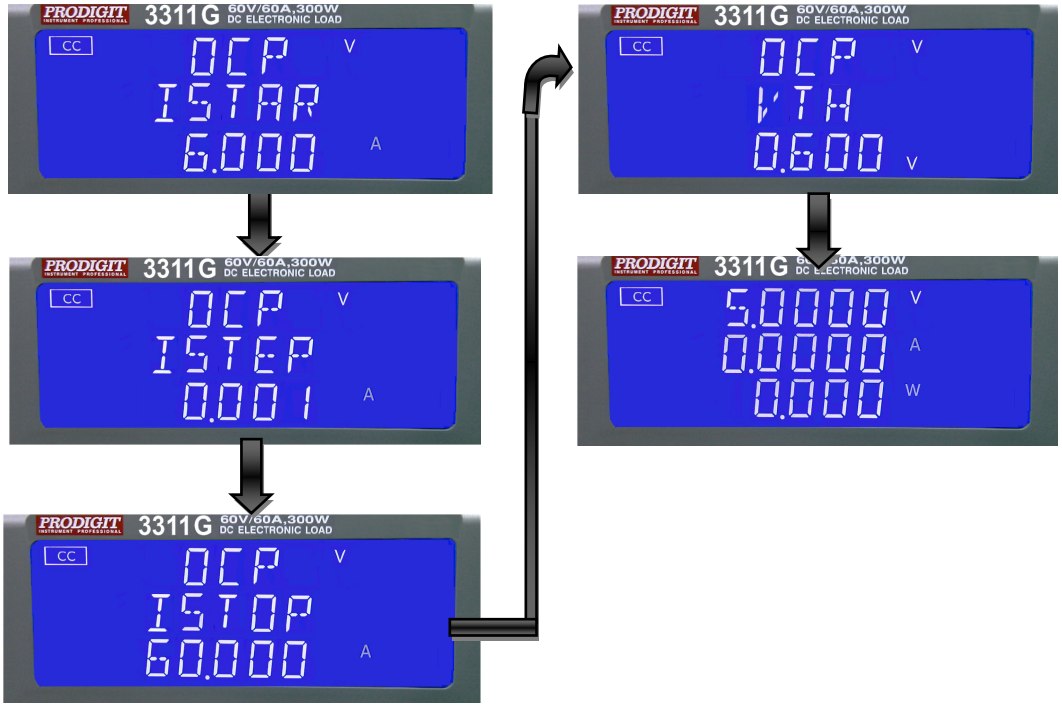
Current reaches the I STOP Threshold the test will be discontinued and the OCP ERROR message will be displayed.

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

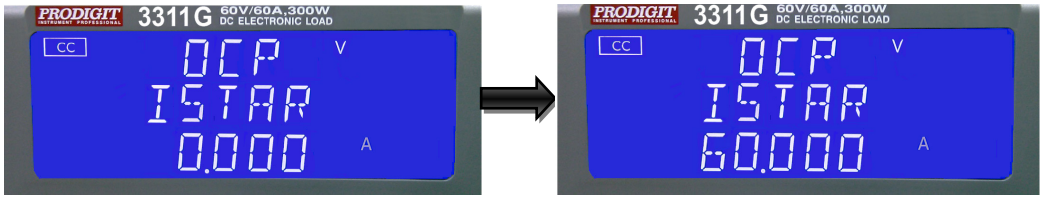
Each press of the OCP button moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during Setting.

The setting sequence is shown below:

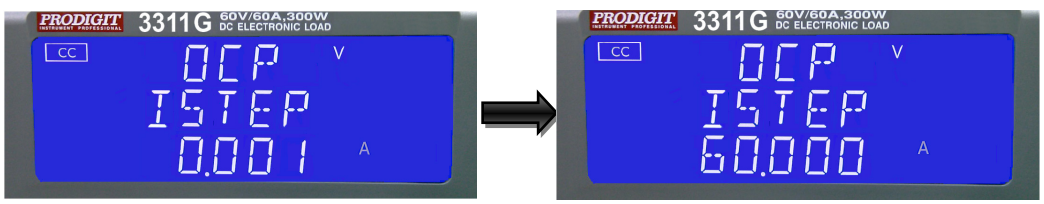
OCP PRESS START (pressing the red start/stop key starts test) →
OCP I STAR (current starting point of the OCP test) →
OCP I STEP (value of incremental current steps from I START) →
OCP I STOP (the OCP test's upper current threshold →
OCP Vth (the voltage threshold setting) →
Exit OCP test set-up



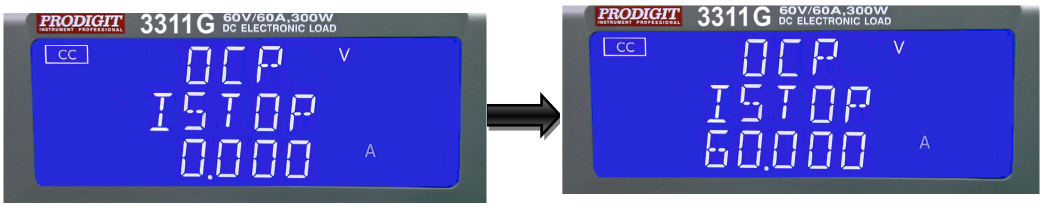
- ISTAR: setting the start current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTAR」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.000A to the full scale of the CC mode specification.
  The setting is by rotating the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



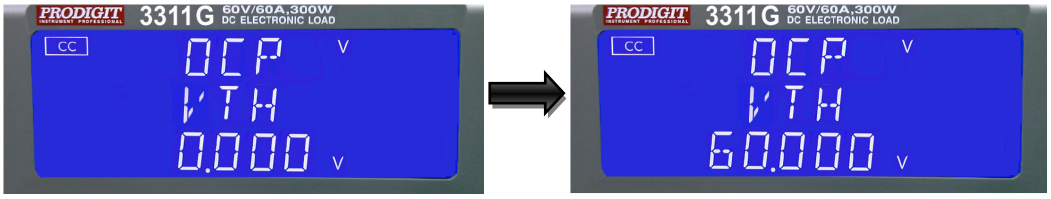
- ISTEP: setting the increment step current point, The LCD display shows 「OCP」on upper 5 digit LCD display, Middle 5 digit LCD display「ISTEP」,lower 5 digit LCD display setting value, the unit is "A".
  The setting range is 0.001A to the full scale of the CC mode specification.
  The setting is by rotating 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.

3.1.19. OPP key

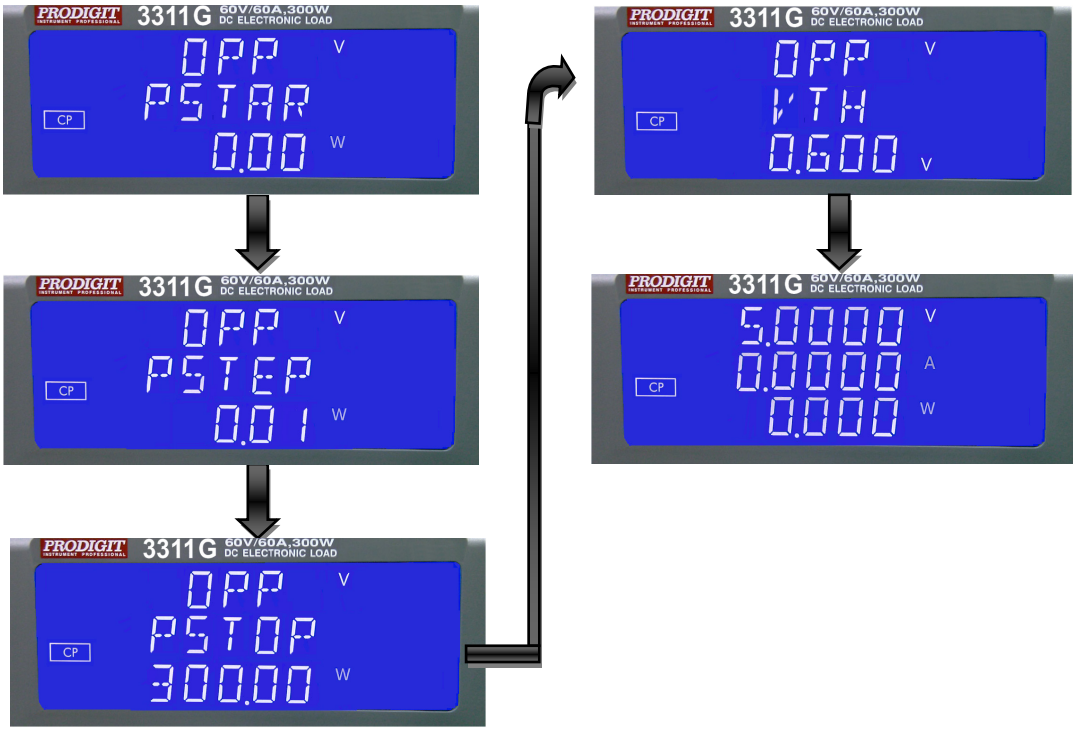
The OPP key allows the parameters of an Over Power Protection test to be entered. The OPP test will ramp up the load power in steps to validate the Device under Test's (DUT) protection and behavior. A voltage threshold level can be set. If the voltage measured during the test is lower than the set Threshold 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.

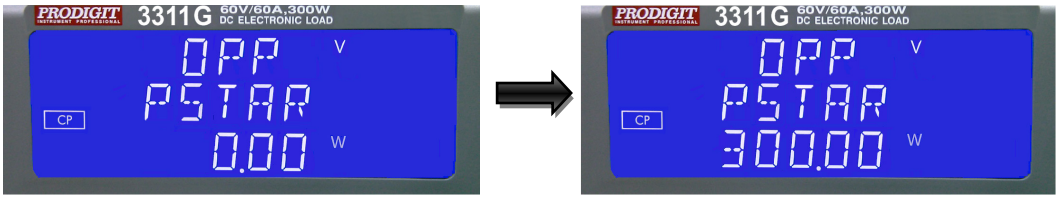
Each press of the OPP button moves the menu on one step. The upper and Middle LCDs show the currently selected test parameter as text. The value is adjusted by the rotary knob and can be read from the lower display during Setting.

The setting sequence is shown below:

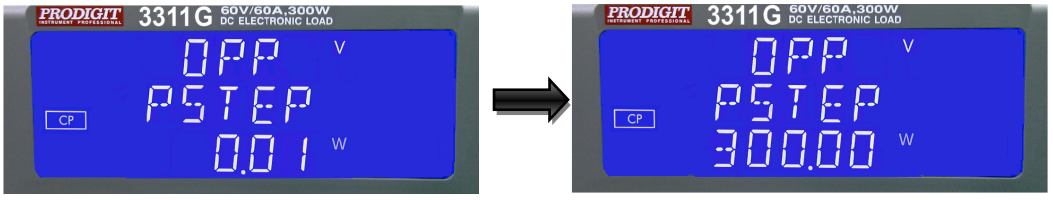
OPP PRESS START (pressing the red start/stop key starts test) →
OPP P STAR (power starting point of the OPP test) →
OPP P STEP (value of incremental current steps from P START) →
OPP P STOP (the OPP test's upper threshold power limit) →
OPP Vth (the voltage threshold setting) →
Exit OPP test set-up



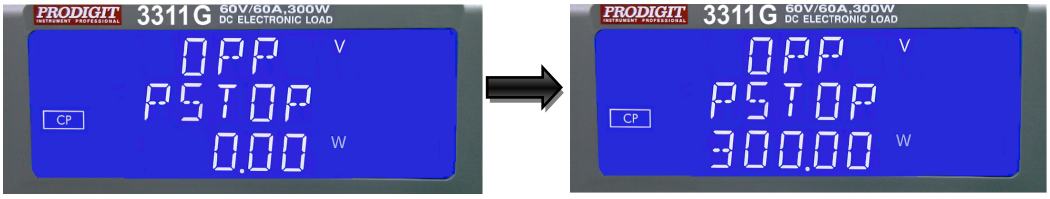
- PSTAR: setting the start power, The LCD display shows 「OPP」on upper 5 digit LCD display, Middle 5 digit LCD display「PSTAR」,lower 5 digit LCD display setting value, the unit is "W", the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting knob.



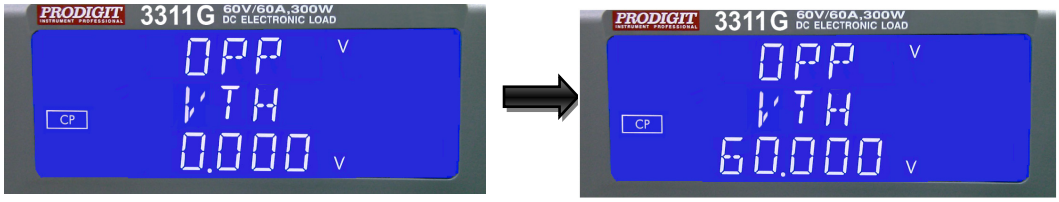
- PSTEP: setting the increment step power, The LCD display shows 「OPP」on upper 5 digit LCD display, Middle 5 digit LCD display「PSTEP」,lower 5 digit LCD display setting value, the unit is "W", the setting range is 0.00W to the full scale of the CP mode specification. The setting is by rotating the setting 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 0.000V 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 OPP PRESS START text is displayed. During the test the middle LCD will show run and the actual power being taken will be displayed on the lower LCD.

Note 1: The message OPP 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 (OPP Vth) during the test
(b) The current taken from the DUT reaches the OPP P STOP setting.

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

Note 3: If the DUT passes the OPP test the maximum power taken during the test is displayed on the lower LCD.

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

3.1.20. 

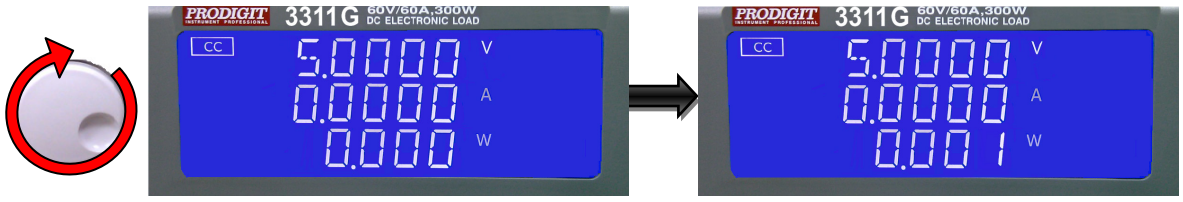
key

The red START/STOP key is used in conjunction with the FUSE, BMS, 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 FUSE, BMS, SHORT, OCP & OPP tests.

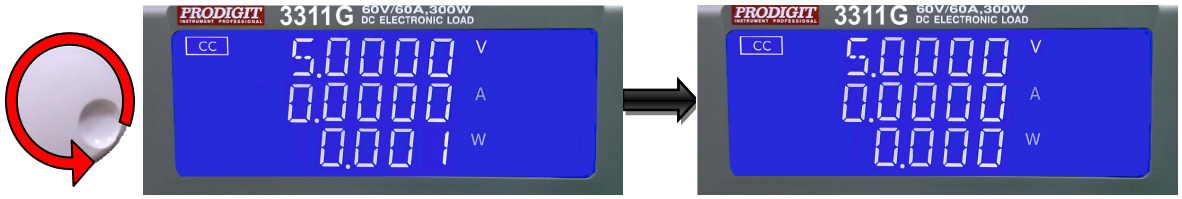
3.1.21. ROTARY Knob and ARROW Keys

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

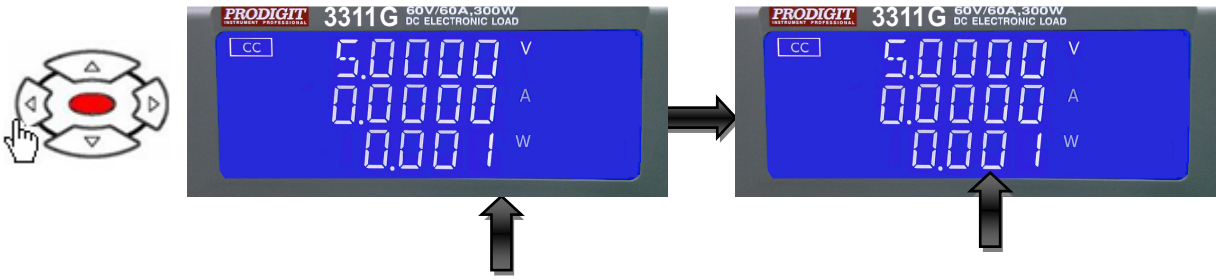
- CLOCKWISE operation of the ROTARY Knob increases the setting value.



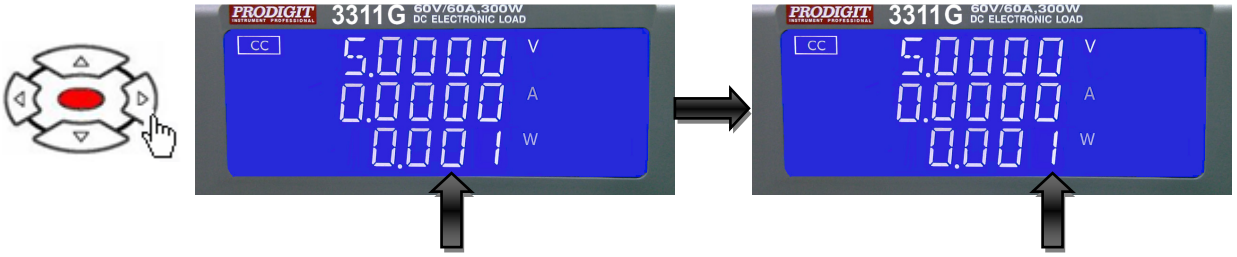
- ANTI-CLOCKWISE operation of the ROTARY Knob decreases the setting value.



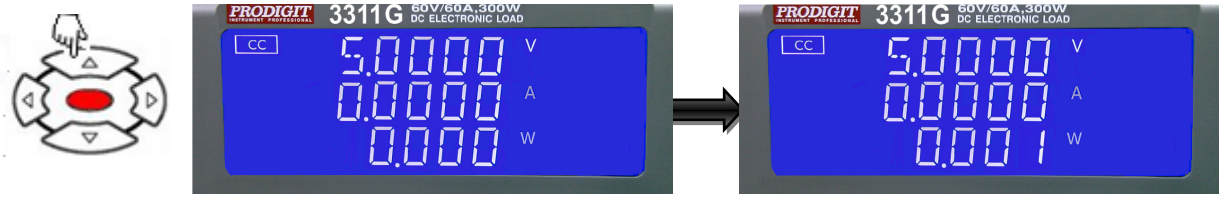
- LEFT ARROW key: Moves the setting selection one digit to the left.



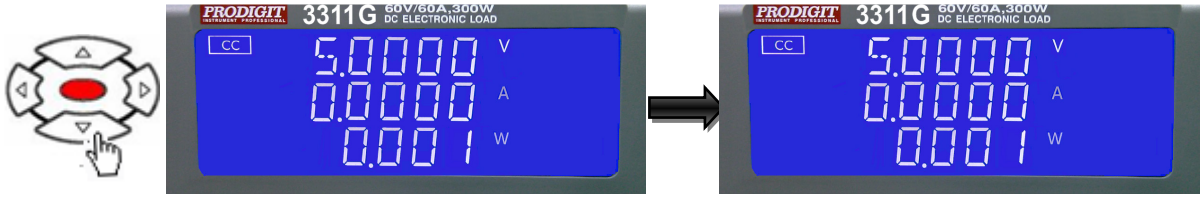
- RIGHT ARROW key moves the setting selection one digit to the right.



- UP ARROW key increases the setting value.



- DOWN ARROW key reduces the setting value.



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

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

3.1.22. DC INPUT Terminal.

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

Please ensure that the voltage and current rating of the DUT do not exceed the maximum rating of the 3310G load module being used. Please also check the output polarity of the DUT prior to connection and testing.

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

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

3.1.23. V-sense input terminal

The V-sense terminals can be used to compensate for a voltage drop in the load lines between the power supply and the 3310G series Electronic Load. This is a useful feature useful when the load current is relatively high.

If remote sense is required the V-sense terminals are connected to the appropriate positive and negative terminals of the power supply as shown in Fig 3-2.

In the CONFIG menu the V-sense function can be set to AUTO or ON.

Please note that if V-sense is set to 'AUTO' and the sense leads are connected to The DUT the losses need to be approx. 600~800mV (3310G, 3311G & 3315G) or 3~4V (3312G), 6~8V(3314G) before the display compensates for the voltage loss.

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

The maximum voltage sense compensation is the same as the rating of the 3310G series electronic load module. For example the 3315G is capable of sinking current at up to 60Vdc. Therefore the maximum V-sense is also 60Vdc.

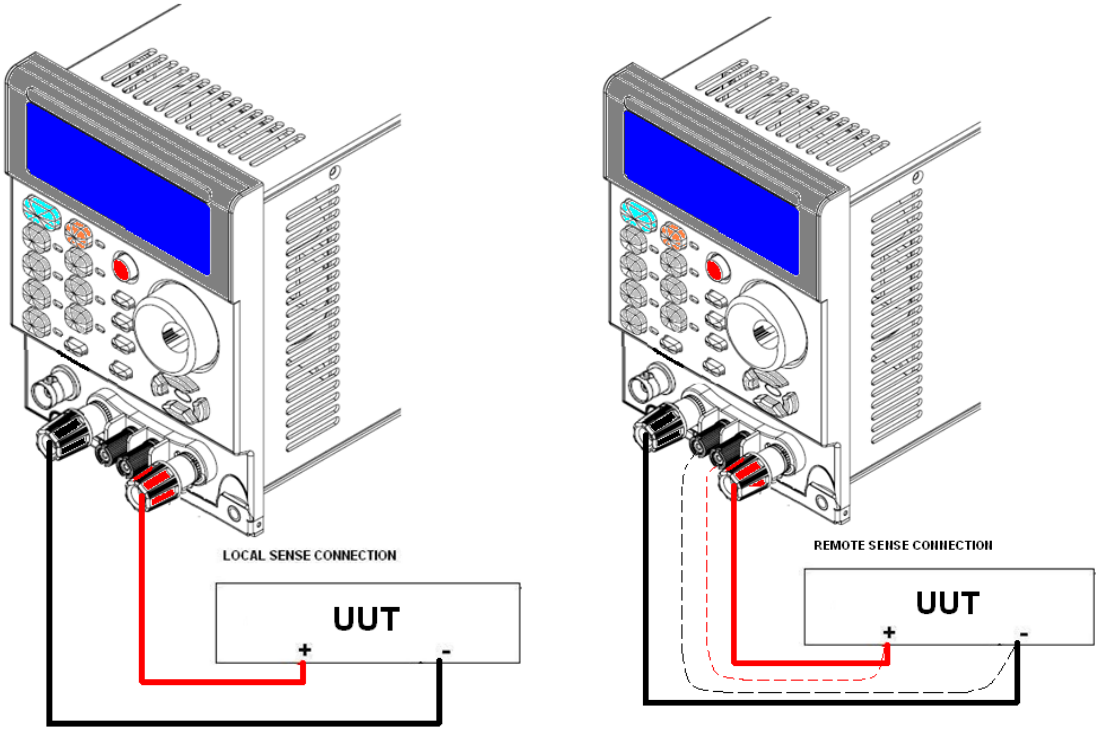


Fig 3-2 typical connection of 3310G series load module

3.1.24. I-monitor

The I-monitor is provided as a BNC socket. It is designed to enable the user to Monitor the Electronic Load's input current or short current. The I-monitor's signal Is 0V to 10V. This signal is proportional to the full scale current that the particular Electronic Load module is capable of.

