Chroma

Programmable
DC Electronic Load
6310A Series
Operation & Programming
Manual

Version 1.0
March 2009
P/N ITM-0096073

Legal Notices

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Warranty

All Chroma instruments are warranted against defects in material and workmanship for a period of one year after date of shipment. Chroma agrees to repair or replace any assembly or component found to be defective, under normal use during this period. Chroma's obligation under this warranty is limited solely to repairing any such instrument, which in Chroma's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Chroma.

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Material Contents Declaration

A regulatory requirement of The People's Republic of China defined by specification SJ/T 11364-2006 mandates that manufacturers provide material contents declaration of electronic products, and for Chroma products are as below:

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls	Polybromodiphenyl Ethers
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
PCBA	×	O	O	O	O	O
CHASSIS	×	O	O	O	O	O
ACCESSORY	×	O	O	O	O	O
PACKAGE	O	O	O	O	O	O

"O" indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of SJ/T-11363-2006 and EU 2005/618/EC.

"×" indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of SJ/T-11363-2006 and EU 2005/618/EC.

1. Chroma is not fully transitioned to lead-free solder assembly at this moment; however, most of the components used are RoHS compliant.
2. The environment-friendly usage period of the product is assumed under the operating environment specified in each product's specification.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.

CE-Conformity Declaration

For the following equipment:
Product Name: DC Electronic Load
Model Name:6314A, 6312A, 63101A, 63102A, 63103A, 63105A, 63106A, 63107A, 63108A, 63112A
Manufacturer's Name: Chroma ATE Inc.
Manufacturer's Address: 66 Hwa-Ya 1st Rd., Hwa-Ya Technical Park, Kuei-Shan Hsiang, Taoyuan Hsien, Taiwan

is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility (89/336/EEC) and electrical equipment designed for use within certain voltage limits (73/23/EEC;93/68/EEC)

For electromagnetic compatibility, the following standards were applied:

EMC: EN61326-1:2006, Table 2 CISPR 11: 2003+A1: 2004+A2: 2006, (Class A)
IEC 61000-4-2: 1995+A1: 1998+A2: 2000
IEC 61000-4-3: 2002+A1: 2002
IEC 61000-4-4: 2004
IEC 61000-4-5: 1995+A1: 2000
IEC 61000-4-6: 1996+A1: 2000
IEC 61000-4-8: 1993+A1: 2000
IEC 61000-4-11: 2004
EN61000-3-2: 2000+A2: 2005, Class A
EN61000-3-3: 1995+A1: 2001+A2: 2005

For safety requirement, the following standard was applied:

Safety: IEC/EN61010-1: 2001

Taiwan	2008.07.18	
Place	Date	Vice President, Engineering

Warning:
This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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 specific WARNINGS given elsewhere in this manual will violate safety standards of design, manufacture, and intended use of the instrument. *Chroma* assumes no liability for the customer's failure to comply with these requirements.

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

PROTECTIVE GROUNDING
Make sure to connect the protective grounding to prevent an electric shock before turning on the power.

NECESSITY OF PROTECTIVE GROUNDING
Never cut off the internal or external protective grounding wire, or disconnect the wiring of protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.

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 holders. 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.

DO NOT REMOVE THE COVER OF THE INSTRUMENT
Operating personnel must not remove the cover of the instrument. Component replacement and internal adjustment can only be done by qualified service personnel.

Safety Symbols

	**DANGER** - High voltage.
	**Explanation:** To avoid injury, death of personnel, or damage to the instrument, the operator must refer to an explanation in the instruction manual.
	**Protective grounding terminal:** To protect against electrical shock in case of a fault. This symbol indicates that the terminal must be connected to ground before operation of equipment.
WARNING	The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.
CAUTION	The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the products. Do not proceed beyond a **CAUTION** sign until the indicated conditions are fully understood and met.

Revision History

The following lists the additions, deletions and modifications in this manual at each revision.

Date	Version	Revised Sections
Mar. 2009	1.0	Complete this manual

Table of Contents

PART 1

Operation

1. General Information

1.1 Introduction

This manual contains specifications, installation, operation, and programming instructions of 6314A, 6312A electronic load mainframes as well as 63102A, 63103A, 63105A ... electronic load modules. Here “Load” means the electronic load modules of Chroma 6310A Series while “Mainframe” means the 6314A, 6312A electronic load mainframes.

1.2 Description

The functions of 6314A and 6312A mainframes are the same. The former has four slots for Load modules while the latter has two slots. The functions of 63102A, 63103A, 63105A and etc. are all the same. The differences are in input voltage, load current, and power ratings. An individual module may have one or two channels. Each channel has its own channel number, load & measurement connectors, and operates independently in constant current (CC) mode, constant resistance (CR) mode, constant voltage (CV) mode, or constant power (CP) mode.

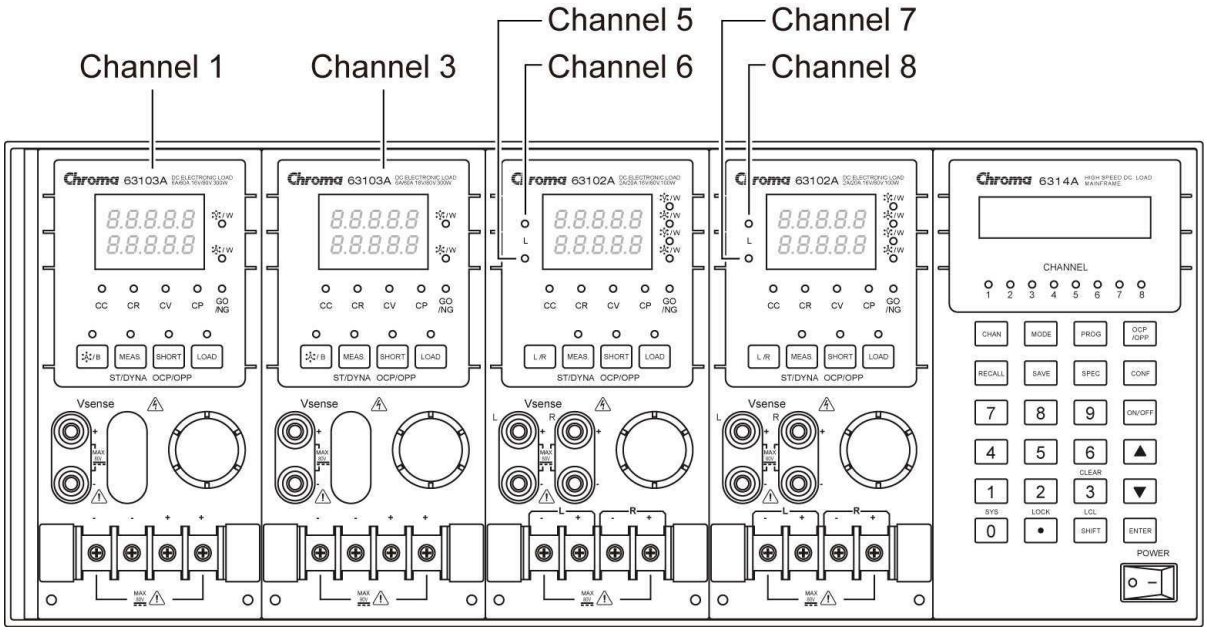


Figure 1-1 The Front Panel of the Electronic Load

On the front panel of the electronic load as shown in Figure 1-1 there are two groups of keypads. One is the Mainframe keypad. The other is the Load keypad. In this manual, Mainframe keypad is described as **MODE** while Load keypad is described as **SHORT**.

1.3 Overview of Key Features

A. Configuration

- Flexible configuration with plug-in electronic load modules in mainframes.
- Local operation via front panel keypad.
- Remote control via GPIB/USB or RS-232C interface.
- Photocoupler isolation offers true floating Load.
- Automatic fan speed control to reduce noise.
- Up to 8 channels for one Mainframe.

B. Load

- Constant current (CC), constant resistance (CR), constant voltage (CV), and constant power (CP) operation modes.
- Programmable slew rate, load levels, load periods and conduct voltage (Von).
- Programmable dynamic loading with speed up to 20KHz.
- Minimum input resistance allows load to sink high current even with low input voltage (1 V).
- Selective voltage and current ranges.
- Remote sensing capability.
- 100 sets of memories to save/recall user-definable setups.
- 10 sets of OCP memories to save/recall user-definable setups.
- 10 sets of OPP memories to save/recall user-definable setups.
- 10 sets of programs to link files for automatic test.
- 15-bit A/D converter with precision measurement.
- Short circuit simulation.
- Automatic GO/NG inspection to confirm UUT within spec.
- Independent GO/NG signals for each channel.

1.4 Specifications

Mainframe	:	6314A/6312A
AC input	:	115/230 switchable or 100/200 switchable Vac line
Fuse	:	2.5A, 250V/2A, 250V
Amplitude	:	±10%
Frequency	:	47 to 63 Hz
Maximum VA	:	300VA/200VA
Trigger output	:	Vlo = 0.8V maximum at Ilo = 1 mA Vhi = 3.2V minimum at Ihi = –40μA
Weight	:	24Kg/15Kg
Dimension	:	
Width	:	440mm/275mm
Height	:	177.4 mm (excluding feet) 186mm (including feet)
Depth	:	560mm (including Load module)

∗ The specifications of Load are listed below.

ⓘ NOTICE

1. The equipment is for indoor use only.
2. The altitude up to 2000 meters is allowed to use the equipment.
3. All specifications are tested under 20°C ~ 30°C except otherwise stated.
4. The range of operation temperature is 0°C ~ 40°C.
5. The relative humidity is from 10% to 90%.
6. The specifications of DC current accuracy are tested after the input is applied for 30 seconds.
7. The power of the load module of 6310 series is supplied from 6314/6312 mainframe.
8. The typical temperature coefficient is 100ppm.
9. The specifications of CR mode accuracy: v means 1/ohm.
10. The transient overvoltage at Mains supply is 2500 V.
11. Pollution Degree: 2.

⚡ CAUTION

This equipment is not intended for performing measurements on CAT I, II, III or IV.

* 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 directly connected to mains.

MODEL	**63101A**		**63105A**	
POWER	20W	200W	30W	300W
CURRENT	0~4A	0~40A	0~1A	0~10A
VOLTAGE	0~80V		0~500V	
MIN. OPERATING VOLTAGE (DC)*1(Typical)	0.4V@2A	0.4V@20A	1V@0.5A	1V@5A
	0.8V@4A	0.8V@40A	2V@1A	2V@10A
CONSTANT CURRENT MODE Range	0~4A	0~40A	0~1A	0~10A
Resolution	1mA	10mA	0.25mA	2.5mA
Accuracy	0.1%+0.1%F.S.	0.1%+0.2%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.
CONSTANT RESISTANCE MODE Range	0.0375Ω~150Ω (200W/16V) 1.875Ω~7.5KΩ (200W/80V)		1.25Ω~5KΩ (300W/125V) 50Ω~200KΩ (300W/500V)	
Resolution	12 bits		12 bits	
Accuracy	150Ω : 0.1 mho +0.2% 7.5KΩ : 0.01 mho +0.1%		5KΩ : 20m mho +0.2% 200KΩ : 5m mho +0.1%	
CONSTANT VOLTAGE MODE Range	1~80V		2.5~500V	
Resolution	20mV		125mV	
Accuracy	0.05%±0.1%F.S.		0.05%±0.1%F.S.	
CONSTANT POWER MODE Range	0 ~ 20W	0 ~ 200W	0 ~ 30W	0 ~ 300W
Resolution	5mW	50mW	7.5mW	75mW
Accuracy	0.5%±0.5%F.S.		0.5%±0.5%F.S.	
DYNAMIC MODE				
DYNAMIC MODE	C.C. MODE		C.C. MODE	
T1 & T2	0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS		0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS	
Accuracy	1μS /1mS+100ppm		1μS /1mS+100ppm	
Slew Rate	0.64~160mA/μS	6.4~1600mA/μS	0.16~40mA/μS	1.6~400mA/μS
Resolution	0.64mA/μS	6.4mA/μS	0.16mA/μS	1.6mA/μS
Current	0~4A	0~40A	0~1A	0~10A
Resolution	1mA	10mA	0.25mA	2.5mA
Current Accuracy	0.4% F.S.		0.4% F.S.	
MEASUREMENT SECTION				
VOLTAGE READ BACK				
Range	0~16V	0~80V	0~125V	0~500V
Resolution	0.25mV	1.25mV	2mV	8mV
Accuracy	0.025%+0.025% F.S.		0.025%+0.025% F.S.	
CURRENT READ BACK				
Range	0~4A	0~40A	0~1A	0~10A
Resolution	0.0625mA	0.625mA	0.016mA	0.16mA
Accuracy	0.05%+0.05% F.S.		0.05%+0.05% F.S.	
POWER READ BACK				
Range	0 ~ 20W	0 ~ 200W	0 ~ 30W	0 ~ 300W
Accuracy	0.1%+0.1% F.S		0.1%+0.1% F.S	
PROTECTIVE SECTION				
Over Power Protection	≒20.8W	≒208W	≒31.2W	≒312W
Over Current Protection	≒4.08A	≒40.8A	≒1.02A	≒10.2A
Over Temperature Protection	≒85°C		≒85°C	
Over Voltage Protection	≒81.6V		≒510V	
GENERAL				
SHORT CIRCUIT				
Current (CC)	–	≒40A	–	≒10A
Voltage (CV)	–	0V	–	0V
Resistance (CR)	–	≒0.0375Ω	–	≒1.25Ω

Power (CP)	–	≒200W	–	≒300W
INPUT RESISTANCE (LOAD OFF)	100KΩ (Typical)		100KΩ (Typical)	
Temperature Coefficient	100PPM/℃(Typical)		100PPM/℃(Typical)	
SIZE	81(W)× 172(H)×495(D)		81(W)× 172(H)×495(D)	
WEIGHT (Approx.)	4.2Kg		4.2Kg	
Operating Range	0~40℃		0~40℃	
EMC & SAFETY	CE		CE	

MODEL	**63102A(100W*2)**		**63103A**	
POWER	20W	100W	30W	300W
CURRENT	0~2A	0~20A	0~6A	0~60A
VOLTAGE	0~80V		0~80V	
MIN. OPERATING VOLTAGE (DC)	1.0V at 2A	1.0V at 20A	1.0V at 6A	1.0V at 60A
CONSTANT CURRENT MODE Range	0~2A	0~20A	0~6A	0~60A
Resolution	0.5mA	5mA	1.5mA	15mA
Accuracy	0.1%+0.1%F.S.	0.1%+0.2%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.
CONSTANT RESISTANCE MODE Range	0.075Ω~300Ω (100W/16V) 3.75Ω~15KΩ (100W/80V)		0.025Ω~100Ω (300W/16V) 1.25Ω~5KΩ (300W/80V)	
Resolution	12 bits		12 bits	
Accuracy	300Ω : 0.1 mho +0.2% 15KΩ : 0.01 mho +0.1%		100Ω : 0.1 mho +0.2% 5KΩ : 0.01 mho +0.1%	
CONSTANT VOLTAGE MODE Range	1~80V		1~80V	
Resolution	20mV		20mV	
Accuracy	0.05%±0.1%F.S.		0.05%±0.1%F.S.	
CONSTANT POWER MODE Range	0 ~ 20W	0 ~ 100W	0 ~ 30W	0 ~ 300W
Resolution	5mW	25mW	7.5mW	75mW
Accuracy	0.5%±0.5%F.S.		0.5%±0.5%F.S.	
DYNAMIC MODE				
DYNAMIC MODE	C.C. MODE		C.C. MODE	
T1 & T2	0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS		0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS	
Accuracy	1μS /1mS+100ppm		1μS /1mS+100ppm	
Slew Rate	0.32~80mA/μS	3.2~800mA/μS	0.001~0.25A/μS	0.01~2.5A/μS
Resolution	0.32mA/μS	3.2mA/μS	0.001A/μS	0.01A/μS
Current	0~2A	0~20A	0~6A	0~60A
Resolution	0.5mA	5mA	1.5mA	15mA
Current Accuracy	0.4% F.S.		0.4% F.S.	
MEASUREMENT SECTION				
VOLTAGE READ BACK				
Range	0~16V	0~80V	0~16V	0~80V
Resolution	0.25mV	1.25mV	0.25mV	1.25mV
Accuracy	0.025%+0.025% F.S.		0.025%+0.025% F.S.	
CURRENT READ BACK				
Range	0~2A	0~20A	0~6A	0~60A
Resolution	0.03125mA	0.3125mA	0.09375mA	0.9375mA
Accuracy	0.05%+0.05% F.S.		0.05%+0.05% F.S.	
POWER READ BACK				
Range	0 ~ 20W	0 ~ 100W	0 ~ 30W	0 ~ 300W
Accuracy	0.1%+0.1% F.S		0.1%+0.1% F.S	
PROTECTIVE SECTION				
Over Power Protection	≒20.8W	≒104W	≒31.2W	≒312W
Over Current Protection	≒2.04A	≒20.4A	≒6.12A	≒61.2A
Over Temperature Protection	≒85°C		≒85°C	
Over Voltage Protection	≒81.6V		≒81.6V	
GENERAL				
SHORT CIRCUIT				
Current (CC)	–	≒20A	–	≒60A
Voltage (CV)	–	0V	–	0V
Resistance (CR)	–	≒0.075Ω	–	≒0.025Ω