For example. 3311G: Imax = 60A therefore I-monitor 10V = 60A so 1V = 6A

Please refer to the specification Table 1-1 for the maximum current that each 3310G series module is capable of.

The current monitor of this unit is NOT isolated. Please be careful when you connect an oscilloscope. Improper connections are likely to cause damage. Please follow the connection rule on the following page.

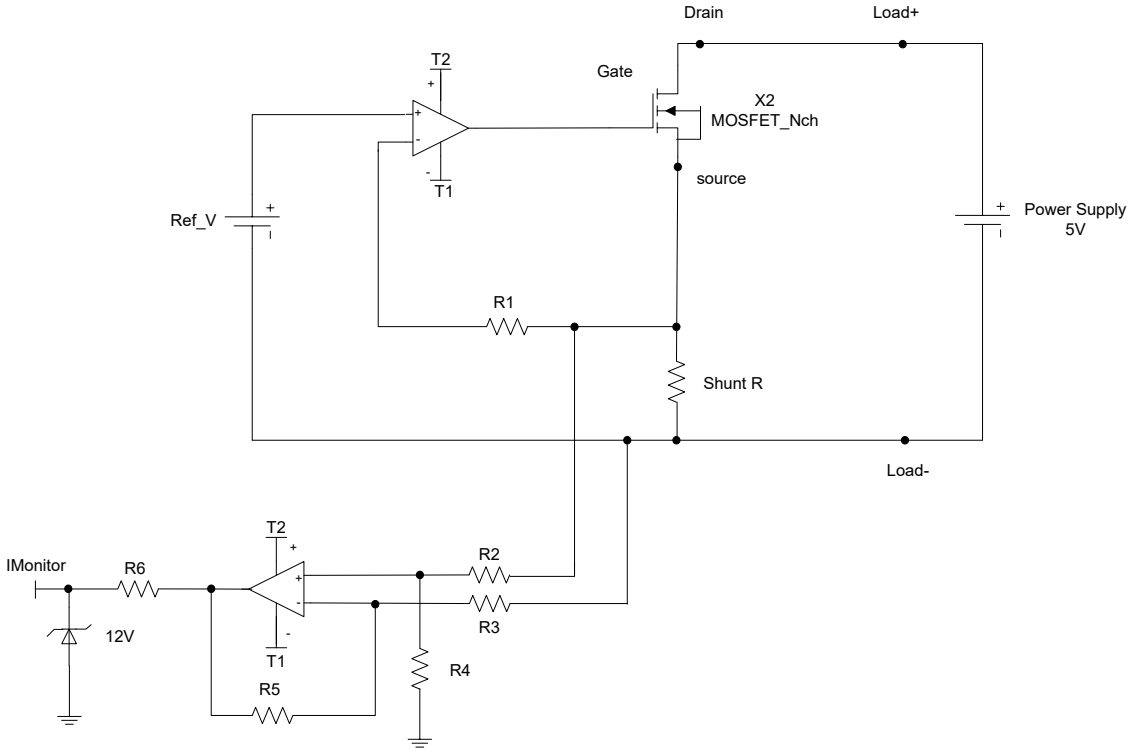


Fig 3-3 An equivalent circuit in terms of the current monitor

Connecting the I-monitor to an oscilloscope

When you connect this product to an oscilloscope, please ensure the correct polarities of the connecting probes as shown in Fig. 3-4.

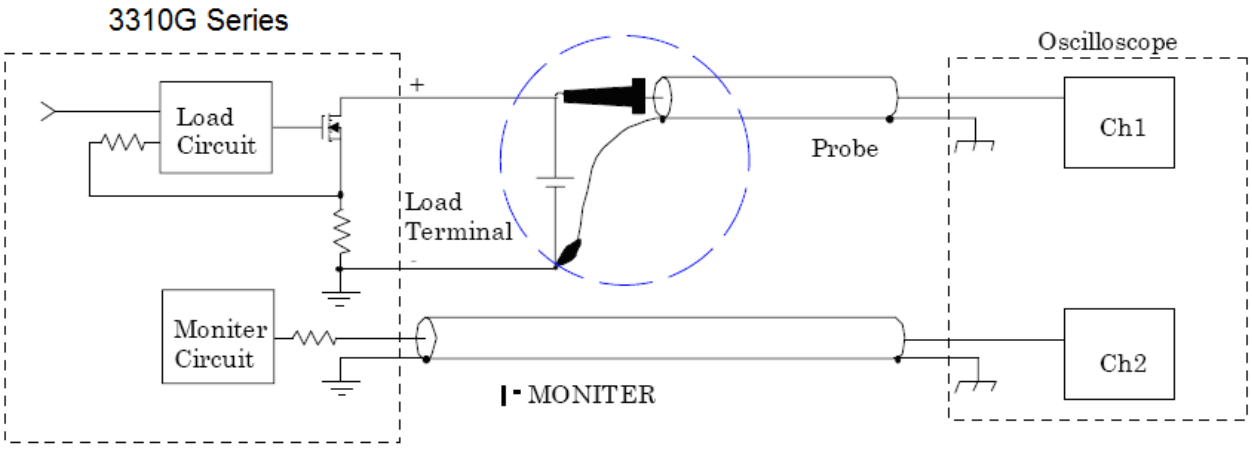


Fig 3-4 (Correct) Connections to an oscilloscope

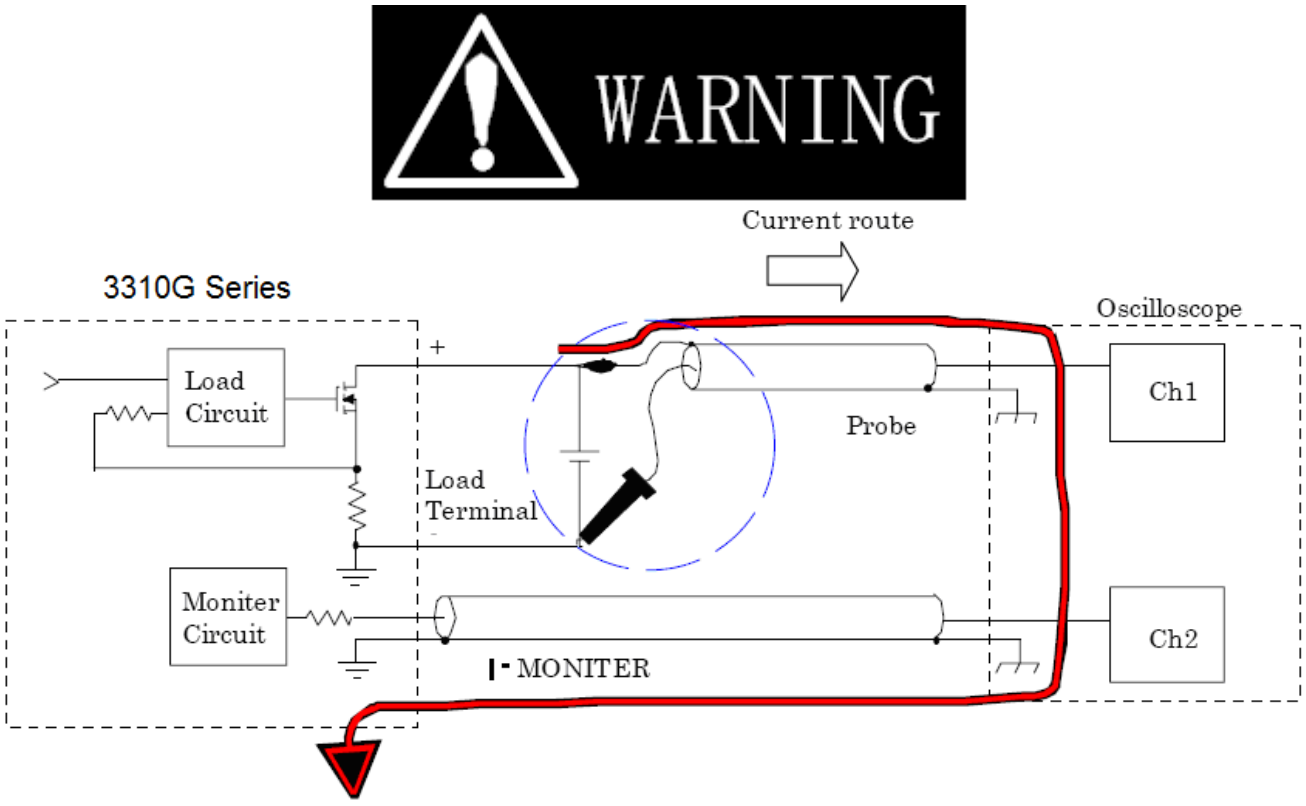


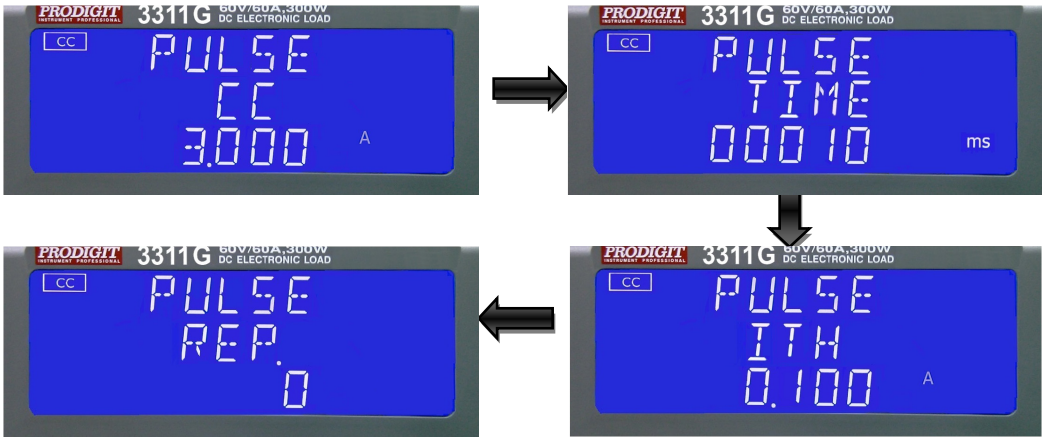
Fig 3-5 (Wrong) Connections to an oscilloscope

If the probes connection is reversed as shown in Fig 3-5, a large current would flow through the probe and the internal circuitry of the oscilloscope is likely to be damaged.

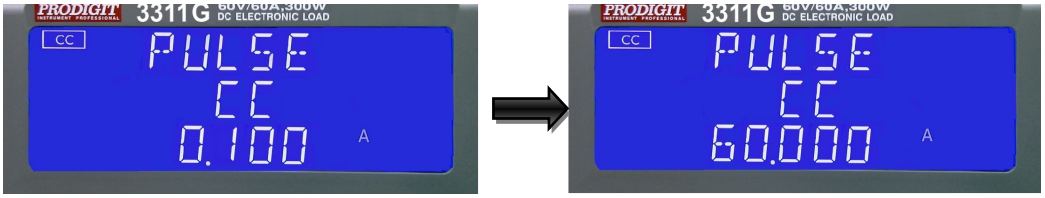
3.1.25. FUSE KEY

FUSE Test has Trip (Blown) and Non-Trip (no Blown) 2 types.
FUSE Test setting parameters include test current (Pulse CC), Test Time, Test ITH, Test Repeat cycle, the setting sequence is shown below:

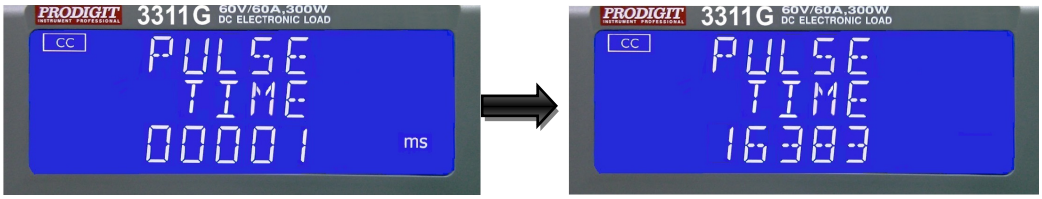
➔ PULSE CC
➔ PULSE TIME
➔ PULSE ITH
➔ PULSE REP



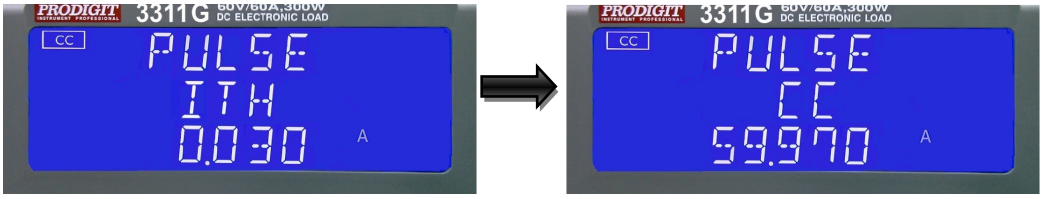
- Setting the PULSE CC current , the upper 5 digit monitor display the “PULSE” ,the Middle 5 digit monitor display the “CC”, and lower monitor display setting value, the unit is "A". The range is 0.100A to the full scale of the CC mode specification.



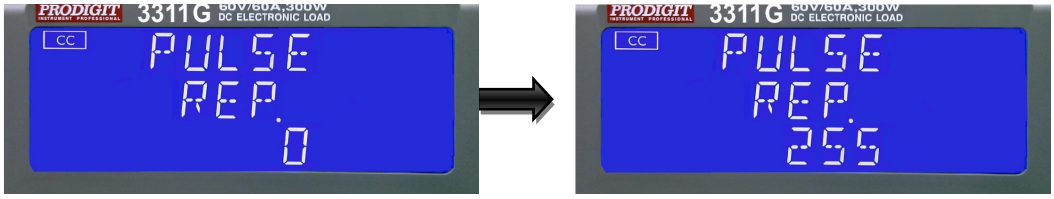
Setting the PULSE TIME , the upper 5 digit monitor display the “PULSE” ,the Middle 5 digit monitor display the “TIME”, and lower monitor display setting value, the unit is "ms". The range is 1ms to the 16383 S, Step 1ms by rotating the setting knob.



Setting the PULSE ITH Current, the upper 5 digit monitor display the “PULSE” ,the Middle 5 digit monitor display the “ITH”, and lower monitor display setting value, the unit is "A". The range is 0.030A to the 59.970A, Step 0.001A by rotating the setting knob.



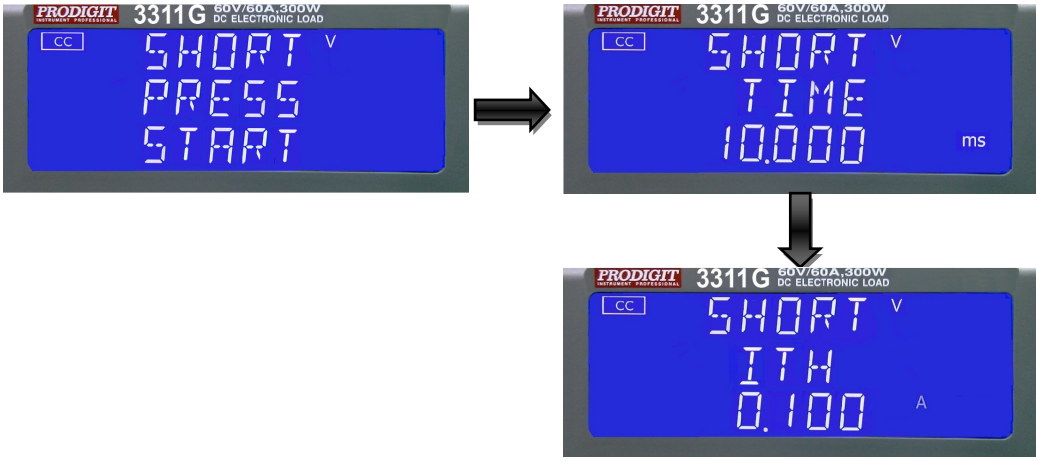
- Setting the PULSE REP, the upper 5 digit monitor display the “PULSE”, the Middle 5 digit monitor display the “REP”, and lower monitor display setting Value, The range is 0 to the 255, Step 1 by rotating the setting knob.



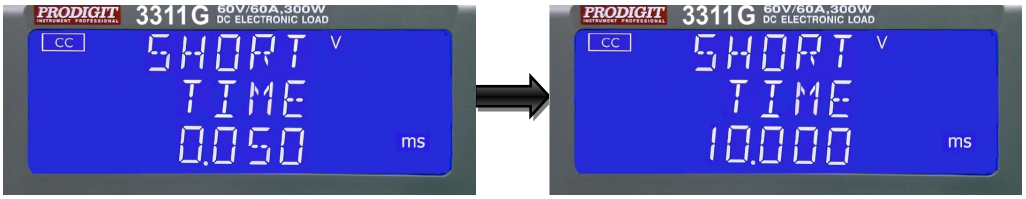
3.1.26. **BMS** KEY

BMS SHORT Test setting parameters, the setting Sequence is shown below:

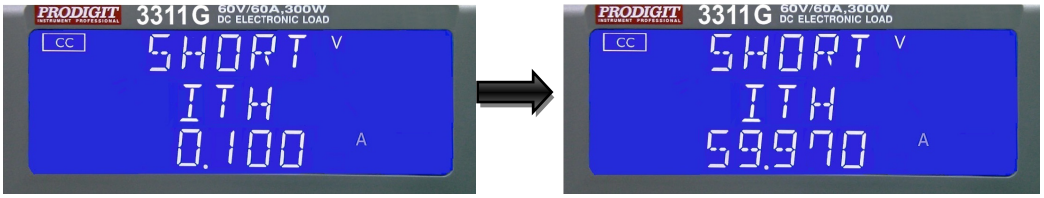
➔ SHORT PRESS START
➔ SHORT TIME
➔ SHORT ITH



- Setting the BMS SHORT TIME, the upper 5 digit monitor display the “SHORT”, the Middle 5 digit monitor display the “TIME”, and lower monitor Display setting value, the unit is "ms". The range is 0.05ms to the 10.000ms, Step 0.01ms by rotating the setting knob.



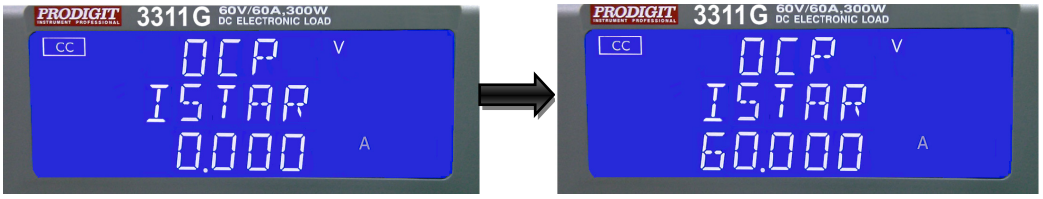
- Setting the BMS SHORT ITH current, the upper 5 digit monitor display the “SHORT”, the Middle 5 digit monitor display the “ITH”, and lower monitor Display setting value, the unit is "A". The range is 0.100A to the 59.970A, Step 0.01A by rotating the setting knob.



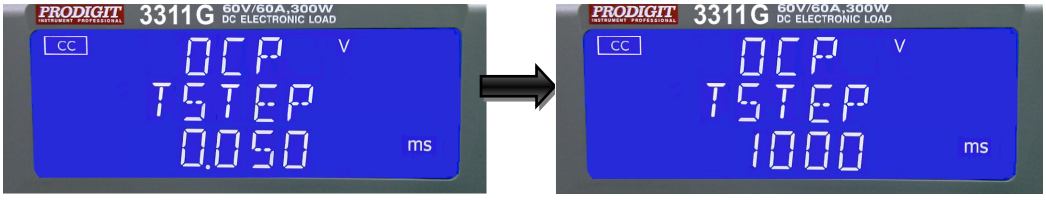
BMS OCP TEST:
BMS OCP Test setting parameters, the Setting Sequence is shown below:

- ➔ OCP PRESS START
- ➔ OCP ISTAR
- ➔ OCP TSTEP
- ➔ OCP ISTEP
- ➔ OCP ISTOP
- ➔ OCP ITH

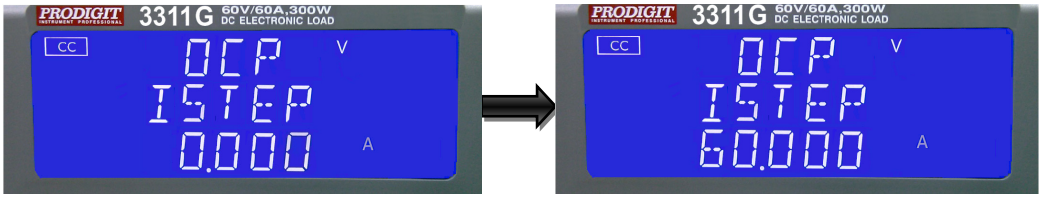
- Setting the BMS OCP ISTAR current, the upper 5 digit monitor display the “OCP”, the Middle 5 digit monitor display the “ISTAR”, and lower monitor Display setting value, the unit is "A". The range is 0.000A to the 60.000A, Step 0.001A by rotating the setting knob.



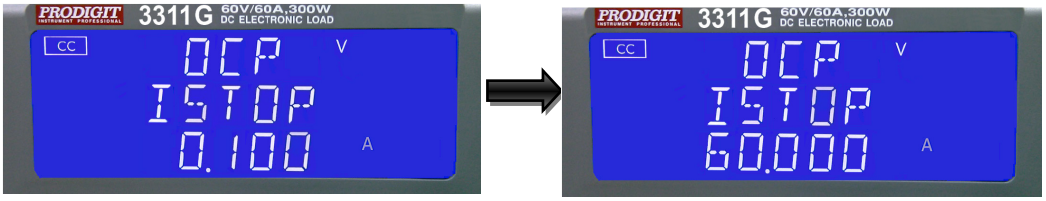
- Setting the BMS OCP TSTEP, the upper 5 digit monitor display the “OCP”, the Middle 5 digit monitor display the “TSTEP”, and lower monitor Display setting value, the unit is "ms". The range is 0.05ms to the 1000ms, Step 0.01ms by rotating the setting knob.



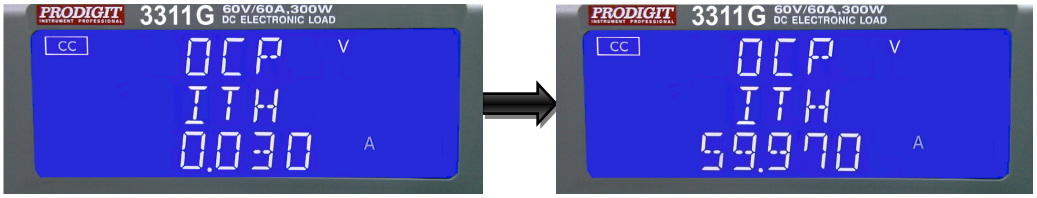
- Setting the BMS OCP ISTEP current, the upper 5 digit monitor display the “OCP”, the Middle 5 digit monitor display the “ISTEP”, and lower monitor Display setting value, the unit is "A". The range is 0.000A to the 60.000A, Step 0.001A by rotating the setting knob.



- Setting the BMS OCP ISTOP current, the upper 5 digit monitor display the “OCP”, the Middle 5 digit monitor display the “ISTOP”, and lower monitor Display setting value, the unit is "A". The range is 0.100A to the 60.000A, Step 0.001A by rotating the setting knob.

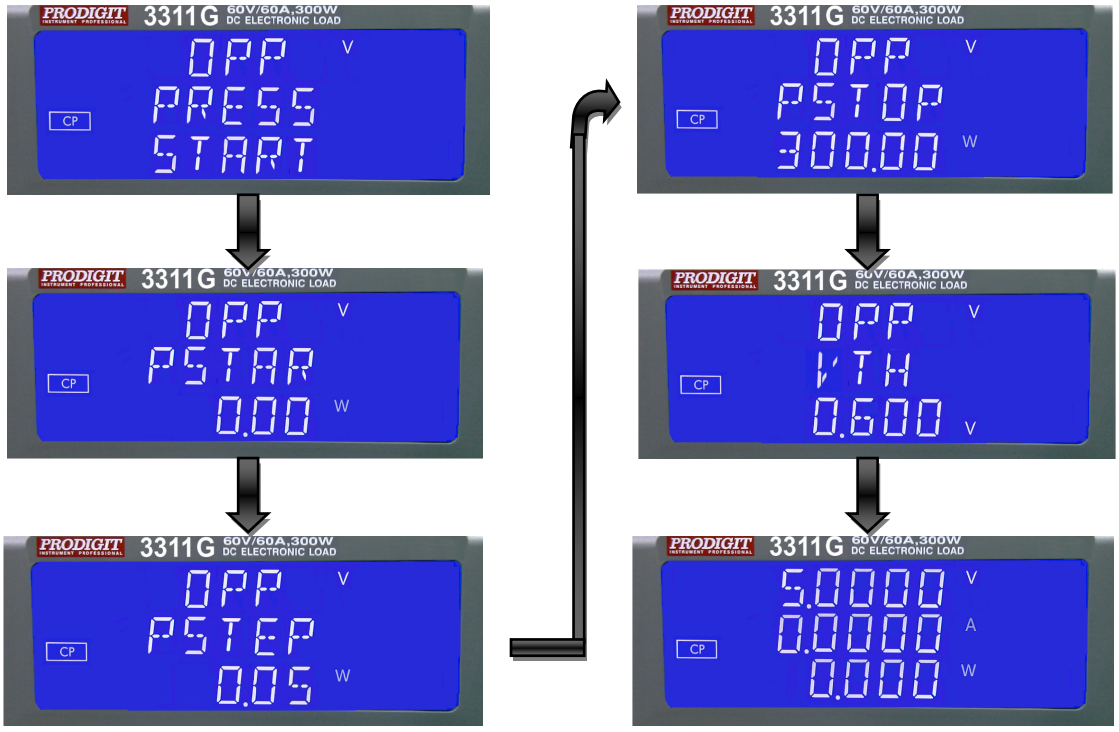


- Setting the BMS OCP ITH current, the upper 5 digit monitor display the “OCP”, the Middle 5 digit monitor display the “ITH”, and lower monitor Display setting value, the unit is "A". The range is 0.030A to the 59.970A, Step 0.001A by rotating the setting knob.

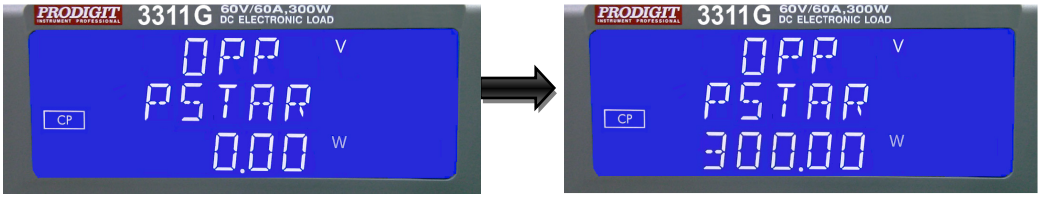


BMS OPP TEST:
BMS OPP Test setting parameters, the Setting Sequence is shown below:

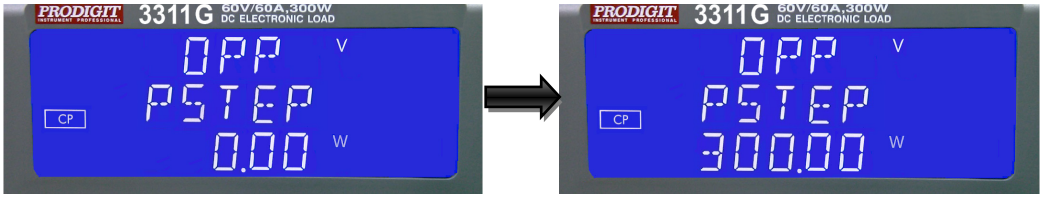
➔ OPP PRESS START
➔ OPP PSTAR
➔ OPP PSTEP
➔ OPP PSTOP
➔ OPP VTH



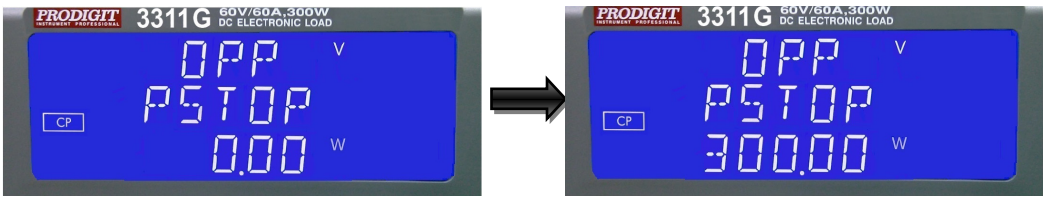
- Setting the BMS OPP PSTAR Watt, the upper 5 digit monitor display the “OPP”, the Middle 5 digit monitor display the “PSTAR”, and lower monitor Display setting value, the unit is "W". The range is 0.00W to the 300.00W, Step 0.01W by rotating the setting knob.



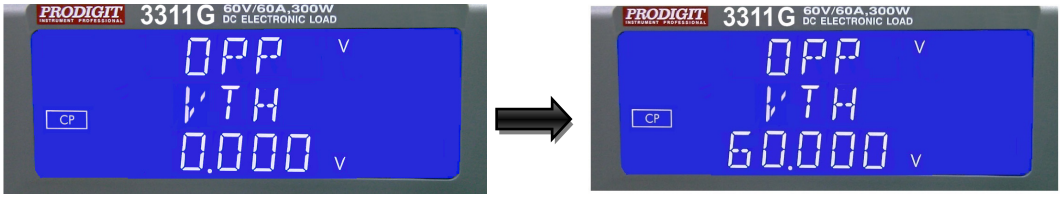
- Setting the BMS OPP PSTEP Watt, the upper 5 digit monitor display the “OPP”, the Middle 5 digit monitor display the “PSTEP”, and lower monitor Display setting value, the unit is "W". The range is 0.00W to the 300.00W, Step 0.01W by rotating the setting knob.



- Setting the BMS OPP PSTOP Watt, the upper 5 digit monitor display the “OPP”, the Middle 5 digit monitor display the “PSTOP”, and lower monitor Display setting value, the unit is "W". The range is 0.00W to the 300.00W, Step 0.01W by rotating the setting knob.



- Setting the BMS OPP VTH Voltage, the upper 5 digit monitor display the “OPP”, the Middle 5 digit monitor display the “VTH”, and lower monitor Display setting value, the unit is "V". The range is 0.000V to the 60.000V, Step 0.01V by rotating the setting knob.

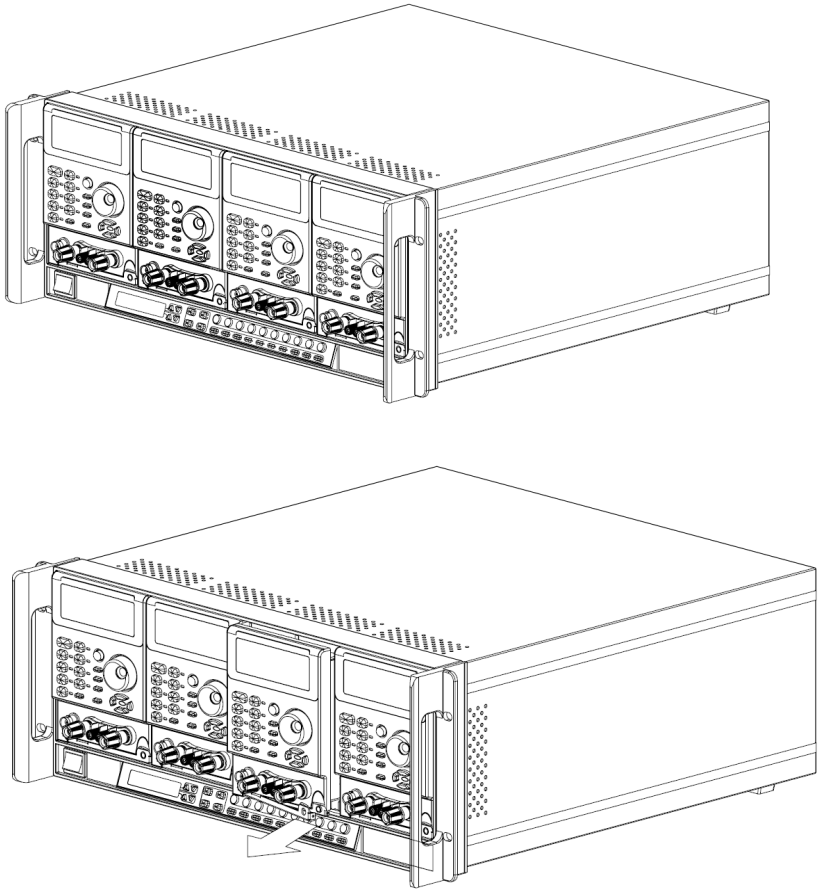


3.1.27. The withdraw handle

The following procedure details how to remove the 3310G series Load Module from the mainframe.

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

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



3.1.28. Analog programming input

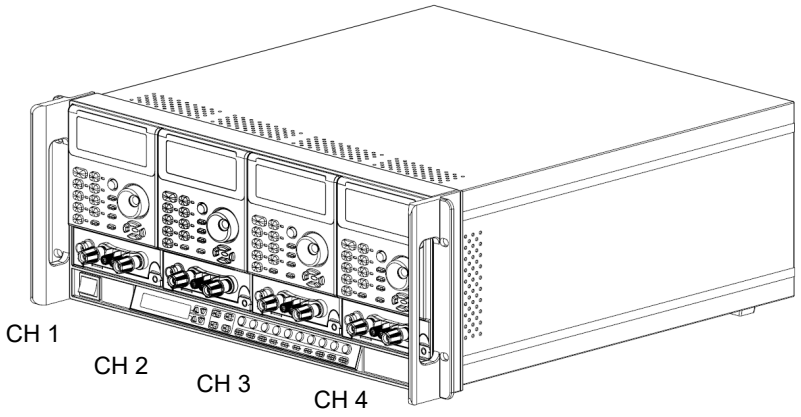
The Electronic Load has an analog programming input on the rear panel of the mainframe. The analogue programming input enables the load module to track and load according to an external 0-10V (ac or ac + dc) signal.

The analog programming input is configured as a BNC socket on the mainframe's rear panel. For the multi slot 3300G & 3305G mainframes the BNC socket is labeled with the respective channel number to correspond with the electronic load module fitted in that position.

The numbering convention is left to right. So channel 1 relates to the load module located on the left hand side and channel 4 is the load module on the right hand side

The analogue programming input operates in CC or CP modes only. The 3310G series Load
Module will attempt to load proportionally according to the signal and the load module's maximum current or power range. For example: 3311G: Imax = 60A and Pmax = 300W

So in CC mode if analogue programming input is 5V = 30A load setting
Or in CP mode if analogue programming input is 1V = 30W load setting



The analog programming signal can act alone or it can be summed with the programmed value set via the front panel or the optional computer interface (GPIB, RS-232, USB, or LAN) or the front panel.

Example:

Fig 3-6 shows the result of an analog programming signal at 4 Vac, 500Hz when it is summed with a 24A programmed setting in CC mode of 3311G Load module.

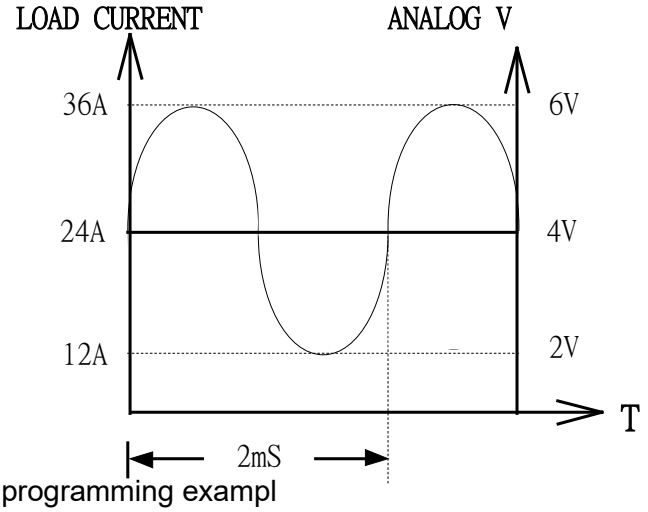


Fig 3-6 Analog programming exampl

3-2 Initial setting of 3310G series load module

The following tables detail the initial settings of the 3310G series of Load Modules when Shipped from the factory.

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	60.000 V
CC H+Preset		0.0000 A		V_Lo	0.000 V
CR H+Preset		120000 Ω		I_Hi	30.000 A
CR L+Preset		120000 Ω		I_Lo	0.000 A
CV H+Preset		60.000 V		W_Hi	150.00 W
CV L+Preset		60.000 V		W_Lo	0.000 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	1.0 V
DYN	T HI	0.050 mS		LD-OFF	0.500 V
	T L0	0.050 mS		POLAR+LOAD	
	RISE	500mA/uS		MPPT	2000ms
	FALL	500mA/uS		AVG	1
	SUR._I	30.000A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.6V
	S.TIME	100		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	3A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.1A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-1 3310G initialize

Item		Initial value		Item	Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	60.000 V
CC H+Preset		0.0000 A		V_Lo	0.000 V
CR H+Preset		60000Ω		I_Hi	60.000 A
CR L+Preset		60000Ω		I_Lo	0.000 A
CV H+Preset		60.000 V		W_Hi	300.00 W
CV L+Preset		60.000 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	1.0 V
DYN	T HI	0.050ms		LD-OFF	0.500 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	1000mA/us		MPPT	2000ms
	FALL	1000mA/us		AVG	1
	SUR._I	60.000A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.6V
	S.TIME	100		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	3A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.1A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-2 3311G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	250.00 V
CC H+Preset		0.0000 A		V_Lo	0.00 V
CR H+Preset		1500 KΩ		I_Hi	12.0000 A
CR L+Preset		1500 KΩ		I_Lo	0.0000A
CV H+Preset		250.00V		W_Hi	300.00 W
CV L+Preset		250.00 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	2.0 V
DYN	T HI	0.050ms		LD-OFF	0.50 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	50.0mA/us		MPPT	2000ms
	FALL	50.0mA/us		AVG	1
	SUR._I	12.000A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.6V
	S.TIME	100		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	3A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.1A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-3 3312G 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 KΩ		I_Hi	12.0000 A
CR L+Preset		3000 KΩ		I_Lo	0.0000A
CV H+Preset		500.00V		W_Hi	300.00 W
CV L+Preset		500.00V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	4.0 V
DYN	T HI	0.050ms		LD-OFF	0.50 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	50.0mA/us		MPPT	2000ms
	FALL	50.0mA/us		AVG	1
	SUR._I	12.000A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.6V
	S.TIME	100		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	3A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.1A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-4 3314G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.00000 A	LIMIT	V_Hi	60.000 V
CC H+Preset		0.00000 A		V_Lo	0.000 V
CR H+Preset		240KΩ		I_Hi	15.0000 A
CR L+Preset		240KΩ		I_Lo	0.0000A
CV H+Preset		60.000V		W_Hi	75.000 W
CV L+Preset		60.000V		W_Lo	0.000 W
CP L+Preset		0.0000W	CONFIG	SENSE	Auto
CP H+Preset		0.0000W		LD-ON	1.0 V
DYN	T HI	0.050ms		LD-OFF	0.500V
	T L0	0.050ms		POLAR+LOAD	
	RISE	250mA/us		MPPT	2000ms
	FALL	250mA/us		AVG	1
	SUR._I	15.000A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.6V
	S.TIME	100		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	3A		CV_BW	1
	TIME	10ms			
			SHORT		Disable
	ITH	0.1A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-5 3315G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	80.400 V
CC H+Preset		0.0000 A		V_Lo	0.000 V
CR H+Preset		60000Ω		I_Hi	80.400 A
CR L+Preset		60000Ω		I_Lo	0.000 A
CV H+Preset		80.400 V		W_Hi	400.20 W
CV L+Preset		80.400 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	1.0 V
DYN	T HI	0.050ms		LD-OFF	0.670 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	337.5mA/us		MPPT	2000ms
	FALL	337.5mA/us		AVG	1
	SUR._I	80.400A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.804V
	S.TIME	100mS		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	4.020A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.134A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-6 3316G initialize

Item		Initial value	Item		Initial value
CC L+Preset		0.0000 A	LIMIT	V_Hi	80.400 V
CC H+Preset		0.0000 A		V_Lo	0.000 V
CR H+Preset		30000Ω		I_Hi	160.200 A
CR L+Preset		30000Ω		I_Lo	0.000 A
CV H+Preset		80.400 V		W_Hi	800.40 W
CV L+Preset		80.400 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	1.0 V
DYN	T HI	0.050ms		LD-OFF	0.670 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	675.0mA/us		MPPT	2000ms
	FALL	675.0mA/us		AVG	1
	SUR._I	160.200A		TURBO	OFF
	NOR.I	0.000A		BATT1	0.804V
	S.TIME	100mS		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	8.010A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.267A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-7 3317G & 3317-M 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		180E4Ω		I_Hi	20.400 A
CR L+Preset		180E4Ω		I_Lo	0.000 A
CV H+Preset		500.00 V		W_Hi	400.20 W
CV L+Preset		500.00 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	4.0 V
DYN	T HI	0.050ms		LD-OFF	1.00 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	80.0mA/us		MPPT	2000ms
	FALL	80.0mA/us		AVG	1
	SUR._I	20.400A		TURBO	OFF
	NOR.I	0.000A		BATT1	3.00V
	S.TIME	100mS		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	1.020A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.034A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-8 3318G 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		900E3Ω		I_Hi	40.200 A
CR L+Preset		900E3Ω		I_Lo	0.000 A
CV H+Preset		500.00 V		W_Hi	800.40 W
CV L+Preset		500.00 V		W_Lo	0.00 W
CP L+Preset		0.000W	CONFIG	SENSE	Auto
CP H+Preset		0.000W		LD-ON	4.0 V
DYN	T HI	0.050ms		LD-OFF	1.00 V
	T L0	0.050ms		POLAR+LOAD	
	RISE	160.0mA/us		MPPT	2000ms
	FALL	160.0mA/us		AVG	1
	SUR._I	40.200A		TURBO	OFF
	NOR.I	0.000A		BATT1	3.00V
	S.TIME	100mS		BATT2	10
	S.STEP	1		EXTIN	OFF
FUSE	CC	2.010A		CV_BW	1
	TIME	10ms	SHORT		Disable
	ITH	0.067A	OPP		Disable
	REP	0	OCP		Disable
BMS	Disable				

Table 3-9 3319G & 3319-M initialize

3-3 Input terminal and wire consideration

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

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

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

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

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

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

A major consideration in making the input connection is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires should be large enough to limit the voltage drop to less than 0.5V per lead.

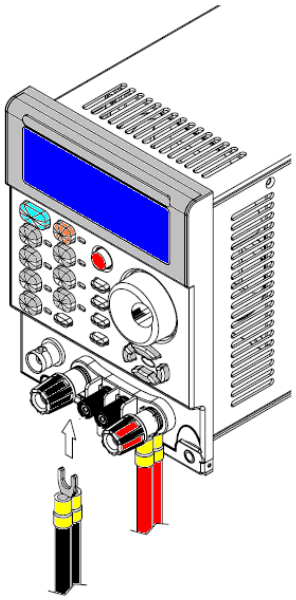


Fig 3-7 Hook Terminal Y type large size terminal connections

3.3.6 Wire/Cable Guide

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

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

Table 3-10 Stranded Copper Wire Ampere Capacity

3-4 . Protection features

The protection features of the 3310G series Electronic load modules are as follows:

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

The Overvoltage protection circuit is set at a predetermined voltage and cannot be adjusted. The OVP level is 105% of the 3310Gs nominal voltage rating.

CAUTION: Never apply an AC voltage to the input of the 3310G series Load. Do not apply a DC voltage that is higher than 3310G Load Module's rating. If this advice is ignored it is likely that damage will be caused to the electronic load module. This damage will not be covered by the warranty.

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

can be switched on again.

3.4.3. Over power protection (OPP): The 3310G series Electronic Load monitors the power dissipation level. The input to the load is automatically switched to LOAD OFF if the power dissipation is greater than 105% of the rated power input. If an over power condition occurs the display will show OPP

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

3.4.5. Reverse Polarity: The 3310G series load module will tolerate a reverse current up to the maximum current rating of the load module. The '-'symbol will be shown on the voltage and current displays.

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

If a reverse polarity situation occurs the load will sink power even if the LOAD button is OFF. No current will be displayed on the 3310G series load module. Current up to the load's maximum current rating will be tolerated in reverse polarity. However there is no OVP OCP and OPP protection. It is strongly recommended that the load lines be fused if it is likely that the load could be subject to reverse polarity. These fuses should be fast acting and rated at the maximum current of the load module +5%.

Chapter 4 Applications

This chapter details the basic operating modes along with some common applications in which the 3310G series Electronic Load modules are used.

4-1 Local sense connections

Local sensing is used in applications where the lead lengths are relatively short, or where load regulation is not critical. When connected in local sense mode the 5 digit voltage meter of the 3310G series Electronic load measures the voltage at its DC input terminals. The connecting leads between the DUT and the Electronic Load should be bundled or tie wrapped together to minimize inductance.

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

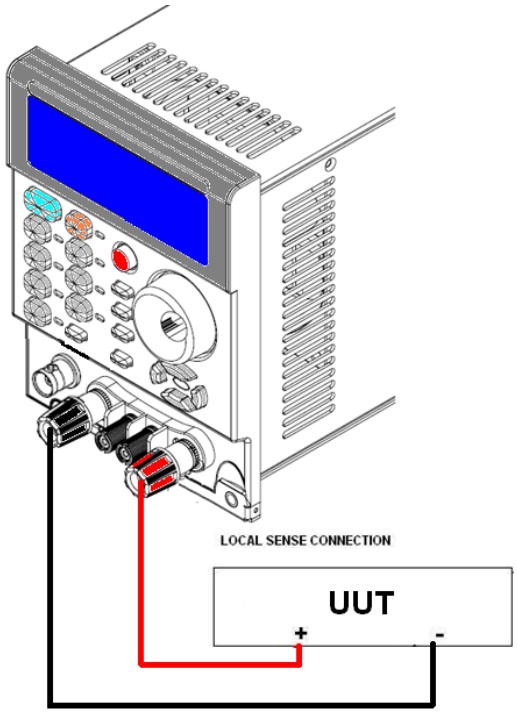


Fig 4-1 Local voltage sense connections

4-2 Remote sense connections

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

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

Please note that if V-sense is set to AUTO and the sense leads are connected to the DUT the losses need to be approximately 600~800mV for 3310G and 3311G as the following table before the display compensates for the voltage loss. If V-sense is set to 'ON' and the sense terminals are connected to the DUT the load will check and compensate for all voltage drops. The maximum voltage sense compensation is the same as the rating of the 3310G. For example Vmax of 3310G is 60Vdc so maximum Vsense is also 60Vdc.