Power (CP)	–	≒100W	–	≒300W
INPUT RESISTANCE (LOAD OFF)	100KΩ (Typical)		100KΩ (Typical)	
Temperature Coefficient	100PPM/℃(Typical)		100PPM/℃(Typical)	
SIZE	81(W)× 172(H)×495(D)		81(W)× 172(H)×495(D)	
WEIGHT (Approx.)	4.2Kg		4.2Kg	
Operating Range	0~40℃		0~40℃	
EMC & SAFETY	CE		CE	

MODEL	**63107A(30W,250W)**			**63106A**	
POWER	30W	30W	250W	60W	600W
CURRENT	0~5A	0~4A	0~40A	0~12A	0~120A
VOLTAGE	0~80V			0~80V	
MIN. OPERATING VOLTAGE (DC)	1.0V at 5A	1.0V at 4A	1.0V at 40A	1.0V at 12A	1.0V at 120A
CC MODE Range	0~5A	0~4A	0~40A	0~12A	0~120A
Resolution	1.25mA	1mA	10mA	3mA	30mA
Accuracy	0.1%+0.1%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.
CR MODE Range	0.3Ω~1.2KΩ (30W/16v) 15Ω~60KΩ (30W/80v)	0.375Ω~150Ω (250W/16v) 1.875Ω~7.5KΩ (250W/80v)		12.5mΩ~50Ω (600W/16v) 0.625Ω~2.5KΩ (600W/80v)	
Resolution	12 bits	12 bits		12 bits	
Accuracy	12KΩ: 0.1 mho +0.2% 60KΩ: 0.01 mho +0.1%	150Ω: 0.1 mho +0.2% 7.5KΩ: 0.01 mho +0.1%		50Ω: 0.4 mho +0.5% 2.5KΩ: 0.04 mho +0.2%	
CV MODE Range	1~80V			1~80V	
Resolution	20mV			20mV	
Accuracy	0.05%±0.1%F.S.			0.05%±0.1%F.S.	
CP MODE Range	0 ~ 30W	0 ~ 30W	0 ~ 250W	0 ~ 60W	0 ~ 600W
Resolution	7.5mW	7.5mW	62.5mW	15mW	150mW
Accuracy	0.5%±0.5%F.S.			0.5%±0.5%F.S.	
DYNAMIC MODE					
DYNAMIC MODE	C.C. MODE			C.C. MODE	
T1 & T2	0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS			0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS	
Accuracy	1μS /1mS+100ppm			1μS /1mS+100ppm	
Slew Rate	0.8~200mA/μS	0.64~160mA/μS	6.4~1600mA/μS	0.002~0.5A/μS	0.02~5A/μS
Resolution	0.8mA/μS	0.64mA/μS	6.4mA/μS	0.002A/μS	0.02A/μS
Current	0~5A	0~4A	0~40A	0~12A	0~120A
Resolution	1.25mA	1mA	10mA	3mA	30mA
Current Accuracy	0.4% F.S.			0.4% F.S.	
MEASUREMENT SECTION					
VOLTAGE READ BACK					
Range	0~16V	0~80V	0~16V	0~80V	0~16V	0~80V
Resolution	0.25mV	1.25mV	0.25mV	1.25mV	0.25mV	1.25mV
Accuracy	0.025%+0.025% F.S.			0.025%+0.025% F.S.	
CURRENT READ BACK					
Range	0~5A	0~4A	0~40A	0~12A	0~120A
Resolution	0.078125mA	0.0625mA	0.625mA	0.1875mA	1.875mA
Accuracy	0.05%+0.05% F.S.			0.05%+0.05% F.S.	
POWER READ BACK					
Range	0 ~ 30W	0 ~ 30W	0 ~ 250W	0 ~ 60W	0 ~ 600W
Accuracy	0.1%+0.1% F.S			0.1%+0.1% F.S	
PROTECTIVE SECTION					
Over Power Protection	≒31.2W	≒31.2W	≒260W	≒62.4W	≒624W
Over Current Protection	≒5.1A	≒4.08A	≒40.8A	≒12.24A	≒122.4A
Over Temperature Protection	≒85°C			≒85°C	
Over Voltage Protection	≒81.6V			≒81.6V	
GENERAL					
SHORT CIRCUIT					
Current (CC)	–	–	≒40A	–	≒120A
Voltage (CV)	–	–	0V	–	0V
Resistance (CR)	–	–	≒0.0375Ω	–	≒0.0125Ω

Power (CP)	–	–	≒250W	–	≒600W
INPUT RESISTANCE (LOAD OFF)	100KΩ (Typical)			100KΩ (Typical)	
Temperature Coefficient	100PPM/℃(Typical)			100PPM/℃(Typical)	
SIZE	81(W)× 172(H)×495(D)			162(W)× 172(H)×495(D)	
WEIGHT (Approx.)	4.5Kg			8.4Kg	
Operating Range	0~40℃			0~40℃	
EMC & SAFETY	CE			CE	

MODEL	**63108A**		**63112A**	
POWER	60W	600W	120W	1200W
CURRENT	0~2A	0~20A	0~24A	0~240A
VOLTAGE	0~500V		0~80V	
MIN. OPERATING VOLTAGE (DC)	2.5V at 2A	2.5V at 20A	1.0V at 24A	1.0V at 240A
CONSTANT CURRENT MODE Range	0~2A	0~20A	0~24A	0~240A
Resolution	0.5mA	5mA	6mA	60mA
Accuracy	0.1%+0.1%F.S.	0.1%+0.2%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.
CONSTANT RESISTANCE MODE Range	0.625Ω~2.5KΩ (600W/125V) 25Ω~100KΩ (600W/500V)		6.25mΩ~25Ω (1200W/16V) 0.3125Ω~1.25KΩ (1200W/80V)	
Resolution	12 bits		12 bits	
Accuracy	2.5KΩ : 50m mho +0.2% 100KΩ : 5m mho +0.1%		25Ω : 0.8 mho +0.8% 1.25KΩ : 0.08 mho +0.2%	
CONSTANT VOLTAGE MODE Range	2.5~500V		1~80V	
Resolution	125mV		20mV	
Accuracy	0.05%±0.1%F.S.		0.05%±0.1%F.S.	
CONSTANT POWER MODE Range	0 ~ 60W	0 ~ 600W	0 ~ 120W	0 ~ 1200W
Resolution	15mW	150mW	30mW	300mW
Accuracy	0.5%±0.5%F.S.		0.5%±0.5%F.S.	
DYNAMIC MODE				
DYNAMIC MODE	C.C. MODE		C.C. MODE	
T1 & T2	0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS		0.025mS - 50mS/Res: 5uS 0.1mS - 500mS/Res: 25uS 10mS – 50S/Res: 2.5mS	
Accuracy	1μS /1mS+100ppm		1μS /1mS+100ppm	
Slew Rate	0.32~80mA/μS	3.2~800mA/μS	0.004~1A/μS	0.04~10A/μS
Resolution	0.32mA/μS	3.2mA/μS	0.004A/μS	0.04A/μS
Current	0~2A	0~20A	0~24A	0~240A
Resolution	0.5mA	5mA	6mA	60mA
Current Accuracy	0.4% F.S.		0.4% F.S.	
MEASUREMENT SECTION				
VOLTAGE READ BACK				
Range	0~125V	0~500V	0~16V	0~80V
Resolution	2mV	8mV	0.25mV	1.25mV
Accuracy	0.025%+0.025% F.S.		0.025%+0.025% F.S.	
CURRENT READ BACK				
Range	0~2A	0~20A	0~24A	0~240A
Resolution	0.03125mA	0.3125mA	0.375mA	3.75mA
Accuracy	0.05%+0.05% F.S.		0.075%+0.075% F.S.	
POWER READ BACK				
Range	0 ~ 60W	0 ~ 600W	0 ~ 120W	0 ~ 1200W
Accuracy	0.1%+0.1% F.S		0.1%+0.1% F.S	
PROTECTIVE SECTION				
Over Power Protection	≒62.4W	≒624W	≒124.8W	≒1248W
Over Current Protection	≒2.04A	≒20.4A	≒24.48A	≒244.8A
Over Temperature Protection	≒85°C		≒85°C	
Over Voltage Protection	≒510V		≒81.6V	
GENERAL				
SHORT CIRCUIT				
Current (CC)	–	≒20A	–	≒240A
Voltage (CV)	–	0V	–	0V
Resistance (CR)	–	≒0.625Ω	–	≒0.00625Ω
Power (CP)	–	≒600W	–	≒1200W

INPUT RESISTANCE (LOAD OFF)	100KΩ (Typical)	100KΩ (Typical)
Temperature Coefficient	100PPM/℃(Typical)	100PPM/℃(Typical)
SIZE	162(W)× 172(H)×495(D)	324(W)× 172(H)×495(D)
WEIGHT (Approx.)	8.4Kg	16.8Kg
Operating Range	0~40℃	0~40℃
EMC & SAFETY	CE	CE

* Before using CCL mode on model 63105A & 63108A, it needs to set **CC Vrange Select** in Configuration to "2. LOW" for access permission.

NOTE*1:

Low voltage operation, under 0.8 volt, is possible at correspondingly reduced current level. Operating temperature range is 0ºC to 40ºC. All specifications apply for 25ºC±5ºC, except as noted.

2. Installation

2.1 Introduction

This chapter describes how to install the Load to the Mainframe and make connections to the Loads. It also discusses the turn-on check procedure and application considerations.

2.2 Inspection

As soon as the device is unpacked, inspect any damage that might have occurred during shipment. Keep all packing materials in case that the Load or the Mainframe has to be returned. If any damage is found, please file a claim with the carrier immediately. Do not return the instrument to Chroma without prior approval.

In addition to this manual, be sure that the following items are received along with the Mainframe and Load.

* Power Cord & Manual for the Mainframe
* Measurement and Load Cables for the Load Modules

2.3 Installing the Modules

CAUTION
Load module can be damaged by electronic discharge (static electricity). Use standard anti-static work practices when handling and installing the modules. Avoid touching the connectors and the circuit board.

The Chroma 6314A Mainframe has room for four single-width Loads (63102A, 63103A), or two double-width Loads (63106A). Loads can be combined in the Mainframe in any order. The Chroma 6312A mainframe has room only for two single-width Loads or one double-width Load. The procedures of the module installation in both Mainframes are the same. Only a screwdriver is required to install the Load to the Mainframe.

Procedures:
1. Disconnect the power cord with the Mainframe power off.
2. Remove any packing materials from the Mainframe.
3. Start installing the modules in the slot (see Figure 2-1).
4. Insert the load module into the slot of the Mainframe along the rail.
5. Lock the module in place by a screwdriver (see Figure 2-1).
6. Install each additional module in the slot next to the previous one likewise if applicable.

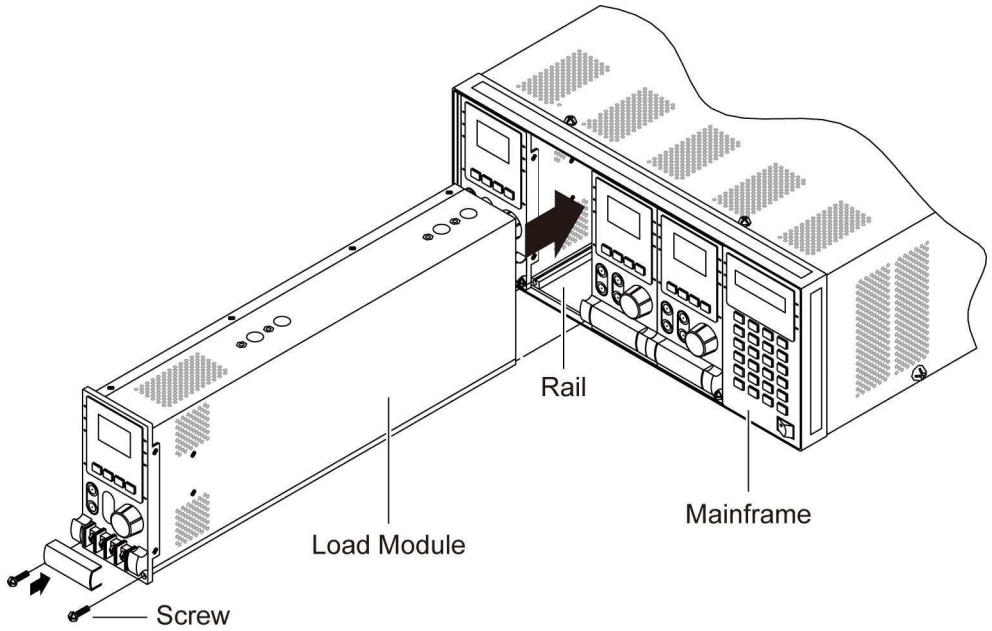


Figure 2-1 Installing Modules in the Electronic Load

☞ **WARNING**
If the Mainframe is not installed with all modules, the empty one must be covered with the panel cover (Chroma part No: L00 000190) for safety and airflow.

2.3.1 Channel Number

The channel number of a specific Load is determined by the location of that module in relation to the leftmost of the Mainframe. As some Loads (63102A) have two channels in one module, channel 1 and 2 are always on the leftmost slot of the Mainframe, and channel 7 and 8 on the rightmost. The channel number is fixed for Mainframe even Load module is empty. Figure 2-2 shows the channel assignments for a Chroma 6314A Mainframe containing two Loads of 63103A single channel/module, and two Loads of 63102A double channel/module. Channel number is automatically assigned to each channel: 1, 3, 5, 6, 7, 8. At present channel 2 and 4 are empty. 6312A Mainframe has four channels (1, 2, 3, 4) only.

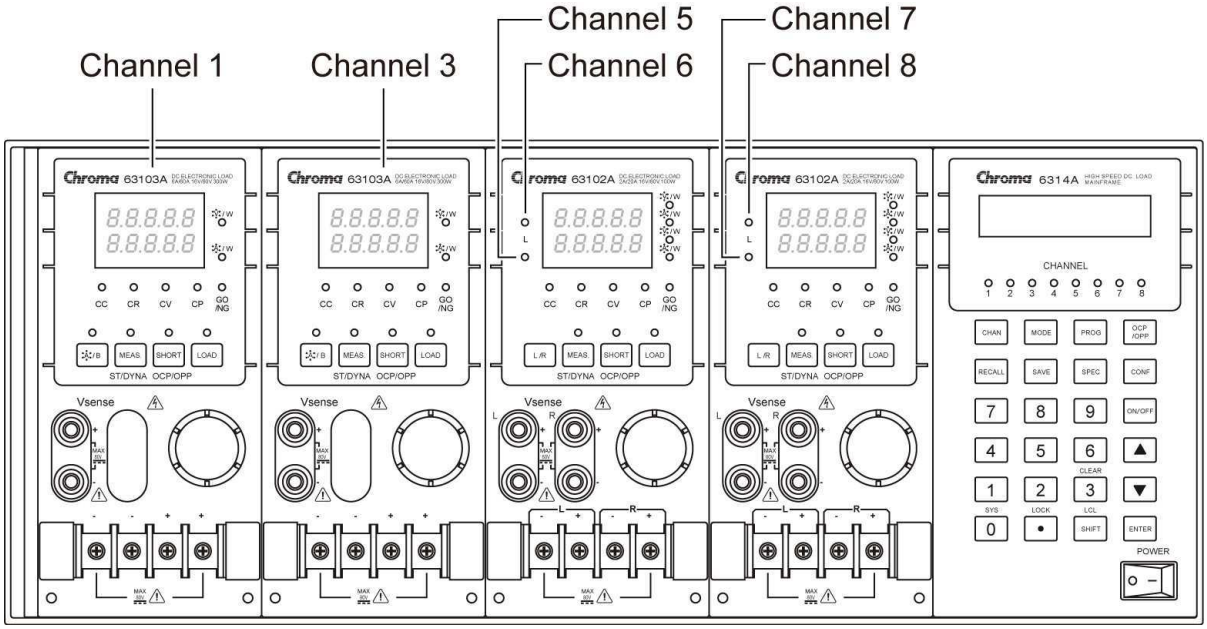


Figure 2-2 Channel Number Example

2.4 Installing the Mainframe

The electronic Load can operate well within the temperature range of 0 to 40 degree C. However, the electronic Load must be installed in a location that has enough space at the top, four sides, and the rear of the unit for adequate air flowing. At least 3 cm (1 inch) space above the unit is required for adequate air circulation. Note that the unit must have enough vertical space for air circulation when it is stacked. The feet of the Mainframe can be removed for rack mounting.

If the equipment is installed on top of the electronic Load in the cabinet, it must use a filter panel above the unit to ensure adequate air circulation. A 1U (EIA standard) panel is sufficient.

2.4.1 Changing Line Voltage

The electronic Load can operate with a 115/230 Vac input as indicated on the rear LINE label. The 100/200 line voltage input model is used only in Japan. If the factory set switch on this label does not correspond to the local nominal line voltage, turn off the Mainframe power and disconnect the power cord. Set switch to the correct line voltage as shown in Figure 2-3.

ⓘ NOTICE
Line fuses do not need to be changed when the line voltage is changed. The line fuses will protect the electronic Load in any indicated voltage settings.

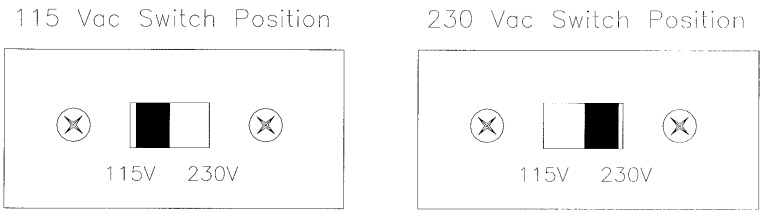


Figure 2-3 Line Voltage Switch

2.4.2 Turn-On Self-Test

Check the following things before turning on the Load.