Model	When V-sense is AUTO, the voltage at which the V-sense terminal starts voltage sensing.
3310G	600~800[mV]
3311G	600~800[mV]
3312G	3~4[V]
3314G	6~8[V]
3315G	600~800[mV]
3316G	0.8~1.06[V]
3318G	6~8[V]
3317G	0.8~1.06[V]
3319G	6~8[V]
3317G-M	0.8~1.06[V]
3319G-M	6~8[V]

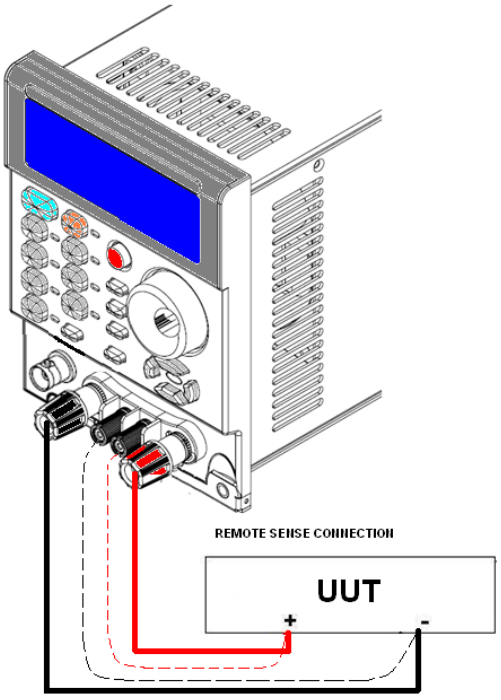


Fig 4-2 Remote voltage sense connections

4-3 Constant Current mode application

The Constant Current (CC) mode is ideal for testing the Load Regulation, Cross Regulation, Output Voltage and Dynamic Regulation of the power supply under test. The CC mode can also be used to test the Discharge Characteristics and the Life Cycle of cells and battery packs. In CC operation the 3310G can operate as a static load with switchable high and low current levels. It is also possible to operate the load dynamically enabling the user to adjust sink current with time.

4.3.1 Static mode: (Fig 4-3)

Major application areas include:

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

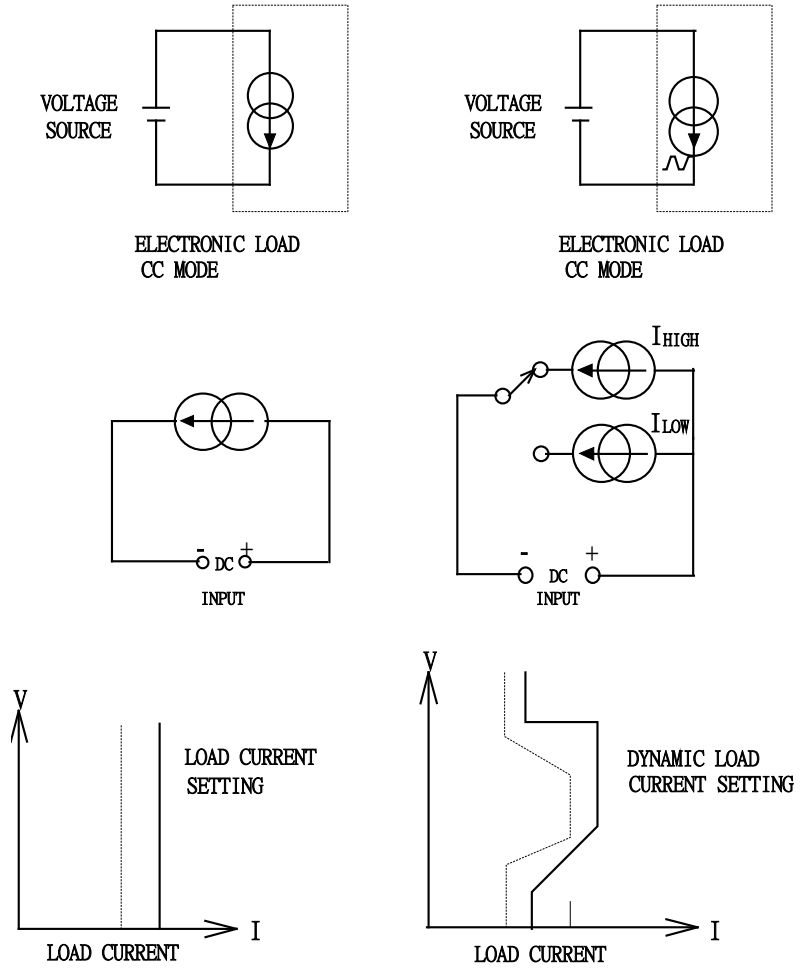


Fig 4-3 constant CURRENT mode application

4.3.2 Dynamic mode:

The built-in pulse generators allow the user to recreate real world loads that vary With time

Major application areas for dynamic operation in CC mode include:

- Power supply load transient response testing
- Power recovery time testing
- Battery Pulse load simulation
- Power component testing
- Two levels of current can be set and the rate of change between the 2 current levels can be adjusted in relation to time. The current rise (slew) rate and the current fall (slew) rate can be adjusted independently from each other and are further defined below

- 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

- Please see Fig 1-11 for more information on slew rates.

- The time the waveform is high (Thigh) and the time the waveform is low (Tlow) can Also be adjusted. The diagram below shows the 6 adjustable parameters that Define the dynamic waveform.

4.3.3 Analogue programming input

The analogue programming input can also be used in CC mode. The analogue programming input allows a complex dynamic waveform to be set up on an external oscillator. The 3310G series load module will track and load according to the external signal as long as it is within its dynamic capability. The input signal can be the range of 0-10V(dc+ac). The 10V is proportional to the full current capability of the load module.

More information on the analogue programming input can be seen in section 3.2.

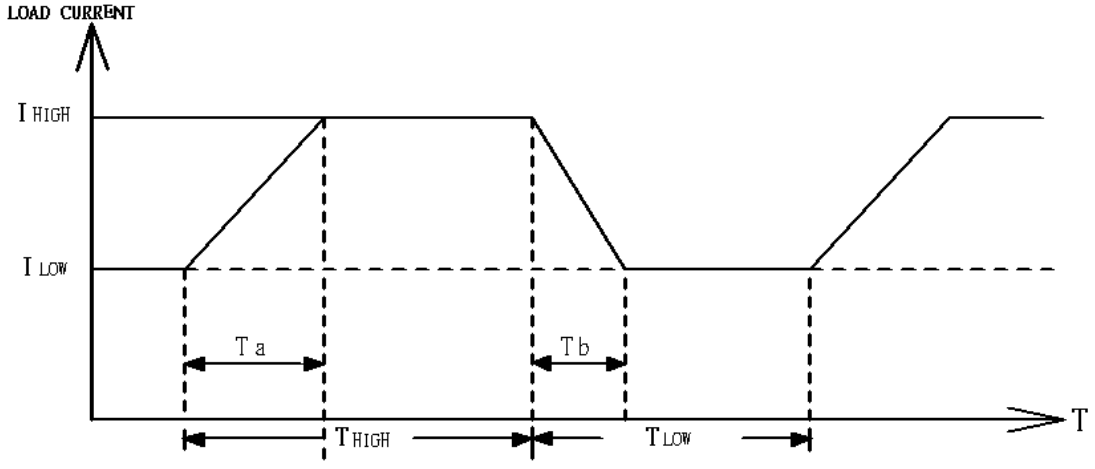


Fig 4-4 Dynamic load current with independent programmed Rise/Fall slew rate

4.3.4 CC Mode Operating Instructions

Example: PSU 5 V / 3 A, CC mode, Level HI 3.000A, Level 1.500A

4.3.4.1 . These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate According to the operating mode is selected CC.

4.3.4.2 . Pressing the "Preset" Key (13) once will cause the Button to illuminate.

4.3.4.2.1. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Hi, adjusted By The rotary knob and arrow key (21) can be read from the lower display during Setting 3.0000 A.

4.3.4.2.2. Pressing the LEVEL key (12) LED once will off, Select LEVEL Lo, adjusted by the Rotary knob and arrow key (21) can be read from the lower display during setting 1.5000A.

4.3.4.3 . Pressing the "Preset" Key (13) LED once will cause the button to off, Leave setting mode.

4.3.4.4..Pressing the “LOAD “ Key(9) LOAD button lit(Load on), Pressing the "LEVEL" key(12), LED Once will illuminate, Select is “LEVEL Hi”

4.3.4.5..Pressing the "LEVEL" key(12), LED Once will off, Select is “LEVEL Lo”

4-4 Constant Resistance mode application

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

4.4.1 Power supply power up sequence

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

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

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

However please note that with the 3310G series of Electronic Loads allow an adjustable current ramp can be set. This feature is found within the dynamic settings as RISE slew rate. Even in static mode the 3310G load will regulate its current demand at ‘Load ON’ in line with the adjusted RISE slew rate. The FALL slew rate also in the dynamic settings allows the current ramp down to be controlled at ‘Load OFF’.

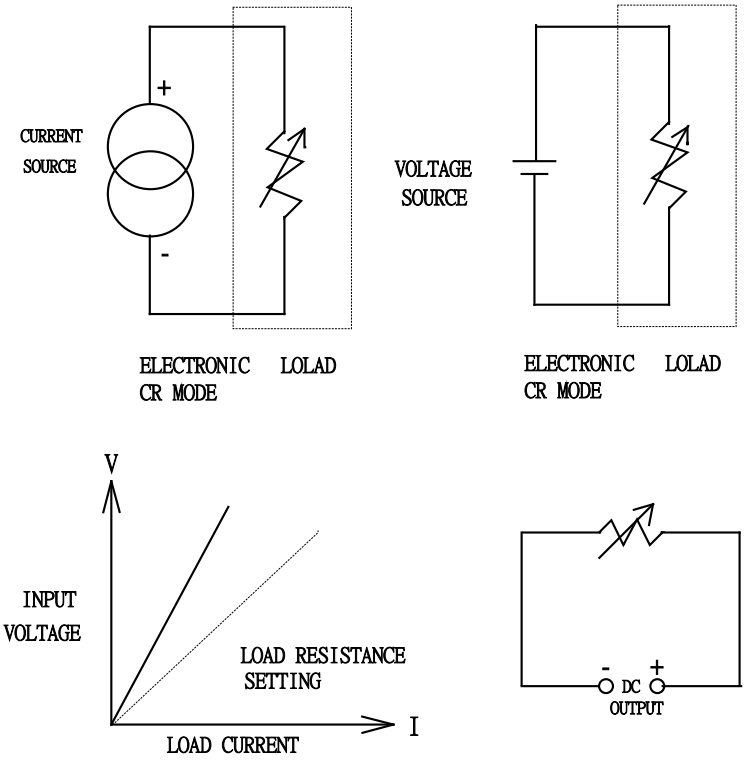


Fig 4-5 Constant Resistance mode Application

4.4.2 CR Mode Operating Instructions

Example: PSU 5 V / 3 A, CR mode, Level HI 2.0 Ohm, Level Lo 4.0 Ohm

4.4.2.1. These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate According to the operating mode is selected CR

4.4.2.2. Pressing the "Preset" Key (13) once will cause the button to illuminate.

4.4.2.2.1. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Hi, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 2.0000Ω.

4.4.2.2.2. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Lo, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 4.0000Ω.

4.4.2.3. Pressing the "Preset" Key (13) LED once will cause the button to off, Leave setting Mode.

4.4.2.4. Pressing the “LOAD “Key (9) LOAD button lit (Load on), Pressing the "LEVEL" Key (12), LED Once will illuminate, Select is “LEVEL Hi”

4.4.2.5. Pressing the "LEVEL" key (12), LED Once will off, Select is “LEVEL Lo”

4-5 Constant Voltage mode application

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

4.5.1 Current source testing.

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

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

4.5.2 Power supply current limit characterization

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

It is very difficult or impossible to find the current limit curve by CC or CR mode. However it becomes simple by using CV mode. The user sets the CV voltage and Records the output current. Plotting the current measurements against the voltage Settings result in the output current limit curve of a power supply (Figure 4-6).

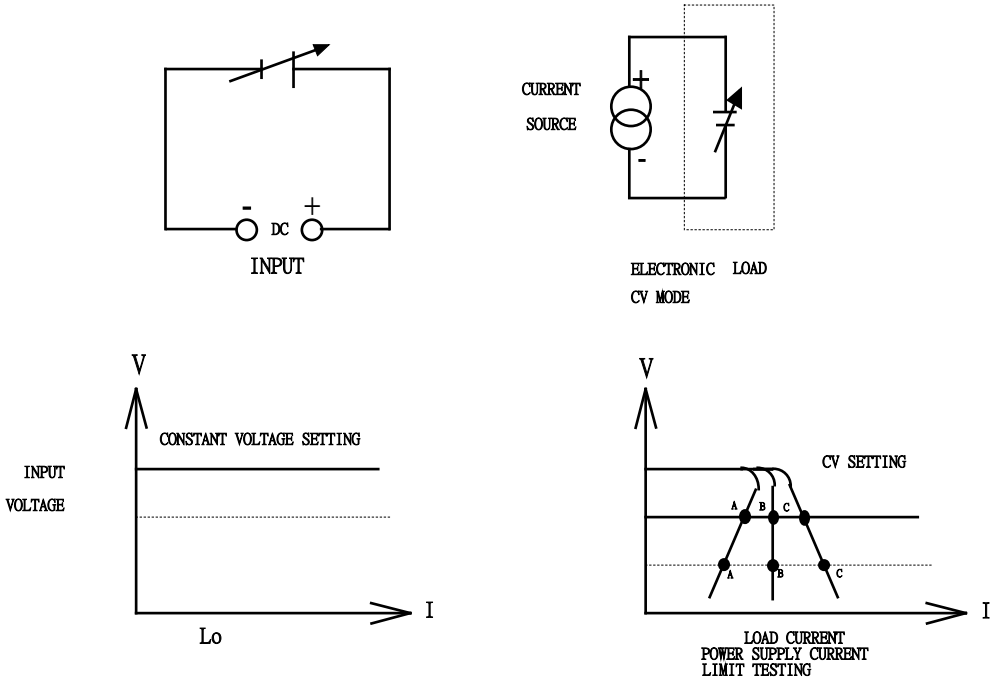


Fig 4-6 Constant Voltage mode application

4.5.3 CV Mode Operating Instructions

Example: PSU 5 V / 1A, CV mode, Level HI 4.000V, Level 3.000V

4.4.3.1. These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate According to the operating mode is selected CV.

4.4.3.2. Pressing the "Preset" Key (13) once will cause the button to illuminate.

4.4.3.2.1. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Lo, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 3.0000V.

4.4.3.2.2. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Hi, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 4.0000V.

4.4.3.3. Pressing the "Preset" Key (13) LED once will cause the button to off, Leave setting Mode.

4.4.3.4. Pressing the “LOAD “Key (9) LOAD button lit (Load on), Pressing the "LEVEL" Key (12), LED Once will illuminate, Select is “LEVEL Hi”

4.4.3.5. Pressing the "LEVEL" key (12), LED Once will off, Select is “LEVEL Lo”

4-6 Constant Power mode application

4.6.1. Battery Evaluation

Primary or secondary batteries are the power source for a wide range of portable electronics products, such as notebook computers, video cameras and mobile phones. To ensure long usage times and customer satisfaction the battery pack should be able to provide a constant power for the longest time possible.

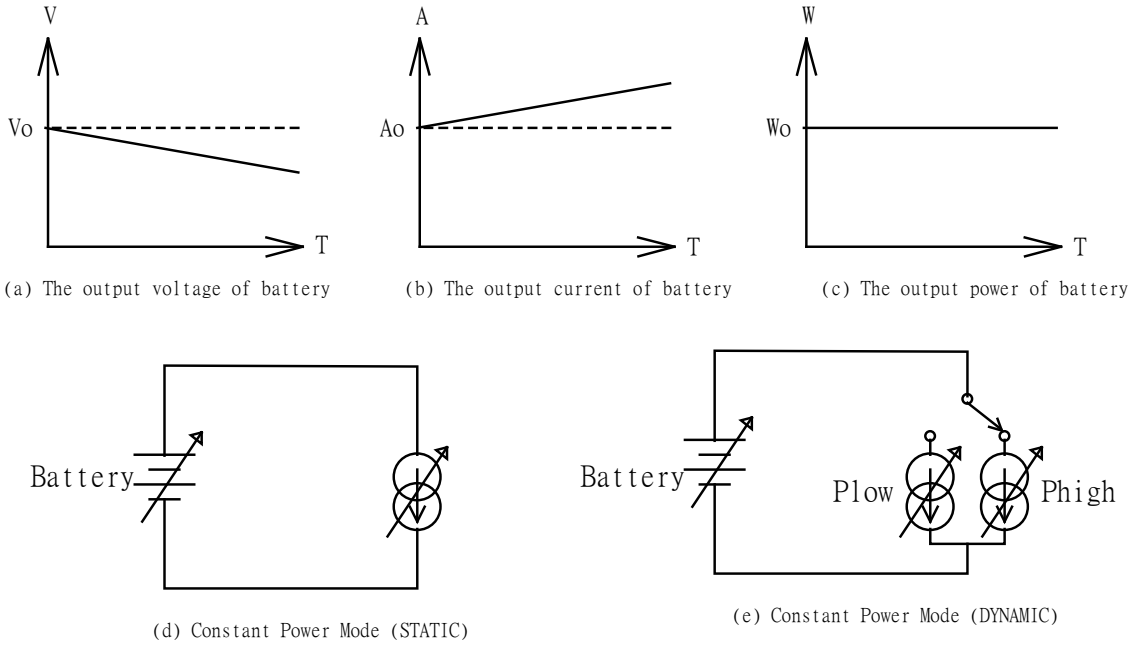
It can be measured that the output voltage of a battery will drop over time (Fig 4-7a). The rate of voltage decay depends on a number of factors including duty cycle, chemistry type, battery age and ambient temperature.

So to keep the device powered for the longest possible time the battery must be able to provide a stable power output regardless of output voltage (Fig 4-7c). In order to maintain a constant power the output current will need to increase over time to compensate for the reducing voltage (Fig 4-7b).

Operating the 3310G series electronic load in CP mode is ideal for testing the characteristics of a battery. This is because as the battery voltage drops the load current will automatically increase in order to keep the CP setting. By logging sink values against time the test engineer can also measure the battery’s energy capacity at various discharge rates.

The 3310G also features an adjustable Load OFF setting. This allows a voltage level to be set so that the electronic load automatically stops sinking power upon reaching this preset voltage. This can be used to ensure the battery is not subjected to a damaging deep discharge.

Along with static operation the load can also be operated dynamically in CP mode. The dynamic functions allow the ramp, fall and plateau times to be adjusted between 2 levels of power. This capability means that ‘real world’ loads can be more accurately simulated. For example the dynamic mode could be used to test the performance of a battery that is required to provide power pulses to transmit data from a radio frequency terminal.



(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

4.6.2. CP Mode Operating Instructions

Example: PSU 5 V / 3 A, CC mode, Level HI 10.00W, Level 5.000W

4.6.2.1. These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate According to the operating mode is selected CP.

4.6.2.2. Pressing the "Preset" Key (13) once will cause the button to illuminate.

4.6.2.2.1. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Hi, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 10.000W.

4.6.2.2.2. Pressing the LEVEL key (12) LED once will illuminate, Select LEVEL Hi, Adjusted by the rotary knob and arrow key (21) can be read from the lower Display during Setting 5.000W.

4.6.2.3. Pressing the "Preset" Key (13) LED once will cause the button to off, Leave setting Mode.

4.6.2.4. Pressing the “LOAD “Key (9) LOAD button lit (Load on), Pressing the "LEVEL" Key (12), LED Once will illuminate, Select is “LEVEL Hi”.

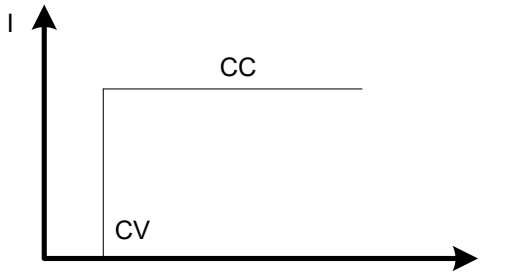
4.6.2.5. Pressing the "LEVEL" key (12), LED Once will off, Select is “LEVEL Lo”.

4-7 Applications with current limiting or power limiting function CV mode operation (charging device)

Operating in the current-limiting CV mode, the 3310G series can limit current or power when operating at a Constant voltage load. It is especially suitable for charging piles, Constant current sources and other power product testing applications.

Operation method:

- Connect the DUT to the LOAD INPUT terminal
- Switch the electronic load to CC Mode or CP Mode first, and press the Preset key to set the current limit point or power limit point.
- Press the Limit key, and "Add.CV" will appear on the LCD display. At this time, after setting the CV value to be set, press START KEY to start the test.
- If you need to modify the current limit or power limit during the test, you can change the current limit or power limit after pressing the Preset button again.
- If you need to change the CV test point during the test, press the Limit button again, and “Add.CV” will appear on the LCD screen again. At this time, the CV setting value can be changed.
- Finally, press STOP KEY to stop the test.



I/V Curve

Remote control CV + current limit or power limit
for example

- REMOTE (Set up remote control)
- MODE CC or CP (Set to CC or CP mode)
- CC:HIGH 2 or CP:HIGH 200 (Set current limit to 2A or limit power 200W)
- LIM:ADDCV:VOLT 50 (Set the Constant voltage to 50V)
- LIM:ADDCV ON (Start testing CV + current limit or power limit mode)
- LIM:MEAS: CURR? (Read the current value of the electronic load)
- LIM:MEAS: VOLT? (Read the voltage value of the electronic load)
- LIM:ADDCV:CURR 2.5 (Modify the current limit to 2.5A during the test)
- LIM:ADDCV:POW 250 (Modify the power limit point to 250W during the test)
- LIM:ADDCV:VOLT 40 (Modify the Constant voltage to 40V)
- LIM:ADDCV OFF (Stop testing CV + current limit or power limit mode)

4-8 Applications with current limiting or power limiting function CV mode operation (Discharging device)

Operate in CC mode to CV mode, 3310G series at the same time as a Constant Current and Constant Voltage Load, as shown in Fig 4-8.

When Operating at Constant Current (CC) load, 3310G series electronic load to Voltage source (VBatt) Constant Current load (I) and keep Constant Voltage.

When Operating at Constant Voltage Load on, the VBatt is greater than V, Input current changes its input voltage is keep fixed.

When the VBatt voltage is less than equal to the set voltage CV, the load does not sink current.
Operation Way:

- Load input terminals are connected to the DUT
- Change to CC mode and setting CC current setting.
- Press Limit key to setting the CV voltage and the display will show “+Add.CV”.
- Press START key to start up the CC+CV test, and press “STOP “key to stop CC+CV Test.