1. The unit has been factory set to the correct line voltage. Refer to the line voltage on the rear panel.
2. The power cord is connected to the AC input socket.

☞ **WARNING**

The power provides a chassis ground through a third connector. Be sure that the outlet is a three-conductor type with the correct pin connected to earth ground.

Turn on the Load by the power switch on the front panel of the Mainframe and observe the display. Immediately after turning on, the electronic Load executes a self-test which checks the GPIB interface board and the input circuitry of the installed modules. All of the LED segments on the front panel are momentarily activated. The Mainframe displays

```
GPIB ADDRESS  1
```

and then

```
LOAD MODULE
CHANNEL SCANing
```

The LCD displays the GPIB address in power-on condition. The GPIB address switch is on the rear panel if the GPIB card is installed. If the GPIB card is not installed, the LCD will show `LOAD MODULE CHANNEL SCANing`. The Mainframe checks the existing channels when the display shows `CHANNEL SCANing`. The LED segments on the front panel are momentarily activated. If the Mainframe fails any portion of the self-test, the LED will blink and the LCD has no display. When the self-test completes, the Mainframe will display the active channel, which is installed.

The Load module also executes a self-test that checks firmware and communicates with the Mainframe. All of the LEDs on the front panel are momentarily activated, and the 7-segment LED displays the model number as well as the firmware version. If any error is found in self-test, the display will stop here. Check the Load and Mainframe connection when an error occurs. When the self-test completes, the 7-segment will display measurement V & I. The double channel/module goes to the L channel.

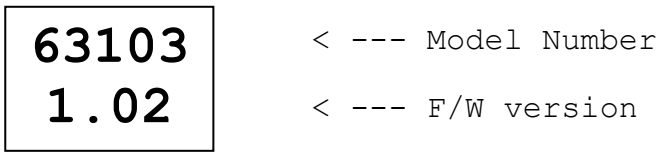


Figure 2-4 Module Panel Self-test Display

In case of failure, return the Mainframe or Load module to Chroma sales or service office for repair services.

2.5 Application Connection

2.5.1 Load Connections

☞ **WARNING**
To meet the safety requirements, load wires must be thick enough not to overheat while carrying the short-circuit output current of the device connected to the electronic Load.

Before connecting the load wires to the Load module, remove the terminal cover from the Load. Install it after the load wires are connected. Input connections are made to the + and – terminal block on the front of each Load module. The major considerations in making the input connections are the wire size, length and polarity. The minimum wire size required to prevent the overheating may not be enough to maintain good regulation. The wires should be thick enough to limit the voltage drop to no more than 0.5V per lead. The wires should be as short as possible, and bundled or tied together to minimize inductance and noise picked up from them. Connect the wire from the PLUS (+) terminal on the module to the HIGH potential output terminal of the power supply (UUT). Connect the wire from the MINUS (–) terminal on the module to the LOW potential output terminal of the power supply (UUT). Figure 2-5 illustrates the typical setup for the Load module to the UUT.

☞ **WARNING**
To prevent accidental contact with hazardous voltage, the terminal cover must be installed correctly. Each terminal can carry 40 Amps at most. If the input current of Load is over 40 Amps, it must use multiple terminals for connection.

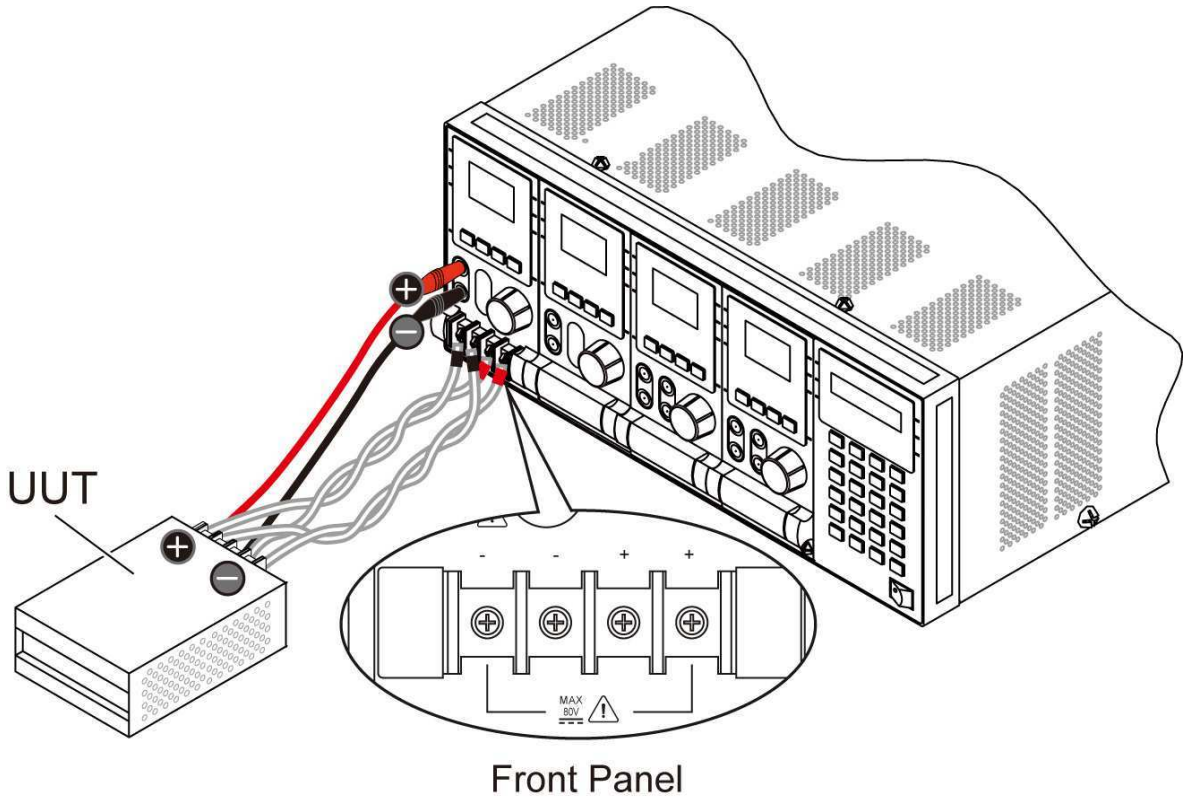


Figure 2-5 Load & Remote Sensing Connection

2.5.2 Remote Sensing Connections

There are two sensing points for the electronic Load module. One is the measurement at Load, terminal, and another is the measurement at Vsense. The Load module will automatically switch to Vsense when the Vsense terminals are connected to the UUT, otherwise it will measure at the Load terminals. Remote sensing compensates for voltage drop in applications that require long lead lengths. It is useful when a module is operating in CV, CR or CP mode, or when it needs precise measurement. Figure 2-5 also illustrates a typical setup for remote sensing operation.

ⓘ NOTICE
The potential of Vsense red connector must be higher than that of Vsense black connector.

2.5.3 Parallel Connections

Figure 2-6 illustrates how modules can be paralleled for increased power dissipation. Modules can be directly paralleled in CC, CR, CP modes of static operation, but cannot be paralleled in CV mode. Each module will dissipate the power that has been programmed. For example, if two modules are connected in parallel, one is programmed to 10A, and another is 15A, the total current drawn from the source is 25A.

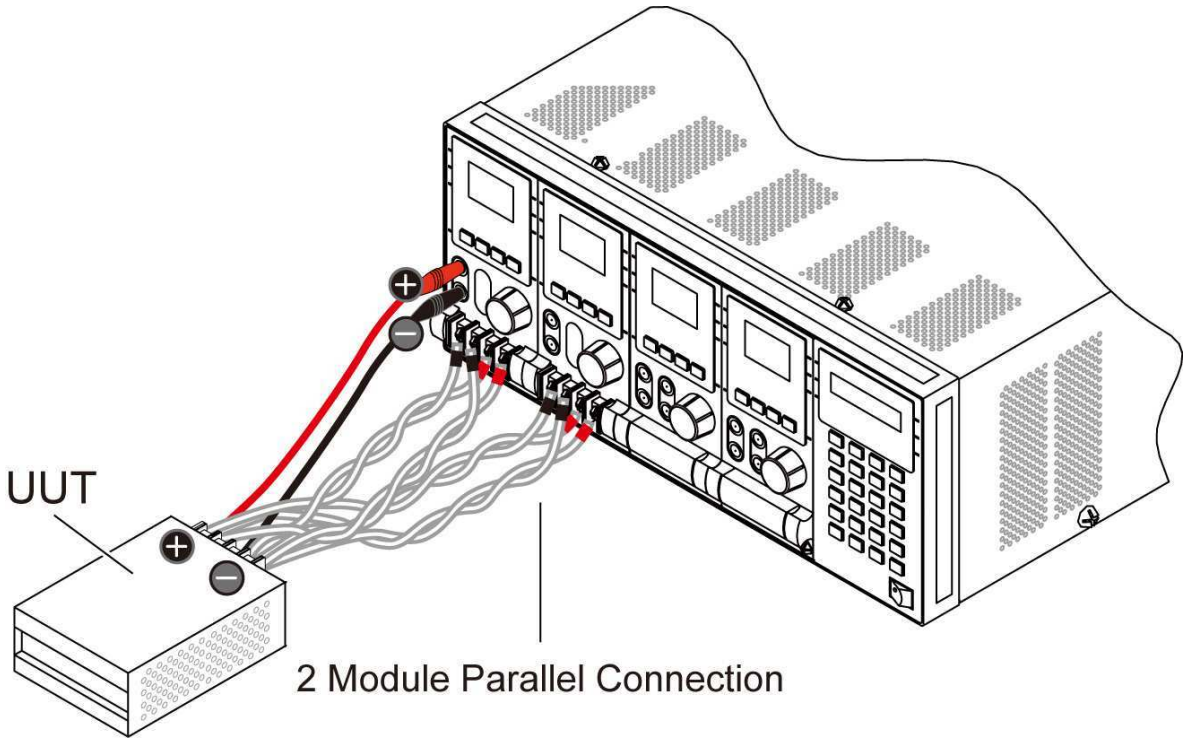


Figure 2-6 Parallel Connection

2.6 Remote Control Connection

The remote operation of Load can be done through GPIB or USB or RS-232C. These connectors on the rear panel connect the Load to the controller or a computer. The GPIB or USB interface of the electronic load is optional. The 6310A Series Remote Controller can control load through RS-232C port. Connect the Remote Controller to the electronic Load before powering on. If such is not done, the Load will shut down, or the fuse for remote controller in Mainframe will be broken.

3. Operation Overview

3.1 Introduction

The Chroma 6314A and 6312A multiple electronic load mainframes are used for design, manufacturing, testing and quality assurance. The Mainframe contains four (two) slots for load modules. Load modules occupy either one or two slots. It depends on the power rating of the module. The Mainframe can dissipate up to 1200 watts when it is full loaded. It contains a processor, GPIB or USB and RS-232C connectors, front panel keypad and display, and PASS/FAIL signals. Built-in remote control function allows you to control, read back current, voltage and status. The SYNC function of the Mainframe synchronizes each module when module current/voltage level changes. Save/Recall feature allows you to save up to 100 files, 10 OCP files, 10 OPP files, 10 programs, and one default setting. All of them can be saved in Mainframe EEPROM for future use.

The Mainframe contains three (two) cooling fans, and the module one cooling fan. The fan speed can automatically increase or decrease when the module power rises or falls. This feature reduces overall noise level because the fans do not always run at the maximum speed.

Each module can operate independently in constant current (CC), constant resistance (CR), constant voltage (CV), and constant power (CP) modes. An individual module may have one or two channels. Each of them has its own channel number, contains its own input connectors, and can be turned on/off or short-circuited independently. If your application requires a greater power or current capacity than one module can provide, you have to connect load modules in parallel in CC, CR or CP mode.

Each load module can be independently controlled either remotely via GPIB/USB/RS-232C or locally via the front panel. Once a channel is selected or addressed, all subsequent commands go to that channel till another channel is selected or addressed. Operation of all models in the Mainframe is similar in spite of power ratings. The module has a keypad to control itself too.

3.2 Front Panel Description

The front panel of Mainframe includes a 16 × 2 character LCD display, 8 (4) channel indicators, and keypads. All parameters of Load are set through Mainframe. The LCD display also shows which function is being performed when you use the keypads. Three of the keys perform two functions. The alternative function is labeled in blue above the key. It is selected by pressing the blue **SHIFT** key and the function key simultaneously. Figure 3-1 shows the front panel of Mainframe 6312A.

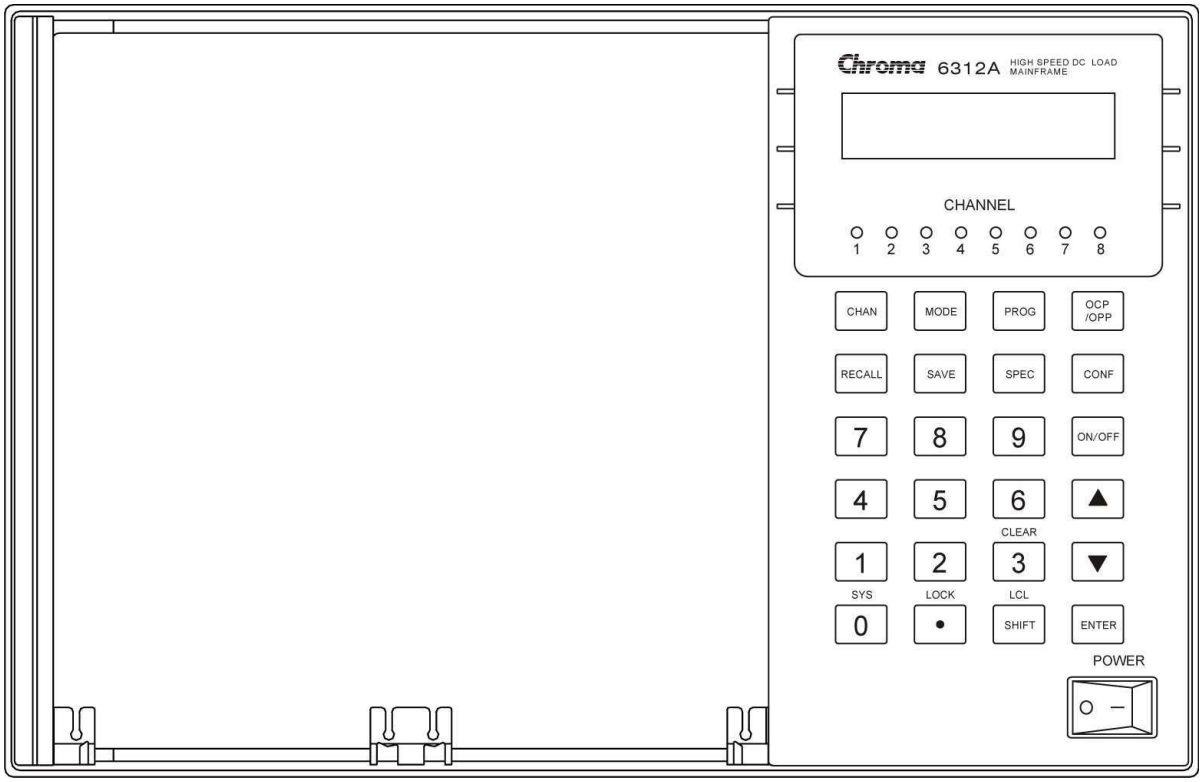


Figure 3-1 The Front Panel of Mainframe 6312A

3.3 Rear Panel Description

The rear panel of Mainframe includes an RS-232C connector, a GO/NG output port, a DIGTAL I/O port, an AC LINE socket, a fuse holder, an optional GPIB or USB connector, and three cooling fans. Figure 3-2 shows the rear panel of Mainframe 6314A.

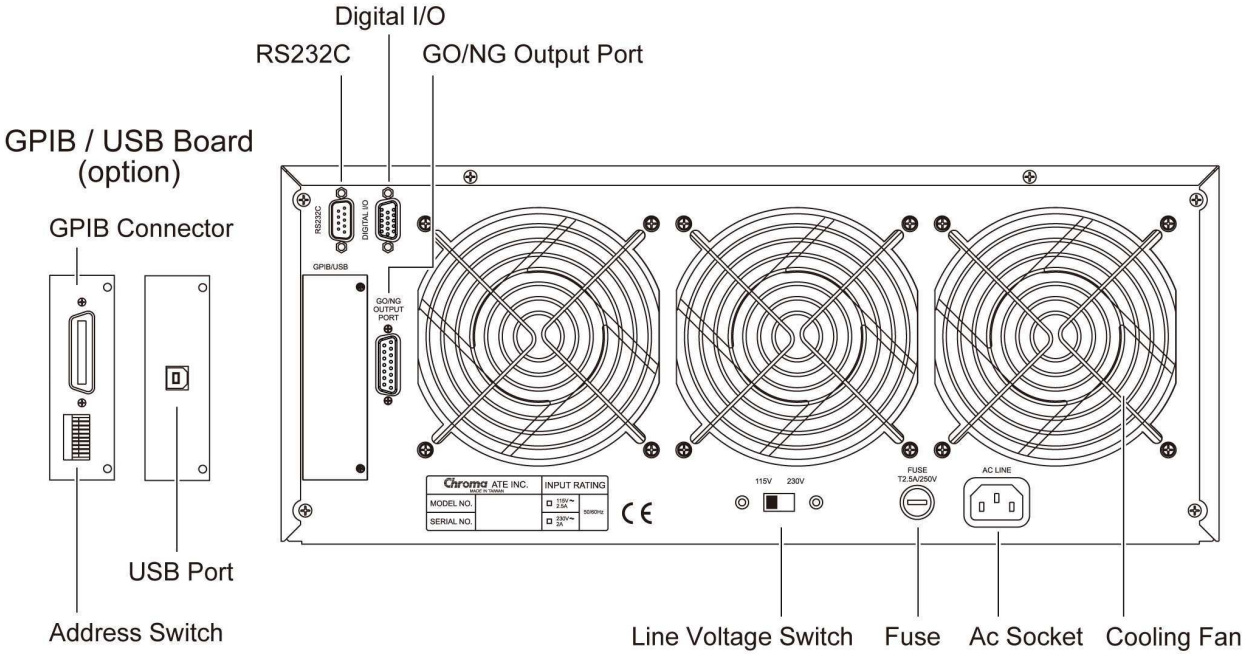


Figure 3-2 The Rear Panel of Mainframe 6314A

3.4 Local/Remote Control

Local (front panel) control is in effect immediately after the power is applied. The front panel keypad and display allow manual control of individual module when Load is used in bench test applications. Remote control goes into effect as soon as the Mainframe receives a command via GPIB or USB or RS-232C. With remote control in effect, only the computer can control the Load. The front panel keypad has no effect except the **LCL** key. You can return the Load to local control from remote control by pressing **LCL** key. The **SHIFT** key acts as **LCL** when Load is in remote state.

Most of the functions that perform remotely can perform locally too at the front panel of Mainframe. The keypads on the module can perform simple functions like short, load on/off, static /dynamic, and load A/B or display selection R/L.

Details of local operation are given in *Chapter 4 Local Operation*. Fundamentals of remote programming are described in the second part of this manual, Chroma 6310A Programming Manual.

3.5 Modes of Operation

There are four modes of operation: Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV), and Constant Power (CP).

When you press **ENTER** key to program to a mode, a module will change to a new mode. In change of modes the module's input is momentarily disabled before a new mode is enabled. This ensures that there will be minimum overshoots in change of modes. The parameters in current, resistance or voltage mode can be programmed simply as the mode is presently selected.

All data set in CC/CR/CV/CP mode will be rescaled to fit the resolution of current/voltage levels or slew rate. In local mode any value can be set to a module from the keypad. There are no upper and lower limits that would cause an error. Mainframe automatically selects data, which are rescaled from the programmed value, truncates and checks high, low boundary before fitting memory. When programmed data are over the boundary, Mainframe will set maximum or minimum level for the Load module. In remote mode programmed value cannot be over boundary. An error will occur when data are over the maximum or minimum value.

3.5.1 Constant Current Mode

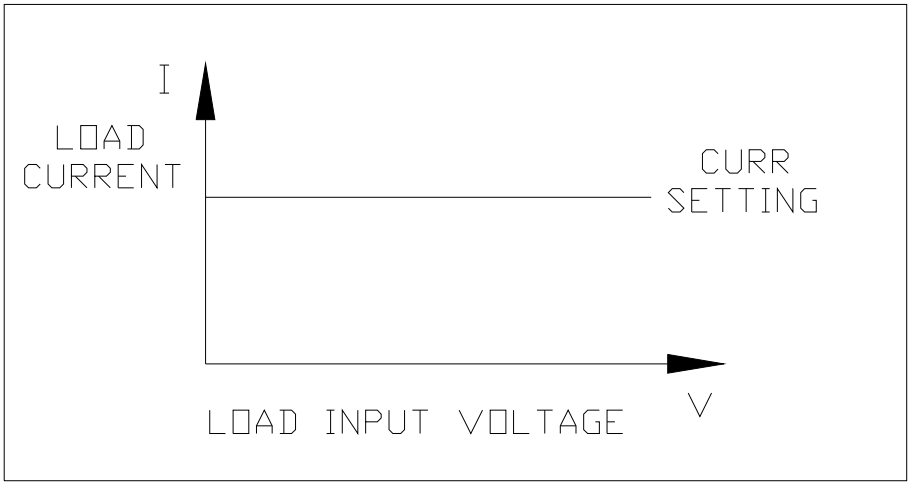


Figure 3-3 Constant Current Mode

In CC mode, the Load will sink a current in accordance with the programmed value regardless of input voltage. The CC mode can be set with front panel key **MODE**. When `MODE SELECT` is displayed, it means to select static low range `CCL` or static high range `CCH`.

Current Ranges (Low, High)

Current can be programmed in either of the two ranges, low range and high range. The low range provides better resolution at low current setting. If any value is over the maximum of low range, you must select the high range. Press **MODE** key first, then use ▲ or ▼ key to select the current range.

`MODE SELECT` `CCL`	Select Static Constant Current low range
`MODE SELECT` `CCH`	Select Static Constant Current high range
`MODE SELECT` `CCDL`	Select Dynamic Constant Current low range
`MODE SELECT` `CCDH`	Select Dynamic Constant Current high range

Select range by pressing **ENTER** key.

The change of modes will affect the module, so will the change of range. Both cause the input to go through an off state. If the CC mode of Load module is active, the new setting will immediately change the input at a rate determined by the slew rate setting.
STATic/DYNAmic Functions

In CC mode two operation functions (STATic, DYNAmic) can be selected. STATic function checks the stability of output voltage from a power supply. In some modules (single channel/module) there are two current levels (A or B) for static function. Both states A and B use the same range. You can select A (CCL1 or CCH1) or B (CCL2 or CCH2) through the **A/B** key on the module's keypad or Mainframe keypad when level1 (A) or level2 (B) changes. Slew rate determines the rate at which Load level changes from one load level state to another. Figure 3-3 shows current level of load module after pressing of **A/B** key.

CCL1:4A, CCL2:2A, CCL↗: 0.2A/μS, CCL↘: 0.08A/μS

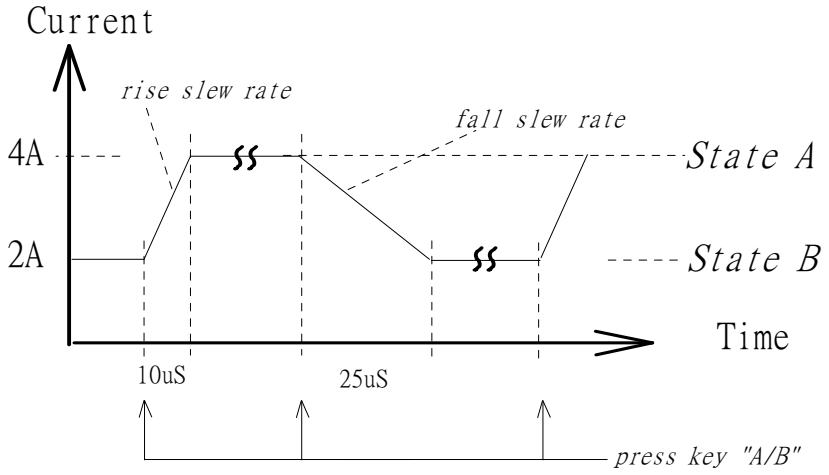


Figure 3-4 Load Level after Pressing A/B Key

Dynamic load operation enables you to program two load levels (CCDL1, CCDL2), load duration (CCDLT1, CCDLT2), and slew rate (CCDL↗, CCDL↘). During operation the loading level is switched between those two load levels according to your specific setting. The dynamic load is commonly used in the test of UUT's performance under transient loading condition. Figure 3-4 shows current waveform of dynamic function

CCDL1:4A, CCDL2:2A, CCDL↗:1A/μS, CCDL↘: 1A/μS, CCDLT1:10mS, CCDLT2:10mS

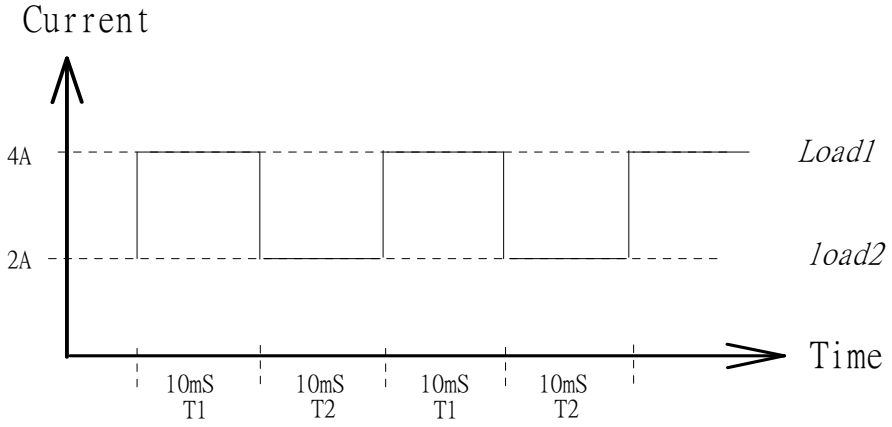


Figure 3-5 Dynamic Current Waveform

The STATic/DYNAmic functions can also be selected through the **MEAS.** key on the Load module. Refer to the description of ST/DYNA KEY operation in 4.2.6 if the ST/DYNA KEY in CONF is set to ON.

Slew Rate (Rise, Fall A/μS or mA/μS)

Slew rate determines the rate at which the current input of a module changes to a newly programmed value. There are two slew rate values. One is for rise rate, and another for fall rate.

Voltage Ranges (Low, High)

There are two voltage ranges for voltage measurement and Von voltage setting. The low range provides better resolution at low voltage measurements. If any value is over the maximum of low range, you must select the high range. The voltage range selection of CC mode is in configuration setting.

3.5.2 Constant Resistance Mode

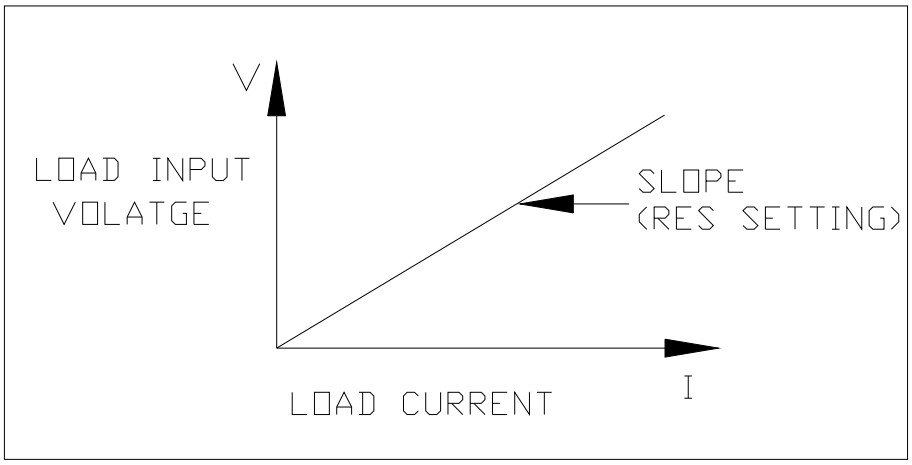


Figure 3-6 Constant Resistance Mode

In CR mode, the Load will sink a current linearly proportional to the input voltage in accordance with the programmed resistance. There is a double pole RC filter of input voltage, so high frequency parts will be removed. The time constant of low pass filter is about 47 μS. The load sink current of CR mode is proportioned to the input voltage through a double pole RC filter. To prevent the load current change caused by the input voltage variation, the power source impedance should be as low as possible, and remote sensing cable must be used to sense load input voltage when high sink current (low setting resistance) is programmed.

Voltage Ranges (Low, High)

Resistance can be programmed in either of the two ranges, low range and high range. The low range is used for input voltage in low voltage range while the high range for input voltage over low voltage range. The current range of CR mode is high range.

MODE SELECT CRL	Select Constant Resistance low voltage range
MODE SELECT CRH	Select Constant Resistance high voltage range

Select range by pressing **ENTER** key.

If input voltage is over the maximum of low range, you must select the high range. Press **MODE** key first, and then use ▲ or ▼ key to select voltage range. In some modules (single channel/module) there are two resistance levels (A or B) for CR function. Both states A/B use the same range. You can select A (CRL1 or CRH1) or B (CRL2 or CRH2) through **A/B** key on the module's keypad. Slew rate determines the rate at which load level changes from one load level state to another.

Slew Rate (Rise, Fall A/μS)

Slew rate in constant resistance mode is programmed in Amps/second.

3.5.3 Constant Voltage Mode

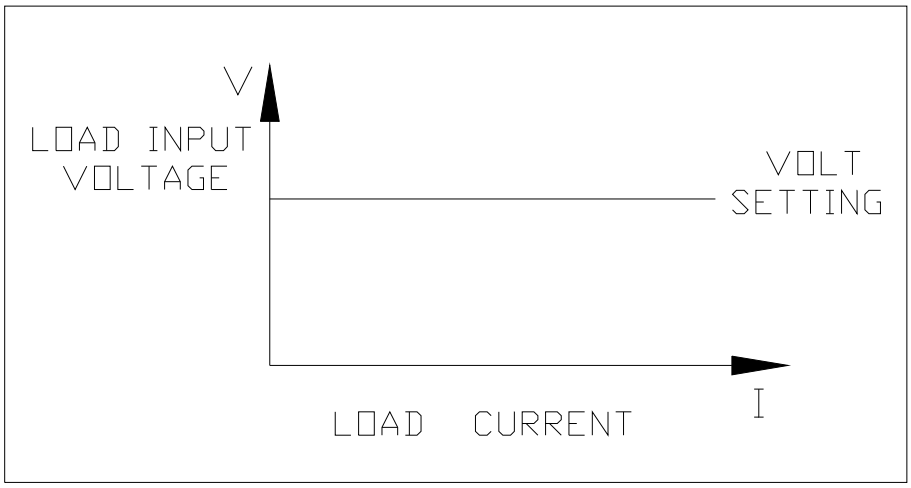


Figure 3-7 Constant Voltage Mode

In CV mode the Load will sink current to control the voltage source in programmed value. In some modules (single channel/module) there are two voltage levels (A or B) for CV

function. You can select A (CV1) or B (CV2) through **A/B** key on the module's keypad. There are two response speeds of CV modes: fast and slow. The fast/slow respond speed means the slew rate of current change.

Voltage & Current Range (High)

MODE SELECT CV

Select Constant Voltage high voltage range

Select range by pressing **ENTER** key.

The voltage and current range of CV mode is high range.

3.5.4 Constant Power Mode

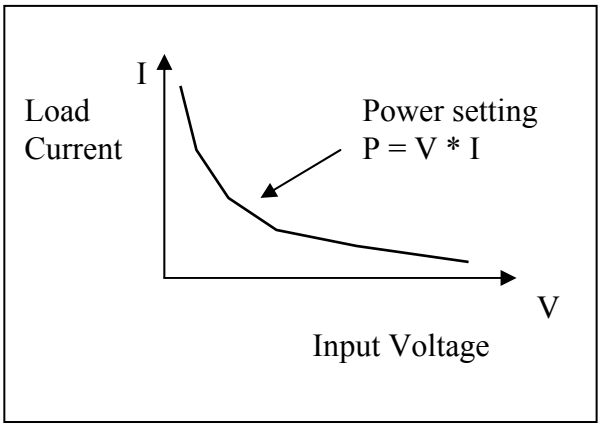


Figure 3-8 Constant Power Mode

In CP mode, the Load will sink a current according to the programmed power. This mode is operated under the F/W calculation. That is, take the measured V data, divide the Power setting and get the I setting value. High frequency parts will be removed as there is a lower pass filter for the measuring data.

Power can be programmed in either of low range or high range by the **RANGE** key. The low power range is operated under low current range mode while the high power range is under high current range mode.

MODE SELECT CPL

Select Constant Power low voltage range

MODE SELECT CPH

Select Constant Power high voltage range

Select range by pressing **ENTER** key.

There are two power levels (A or B) for CP function as other modes. Both A and B states use the same range. You can select CPL1 or CPL2 using **A/B** key. Slew rate determines the rate that the load level changes from one state to another.

3.6 OCP/OPP Mode of Operation

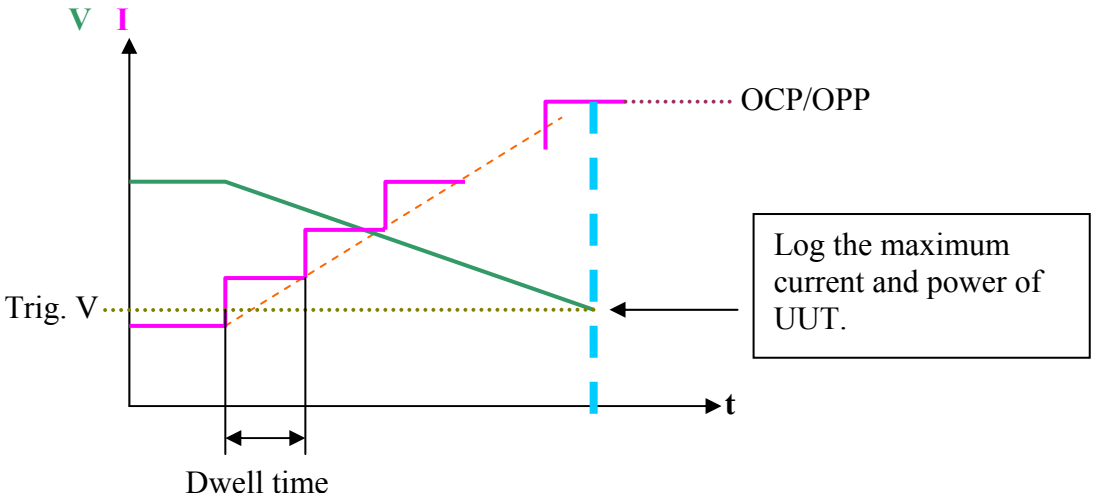


Figure 3-9 OCP/OPP Mode

In this mode the load provides a ramped up current or power to test if the UUT voltage reaches the trigger voltage level to judge if the OCP or OPP protection is acting normally. Press **OCP/OPP** key to select the OCP mode or OPP mode for operation.