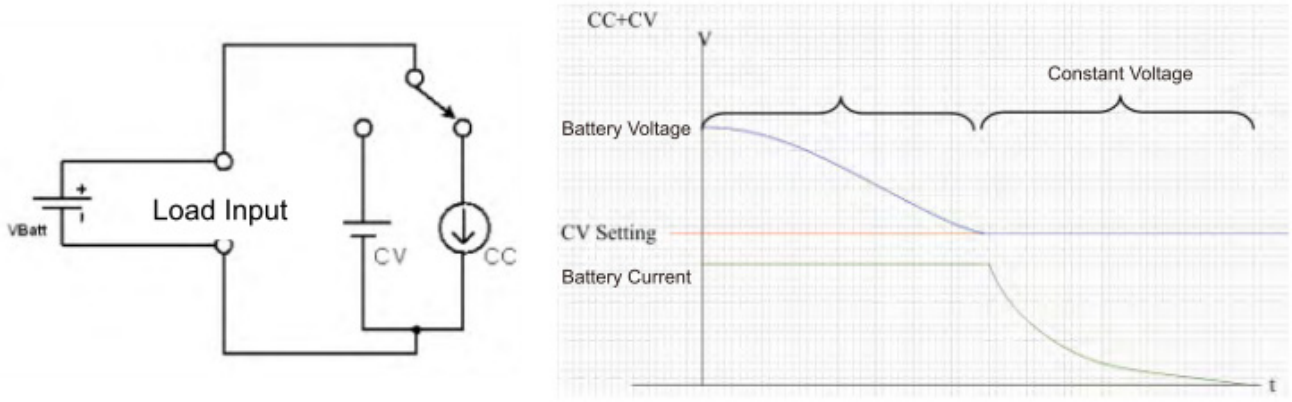


Fig 4-8 CC+CV mode operation application

Remote Control CC+CV
for example：

REMOTE （Setting Remote Control）
MODE CC （Setting CC mode）
CC：HIGH 2 （Setting load on current 2A）
LIM: ADDCV:VOLT 50 （Setting Constant Voltage is 50V）
LIM：ADDCV ON （Start testing CC to CV mode ）
LIM: MEAS：CURR? （Read current value）
LIM: MEAS：VOLT? （Read Voltage value）
LIM: ADDCV:CURR 2.5 (Modify the current limit to 2.5A during the test)
LIM：ADDCV OFF （Stop testing CC switch to CV mode）

4-9 Application with switching from CP mode to CV mode operation (battery discharge)

Operating in CP to CV mode, 3310G series at the same time as a Constant Power and Constant Voltage Load, as shown in Fig 4-9.

When Operating at Constant Power (CP) load, 3310G series electronic load provides Specified power, independent Constant Voltage source (VBatt) is output voltage.
When Operating at Constant Voltage Load on, the VBatt is greater than V, Input power Changes its input voltage is keep fixed.

When the VBatt voltage is less than equal to the set voltage CV, the load does not sink Current.
Operation Way:

- Load input terminals are connected to the DUT
- Change to CP mode and setting CP power setting.
- Press Limit key to setting the CV voltage and the display will show “Add.CV”.
- Press START key to start up the CP to CV test, and press “STOP “key to stop CP to CV Test.

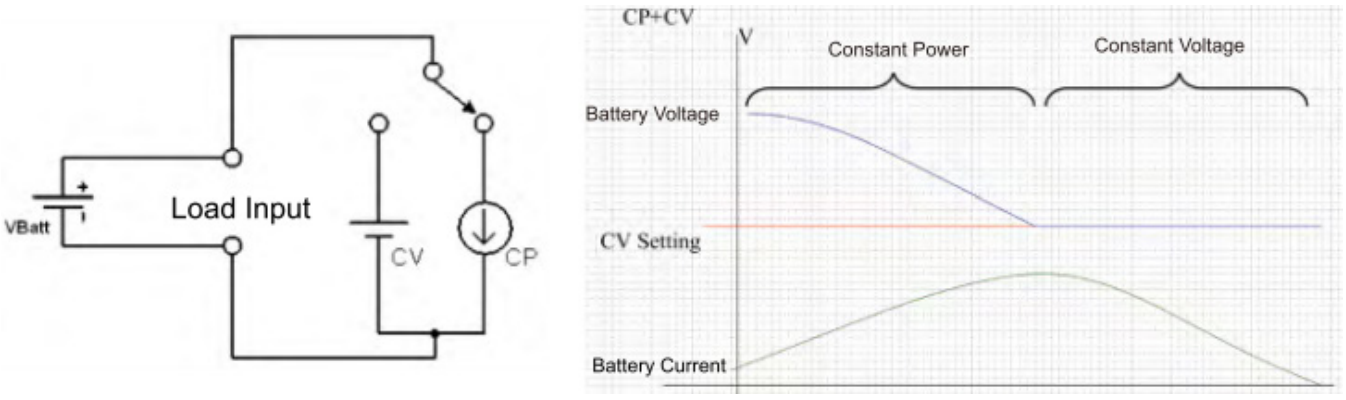


Fig 4-9 Application of CP to CV operation mode

Remote control CP to CV mode
for example：

REMOTE	(Setting Remote Control)
MODE CP	(Setting CP mode)
CP : HIGH 100	(Setting Constant power is 100W)
LIM: ADDCV: VOLT 50	(Setting Constant Voltage is 50V)
LIM : ADDCV ON	(start test CP to CV mode)
LIM: MEAS : POW?	(Read Power value)
LIM: MEAS : VOLT?	(Read Voltage value)
LIM:ADDCV: POW 250	(Modify the power limit point to 250W during the test)
LIM：ADDCV OFF	(stop test CP to CV mode)

4-10 The connection of a multiple output power supply

The following is a rule for a multiple output power supply connects to the 3310G 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 3310G series Electronic load.

Here is an example of +5V, -5V, +12V and -12V four outputs power supply connected to a 3310G series electronic load.

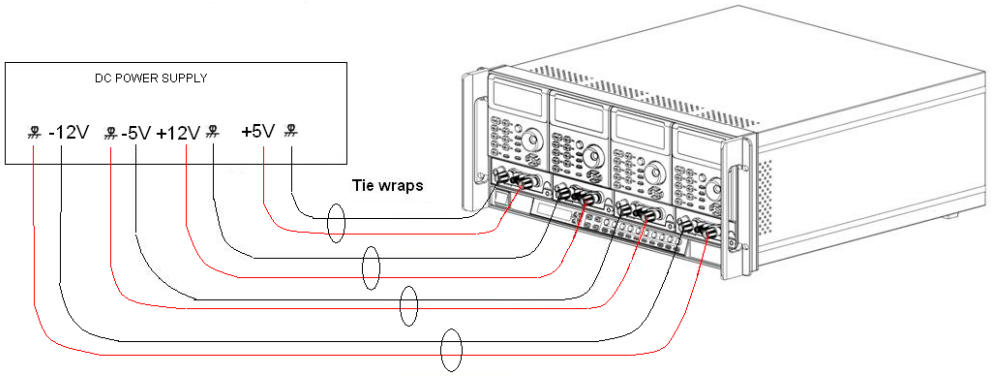


Fig 4-10 Connection between 3310G series plug-in load and multiple output power supply

4-11 Parallel operation

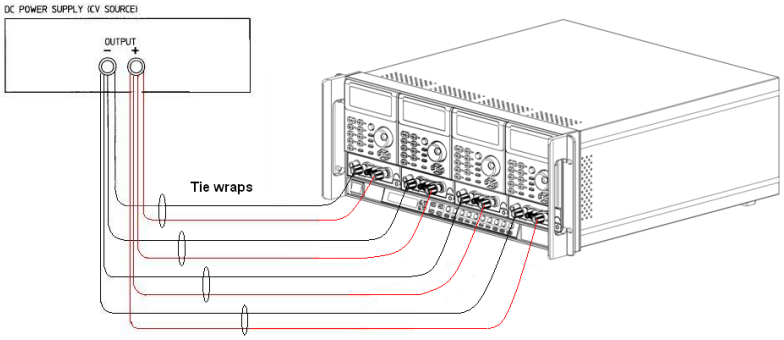
It is possible to operate load modules in parallel if the power and/or current capability of a Single 3310G series load module is not sufficient.

The positive and negative outputs of the power supply are connected individually to each Load module as shown in the Fig 4-11 below. The setting is made at each individual load Module. The total load current is the sum of the load currents being taken by each module.

It is permitted to operate 'G' series load modules with different voltage, current and power Ratings to sink in parallel. For example the 4 loads modules shown in Fig 4-9 could be a Mixture of 3311G, 3312G, and 3314G.

While in static mode the load modules can be set to operate in CC, CR or CP. When using Multiple loads to sink power from a single DC Source it is not permissible to operate in Dynamic mode.

Note: 1. the electronic load can be operated in parallel in CC, CR, CV and CP modes.
2. The electronic load do not use under series connection.



I=I1+I2+I3+I4

Fig 4-11 3310G series plug-in module parallel operation

4-12 Zero-Volt loading application

As shown in Fig 4-12, the Electronic load can be connected in series with a DC voltage source which output voltage greater than 0.6V (3310G,3311G), 1V (3312G), 6V(3314G) or 0.3V(3315G) 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 0.6V (3310G,3311G), 1V (3312G), 6V(3314G) or 0.3V(3315G) operating voltage required by the Electronic load. This application is suitable for low voltage Battery cell with high discharge current testing.

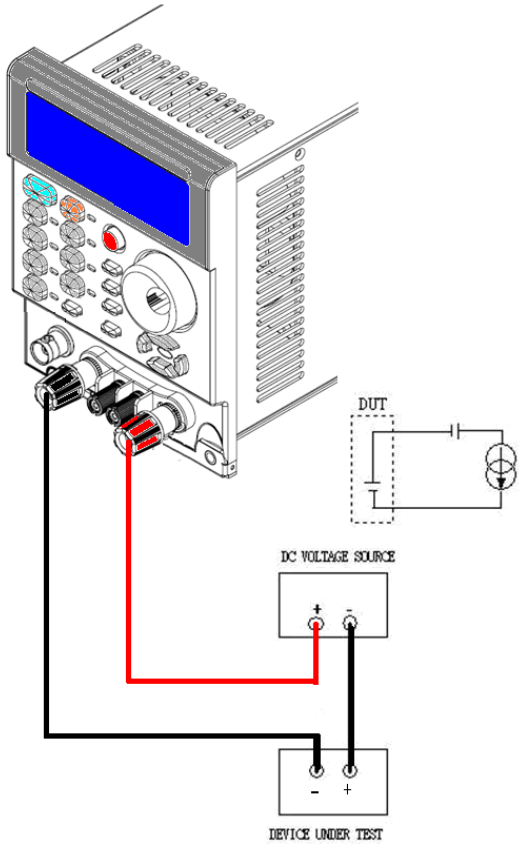


Fig 4-12 Zero-Volt loading connection

4-13 3310G series electronic load OCP, OPP, SHORT operation flow Chart

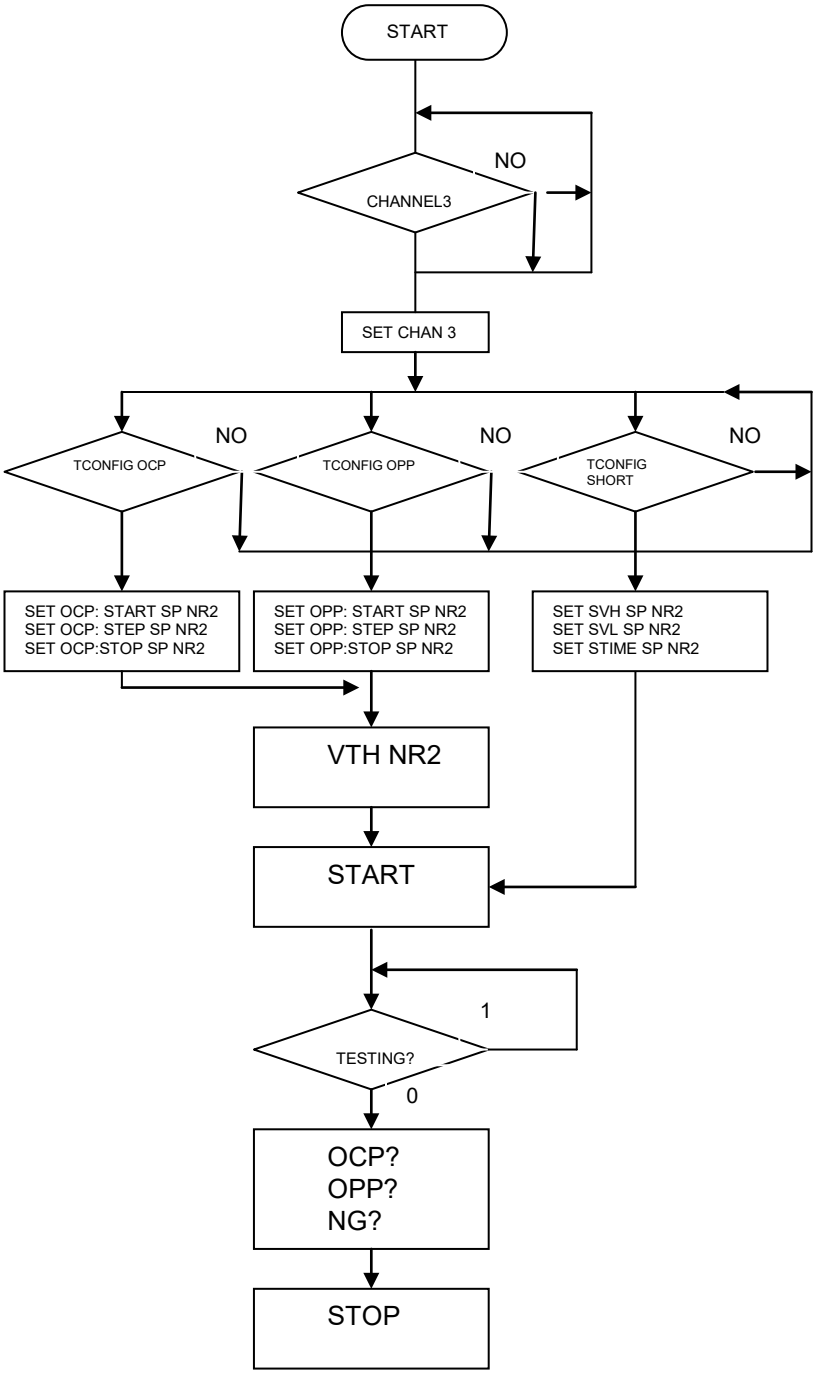


Fig 4-13 3310G series electronic load OCP, OPP, SHORT operation flow chart

4-14 Power Supply OCP testing

4.14.1 OCP Manual control

Example:

4.14.1.1 First, press Limit Key function to setting I_Hi 6A.

4.14.1.2 Press Limit Key function to setting I_Lo 0A.

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

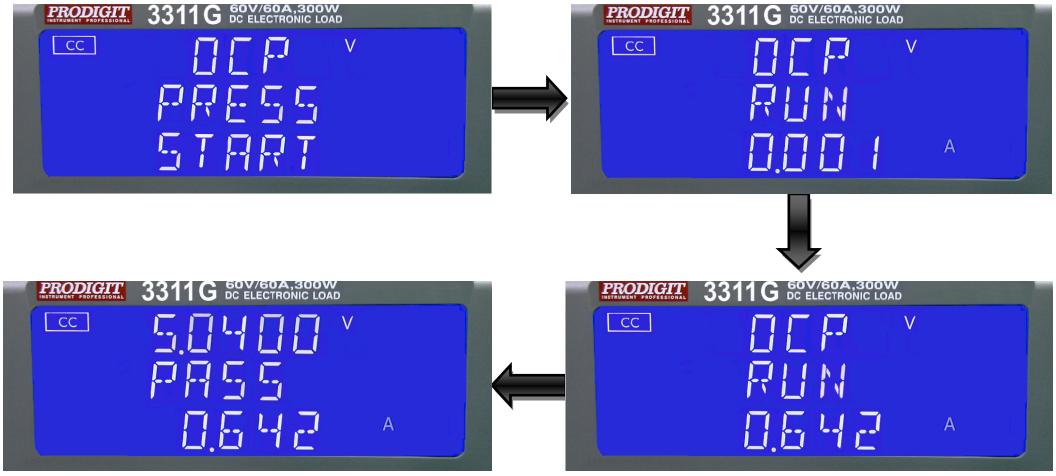
4.14.1.4 Setting start load current 0A, press OCP key to the next step.

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

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

4.14.1.7 Setting OCP VTH 0.600V, press OCP key to the next step.

4.14.1.8 Press START/STOP test key.



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

4.14.2 Remote control OCP

EX:

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

4-15 Power Supply OPP testing

4.15.1 OPP Manual control

Example:

4.15.1.1 First, press Limit Key function to setting W_Hi 30.00W..

4.15.1.2 Press Limit Key function to setting W_Lo 0W..

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

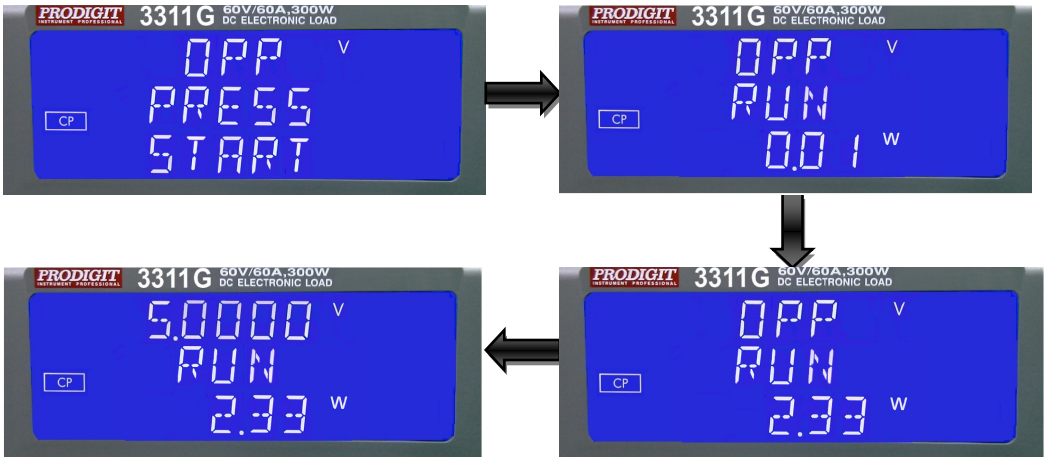
4.15.1.4 Setting start load watt 0W, press OPP key to the next step.

4.15.1.5 Press up key, set step load watt 0.01W, press OPP key to the next step.

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

4.15.1.7 Setting OPP VTH 0.600V，press OPP key to the next step.

4.15.1.8 Press START/STOP Test key.



4.15.1.9 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".

4.15.2 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）

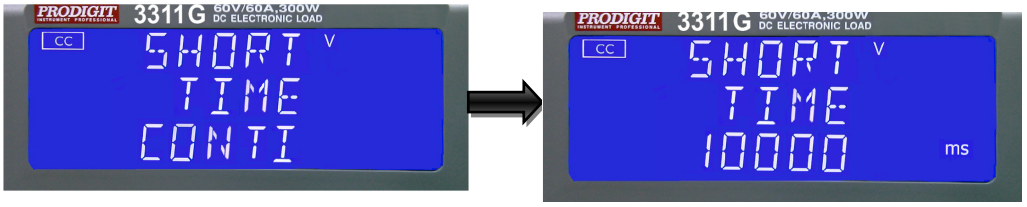
4-16 SHORT testing

4.16.1 SHORT Manual control

Example:

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

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



4.16.1.3 Press down key, setting V-Hi voltage to 1.000V, press Short key to the next Step.

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

4.16.1.5 Press START/STOP test key.

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

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

4.16.2 Remote control SHORT

EX:

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

4-17 3310G series Turbo Mode load

The 3310G series electronic load module can be used with the 3300G series mainframe, Including single 3302G mainframe, dual 3305G mainframe and 4 channel 3300G Mainframe. The 3317G/3319G is a stand-alone electronic load.

In addition to carrying over the outstanding performance of the 3310F series, the 3310G Series electronic Loads add a unique Turbo mode. This mode allows the load to support up to two times the rated current and power of a 3310F Series load for short periods of time.

Turbo mode is very valuable for enhanced protection testing of power products. Examples Include power supplies, Battery Management Systems (BMS) and protection devices such as Fuses / Breakers or PTC Resettable fuses. In so doing, the 3310G Series can test and verify the actual trip current levels and response times under the abnormal operating conditions.

The current can be increased by 2 times during the test which can improve the test current Shortage of electronic load.

The built-in test functions for Turbo mode include Short, OCP, OPP, BMS and Fuse tests. The following example illustrates the ease of performing these kinds of test with the 3310G Loads.

1. Turbo mode ON/OFF indicator, Turbo mode includes Short, OCP, OPP, BMS and Fuse test functions, the others new functions are MPPT with CC and CR mode, CV response time setting, Battery discharge Batt1 ~ Batt3 in Config key.
2. Fuse (Current Protection Components) Test function key.
3. BMS (Battery Management System) test mode key.
4. Add CC+CV and CP+CV for battery discharge test.

4-18 Current protection component test

Common current protection devices include Fuses, Breakers and newer PTC Resettable fuses etc. Their role is to disconnect a load when the actual current exceeds the rated current of the load to avoid overheating, even fire, and other dangerous conditions. Therefore, the current protection component is the last line of defense to ensure safety when the load current is abnormal. When an abnormality occurs, the protective device must be able to provide the protection capability for disconnecting the circuit. The protection of these components have their own function and different price points. For example, a fuse is a one-time use device while circuit breakers and PTCs are reusable.

The current rating of the current protection component usually has a product relationship with the protection response time. The greater the current through the current protection component, the faster the reaction time. That means it is related to the total energy into the protection component.

To test these protection devices, the 3310G Series of electronic loads are specifically designed for test verification of current protection components. A Fuse Test function that can be used with Turbo mode that provides 2 times the rated current and power for a short period of time. This allows testing and verification of these components with about 2 times the current and power specifications of the components.

Fuse

Breaker

PTC

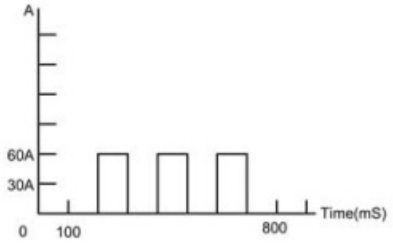
Turbo mode ON
Fuse Function Test

Model		3310G	3311G	3312G	3314G	3315G
Short / OCP / OPP Test Function						
Maximum Current	Turbo OFF	30A	60A	12A	12A	15A
	Turbo ON	60A	120A	24A	24A	30A
Fuse Test Mode *4						
Trip & Non-Trip Time	Turbo OFF	r1 : 1~5999ms, r2 : 6~16383sec				
	Turbo ON *1	1~2000mS				
Meas. Accuracy		r1 : ±0.2mS (<200mS), ±20mS (>200mS), r2 : ±0.5S				
Repeat Cycle		0~255				

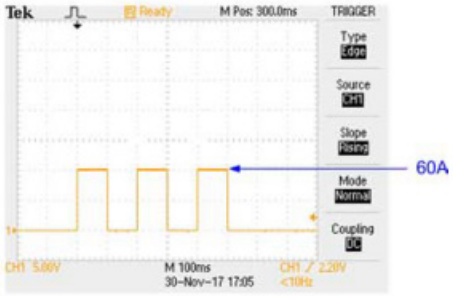
Model		3316G	3318G	3317G	3319G
Short / OCP / OPP Test Function					
Maximum Current	Turbo OFF	80A	20A	160A	40A
	Turbo ON	160A	40A	320A	80A
Fuse Test Mode *4					
Trip & Non-Trip Time	Turbo OFF	r1 : 1~5999ms, r2 : 6~16383sec			
	Turbo ON *1				
Meas. Accuracy		r1 : ±0.2mS (<200mS), ±20mS (>200mS), r2 : ±0.5S			
Repeat Cycle		0~255			

Fuse Test functions are divided into two types, Trip (fuse) and Non-Trip (no fuse).
Fuse Test setting parameters include the test current (Pulse CC), the test time (PULSE TIME), the number of test repetitions PULSE REPEAT Cycles and the Ith or current threshold value.