Press **OCP/OPP** key to enter into OCP mode of operation

```
CURRENT RANGE
1.CCH   2.CCL
```

Select OCP mode of current range

Select range by pressing **ENTER** key.

Press and hold OCP/OPP key to enter into OPP mode of operation

```
POWER RANGE
1.CPH   2.CPL
```

Select OPP mode of power range

Select range by pressing **ENTER** key.

3.7 Load Synchronization

The Chroma 6314A/6312A multiple electronic load mainframes contain eight and four load channels respectively. The channel on/off or change of load timing is important. You can set module change synchronously through SYNC RUN in configuration setting. If a channel is set at SYNC RUN ON, it means that channel on/off or change of load level is synchronized with other Load modules. In other cases channel on/off can be controlled only by the module's **LOAD** key.

3.8 Measurements

Each module measures current and voltage of the UUT. The sampling rate in fast is about 5 mS. Voltage and current measurements are performed with a 15-bit resolution of full-scale ratings. The user can also enter into **CONF** to do the VI MEASURE setting, see section 4.2.6.

3.9 Slew Rate & Minimum Transient Time

Slew rate is defined as the change in current over time. A programmable slew rate allows a controlled transition from one load setting to another to minimize induced voltage drops on inductive power wiring, or control induced transients on a test device. If the transient from one setting to another is large, the actual transient time can be calculated by dividing the current transition by the slew rate. The actual transition time is defined as the time required for the change of input from 10% to 90% or from 90% to 10% of the programmed excursion. If the transition from one setting to another is small, the small signal bandwidth of Load will limit the minimum transition time for all programmable slew rates. Because of the limit, the actual transition time is longer than the expected time based on the slew rate. Therefore, both minimum transition time and slew rate must be considered in the determination of actual transition time. The minimum transition time is from 24 μS to 6 mS, which depends on slew rate setting.

3.10 Start/Stop Sink Current

In the simulation of transient characteristics of load to UUT, the critical problems are when and how the Load starts sinking current to UUT. You may set the conducting voltage Von to solve the problems. The Load will start or stop sinking current when the output voltage of UUT reaches the Von voltage. You can start sinking current when setting is load ON, and the input voltage of the module is over Von voltage, but stop sinking when load OFF, or the input voltage below Von voltage. For start and stop sinking current refer to Figure 3-10 and Figure 3-11 separately.

There are two operation modes for Von control. One is latch, and another non-latch. Latch means that when voltage is over Von voltage, Load will start sinking current continuously in spite that input voltage drop is below Von voltage. Non-latch means that when input voltage is below Von voltage, Load will stop sinking current. The Von voltage and operation mode of Von is set in configuration.

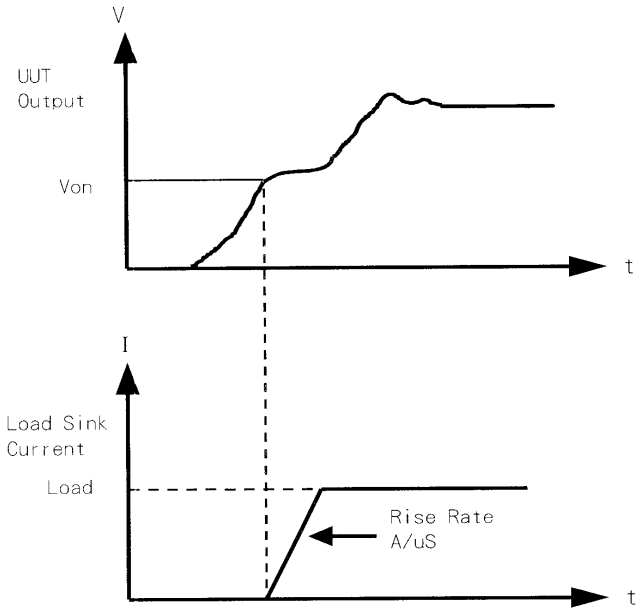


Figure 3-10 Start Sinking Current (Von Non-Latch)

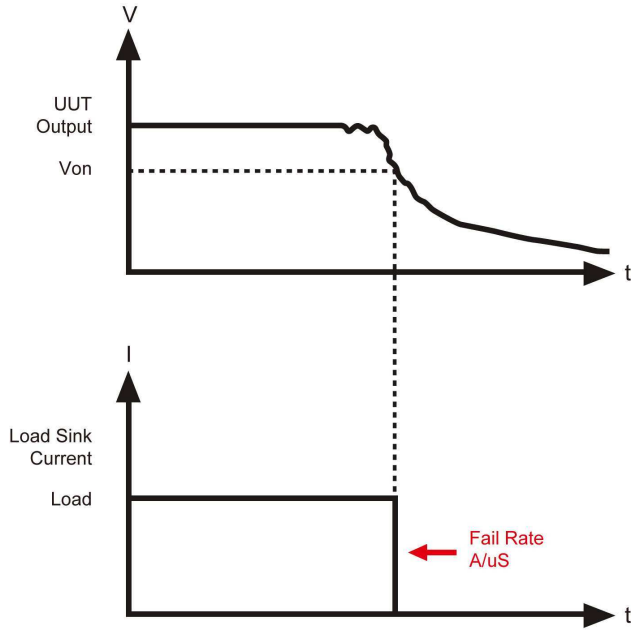


Figure 3-11 Stop Sinking Current (Von Non-Latch)

3.11 Short On/Off

Load module can simulate a short circuit at its input by setting the load on with full-scale current. The short circuit can be on/off at the front panel or via remote control. There are two operations for **SHORT** key on the front panel. One is toggled on/off, and another controlled by key. They are selected in configuration. The **SHORT** key will be enabled only when Load is ON.

Toggled on/off means pressing **SHORT** once to enable short circuit, and again to disable. Control by Key means pressing **SHORT** and holding it to enable short circuit, and releasing it to return to normal operation.

The actual value of electronic short is dependent on the mode and range that are active when the short is turned on. In CC mode it is equivalent to the programming of the maximum current under the maximum power limit. In CR mode it is equivalent to the programming of the minimum resistance for the present resistance range. In CV mode it is equivalent to the programming of zero voltage. In CP mode it is equivalent to the programming of the maximum power for the present power range. Turning on the short circuit does not affect the programmed setting, and Load input will return to the previously programmed values when the short circuit is turned off.

When executing SHORT in OCP mode or OPP mode, it will follow the setting made in OCP mode or OPP mode to do current or power loading step by step till the trigger voltage stops loading.

Be noted that turning on the short circuit may cause the Load to sink so much current to trigger the protection circuit, and that will turn off the Load. In addition, the short circuit will not function when operated in the low range of CC mode.

3.12 Load On/Off

A module's input can be toggled on/off through the **ON/OFF** key on the front panel of Mainframe, or the **LOAD** key on module, or the remote control. The on/off change of input is done according to the slew rate.

Turning off the load does not affect the programmed setting. The load will return to the previously programmed values when the Load is turned on again.

3.13 Protection Features

Each load module includes the following protection features: Overvoltage, Overcurrent, Overpower, Overtemperature, and Reverse Voltage.

The appropriate bits in the Mainframe's statue registers are set when any of the protection features mentioned above is active. Besides, the Load's buzzer will produce beep sound to inform you till protection status is reset. When any protection occurs, it will cause the Load input to be turned off.

- Overvoltage
  The overvoltage protection circuit is set at a level slightly above the voltage range specified in the specification of the Load. The overvoltage (OV) and voltage fault (VF) status register bits are set when the OV condition occurs. They will remain set till they are reset. The Load module will display OVP when overvoltage protection occurs.

- Overcurrent
  When Load is operating in CR or CV mode, it is possible for a module to attempt to sink current more than it is rated for. The limit level of current is set at a level slightly above the current of the Load. The overcurrent (OC) and current error (CE) status register bits are set when the OC condition occurs, and will remain set till they are reset. The Load module will display OCP when overcurrent protection occurs.

- Overpower
  The overpower protection circuit is set at a level slightly above the power range specified in the specifications of the Load. The overpower (OP) and power error (PE) status register bits are set when the OP condition occurs, and will remain set till they are reset. The Load module will display OPP when overpower protection occurs.

- Over temperature
  Each Load has an over temperature protection circuit, which will turn off the load if internal temperature exceeds safe limit. The over temperature (OT) and temperature error (TE) status register bits are set when the OT condition occurs, and will remain set till they are reset. The Load module will display OTP when over temperature protection occurs.

- Reverse Voltage
  The Load conducts a reverse current when the polarity of UUT connection is not correct. The maximum safe reverse current is the same as the rated current of Load. If the reverse current of UUT is over the rated current of Load, the Load may be damaged. If a reverse voltage condition is detected, you must turn off power to UUT immediately, and make a correct connection. The reverse voltage (RV) and voltage fault (VF) status register bits are set when the RV condition occurs, and will remain set till they are reset. The Load module will display REV when reverse voltage protection occurs.

All of the protection features will latch when they are tripped. When any protection occurs the module will turn off the load input, and produce beep sound till you remove the condition and reset protection by pressing **LOAD** key on the module.

⚠ CAUTION
To protect the electronic Load from possible damage, the input voltage must not exceed the maximum input voltage rating specification. Besides, Load + terminal potential must be more than – terminal potential.

3.14 Save/Recall Setting

The setting of the electronic Load for all channels can be saved and recalled for use in various test setups. This simplifies the repetitive programming of different things. The present setting of mode parameters (CC, CR, CV, CP), programs, OCP, OPP and power on status (DEFAULT) can be saved in the EEPROM using **SAVE** key. Later you can recall the settings from the specified file using **RECALL** key. The **SAVE** and **RECALL** keys affect all channels simultaneously.

3.15 Program

The program feature is so powerful. It allows you to simulate various test conditions. There are ten programs in the electronic Load. Each program has ten sequences. The setting mapping of program sequence to file is one to one. It means that program 1, sequence 1 maps to file 1, and program 3, sequence 4 maps to file 24. For setting and running the program please refer to 4.2.3 and 4.2.4.

4. Local Operation

4.1 Introduction

This chapter describes how to operate the electronic load from the local panel in details. The descriptions include: Mainframe panel control, Module panel control and indicators.

4.2 Local Operation of Load Mainframe

In order to use the front panel keys to control the electronic load, local operation must be in effect. Immediately after power is applied, local operation will be in effect. When local operation is in effect, you can select a channel, and use the display as well as keypad on the front panel to control the Load. The display of Mainframe can be used to view the programmed setting of a selected channel. The input voltage/current is displayed on module's display. The mainframe will scan module type at power-on, and memorize it for channel setting.

ⓘNOTICE
When you edit setting, the display will blink setting, and let you know that the active setting is to be edited or selected.

In the remote state, the keys on the front panel will have no effect. Only the remote controller can program the Load. The display of module will show the present input voltage and current readings or the last display while the local state is in effect. The display of the Mainframe will show REMOTE message.

ⓘNOTICE
In the setting of load module level the resolution of current, voltage, resistance and slew rate setting will be different from the entered values. The displayed or stored value of setting will be the actual value of D/A programmed in the load module. The current, voltage and slew rate setting will be degraded as low values are entered. The resistance setting will be degraded as higher values are entered.

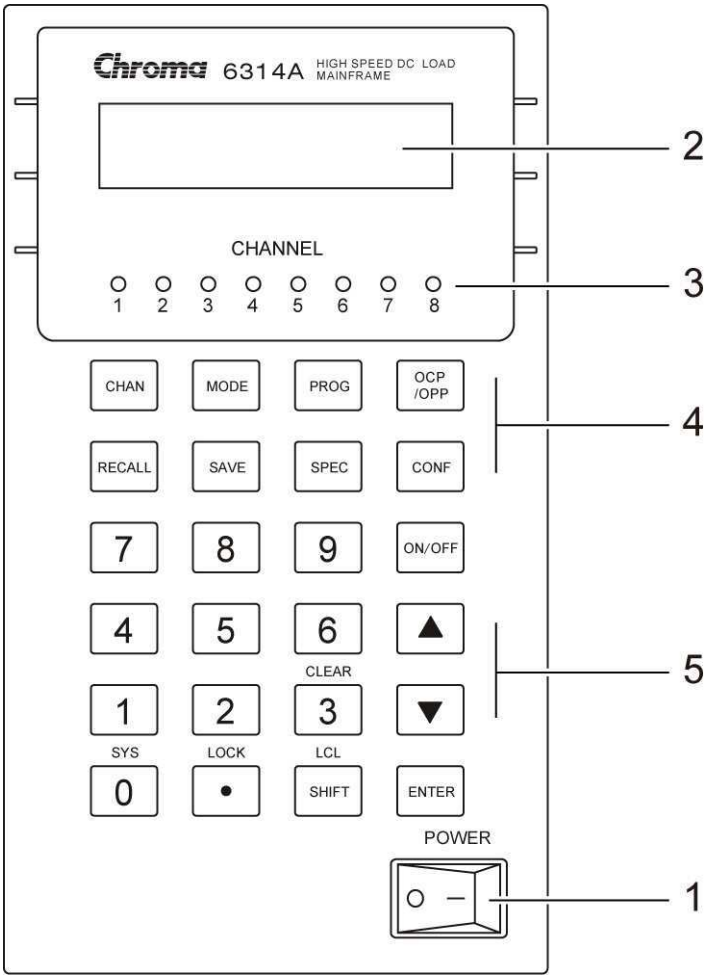


Figure 4-1 Front Panel of Mainframe

1. Line switch — Turn the ac power on/off.
2. LCD display — Display channel information normally.
3. Channel indicator — Indicate the active channel settings.
4. Function keys

CHAN — To select a channel for settings.

MODE — To select a mode for settings.

PROG — To select a program for settings or running.

OCP/OPP — To select OCP or OPP mode.

RECALL — To recall the saved settings from EEPROM, and all channel's settings from specified files (1 to 101), OCP files (1 to 10) and OPP files (1 to 10). Recalling file 101 means to recall the factory default settings. Recalling program is from **PROG**, number 1 to 10.

SAVE — To save all of the present mode settings of all channels in the specified files (1 to 100). To save OCP mode settings of all channels in the OCP files (1 to 10). To save OPP mode

settings of all channels in the OPP files (1 to 10). Saving program is from 1 to 10. Saving DEFAULT is to save the status of all channels for the next time the electronic Load is turned on. All saved settings are stored in EEPROM, and will not be lost when ac power is cycled.

SPEC — To select specification data for editing, or to enable SPEC function.

CONF — To select configuration data for editing.

5. Entry keys

▲ **▼** — They let you scroll through choices in a parameter list that is applied to a specific command. Parameter lists are circular. You can return to the starting position by pressing either of the keys continuously.

ON/OFF — It toggles the output of the electronic Load between on and off states if channel SYNC. RUN is set at on.

ENTER — It executes the entered value or the parameter of the presently accessed command. The parameters you have entered with other keys are displayed but not entered into the Load until you press this key. Before pressing **ENTER** you can change or abort anything previously entered into the display.

SHIFT — It enables a shifted key to function (LOCK, SYS).
When in remote control state, this key acts as a local key.

SHIFT + **3** — The "CLEAR" key lets you correct wrong digits before they are entered.

0–**9** — They are used for entering numeric values.

. — It is a decimal point.

4.2.1 Selecting the Channel

The **CHAN** key is used to select one of the channels for local control. See channel number in 2.3.1. To edit channel settings, you must select a channel first. If the channel does not exist, it cannot be selected. If no module is installed in the mainframe, the display will show `DUMMY CHANNEL`. When you press **CHAN**, the channel number you want to select will automatically increase to the next existing channel. The mainframe will scan the module type at power-on, and memorize it for channel editing.

4.2.2 Setting the Operation Mode

The **MODE** key and ▲ , ▼ keys are used to select modes of channels for local control. Press **MODE** to display the selected channel's active mode. The active mode can be changed by use of ▲ or ▼ key followed by the **ENTER** key. The sequence of mode selection after pressing ▼ key is as follows:

CCL -> CCH -> CCDL -> CCDH -> CRL -> CRH -> CV->CPL->CPH go back to CCL.
Press **ENTER** key to select mode and confirm setting.

ⓘ NOTICE
The eight operation modes of load module settings stored in the mainframe are independent. Changing any mode setting won't affect others. Storing the settings to EEPROM (1-100) will store only one mode setting.

The load levels and slew rate are common to CC, CR , CP modes. CV mode sets voltage level and response speed. There are two level settings for single channel/module of CC, CR, CV and CP modes. They can be switched by the module's **A/B** key.

Setting CC Values

There are four modes for CC operation: CCL, CCH, CCDL, CCDH. The current levels are programmed in Amps. The slew rate levels are programmed in milliamps/μS at low range and in Amps/μS at high range. The timings are programmed in millisecond. The setting buffers of four CC modes are independent. Changing the operation range doesn't affect the settings of other ranges. The following examples show how to set the CC values of Load module for model number 63103A. Before observing the examples, select channel first.