3311G Turbo mode OFF
Fuse mode test result screen

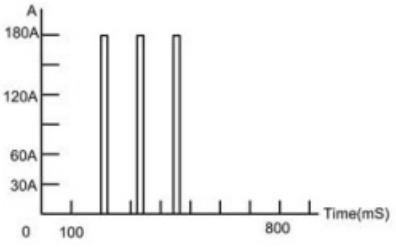


Setting : Turbo : OFF, Fuse ON,
CC pulse 60A, 100mS, repeat 3 cycles



Turbo : OFF, Fuse ON, CC pulse 60A,
100mS, repeat 3 cycles real test waveform

3311G Turbo mode ON
Fuse mode test result screen



Setting : Turbo : ON, Fuse ON,
CC pulse 120A, 10mS, repeat 3 cycles

Turbo : ON, Fuse ON, CC pulse 120A,
10mS, repeat 3 cycles real test waveform

The fuse Trip test determines that when the current is too large the device can provide the Protection of an open circuit. This means the current protection components need to have a fuse action. To test this, the test current needs to be greater than the fuse current specification. After the fuse blows or Circuit Breaker trips, the 3310G Series electronic load determines if the current is lower than the programmed Ith current threshold value. The load LCD will display the Repeat Cycle and the fusing time in ms.

For the Non-Trip test, the current protection component is required to achieve non-blown action, so the test current needs to be lower than the fuse current specification. To verify that at normal current levels the device does not trip, the 3310G Series electronic load checks that during the test time (Pulse Time) the device does not trip after repeating the number of repeat cycles. The load LCD will display the number of Repeat Cycles applied.

4-19 Abnormal testing of power supply

Including AC / DC, DC / DC power supply, Adapter / Charger these products are not only to supply a stable voltage or current, but also need to be able to protect the abnormal situation in order to ensure safety, there will not be overheating or high temperature due to high current, and even cause a fire and other hazards.

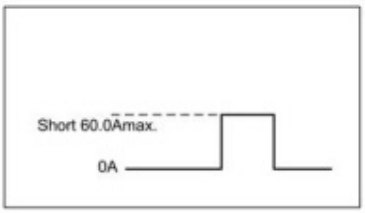
This applies to AC/DC, DC/DC Power Supplies, DC/AC inverters, Power Adapters and Device Chargers. These products are not only designed to supply a stable voltage or current, they also need to protect load against abnormal conditions in order to ensure safe operation under all conditions. They are to prevent overheating or high temperature due to excessive current, which could result in a fire and other hazards.

Short circuit, Over Current and Over Power are all abnormal conditions. These conditions typically represent 125% to 150% of the normal rating and in some cases even more. Therefore, to simulate these abnormal conditions, the maximum current value and the maximum power value of the electronic load to perform these tests must be up to two times the normal rating. One solution is do use a load that is twice as big as needed for normal testing but this will cost more. A better alternative is to use the 3310G Series loads, which can provide up to four times rated power and current conditions with a 'normal' rated model.

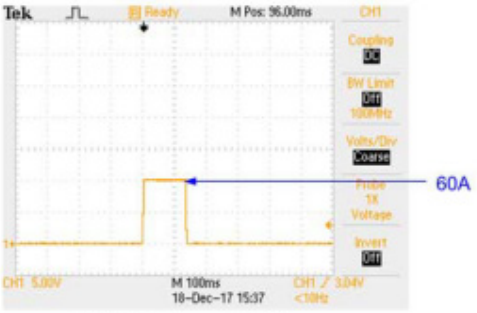
Model		3310G	3311G	3312G	3314G	3315G
Short / OCP / OPP Test Function						
Maximum Current	Turbo OFF	30A	60A	12A	12A	15A
	Turbo ON	60A	120A	24A	24A	30A
Meas. Accuracy		± 1.0% of (Reading + Range)				
Short Time	Turbo OFF	100ms~10 Sec. or Continue				
	Turbo ON	100~2000ms				
OCP Time (Tstep)	Turbo OFF	100ms				
	Turbo ON	20ms				
OPP Time (Tstep)	Turbo OFF	100ms				
	Turbo ON	20ms				

Model		3316G	3318G	3317G	3319G
Short / OCP / OPP Test Function					
Maximum Current	Turbo OFF	80A	20A	160A	40A
	Turbo ON	160A	40A	320A	80A
Meas. Accuracy		± 3.0% of (Reading + Range)			
Short Time	Turbo OFF	100ms~10 Sec. or Continue			
	Turbo ON	100~2000ms			
OCP Time (Tstep)	Turbo OFF	100ms			
	Turbo ON	20ms			
OPP Time (Tstep)	Turbo OFF	100ms			
	Turbo ON	20ms			

3311G Turbo mode OFF
Short test result screen

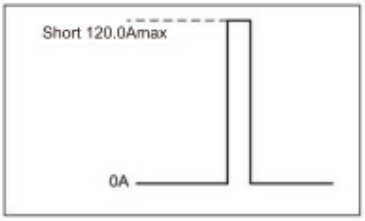


3311G Turbo mode OFF
Short test setting

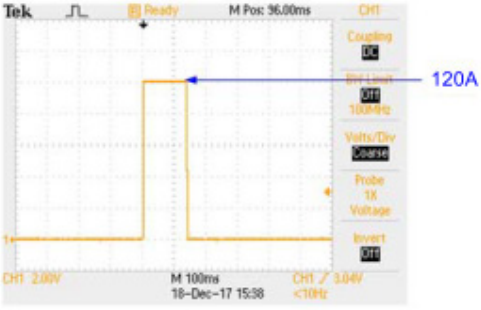


3311G Turbo mode OFF
Short real test waveform

3311G Turbo mode ON
Short test result screen

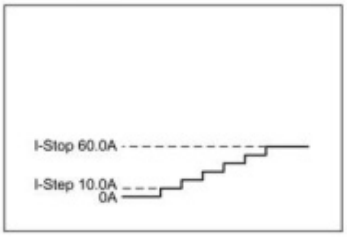


3311G Turbo mode ON
Short test setting

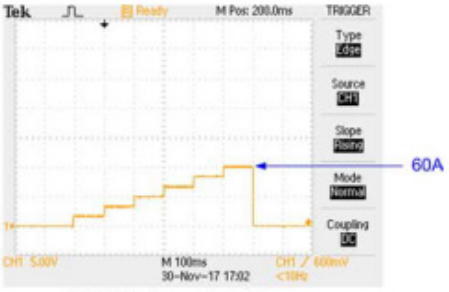


3311G Turbo mode ON
Short real test waveform

3311G Turbo mode OFF
OCP test result screen

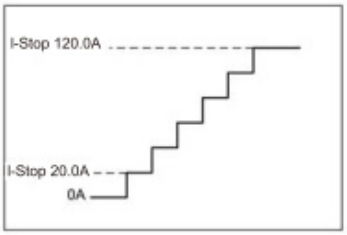


3311G Turbo mode OFF
Setting OCP Istep 10A, Istop 60A

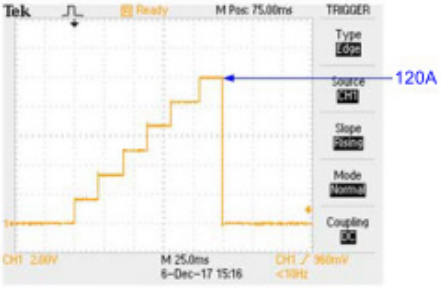


3311G Turbo mode OFF
OCP Istep 10A, Istop 60A real test waveform波形

3311G Turbo mode ON
OCP test result screen

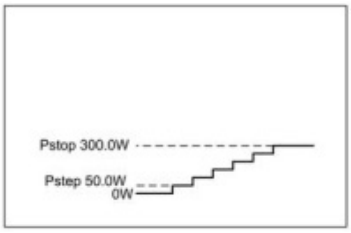


3311G Turbo mode ON
Setting OCP Istep 20A, Istop 120A



3311G Turbo mode ON
OCP Istep 20A, Istop 120A real test waveform

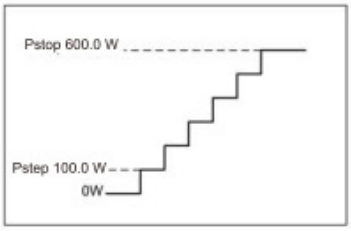
3311G Turbo mode OFF
OPP test result screen



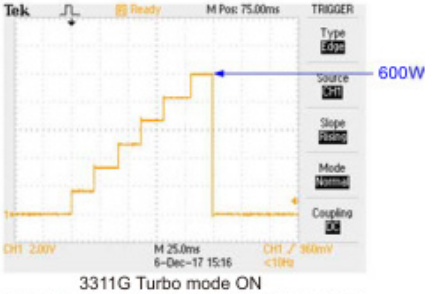
3311G Turbo mode OFF
Setting OPP Pstep 50W, Pstop 300W

3311G Turbo mode OFF
OPP Pstep 50W, Pstop 300W real test waveform

3311G Turbo mode ON
OPP test result screen



3311G Turbo mode ON
Setting OPP Pstep 100W, Pstop 600W



3311G Turbo mode ON
OPP Pstep 100W, Pstop 600W real test waveform

The power supply products under test must respond with the appropriate protection function but the abnormal situation duration is often quite short. To test for conditions, Prodigit's 3310G Series electronic load can increase the electronic load current and power in the new Turbo mode some period of time (within 2 second) up to 2 times the rated value. For example, the 3311G 60V / 60A / 300W in Turbo mode can increase its load current to 120A or power to 600W electronic load for up to two second. When verifying power products using Turbo mode in a production test environment, 3310G Series electronic loads offer greater test verification capability compared to conventional DC loads. Furthermore, the 3310G Series built-in measurement circuits can also measure the actual trip current value and protection response time under short-circuit or overload test conditions.

4-20 BMS Protective device

Lithium batteries are widely used in a variety of electronic products and electric vehicles and other devices. In order to protect the lithium battery from catching fire, exploding or any other dangerous condition, the lithium battery must be designed with a Battery Management System (BMS) protection circuit.

The BMS ensures the charging voltage does not exceed the maximum safe value of the lithium battery (Over Voltage Protection or OVP) during charge cycles. It also monitors Discharge to ensure battery does short-circuit or exceed its rated current (Over Current Protection or OCP). Finally, internal battery and cell temperatures are monitored for over or under temperature protection (OTP/UTP).

Previous Prodigit 3310F Series electronic loads were developed with BMS test functions back in 2015 as an option on the 3302F mainframe. The 3310G Series electronic now includes standard BMS test functions. Furthermore, the new Turbo mode allows the short circuit protection current and over current protection to be 2 times larger depending on 3310G model.

Battery BMS Board

Turbo mode ON
BMS ON
Short Function Test

MODEL		3310G		3311G		3312G	
Short / OCP / OPP Test Function							
Maximum Current	Turbo OFF	30A		60A		12A	
	Turbo ON*1	60A		120A		24A	
Meas. Accuracy		± 1.0% of (Reading + Range)					
BMS Test Mode *3		OFF	ON	OFF	ON	OFF	ON
Short Time	Turbo OFF	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms
	Turbo ON*1	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms
Meas. Accuracy		NA	±0.005mS	NA	±0.005mS	NA	±0.005mS
OCP Time (Tstep)	Turbo OFF	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms
	Turbo ON*1	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms
Meas. Accuracy		NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS
OPP Time (Tstep)	Turbo OFF	100mS	NA	100mS	NA	100mS	NA
	Turbo ON*1	20mS	NA	20mS	NA	20mS	NA
Meas. Accuracy		NA	NA	NA	NA	NA	NA

MODEL		3314G		3315G		3316G	
Short / OCP / OPP Test Function							
Maximum Current	Turbo OFF	12A		15A		80A	
	Turbo ON*1	24A		30A		160A	
Meas. Accuracy		± 1.0% of (Reading + Range)				± 3.0% of (Reading + Range)	
BMS Test Mode *3		OFF	ON	OFF	ON	OFF	ON
Short Time	Turbo OFF	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms
	Turbo ON*1	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms
Meas. Accuracy		NA	±0.005mS	NA	±0.005mS	NA	±0.005mS
OCP Time (Tstep)	Turbo OFF	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms
	Turbo ON*1	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms
Meas. Accuracy		NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS
OPP Time (Tstep)	Turbo OFF	100mS	NA	100mS	NA	100mS	NA
	Turbo ON*1	20mS	NA	20mS	NA	20mS	NA
Meas. Accuracy		NA	NA	NA	NA	NA	NA

MODEL		3318G		3317G		3319G	
Short / OCP / OPP Test Function							
Maximum Current	Turbo OFF	20A		160A		40A	
	Turbo ON*1	40A		320A		80A	
Meas. Accuracy		± 3.0% of (Reading + Range)					
BMS Test Mode *3		OFF	ON	OFF	ON	OFF	ON
Short Time	Turbo OFF	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms	100ms~10Sec. or Continue	0.05mS~10ms
	Turbo ON*1	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms	100~2000ms	0.05mS~10ms
Meas. Accuracy		NA	±0.005mS	NA	±0.005mS	NA	±0.005mS
OCP Time (Tstep)	Turbo OFF	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms	100mS	0.05mS~10ms/11~1000ms
	Turbo ON*1	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms	20mS	0.05mS~10ms/11~1000ms
Meas. Accuracy		NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS	NA	±0.005mS/±0.2mS
OPP Time (Tstep)	Turbo OFF	100mS	NA	100mS	NA	100mS	NA
	Turbo ON*1	20mS	NA	20mS	NA	20mS	NA
Meas. Accuracy		NA	NA	NA	NA	NA	NA

The 3310G Series BMS test function for lithium batteries includes short circuit and over current protection modes, which provide a quick, easy and accurate test solution. For BMS short-circuit protection, there is about 2 times more current available for OCP current testing that needs immediate (uS level) protection action function, use 3311G up to 120A current load, in the process of high current pull to BMS rated short circuit current, it can verify B MS short circuit protection can do correct action.

In addition, the 3310G series electronic load can also detect the actual operating current value and operating time of the BMS short circuit protection action, that is, the actual operating current value and operating time when the BMS internal MOSFET switch is turned off.

For BMS overcurrent protection, it is between normal operating current and short-circuit current protection, generally higher than 125% of OCP current, it needs fast (about several hundred mS level) protection action.

3310G series BMS overcurrent (overcurrent during charging and overcurrent during discharge) protection test system with electronic load pull, then confirm whether BMS overcurrent protection is active, when BMS overcurrent protection is not active, increase load current (I Step). Then, confirm whether the OCP of the BMS is active, and continue the process until the BMS OCP action occurs. Therefore, the BMS OCP test can be scanned by gradually increasing the load current to obtain the current point and action reaction time of the BMS overcurrent protection.

- BMS short circuit, overcharge current, over discharge current protection principle
  The BMS circuit protection principle is as shown in the figure below. It is to protect the battery by turning off the MOSFET (loop current = 0A).

  In the BMS, the MOSFET switch is bidirectional. In the normal status, the two switches are ON. Since the two MOSEFT switches have the Rds ON resistance, current flow will cause a Voltage drop. Battery BMS is used this feature to detect charge and discharge currents.

  The MOSFET switching status shown in the figure below is the over-discharge current status. The IC's 3rd pin control MOSFET is ON, this time the discharge switch is OFF (controlled by IC pin 1).

  When the BMS detects a short circuit, over discharge current or low battery voltage, it will turn off the discharge switch to protect the battery.
  When the BMS detects an overcharge current or a battery overvoltage, it will turn off the charge switch to protect the battery.

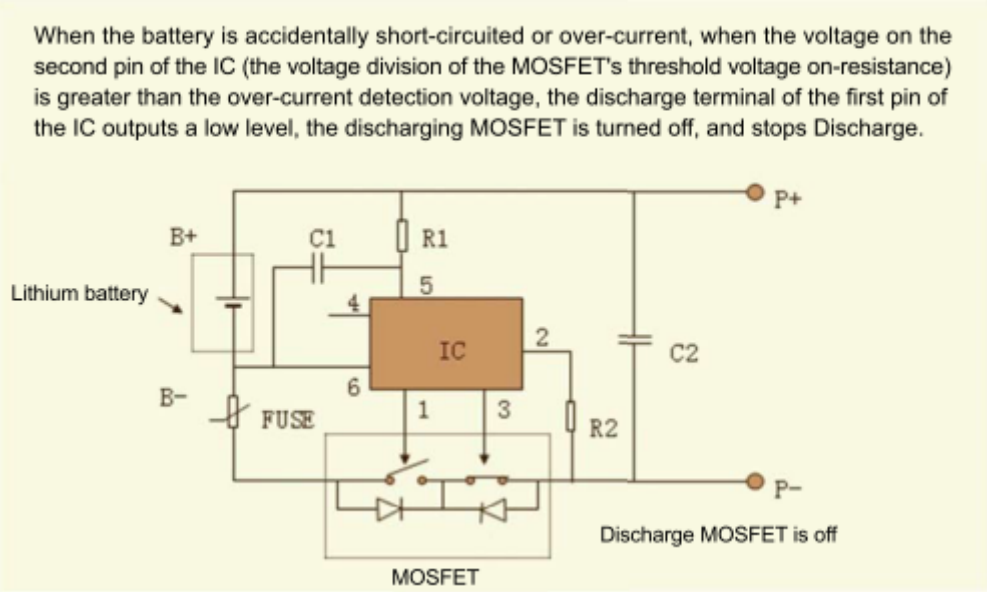


Figure 2.1 BMS internal architecture

- Short-circuit protection (SHORT) test method: Power supply (PS) & LOAD connection is shown in Figure 2.1, LOAD test procedure is shown in Figure 2.3.

In the short-circuit protection test mode, the electronic load will load the maximum current value of the model (for example, 60A for 3311G or 120A for Turbo ON). At the same time, the timer is started to calculate the actual time flowing through the BMS (Note: This time refers to the time between the set threshold current Ith to the BMS action MOSEFT switch OFF, that is, the time lower than the set threshold current Ith.

in addition, the electronic load will measure the actual maximum short circuit current value, Figure 2.4 is 4000 mAh mobile power uses the 3311G BMS test oscilloscope current waveform (left figure) and the electronic load power meter to show the short circuit maximum actual current and short circuit protection reaction time (right figure).

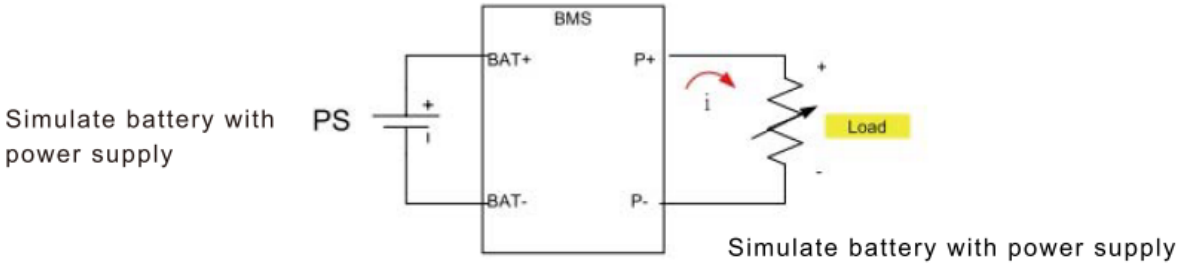


Figure 2.2

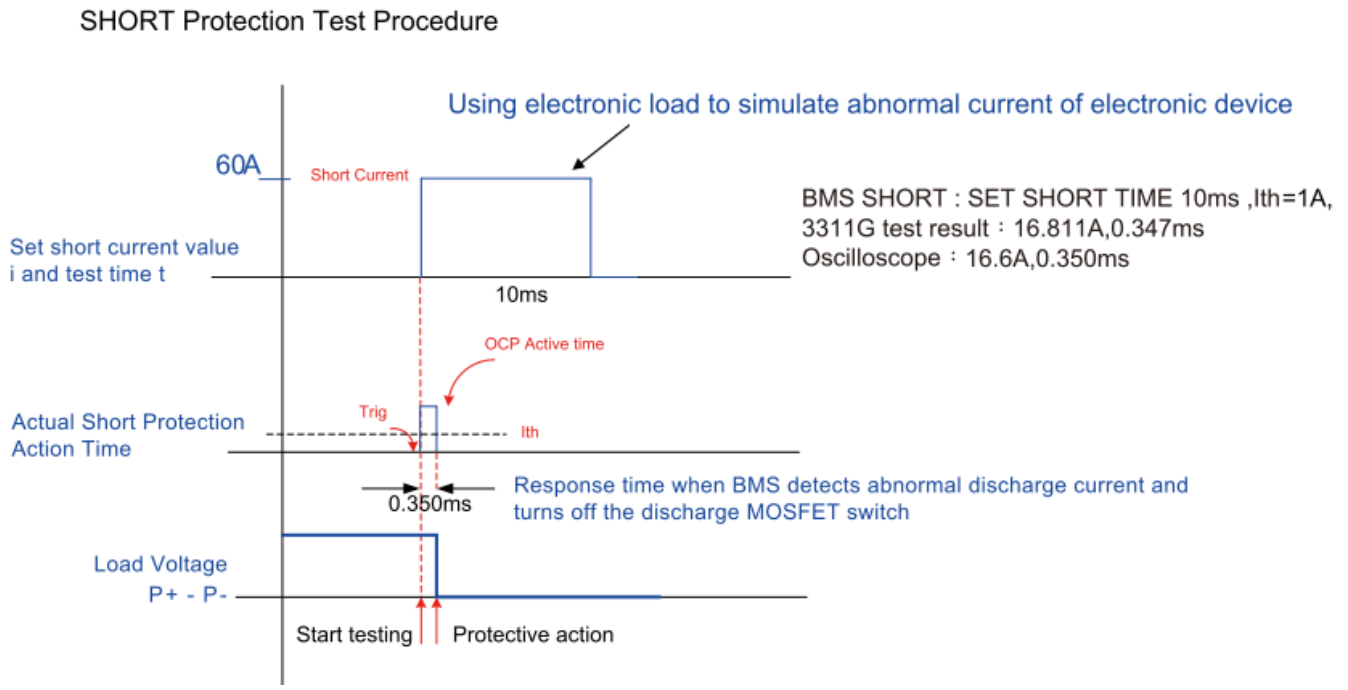


Figure 2.3 3311G short-circuit current test procedure diagram

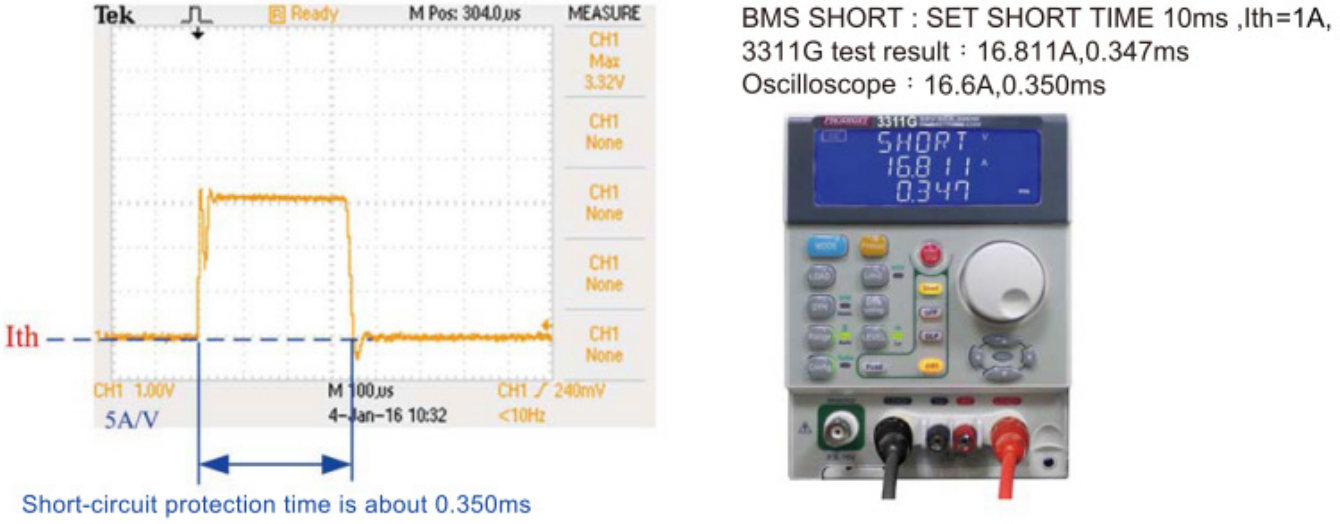


Figure 2.4 4000mAh Power Bank Actual Short Circuit Test Waveform

- Overcharge Current Protection (OCCP) test method: The test method is divided into single pulse and continuous step pulse. Single pulse can be used for rapid test. It can be used for a large number of fast tests suitable for the production line. Continuous step pulse can be used to scan the actual over current protection point. Suitable for research and development that needs accurate point.
  The power supply (PS) & LOAD connection and test procedures are shown in Figure 2.5.