1. Select Range/Function
   Press **MODE**, and use ▲ or ▼ key to select CCL followed by **ENTER** key.
   CCL: static low range CCH: static high range
   CCDL: dynamic low range CCDH: dynamic high range

```
MODE SELECT
    CCL
```

2. Set Current Level
   There are 4000 discrete steps from 0 to full scale in each range. Set level1 (A) current level to 2 amps by pressing **2**, **ENTER** . Set level2 (B) current level to 1 amp by pressing **1**, **ENTER**.

```
CCL1:   1.9995A
CCL2:   0.9990A
```

3. Set Slew Rate
   There are 250 discrete steps in each range. Set the rise 50 mA/μS and fall slew rates to 50 mA/μS by pressing **5**, **0**, **ENTER** for rise and **6**, **0**, **ENTER** for fall slew rate.

```
CCL↗  : 50mA/µS
CCL↘  : 60mA/µS
```

4. Set DYNAmic Function Periods
   Dynamic function has period T1 and T2 to be set. Set dynamic period 1 to 0.1 mS, period 2 to 0.2 mS by pressing **0**, **.**, **1**, **ENTER** and **0**, **.**, **2**, **ENTER**. The range of Dynamic period is from 0.025 µS to 30 Sec.

```
CCDLT1:  0.100mS
CCDLT2:  0.200mS
```

ⓘ NOTICE
If you press **ENTER** key, and the blinking data do not go to next, change configuration setting Enter Data Next to YES.

Setting CR Values

The CR values for the selected channel are programmed by pressing **MODE**, **▲** and **ENTER** keys. The resistance values can be programmed in low voltage (CRL) or high voltage (CRH) range. The current is always in high range. ALL resistance levels are programmed in ohms. The slew rate is in A/µS.

The following examples illustrate how to set CR values of Load module for model number 63103A.

1. Select Range
   Press **MODE** and use **▲** or **▼** key to select CRL followed by **ENTER** key.

```
MODE SELECT
    CRL
```

2. Set Resistor Level
   There are 4000 discrete steps from 0 to full scale in each range. Set the main resistor level1 (A) to 2 ohms by pressing **2**, **ENTER**. Set the level2 (B) resistor level to 1 ohm by pressing **1**, **ENTER**.

```
CRL1:   2.000Ω
CRL2:   1.000Ω
```

3. Set Slew Rate
   There are 250 discrete steps in each range. Set the rise and fall slew rates to 0.1 A/µS by pressing **.**, **1**, **ENTER** for rise slew rate and **.**, **2**, **ENTER** for fall slew rate.

```
CRL↗  : 0.10A/µS
CRL↘  : 0.20A/µS
```

Setting CV Values

The CV values for the selected channel are programmed by pressing **MODE**, ▲ and **ENTER** keys. The voltage values can be programmed in one range. The voltage levels are programmed in volts. And the response speed is programmed in fast/slow operations.

The following examples illustrate how to set CV values of Load module for model number 63103A. Before observing the examples, select channel first.

1. Select Range
   Press **MODE** and use ▲ or ▼ key to select CV followed by **ENTER** key.

```
MODE SELECT
     CV
```

2. Set Voltage Level
   There are 4000 discrete steps from 0 to full scale in each range. Set the main voltage level1 (A) to 5 volts by pressing **5**, **ENTER**. Set the level2 (B) voltage level to 6 volts by pressing **6**, **ENTER**.

```
CV 1:  5.00V
CV 2:  6.00V
```

3. Set Response Speed
   There are two response speeds for CV mode, fast and slow for different UUTs testing. Refer to Figure 4-2 and Figure 4-3 for transfer functions.

```
CV RESPONSE
1:FAST 2:SLOW
```

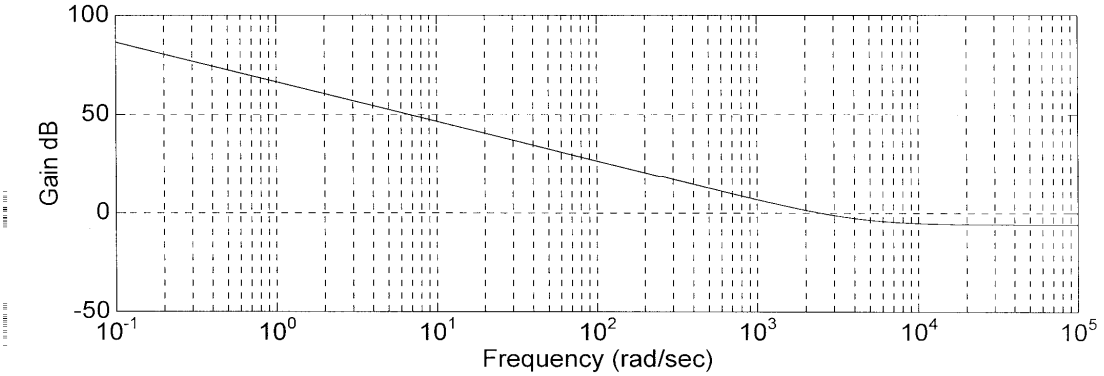


Figure 4-2 CV Response Transfer Function (FAST)

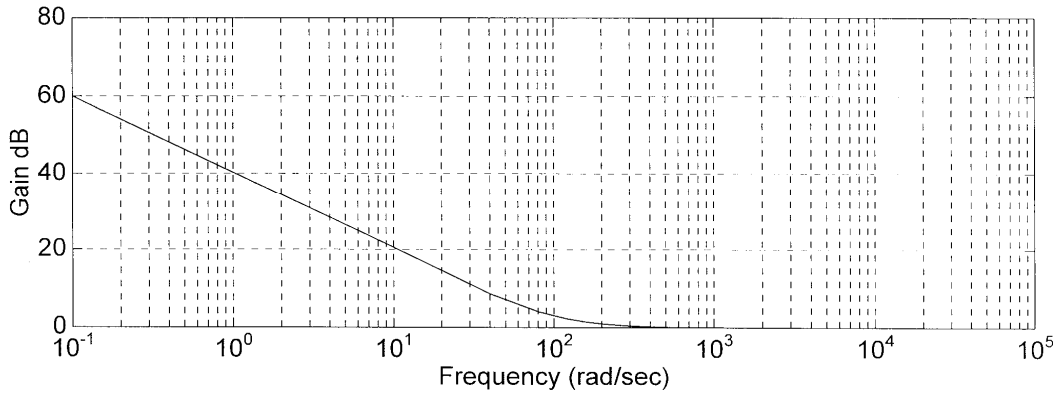


Figure 4-3 CV Response Transfer Function (SLOW)

Setting CP Values

The CP values for the selected channel are programmed by pressing **MODE**, ▲ and **ENTER** keys. The resistance values can be programmed in low voltage (CPL) or high voltage (CPH) range. The current is always in high range. ALL resistance levels are programmed in ohms. The slew rate is in W/μS.

The following examples illustrate how to set CP values of Load module for model number 63103A.

1. Select Range
   Press **MODE** and use ▲ or ▼ key to select CPL followed by **ENTER** key.

```
MODE SELECT
    CPL
```

2. Set Resistor Level
   There are 4000 discrete steps from 0 to full scale in each range. Set the main resistor level1 (A) to 20 watt by pressing **2**, **ENTER**. Set the level2 (B) resistor level to 10 watt by pressing **1**, **ENTER**.

```
CPL1:   20.000W
CPL2:   10.000W
```

3. Set Slew Rate
   There are 250 discrete steps in each range. Set the rise and fall slew rates to 0.1 W/μS by pressing **.**, **1**, **ENTER** for rise slew rate and **.**, **2**, **ENTER** for fall slew rate.

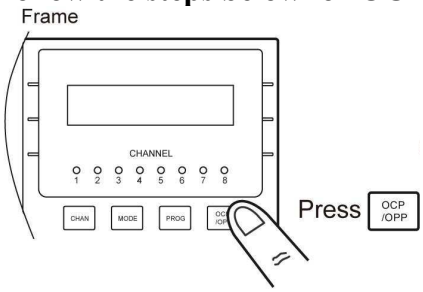
```
CPL↗  : 0.10W/μS
CPL↘  : 0.20W/μS
```

4.2.3 Setting the OCP/OPP Mode of Operation

The **OCP/OPP** key has OCP and OPP two modes for users to do test the UUT voltage and see it reaches the trigger voltage level and judge if the OCP or OPP protection is acting normally.

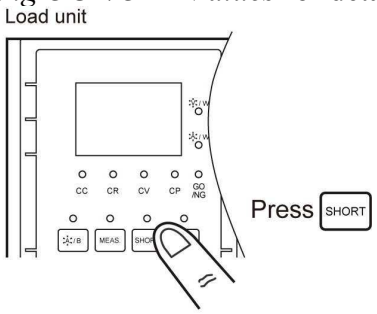
※Note: Follow the steps below for OCP/OPP mode operation.

STEP 1



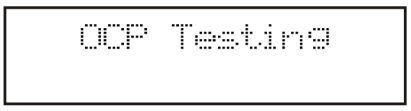
First select the channel to be tested and press **OCP/OPP** key to set the related parameters. See *Setting OCP/OPP Values* for detail information.

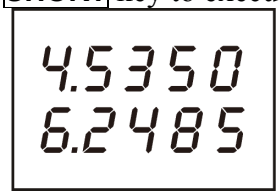
STEP 2



Once STEP 1 is done, go to the Channel and press **SHORT** key to execute OCP or OPP. If operating the R channel of 63102A and 63107A models, first press the **L/R** key of the module and switch to R channel, then press **SHORT** key to execute OCP or OPP.

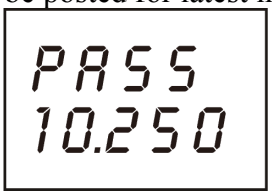
STEP 3





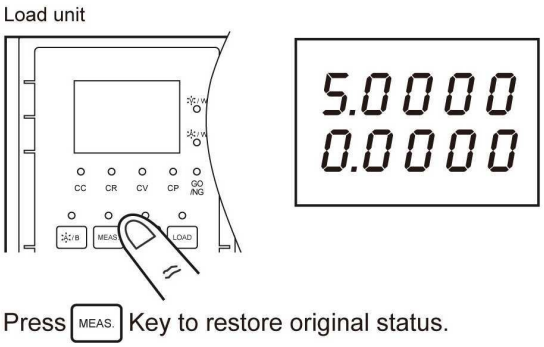
Once STEP 2 is executed, the 7-segment display on the module will show the OCP/OPP execution status in real time so that user can be posted for latest information.

STEP 4



When the OCP/OPP execution is done, a message of Pass or Fail and OCP current or OPP power will show on the module. Once the test is done, it will return to OCP/OPP for editing or executing the test.

STEP 5



When the OCP/OPP execution is done, to clear the 7-segment display of the module for OCP/OPP Pass/Fail screen, press MEAS. key to clear it and restore the display of voltage, current or power.

Setting OCP Values

OCP mode can be executed in any mode. Press **OCP/OPP** key to set the Current Range (CCH, CCL) of OCP mode and follow the option to related values including start current (Istart), end current (Iend), step no. (No. step), dwell time (DwellT), trigger voltage setting (SET Trig. Voltage), OCP low limit (SPEC_L) and OCP high limit (SPEC_H).

※ NOTE:

Set the start current (Istart) and end current (Iend): Set based on the option of CCH or CCL selected for each mode and OCP mode only acts when Istart < Iend.
Range of the step no. (No. step): 1 ~ 1000
Range of the dwell time (DwellT): 1 ~ 1000 mS
Trigger voltage (SET Trig. Voltage): Set based on the user's request, but only acts when the trigger voltage is lower than UUT voltage.
OCP current low limit (SPEC_L) and high limit (SPEC_H): Set based on the user's request.

$$OCP\ Accuracy\ (Typical) = \frac{Iend - Istart}{no.\ Step}$$

The following examples illustrate how to set OCP values of Load module for model number 63103A.

1. Enter into OCP mode and select CURRENT Range
   Press **OCP/OPP** key to enter into CURRENT mode and select the current range. Press **2**,**ENTER** key to select the CCL Range for operation.

```
CURRENT RANGE
1.CCH  2.CCL
```

2. Set the start and end current
   Press **1**,**.**,**5**,**ENTER** key to set the start current (Istart) and press **6**,**ENTER** key to set the end current (Iend).

```
Istart:  1.500 A
Iend:    6.000 A
```

3. Set the number of step and dwell time
   Press **1**, **0**, **0**, **ENTER** key to set the number of step (No. step) and press **2**, **0**, **0**, **ENTER** key to set the dwell time (DwellT).

```
No. step: 100
DwellT:   200 mS
```

4. Set the trigger voltage
   Press **3**, **.**, **6**, **ENTER** key to set the trigger voltage (SET Trig Voltage).

```
   SET  Trig
Voltage: 3.60 V
```

5. Set the low and high limit for OCP specification
   Press **4**, **.**, **5**, **ENTER** key to set the current low limit (SPEC_L) and press **6**, **ENTER** key to set current high limit (SPEC_H).

```
SPEC_L: 4.500 A
SPEC_H: 6.000 A
```

Setting OPP Values

OPP mode can be executed in any mode. Press **OCP/OPP** key to set the Power Range (CPH, CPL) of OPP mode and follow the option to related values including start power (Pstart), end power (Pend), step no. (No. step), dwell time (DwellT), trigger voltage setting (SET Trig. Voltage), OPP low limit (SPEC_L) and OPP high limit (SPEC_H).

※ NOTE:

Set the start power (Istart) and end power (Iend): Set based on the option of CPH or CPL selected for each mode and OPP mode only acts when Pstart < Pend.
Range of the step no. (No. step): 1 ~ 1000
Range of the dwell time (DwellT): 1 ~ 1000 mS
Trigger voltage (SET Trig. Voltage): Set based on the user's request, but only acts when the trigger voltage is lower than UUT voltage.
OPP current low limit (SPEC_L) and high limit (SPEC_H): Set based on the user's request.

$$OPP\ Accuracy\ (Typical) = \frac{Pend - Pstart}{no.\ Step}$$

The following examples illustrate how to set OPP values of Load module for model 63103A.

1. Enter into the OPP mode and Select POWER Range
   Press **OCP/OPP** key to enter into the Power mode and select the power range. Press **2**, **ENTER** key to select the CPL Range for operation.

```
  POWER RANGE
1.CPH  2.CPL
```

2. Set the start and end power
   Press **5**,**ENTER** key to set the start power (Pstart) and press **3**,**0**,**ENTER** key to set the end power (Pend).

```
Pstart: 5.00 W
Pend:   30.00 W
```

3. Set the number of step and dwell time
   Press **2**,**0**,**ENTER** key to the number of step (No. step) and press **5**,**0**,**0**,**ENTER** key to set the dwell time (DwellT).

```
No. step: 20
DwellT:   500 mS
```

4. Set the trigger voltage
   Press **4**,**.**,**5**,**ENTER** key to set the trigger voltage (SET Trig Voltage).

```
   SET  Trig
Voltage: 4.50 V
```

5. Set the low and high limit for OPP specification
   Press **1**,**5**,**ENTER** key to set the power low limit (SPEC_L) and press **3**,**0**,**ENTER** key to set the power high limit (SPEC_H).

```
SPEC_L: 15.00 W
SPEC_H: 30.00 W
```

4.2.4 Setting the Program

The electronic Load is able to select customized basic tests, and link them into a program test for automatic execution.

The **PROG** key is used to select program, or recall program for local control. There are ten programs (1-10). Each program has ten sequences to map files from 1 to 100. The program 1 maps files from 1 to 10. Table 4-1 shows the relationship between the program sequence and the corresponding file.

Program 1 Sequence No.	1	2	3	4	5	6	7	8	9	10
Corresponding File No.	1	2	3	4	5	6	7	8	9	10
Program 2 Sequence No.	1	2	3	4	5	6	7	8	9	10
Corresponding File No.	11	12	13	14	15	16	17	18	19	20
:										
:										
Program 10 Sequence No.	1	2	3	4	5	6	7	8	9	10
Corresponding File No.	91	92	93	94	95	96	97	98	99	100

Table 4-1 The Relationship of the Program Sequence and the Corresponding File.

In running a program you must set its corresponding file parameters first. If one program sequence is not enough for you to test the UUT, you can use program chain function to get more sequences.

Press **PROG** key, and the LCD will display as follows. Press number 1 -10 followed by **ENTER** to recall program from EEPROM, or use ▲ , ▼ keys to edit program.

```
PROGRAM SELECT
No:  1
```

1. Setting the Active Channels
   The LCD displays the active channels for the program to control. The LED channel indicators will be active if the channel is active. The channel can be active only when it exists and the mode of SYNC. RUN is ON. When the channel is not selected or does not exist, the channel number will not be displayed. Press number 1 to 8 to enable or disable the active channel.

```
ACTIVE CHANNEL
1  3  5 6 7 8
```

2. Setting the Program Chain
   The chain function of program enables you to chain program so as to get more sequences for testing. Set program chain number to 0 means no program chain. Program chain function can chain itself for loop test, or chain other programs. Press **1**, **ENTER** to set chain itself for loop test. The default setting is 0.

```
PROGRAM CHAIN
No:  1
```

3. Setting the Sequence P/F Delay Time
   The sequence Pass/Failure delay time let you set the delay time for P/F checking when load condition changes. The failure status of the sequence will latch when a program is executed. It means that any failure will be memorized even when the UUT becomes stable within the specifications later. The range of P/F delay time is from 0 to 60 seconds. Press **1**, **ENTER** to set the sequence P/F delay time 1 second. The default setting is 0 second.

```
SEQ. P/F DELAY
TIME:    1.0Sec
```

4. Setting the Sequence ON/OFF Time
   The sequence ON/OFF time controls the Load input ON/OFF when the program sequence is executed. The range of ON/OFF time is from 0 to 60 seconds.

```
SEQ. ON TIME
TIME:   1.0Sec
```

   Press **0**, **ENTER** keys to set OFF time 0 second. The default setting is 0 second for OFF time.

```
SEQ. OFF TIME
TIME:    0.0Sec
```

5. Setting the Sequence Mode
   There are three modes to control the method of sequence execution.

SKIP (**0** Key):	Skip the sequence. Load will not change input status.
AUTO (**1** Key):	Use ON/OFF time to control Load input on/off. When ON/OFF time passes, the Load will get to the next sequence automatically.
MANUAL (**2** Key) :	Use **▲** or **▼** or number **0** to **9** to control the execution sequence.
EXT (**3** Key):	The Trig. signal from External Trig. by Pin15 of DIGITAL I/O PORT to control the execution sequence.

   Pressing the number key lets you select a random sequence number to execute. Pressing **0** means to go to sequence 10.

   Press **2**, **ENTER** keys to set sequence 1 manual mode. You must set ten sequence settings for one program. The default setting is SKIP.

```
SEQ  1:  SKIP=0
AUTO=1  MANUAL=2
```

   To set the external control, press **▼** and select EXT to key in **3**.

```
SEQ  1:  EXT=3
```

6. Setting the Short Channel
   When the sequence mode is not SKIP, you must set the short channel & time. The short channel is selected as active channel. For selection of short channel press number 1 to 8 to enable or disable the corresponding module short function.

```
SEQ. 1 SHORT  CH.
 1   3   5 6 7 8
```

7. Setting the Short Time
   The range of short time is from 0 to 30 Sec. The short time must be ≤ SEQuence ON time. If the short channel is not selected or the short time is set to 0 Sec., the selected channel will not short. The default setting is channel 0 and 0 Sec.

```
SEQ. 1
SHORT TIME= 0.0S
```

4.2.5 Running the Program

Press **ON/OFF** to run program when program function is selected. The LED channel indicators will be active if channel is active. The display shows as follows.

```
 PROG. 1 SEQ. 1
[ON][KEY][PASS]
```

The upper line displays the executed program and sequence number while the lower line Load, key and test result status.

ON/OFF: It shows Load input status.
KEY (EXT): It shows when MANUAL mode is active and waiting for key input. If external control is selected, the name will change to EXT. Please use the External Trig. signal of pin15 from DIGITAL I/O PORT for control.
PASS/FAIL: It shows the test result compared with SPEC setting.

When program is executed, the setting of sequence will recall files from EEPROM, and the SPEC function is always ON. All function keys are disabled until **ON/OFF** is pressed to stop program execution, or program run finishes. When program run stops or finishes, the LCD will display as follows.

```
  PROGRAM OFF
 RESULT :PASS
```

It means that in the test of program all sequences have passed. If the test fails, LCD will show as follows.

```
PROG. XX :  1 2
3   4 5 6 7 8 9 10
```

PROG. XX stands for the file number of program fail, 1 to 10. Besides, 1, 2, 3...10 shown by LCD stand for failed sequence numbers. The failed sequences are the results of all failed channels. The LED of channel will show the failed channel. In the test by program chain, if the failed program files are more than one set, you can use ▲ ▼ to read the contents of failed programs.

4.2.6 Setting the Specification

The **SPEC** key is to enable/disable the SPEC function or select the settings of specifications. The Load will compare measurement data with the set specifications of HIGH and LOW limit when the SPEC TEST is ON, and the LED, GO/NG, is lighted on the module panel. To set specifications for module, you must go to mode editing by pressing **MODE**, **ENTER** keys, and then **SPEC** key. In other operation modes, pressing **SPEC** is to enable/disable SPEC TEST function. The SPEC TEST ON/OFF function is global. It means that all modules installed on the Mainframe will do GO/NG comparison. The specification unit of CC, CR modes is volt while that of CV mode current. There are three levels for each mode: CENTER, HIGH and LOW. The CENTER level must be set by the value of channel input reference level. The HIGH and LOW levels can be set by value or percentage selected in configuration SPEC. ENTRY MODE. The HIGH/LOW percentage range is from 0 to 100%.

Press **MODE**, **ENTER**, **SPEC** to set the specifications of CC mode. Press **5**, **ENTER** to set CENTER level 5V.

```
VOLTAGE SPEC.
CENTER: 5.0000V
```

Press **5**, **ENTER** to set HIGH level 5%.

```
VOLTAGE SPEC.
HIGH PCet:  5.0%
```

Press **5**, **ENTER** to set LOW level 5%.

```
VOLTAGE SPEC.
LOW PCet:   5.0%
```

The default setting of HIGH and LOW is 100%. The CENTER value is half of the range. For selection of the specifications set by Value or Percentage please refer to 4.2.7.

4.2.7 Setting the Configuration

The electronic Load provides useful features such as Von point, Current limit, Sync run, etc. To use these powerful features, you must set relevant parameters in accordance with application needs by the use of configuration setup. This procedure is only needed for initial setup of a test operation. The configuration of each channel is stored independently in the EEPROM of Mainframe. To set configuration you must press **CONF**.

Set the voltage range of CC mode. There are two voltage ranges for CC mode. High range is for high voltage and low range for low voltage so as to get better voltage resolution. The default setting of Vrange is HIGH.

```
CC Vrange Select
  1:HIGH   2=LOW
```

Set Von point. Von is the conduction voltage level when the electronic Load starts to sink current and the UUT output reaches the Von voltage. The default setting of Von voltage is 1V.

```
Von POINT
VOLTAGE: 3.50V
```

Set Von latch. There are two operation modes for Von control. Von latch ON means that Load will sink current continuously when Von voltage reaches. Von latch OFF means that Load will stop sinking current when UUT voltage is under Von voltage. The default setting of Von latch is OFF. Figure 4-4 and Figure 4-5 show Von LATCH ON and OFF current waveform separately.

```
Von LATCH
1:ON   2:OFF
```

CAUTION

If Von is set to 0V, the Load circuit will be ON in spite of no UUT. This will get overshoot spike. If a UUT is applied, the overshoot may damage the UUT in spite of small setting of Load current. So, do not set Von to 0V.

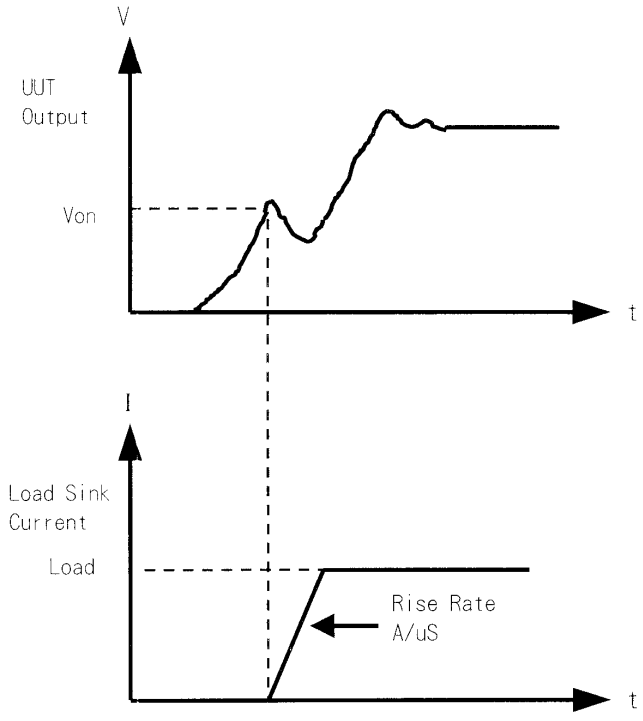


Figure 4-4 Von LATCH ON Current Waveform

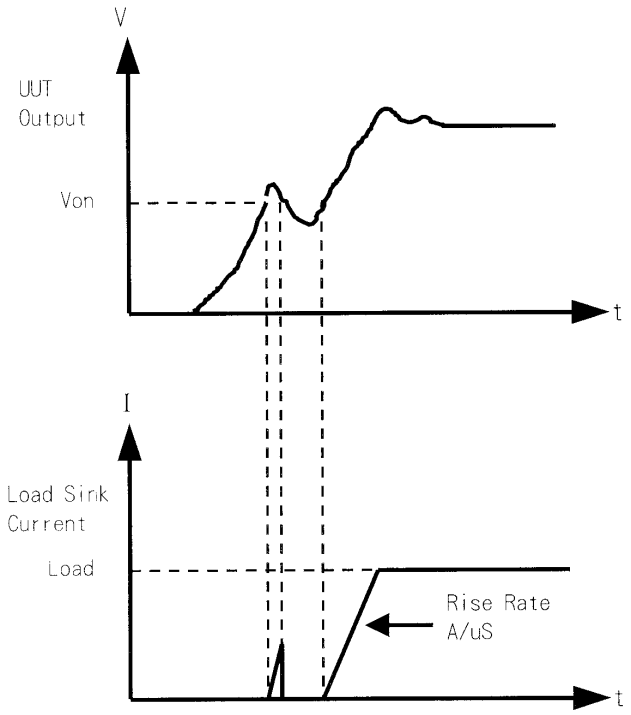


Figure 4-5 Von LATCH OFF Current Waveform

Set VOFF.

The VOFF is set for the user to stop the current loading when the voltage is under the low limit. The default setting of VOFF is OFF.

```
VOFF
1:ON   2:OFF
```

Set VOFF FINAL.

It sets the final loading voltage for VOFF. When VOFF is **ON**, the Von Point and Von Latch must be set in advance. Von Point must be larger than VOFF Final Voltage and Von Latch has to be **ON** for VOFF to execute. Figure 4-6 shows the Von and VOFF Loading Current Waveform separately.

```
VOFF FANAL
VOLTAGE: 1.00V
```

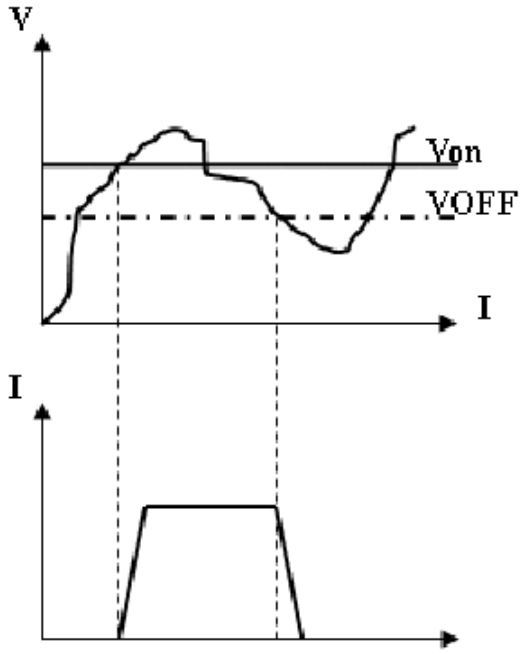


Figure 4-6 Von and VOFF Loading Current Waveform

Set CV mode CURR_LIMIT. It limits the current sinking of Load to protect UUT in CV mode. The default setting of current limit is the maximum Load current.

```
CV CURR_LIMIT
CURRENT:20.000A
```

Set CV SLOW TYPE.
It sets the type of SLOW RESPONSE for 6310A.

```
CV SLOW TYPE
1:MOST   2:MORE
```

If slower RESPONSE is desired, it can select **MOST**. The default setting of CV SLOW TYPE is MORE.

CAUTION
If **MOST** is set for CV SLOW TYPE, it won't be able to use the CV RESPONSE (1. FAST 2. SLOW) set by **MORE** in default for 6310A. The operation will be kept to the slowest CV RESPONSE.

Set sign of voltage for display. The electronic Load will show minus sign of the voltage if you select MINUS. It will not show any sign if you select PLUS. The default setting is PLUS. Selecting MINUS of SIGN OF VOLT. will occupy one digit. The displayed digits are four.

```
SIGN OF VOLT.
1:PLUS 2:MINUS
```

Set the specifications of entry mode. The specifications of Load can be set by VALUE or Percentage for HIGH and LOW data. The percentage values refer to CENTER value of specification. The default setting of SPEC entry mode is percentage.

```
SPEC. ENTRY MODE
 1:VALUE  2:PCet
```

Set SYNChronous run mode. When SYNC run is set at ON, the Load on/off is controlled by **ON/OFF** key on the Mainframe. Under other circumstances the Load on/off is simply controlled by **LOAD** key on the module. The default setting of SYNC run is ON.

```
   SYNC. RUN
 1:ON   2:OFF
```

Select data entry mode by **ENTER**. If ON is selected for data entry, the setting will go to the next one after pressing **ENTER**. If OFF is selected for data entry, the setting will remain the same line for you to change it again and again. The default setting is ON.

```
Enter Data Next
 1:ON   2:OFF
```

Select module SOUND on/off. When you press the key on the module, it will produce a sound if sound = ON. The default setting of sound is ON.

```
    SOUND
 1:ON   2:OFF
```

Select Load module input status when it is powered ON. If ON is selected, the module will be active according to AUTO LOADON mode setting. The default setting of AUTO LOADON is OFF.

```
 AUTO LOADON
 1:ON   2:OFF
```

Select the load on mode of module if AUTO LOADON is ON. If LOAD is selected, the Load module will be active as DEFAULT. If PROG is selected, the module will be active as the program saved last time. The default setting of AUTO LOADON MODE is LOAD.

```
AUTO LOADON MODE
 1:LOAD  2:PROG.
```

Select Load module rotary knob type. There are two types for you to change load module data with the rotary knob.

UPDATED means that the data changed by the rotary knob will be updated on the load module. When you press **LOAD** key to set load module ON, new data will be executed. OLD means that the data changed by the rotary knob will be invalid and the load module data remain the same if the load module is ON again. For the operation of rotary knob please refer to 4.3.1 and 4.3.2.

```
LOADON KNOB TYPE
1=UPDATED 2=OLD
```

Select short key mode. It sets the **SHORT** key mode for Load module. The default setting of SHORT mode is TOGGLE.

```
      SHORT
1:TOGGLE 2:HOLD
```

Set Voltage & Current MEASURE.
It sets the average times for voltage and current measurement. The range is 1~64 and the default setting of VI MEASURE is 20.

```
   VI MEASURE
  AVERAGE:   20
```

Set Timing Function mode
The 6310A Series Loads have unique timing & measurement function that is able to conduct precision time settings and measurements in the range of 00:00:00.000s to 24:00:00.000s. This feature allows users to set a trigger voltage & timeout value for battery discharge testing and similar applications.

For example, the Figure 4-7 below shows the 6310A's internal timer that can be initiated automatically when the battery voltage falls under the preset value. The timer will continue counting until the next preset voltage value is reached. The default setting of TIMING FUNCTION is OFF.

Press **1**, **ENTER** to set the timing function.

```
TIMING FUNCTION
 1:ON   2:OFF
```

Press **2**, **ENTER** to set Vtrg Voltage for timing function.

```
 TIMING FUNCTION
Vtrg:     2.000V
```

Press **0**, **0**, **1**, **ENTER** to set the timeout.

```
 TIMEOUT(24hr)
 00:10:00.000 s
```

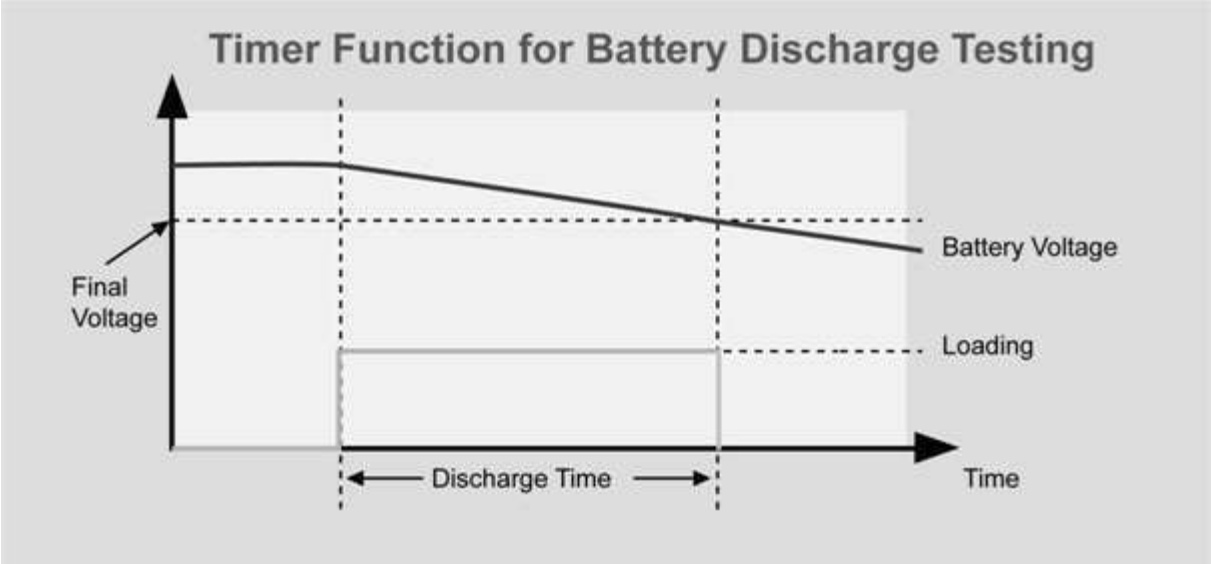


Figure 4-7 Battery Discharge Testing

Set DIGITAL IO

It sets the external signal (High > 4.3V, Low < 0.7V) to be provided to control the frame and module through Digital I/O Port, also to gain the related information. See 4.2.13 for detail description of the Port function. The default setting of DIGITAL IO is OFF.