  In the single-pulse overcurrent protection test mode, the electronic load will be pulled to the set current value (for example, 3311G is the current value between 0~60A or 120A when Turbo is ON), at this time, the electronic load measures the actual maximum overcurrent protection value and the overcurrent response time value. Figure 2.6 is the 3311G single pulse current BMS overcharge current test program diagram, Figure 2.7 is the actual test result, the left picture is the oscilloscope Current waveform when BMS overcharge current protection. The figure on the right shows the actual test overcharge current value and protection reaction time of the 3311G BMS.

- The overcurrent protection test mode of continuous STEP pulse is similar to the single pulse mode. In addition to the initial current setting, the continuous STEP pulse mode increases the time of each STEP, the current increased by each STEP and the current value of the final STEP. Figure 2.8 is the 3311G single pulse current BMS overcharge current test program diagram. Figure 2.9 is the actual test result, the left picture is the oscilloscope current waveform diagram when BMS overcharge current protection, the right picture is the actual test overcharge current value of 3311G BMS and Protect the reaction time.

- In continuous STEP pulse mode, the maximum overcurrent protection value and overcurrent action reaction time value measured by the electronic load are the Measurement results under each STEP. For example, if ISTART is set to 1.000A, OCT TSTEP is 500ms, OCP ISTEP is 0.1A, OCP ISTOP is 5.000A, the measurement process is The electronic load sinks current 1.000A and test whether the battery BMS operates at 500ms. If it is, it will measure the action current value and the action reaction time. If the Battery BMS is no action under 1.000A; the electronic load will increase to 1.100A According to ISTEP setting and test whether it operates at 500ms. If it is, it will measure the Operating voltage value and action time at 1.100A, if the battery BMS is no action at 1.100A. The load Current is increased to 1.200A in the above manner until the final test voltage Value of the battery BMS test is 5.000A.

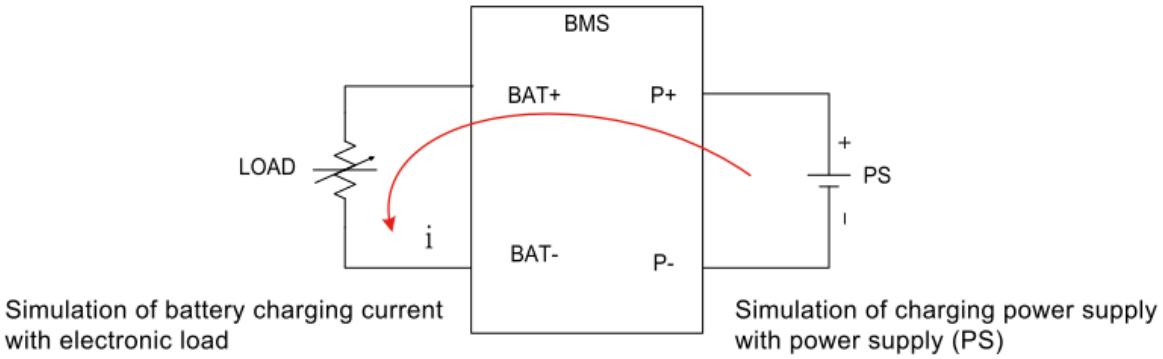


Figure 2.5 Equivalent simulation of BMS charging

- Single Pulse: Used during quick test

OCCP(Over Current Charge Protection) Test Procedure

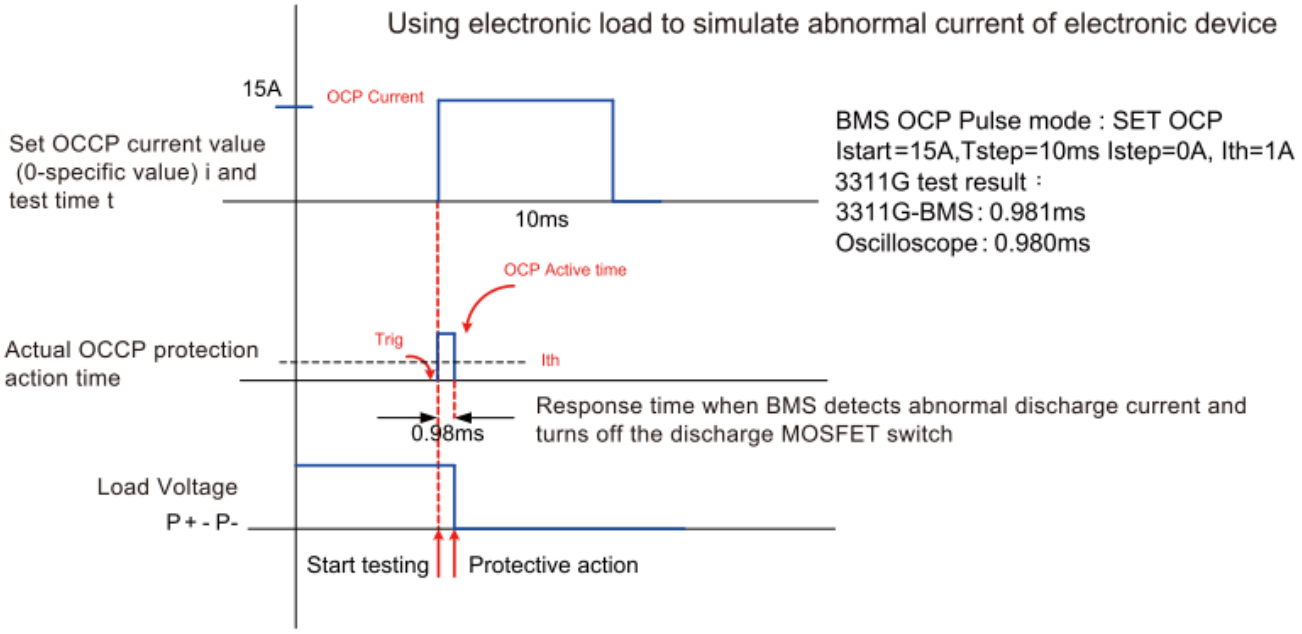


Figure 2.6 3311G BMS overcharge flow test program diagram (single pulse)

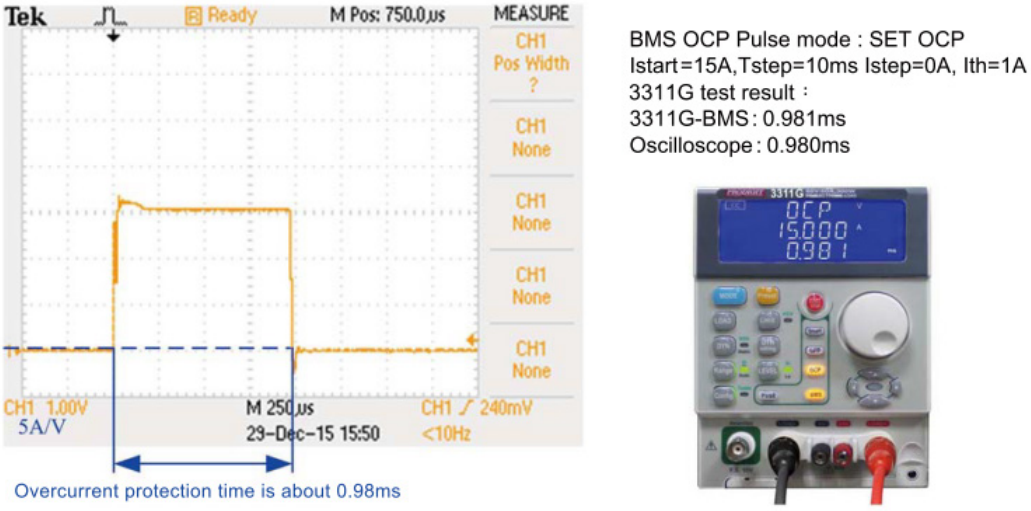


Figure 2.7 3311G BMS overcharge flow test results (single pulse)

- Continuous Step Pulse: Use when scanning the actual overcurrent protection point during charging

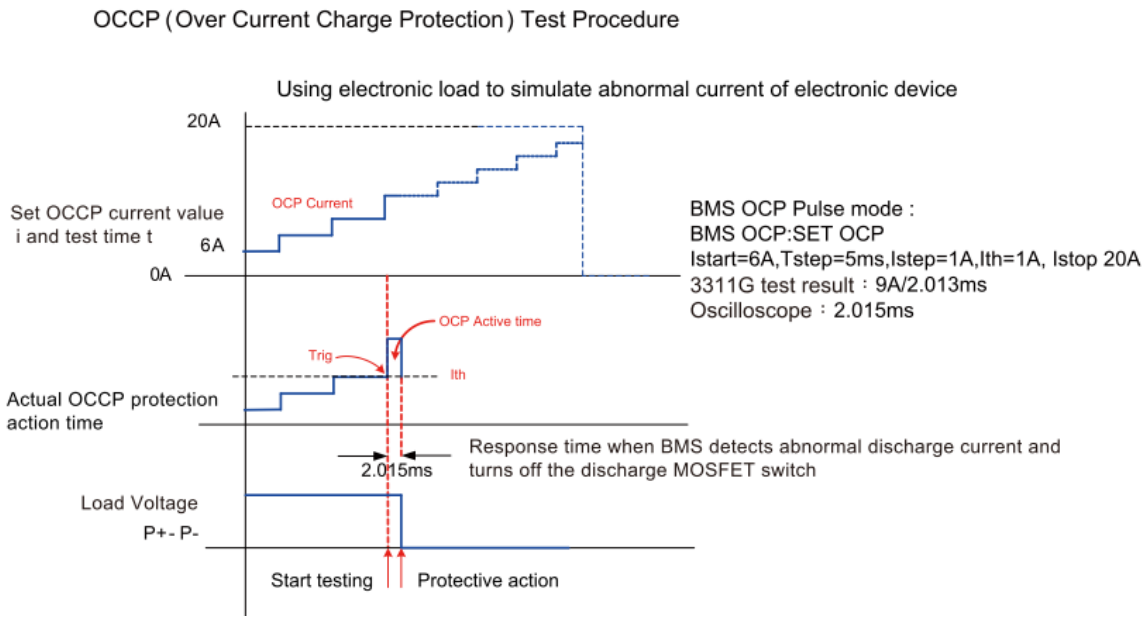


Figure 2.8 3311F BMS overcharge flow test program diagram (continuous STEP pulse)

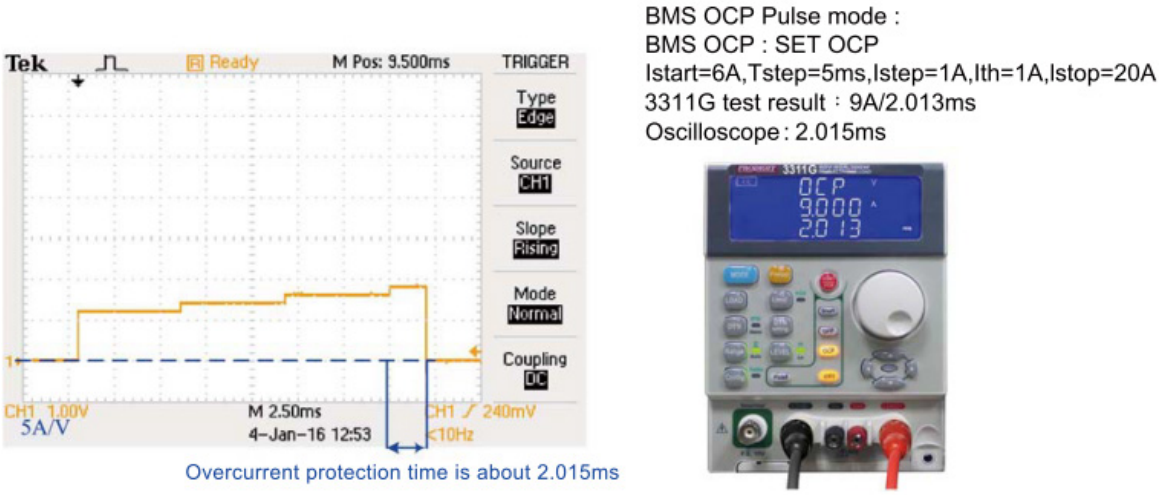


Figure 2.9 3311G BMS Overcharge flow Test Results (Continuous STEP Pulse)

- Over current discharge protection (OCDP) test method: Power supply (PS) & LOAD connection and test procedures are shown in Figure 2.10.

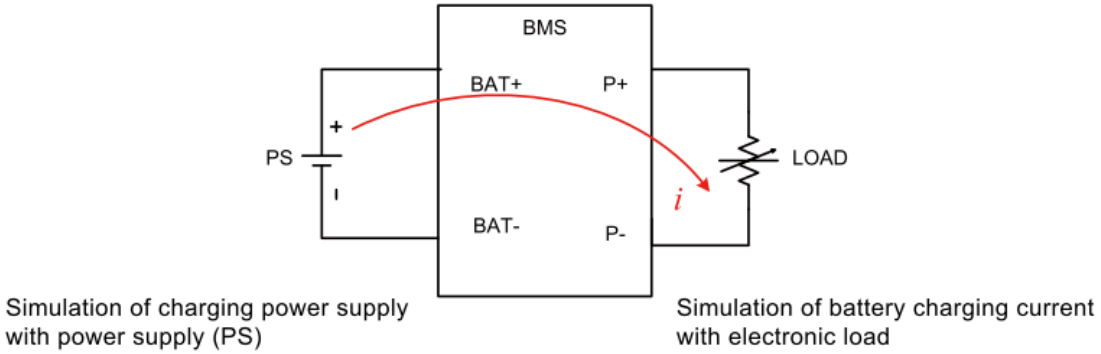


Figure 2.10 Equivalent simulation of BMS discharge

- Single Pulse: Used during quick test
  OCDP(Over Current Discharge Protection) Test Procedure
  The 3311G single pulse current BMS over discharge current test procedure is similar to the BMS overcharge current test. The 3311G BMS function can actually test the overcharge current value and the protection reaction time.

- Continuous Step Pulse: Used when the actual overcurrent protection point during scan discharge OCDP(Over Current Discharge Protection) Test Procedure
  The 3311G continuous pulse current BMS over discharge current test procedure is similar to the BMS overcharge current test. The 3311G BMS function can actually test the overcharge current value and reaction time.

- The function and actual action response of the battery BMS have been explained in detail. The battery BMS can immediately provide protection and disconnection measures for the abnormal voltage, current, temperature and other conditions of the battery to avoid the occurrence of danger, because the battery BMS is a safety measure that must be 100% full-featured test verification that security can be ensure, although the test and verification for the battery BMS can use the oscilloscope to measure the current value and action response time of the BMS action, it is undoubted that the oscilloscope can be tested in detail during the development stage, but in a mass production stage, there is a need for rapid and complete testing that there is a limit on capacity production . For this difficulty, Prodigit integrates the BMS test into the 3310G series electronic load. In addition to the functions of the normal 3310G series, the set test current required for battery BMS testing is increased. Both the current action value and the action response timer are integrated into the 3311G BMS function, allowing a large number of quick tests to verify that the battery BMS becomes a reliable, accurate and fast method.

  To test BMS over-current protection, the 3310G load starts to sink current (I start), then checks whether the BMS over-current protection is active. If the BMS over-current protection is not active, the load starts to increase the load current (I Step) and checks whether the BMS OCP is responds. This process continues until the BMS OCP activates. Thus, the BMS OCP test can determine both OCP function current trip level and response time.

4-21 NTC simulation test (this feature is option)

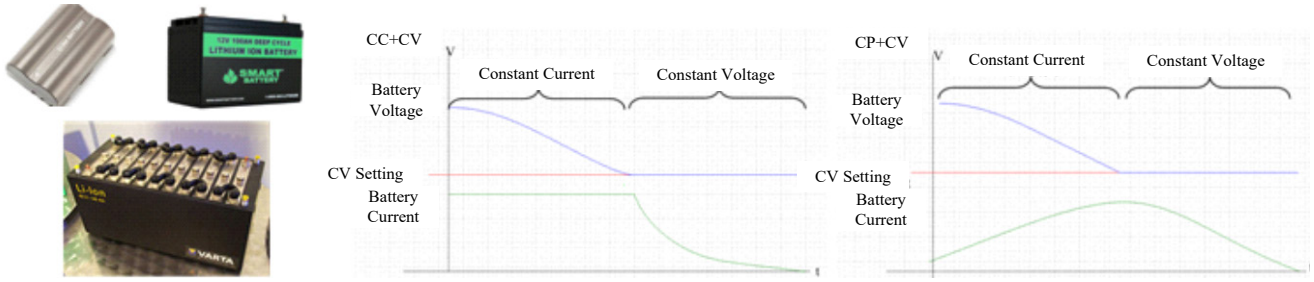
Based on the safety of lithium batteries on the ambient temperature, lithium batteries and chargers must require a temperature protection mechanism to prevent causing the danger under the ambient of the low temperature and high temperature.

NTC Option

3310G series electronic load and 3302G mainframe provided by the NTC simulate resistance (optional), in the 3310G series panels which can be directly set NTC resistance values from 100Ω to 500KΩ, equivalent to 10KΩ NTC resistance from the temperature range of -46 ℃ ~ +179 ℃, set to change the NTC resistance that can be tested to verify if the lithium battery and charger temperature protection is correct action to stop charging or discharging or reduce the charge and discharge current, when the temperature back to working temperature, check the protection action is recovery, return to the operational state, to restore the normal charge and discharge.

4-22 Load operation mode increases CC + CV and CP + CV

3310G series electronic load CC, CR, CV, CP, Dynamic load mode, but also add the new CC + CV and CP + CV operation mode.



In the discharge test of the battery, special attention should be paid to avoid excessive discharge of the battery. Otherwise it will cause the battery voltage is too low due to excessive discharge will cause permanent damage

When using the CC + CV or CP + CV mode of the 3310G series electronic load, the battery will constant current (CC) or constant power (CP) set by the electronic load to perform the discharge. When the minimum allowable discharge voltage of the battery is set to the CV voltage value, which is the lowest voltage of the discharge test, the CC + CV and CP + CV mode can help the battery will not be damaged due to excessive discharge, resulting in battery loss.

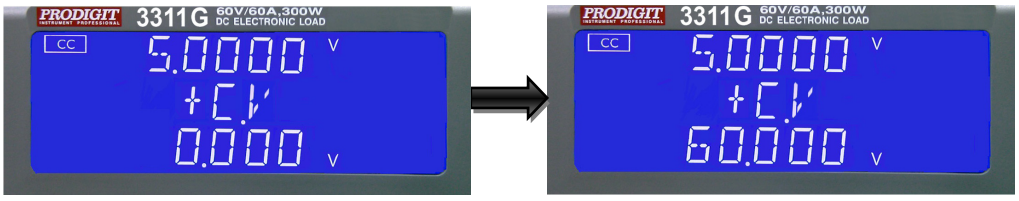
CC+CV or CP+CV Operating Instructions:

4.22.1 CC+CV Operating Instructions:

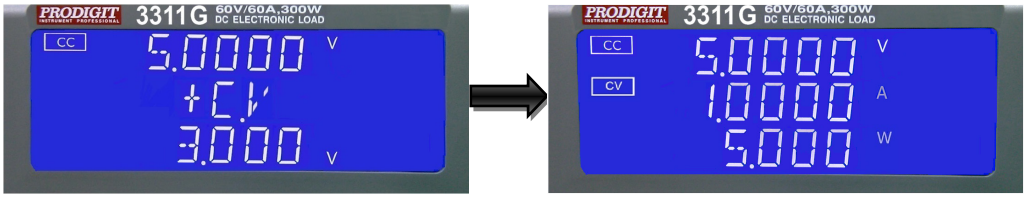
4.22.1.1 These can be selected in turn by pressing the "MODE" key (8), LCD will Illuminate according to the operating mode is selected CC.

4.22.1.2 Pressing the “Preset” Key (13) once will cause the Button to illuminate, Adjusted by the Rotary knob and Arrow key (21) can be read from the Lower display during set the current 1A.

4.22.1.3 Pressing the "Limit" key (14), Select +CV, adjusted by the Rotary knob And Arrow key (21) can be read from the lower display during set +CV Voltage range 0.000V~60.000V.



4.22.1.4 Set CV voltage value to 3.000V Use the knob and arrow keys (21) to Adjust; press the START key (20), LOAD ON.

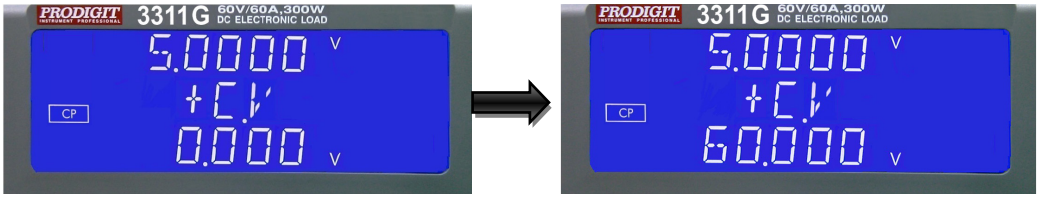


4.22.2 CP+CV Operating Instructions:

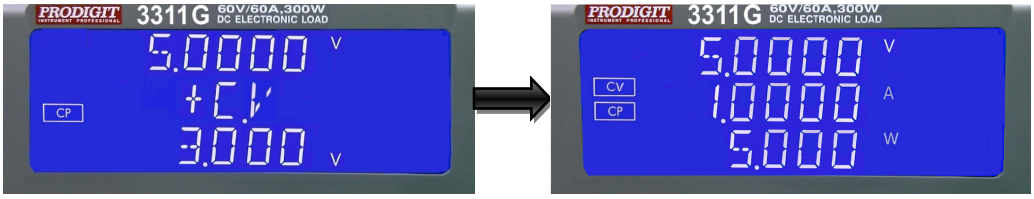
4.22.2.1 These can be selected in turn by pressing the "MODE" key (8), LCD will Illuminate according to the operating mode is selected CP.

4.22.2.2 Pressing the “Preset” Key (13) once will cause the Button to illuminate, Adjusted by the Rotary knob and Arrow key (21) can be read from the Lower display during set the watt 5.000W.

4.22.2.3 Pressing the "Limit" key (14), Select +CV, adjusted by the Rotary knob And Arrow key (21) can be read from the lower display during set +CV Voltage range 0.000V~60.000V.



4.22.2.4 Set CV voltage value to 3.000V Use the knob and arrow keys (21) to Adjust; press the START key (20), LOAD ON.

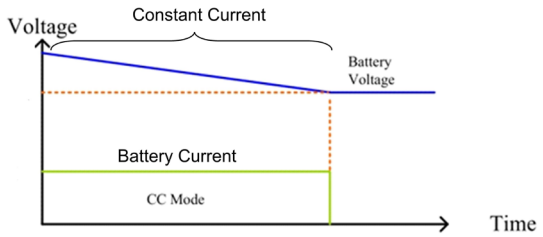


4-23 Battery test function

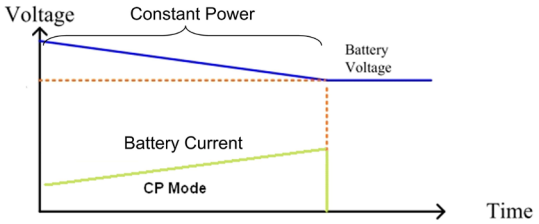
3310G series load adds new TYPE1 ~ TYPE5 total of five battery discharge tests, you can Select the appropriate battery test mode, the test results can be directly displayed on the LCD Display showing the battery AH capacity, the discharge voltage value, the cumulative Discharge time data etc..

4.23.1 TYPE 1: Operating instructions

TYPE1:Measuring discharge capacity, select CC mode or CP Mode, USER Setting UVP(under voltage protect)，Test LOAD ON, When the battery voltage is less than UVP, LOAD OFF and display the total discharge capacity AH.



CC + UVP Battery Discharge mode



CP + UVP Battery Discharge mode

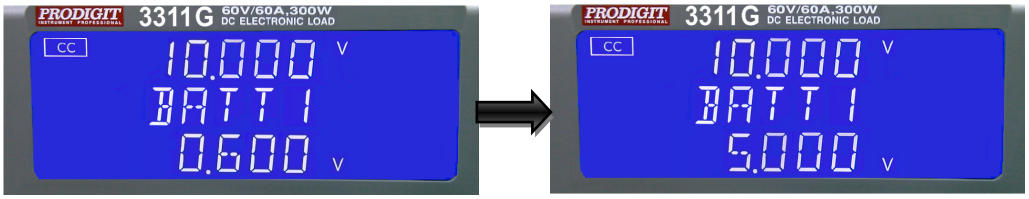
TYPE 1

4.23.1.1 CC Mode Example 1: These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate according to the operating mode is selected CC.

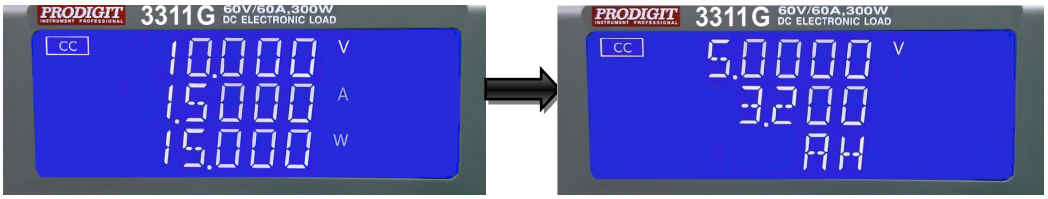
4.23.1.2 Pressing the "Preset" Key (13) once will cause the Button to illuminate, adjusted by The Rotary knob and Arrow key (21) can be read from the lower display during Set the current 1.5000A.

4.23.1.3 Pressing the “Preset” key (12) LED once will off.

4.23.1.4 Pressing the "Config" key (16) Select BATT1, adjusted by the Rotary knob and Arrow key (21) can be read from the lower display during set the UVP Voltage 5.000V.



4.23.1.5 Pressing the "START" key (20), until the battery voltage is less than UVP, LOAD OFF and LCD monitor Display the battery AH capacity, the discharge voltage value.

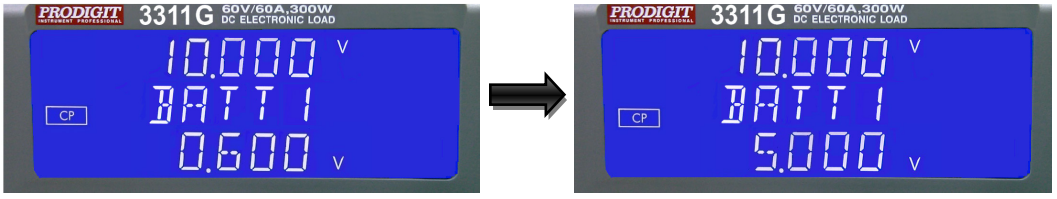


4.23.1.6 CP Mode Example 2: These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate according to the operating mode is selected CP.

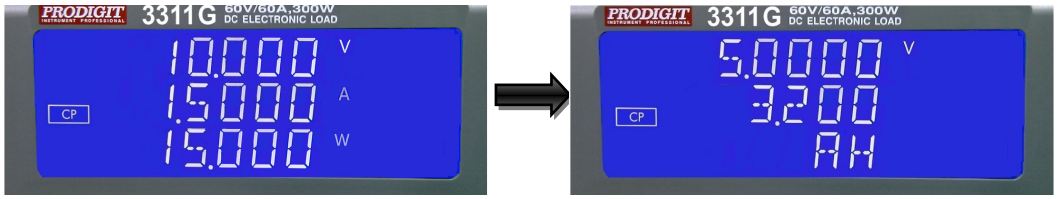
4.23.1.7 Pressing the "Preset" Key (13) once will cause the Button to illuminate, adjusted by The Rotary knob and Arrow key (21) can be read from the lower display during Set the watt 15.000W.

4.23.1.8 Pressing the "Preset" key (13) LED once will off.

4.23.1.9 Pressing the "Config" key (16) Select BATT1, adjusted by the Rotary knob and Arrow key (21) can be read from the lower display during set the UVP Voltage 5.000V.

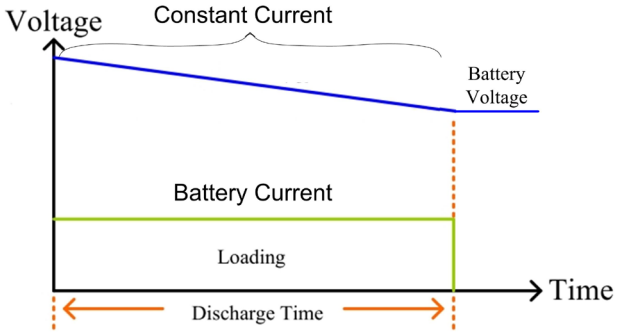


4.23.10 Pressing the "START" key (20), until the battery voltage is less than UVP, LOAD OFF and LCD monitor Display the battery AH capacity, the discharge voltage value.



4.23.2 TYPE 2 Operating instructions

TYPE2: Measuring discharge voltage, user set discharge time and UVP, when the load on Time reaches the set time, LOAD OFF and then display the voltage, TIMER setting range 1~99999Sec (>27H), If the battery voltage is less than UVP during discharge, LOAD OFF and Display the total discharge capacity AH and time.



Battery Discharge Time Test

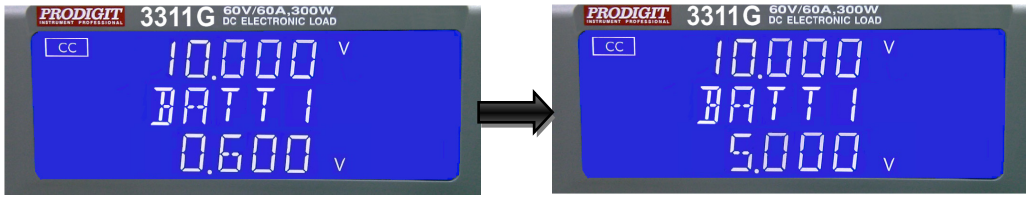
TYPE 2

4.23.2.1 CC Mode Example 1: These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate according to the operating mode is selected CC.

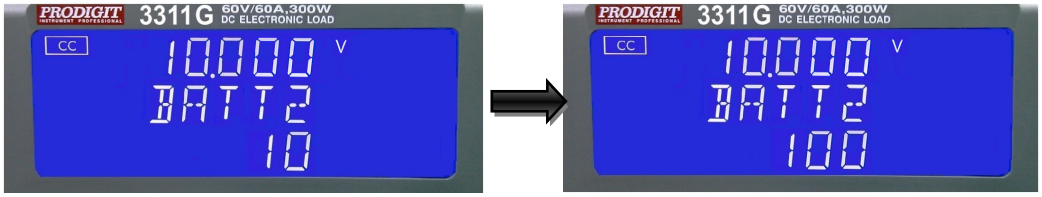
4.23.2.2 Pressing the "Preset" Key (13) once will cause the Button to illuminate, adjusted by The Rotary knob and Arrow key (21) can be read from the lower display during Set the current 1.5000A.

4.23.2.3 Pressing the “Preset" key (13) LED once will off.

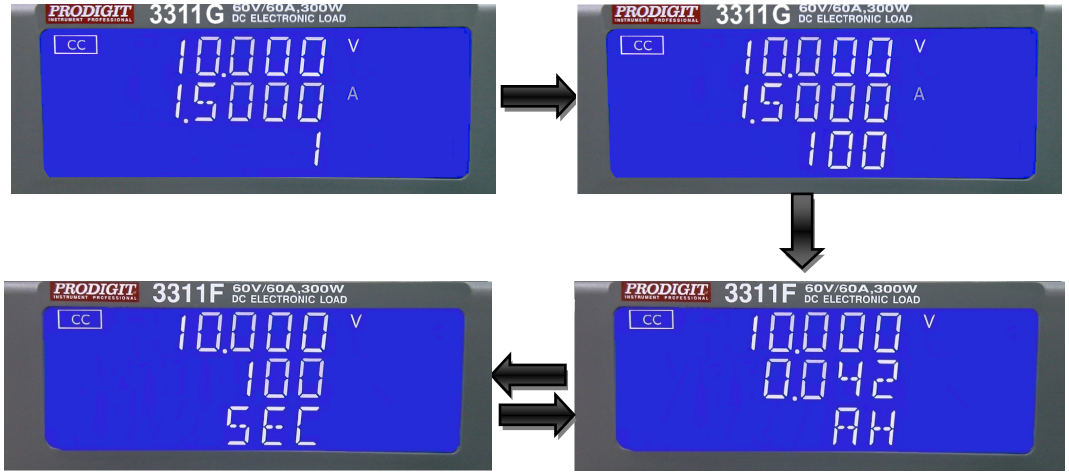
4.23.2.4 Pressing the "Config" key (16) Select BATT1, adjusted by the Rotary knob and Arrow key (21) can be read from the lower display during set the UVP Voltage 5.000V.



4.23.2.5 Pressing the "Config" key (16) Select BATT2, adjusted by the Rotary knob and Arrow key (21) can be read from the lower display during set the time 100s.



4.23.2.6 Pressing the "START" key (20), until the set time is 100 seconds or when the Battery voltage is less than UVP, LOAD OFF and LCD monitor Display the battery AH capacity, the discharge voltage value and time.

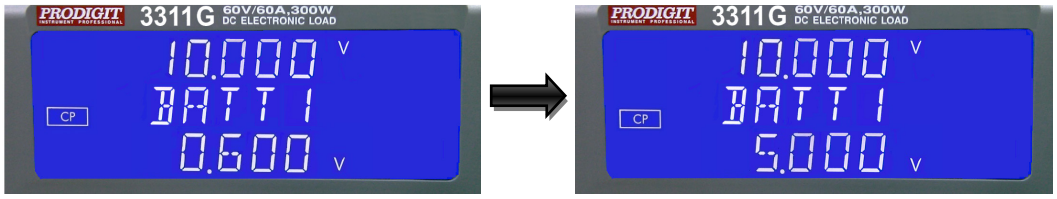


4.23.2.7 CP Mode Example 2: These can be selected in turn by pressing the "MODE" key (8), LCD will illuminate according to the operating mode is selected CP.

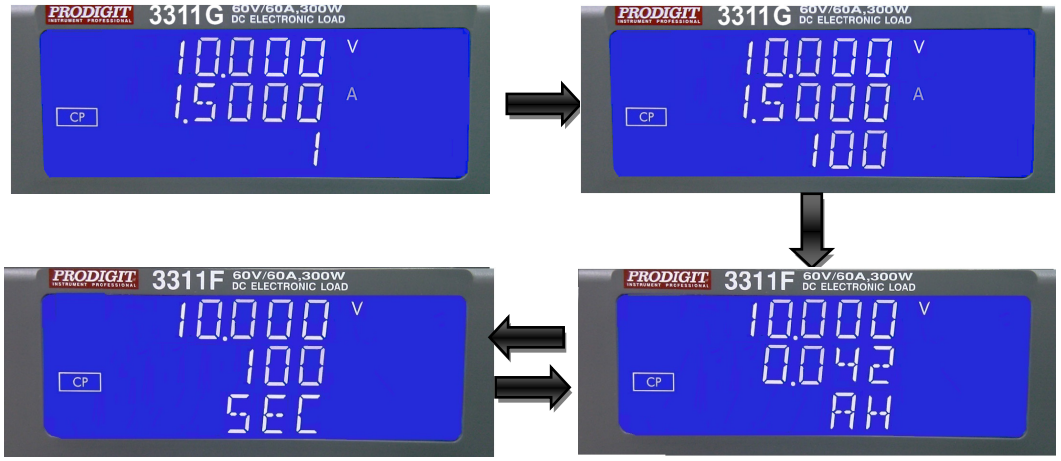
4.23.2.8 Pressing the "Preset" Key (13) once will cause the Button to illuminate, adjusted by The Rotary knob and Arrow key (21) can be read from the lower display during Set the watt 15.000W.

4.23.2.9 Pressing the "Preset" key (13) LED once will off.

4.23.2.10 Pressing the "Config" key (16) Select BATT1, adjusted by the Rotary knob and Arrow key (21) can be read from the lower display during set the UVP Voltage 5.000V.

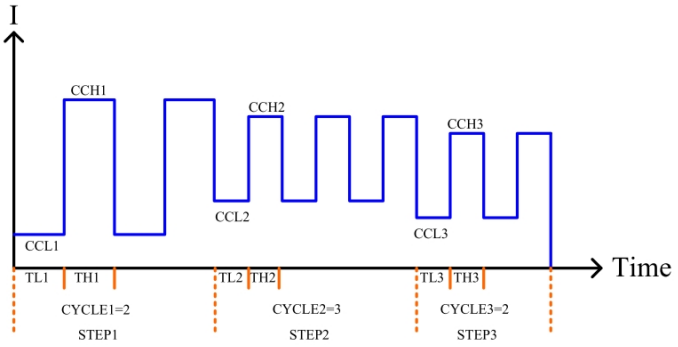


4.23.2.11 Pressing the "START" key (20), until the set time is 100 seconds or when the Battery voltage is less than UVP, LOAD OFF and LCD monitor Display the battery AH capacity, the discharge voltage value and time.



4.23.3 TYPE 3 remote Operating instructions

4.23.3 TYPE3: Cycle Life test, the battery discharge test uses the Pulse mode, the use of counting Dynamic mode test + Repeat function, the test LOAD ON, DYN ON to COUNTER = 0 end, the end LOAD OFF, DYN OFF, and actively respond "OK, +XX.XXXX" (Vmeter), CYCLE setting range 1~2000, STEP: 1~3, Repeat:0~9999.



EXAMPLE:

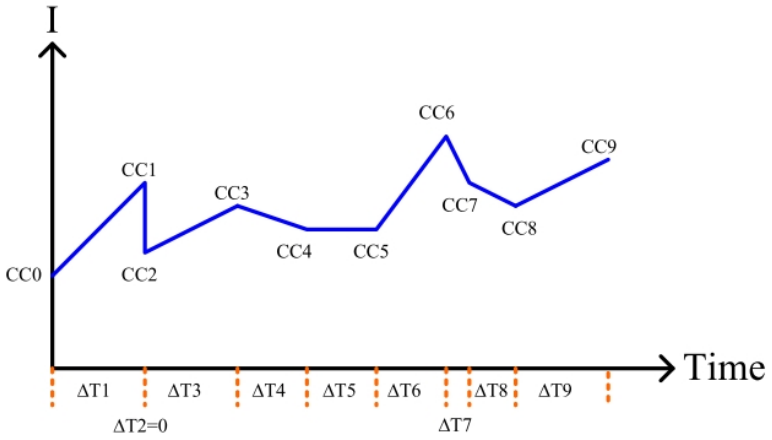
TYPE3: Set TYPE3 type, set a few STEP, CCLn/CCHn/THn/TLn/CYCLEn, REPEAT Parameter, BATT: TEST ON",Command to start testing, at the end of the LOAD will actively respond to the PC value " OK,XXXXX" , XXXXX refers to the voltage at the end.

BATT: TYPE 3
BATT: STEP 2
BATT: CCH1 6.0
BATT: CCL1 1.0
BATT: TH1 2.0
BATT: TL1 2.0
BATT: CYCLE1 500
BATT: CCH2 4.0
BATT: CCL2 1.0
BATT: TH1 1.0
BATT: TL1 1.0
BATT: CYCLE2 500
BATT: REPEAT 1
BATT: TEST ON

4.23.4 TYPE 4 remote Operating instructions

TYPE4: CC RAMP Mode, Slew-Rate Load + Repeat function, the required parameters are STEPn n=1~9, CC0, CC1, ΔT1, CC2, ΔT2...CC9, ΔT9, Repeat, loading mode every second. Need to increase or decrease the current value ΔCC = (CCn-(CCn-1))/Time, Time: 0 ~ 6000Sec, STEP: 1 ~ 9, Repeat: 0 ~ 9999, LOAD OFF at the end, and actively respond "OK, +XX.XXXX" (Vmeter).

Note: When ΔCC < current minimum resolution is changed to increase or decrease every 2 or 3 seconds, and so on.



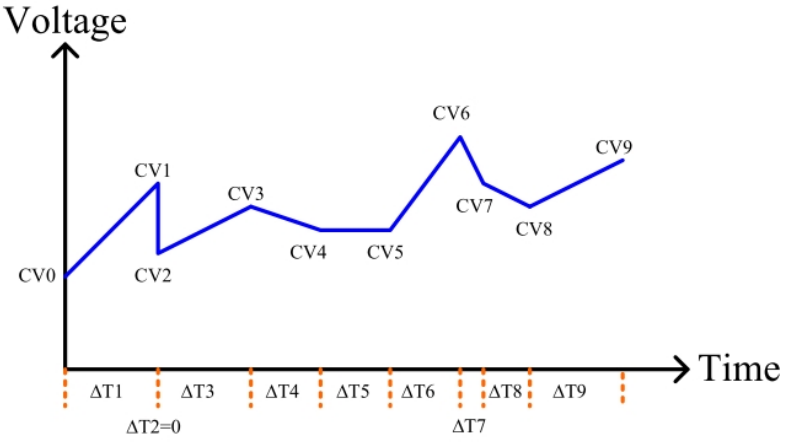
EXAMPLE:

TYPE4：Set TYPE4,Set a few Step，CCn/DTIMEn, REPEAT parameters, BATT:TEST ON" Command to start testing, at the end of the LOAD will actively respond to the PC value "OK, XXXXX", XXXXX refers to the voltage at the end.

BATT: TYPE 4
BATT: STEP 3
BATT: CC0 1
BATT: CC1 3
BATT: DTIME1 1
BATT: CC2 6
BATT: DTIME2 0
BATT: CC3 4
BATT: DTIME3 2
BATT: REPEAT 10
BATT: TEST ON

4.23.5 TYPE 5 remote Operating instructions

TYPE5: CV RAMP Mode, Slew-Rate Load + Repeat function, required parameters are STEPn n=1~9, CV0, CV1, ΔT1, CV2, ΔT2...CV9, ΔT9, Repeat, loading mode every second Increase or decrease the current value ΔCV =(CVn-(CVn-1))/Time,Time:0~6000Sec,STEP:1~9,Repeat: 0~9999, LOAD OFF at the end, and respond “OK,+” XX.XXXX” (Vmeter).



EXAMPLE:

TYPE5：set TYPE5，Set a few Step，CVn/DTIMEn，REPEAT parameters “ BATT:TEST ON” Command to start testing, at the end of the LOAD will actively respond to the PC value “OK,XXXXX” ， XXXXX refers to the current at the end.

BATT: TYPE 4
BATT: STEP 3
BATT: CV0 1
BATT: CV1 3
BATT: DTIME1 1
BATT: CV2 6
BATT: DTIME2 0
BATT: CV3 4
BATT: DTIME3 2
BATT: REPEAT 10
BATT: TEST ON

4-24 Battery real discharge current simulation and test

9923 Current Waveform Generator Provide battery real discharge current waveform simulation

Prodigit whole new develops Model 9923 Current Waveform Generator(Card) provide battery real discharge current waveform simulation, Install the Model 9923 to 3302G, 3305G and 3300G series load mainframe can simulation the battery real discharge current waveform.
Please refer to the Model 9923 Current Waveform Generator application in detail.

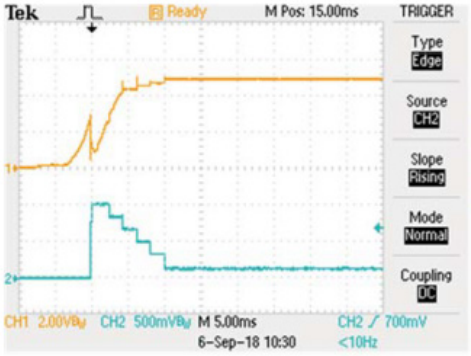
4-25 Capacitive load and sudden load access test of power supply at power on

The power input circuit of an electronic circuit usually has many high-capacity capacitors, when the power supply is turned on; its output will have an instantaneous starting current, The 3310G Series incorporates a unique surge current test mode, instantly delivers load currents up to 200%.(Example: 3311G continuous current specification 60A and maximum surge current can be tested to 120A), Test time up to 2000 ms, The instantaneous starting current for simulating of the load used to connect the power supply or charger to the electronic circuit at startup, It is used to test whether the output voltage waveform of the capacitive load at startup is in compliance with the requirements, as shown below.

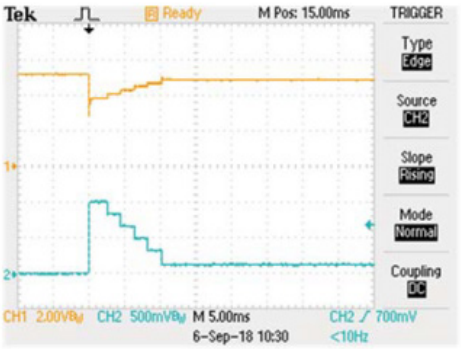
Model	3310G	3311G	3312G	3314G	3315G
Surge Test Mode					
Surge current	0~60A	0~120A	0~24A	0~24A	0~30A
Normal current	0~30A	0~60A	0~12A	0~12A	0~15A
Surge Time	10~2000ms				
Surge Step	1~5				

Model	3316G	3317G	3318G	3319G
Surge Test Mode				
Surge current	0~160A	0~320A	0~40A	0~80A
Normal current	0~80A	0~160A	0~20A	0~40A
Surge Time	10~2000ms			
Surge Step	1~5			

In addition, when the power supply or charger is in operation, the hot plug-in electrical equipment will cause a surge load current when it is connected. The 3311G series incorporates the running surge current test function to view the electrical appliances when the load is suddenly connected, to see if the power supply or charger output voltage is stable enough. As shown below.



Surge test setting :
Surge Current 18A
Normal Current 3A
Surge step : 5
Surge time 10ms



Surge test setting :
Surge Current 18A
Normal Current 3A
Surge step : 5
Surge time 10ms