Press **1**, **ENTER** keys to control frame and module for Digital I/O Port.

```
DIGITAL IO
1:ON   2:OFF
```

CAUTION

DIGITAL IO and TIMING FUNCTION cannot be used at the same time. To control frame and module via external I/O, be sure to set the TIMING FUNCTION to OFF. When DIGITAL IO is set to ON, all settings on the module won't be unable to execute Load ON loading until the DIGITAL IO is set to OFF.

Set ST/DYNA KEY.

It sets the key on the module to Static/DYNAmic function when required. It can change the MEAS. hot key to ST/DYNA for users to switch CC mode and CC Dynamic mod on the module directly. The default setting of ST/DYNA KEY is OFF. Press **1**, **ENTER** to change the MEAS. function to ST/DYNA function.

```
ST/DYNA KEY
1:ON   2:OFF
```

Select Query Model Name.

It gives users the ID for PC by changing the 6310A frame ID to 6310 frame so that the 6310 GPIB commands edited previously can be used to operate the PC. The default setting of Query Model Name is 6310A.

```
Query Model Name
 1:6310 2:6310A
```

Display the versions of load module & mainframe.

```
  MODEL: 63103A
Version:   3.10
```

Press ▼ key.

```
FRAME BOOT PROG.
Version:   1.40
```

Press ▼ key.

```
FRAME DOWN PROG.
Version:   1.21
```

Press ▼ key.

```
FRAME EXEC PROG.
Version:    1.41
```

4.2.8 Recalling Files/OCP Files/OPP Files

Press **RECALL** to recall files from 1 to 101. Files 1 to 100 are user data. File 101 is factor set state. After a file is recalled, the display will go to mode editor for you to edit or view the file. By pressing **RECALL** the display will show the file No. last recalled. The default file No. is 2 when the mainframe is powered on.

Press **RECALL** ,**3**, **ENTER** to recall the number 3.

```
  RECALL FILE
FILE NO:    3
```

The data of all channels will be recalled when you execute file recall.

Press **RECALL** ,**2**,**ENTER** to recall OCP files from 1 to 10.

```
    OCP FILE
FILE NO:    2
```

Press **RECALL** ,**3**,**ENTER** to recall OPP files from 1 to 10.

```
    OPP FILE
FILE NO:    3
```

4.2.9 Saving File/OCP File/OPP File/Default/Program

There are 100 file locations (1 to 100) for you to save files. Press **SAVE**,**2**,**0**, **ENTER** to save a file to location 20.

```
SAVE FILE
FILE NO:  20
```

There are OCP file locations (1 to 10) for you to save files. Press **SAVE**,**2**, **ENTER** to save a file to location 2.

```
OCP FILE
FILE NO:  2
```

There are OPP file locations (1 to 10) for you to save files. Press **SAVE**,**5**, **ENTER** to save a file to location 5.

```
OPP FILE
FILE NO:  5
```

Press **SAVE** ,**▼** until the display shows as follows. The DEFAULT states are used for electronic Load after power-on. Press **1** to save DEFAULT to EEPROM.

```
SAVE DEFAULT
1:YES  2:NO
```

Press **SAVE**, **▼** until the display shows as follows. Press **1** to save program.

```
SAVE PROGRAM
1:YES  2:NO
```

4.2.10 Going To Local

The **SHIFT** key operates as local key, **LCL** when electronic Load is in remote mode. You can press **LCL** key to go to local operation when Load is in remote state. In local operation **SHIFT** key operates as shift key.

4.2.11 Lock Operation

The lock operation disables any setting for change. When data are locked, all settings cannot change. The operation of **ON/OFF** and **SPEC** keys will not be affected by lock function. Press **SHIFT** and **.** simultaneously to enable/disable lock function. This is a toggle key to enable/disable lock function.

4.2.12 Setting System and RS-232C Connection

The parameters of RS-232C are set in the system. There are three parameters for you to set: Baud Rate, Parity Check and Data Bit number. Press **SHIFT** and **0** simultaneously to set system data.

Baud Rate : 0:600, 1:1200, 2:2400, 3:4800, 4:9600 bits/second.
Parity Check : 0:EVEN, 1:ODD, 2:NONE.
Data Bit : 0:7 bits, 1:8 bits.

The RS-232C connector on the rear panel of Mainframe is a 9-pin connector (DB-9, male connector). The RS-232C connector bus signal is defined as follows.

RS-232C Connector

Pin Number	Input/Output	Description
1	Output	+5V
2	Input	R×D
3	Output	T×D
4	Output	DTR
5	Output	GND
6	Input	DSR
7	NC	
8	NC	
9	NC	

Note: Pin 1 (+5V) is for 6310A series Remote Controller only.

4.2.13 Connecting the GO/NG Output Port

The GO/NG output port on the rear panel of Mainframe is a 15-pin connector (DB-15, female connector). The GO/NG signals are TTL active low to indicate NG. They are defined as follows, see Figure 4-8 Pin Assignment of DIGITAL I/O Port and GO/NG OUTPUT Port.

GO/NG Output Port Connector

Pin Number	Channel No.	Description
1	1	H:PASS or SPEC. OFF, L:FAIL
3	2	H:PASS or SPEC. OFF, L:FAIL
5	3	H:PASS or SPEC. OFF, L:FAIL
7	4	H:PASS or SPEC. OFF, L:FAIL
9	5	H:PASS or SPEC. OFF, L:FAIL
11	6	H:PASS or SPEC. OFF, L:FAIL
13	7	H:PASS or SPEC. OFF, L:FAIL
15	8	H:PASS or SPEC. OFF, L:FAIL
8	Enable	H:SPEC. OFF, L:SPEC. ON

Note: Pin 2, 4, 6, 10, 12, 14 are connected to GND.

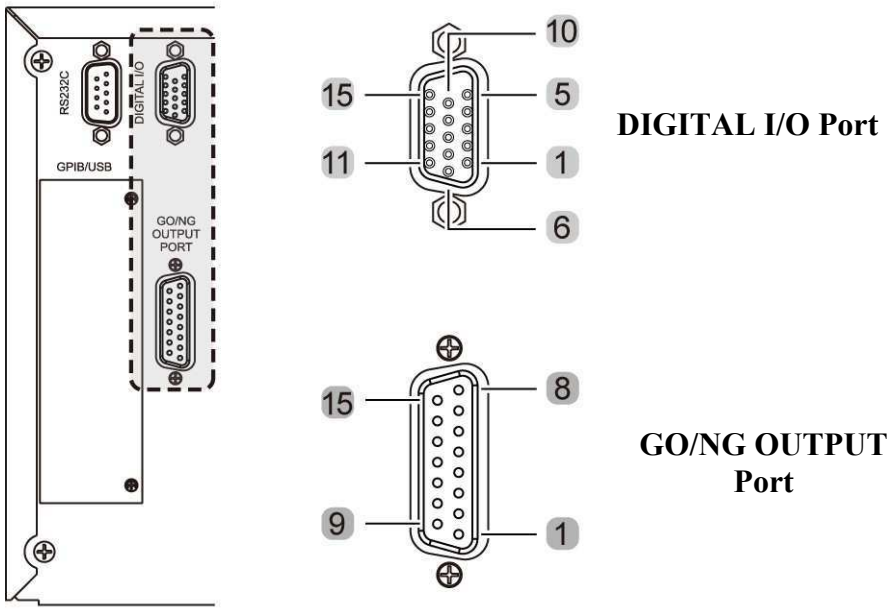


Figure 4-8 Pin Assignment of DIGITAL I/O Port and GO/NG OUTPUT Port

4.2.14 Connecting the DIGITAL IO Port

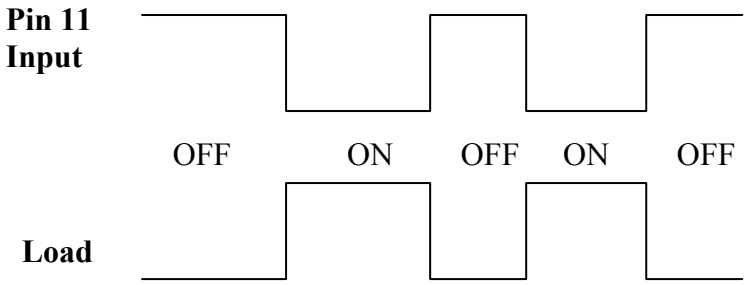
The Digital I/O is a 15 Pin Connector (DR3-15ST, Female) interface controlled by TTL (sink current 10mA max.) The external TTL signal input controls contain External ON/OFF, External Trig., For Sequences Run and the Pass/Fail messages received through this interface including Load ON/OFF, Total Pass, Total Fail, Short Signal and Protection Signal. Please see Figure 4-8 Pin Assignment of DIGITAL I/O Port and GO/NG OUTPUT Port for detail information.

DIGITAL IO Port Connector

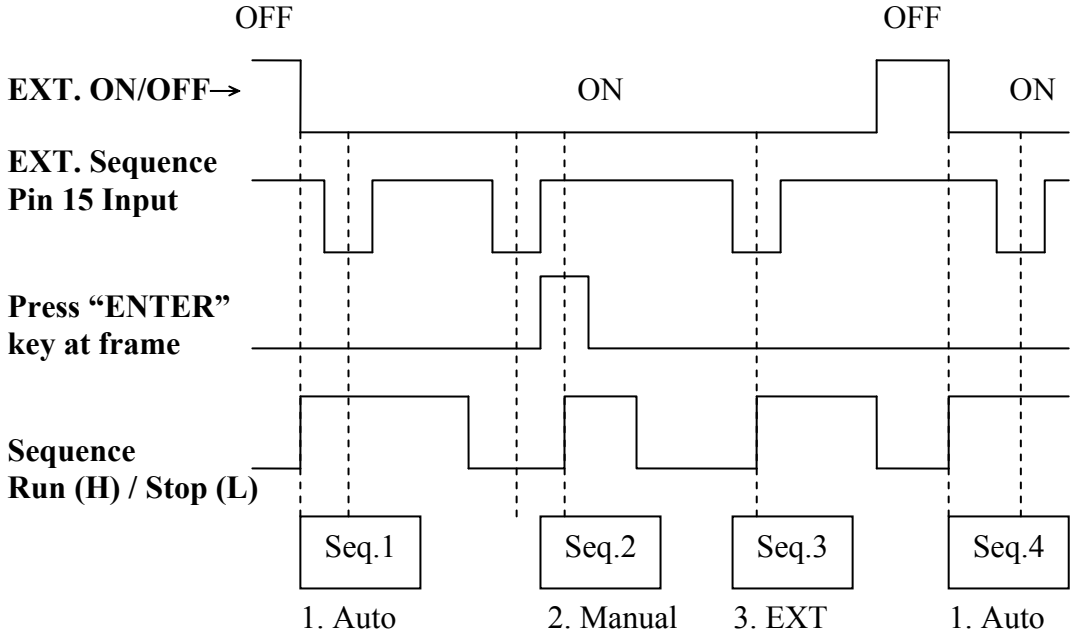
DR3-15ST Definition	
Pin Number	**Definition**
1	—
6	Load ON/OFF (O/P)
7	Total Pass (O/P)
8	Total Fail (O/P)
9	Short Signal (O/P)
10	Protection Signal (O/P)
11	External Load ON/OFF (I/P)
12	—
13	—
15	External Trig. For Sequences Run (I/P)

Note: Pin 2, 3, 4, 5, 14 are connected to **GND**.

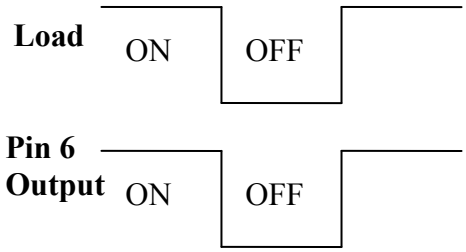
External ON/OFF (I/P) : <50ms (Level)
It uses the TTL input signal (High > 4.3V, Low < 0.7V) to control the mainframe **ON/OFF** key to do Sync. Run loading on Load module.



External Trig. For Sequences Run (I/P) <100ms (Pulse)
This signal is for external control program use only. It can only work when External ON/OFF input is ON. To execute the program loading test, select [3.EXT] in the control items (0.Skip, 1.Auto, 2.Manual, 3.EXT) for program selection. When the sequence is executed to the one requires [EXT] key in, the Port will input a pulse for execution. See section 4.2.4 and 4.2.5 for detail operation.



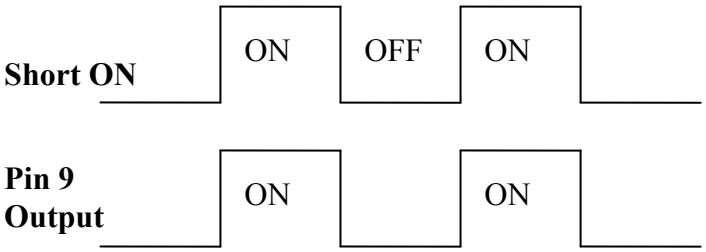
Load ON/OFF (O/P) : <50ms (Level)
This signal is the ON/OFF High/Low Level for actual loading. When the mainframe is ON, it outputs High Level and outputs Low Level when OFF.



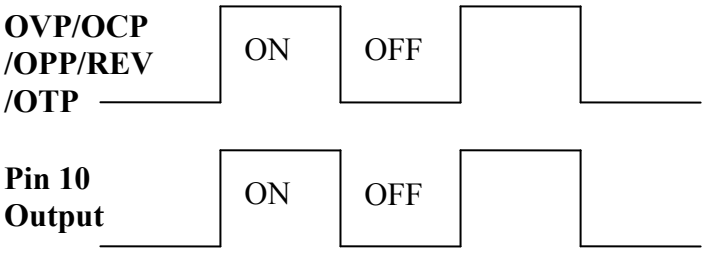
Total Pass (O/P): <100ms (Pulse)
This signal is for Program Seq. only. If all channel test items are Pass, the Pin7 on the Connector will output a High pulse signal to notify that all tests are Pass.

Total Fail (O/P): <100ms (Pulse)
This signal is for Program Seq. only. If one or more of all channel test items are Fail, the Pin 8 on the Connector will output a High pulse to notify the tests are Fail.

Short Signal (O/P): <100ms (Level)
When executing Short command, Short ON will output High Level and Short OFF will output Low Level.



Protection Signal (O/P) : <100ms (Level)
When any of the channels is having protection, Protection ON will output High Level and Protection OFF will output Low Level.



4.2.15 Setting the GPIB Address

Please refer to the second part of this manual, Chroma 6310A Programming Manual. GPIB address displays after RS-232C parameters in the system. You can use this feature to check GPIB address.

```
GPIB ADDRESS  1
```

4.3 Local Operation of Load Module

There are two kinds of panels in Load module. One is a single channel/module panel. The other is a double channels/module panel. There are four keys for each of the module panels. Only one key is different from these keypads. Figure 4-6 shows the single channel/module front panel.

4.3.1 Local Operation of Single Channel/Module (Panel A)

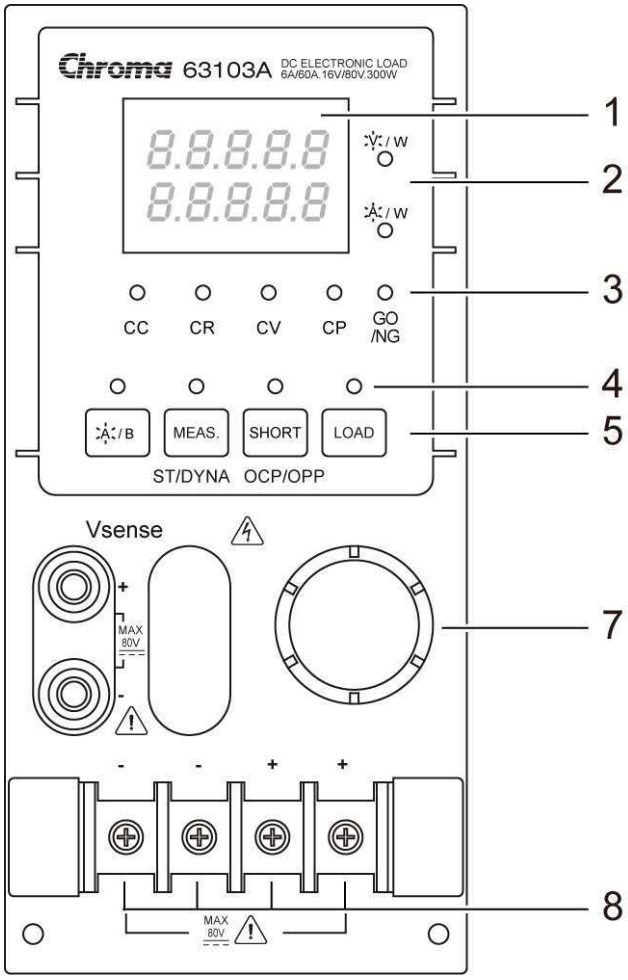


Figure 4-9 Single Channel/Module (Panel A)

1. 7-segment LED Display
   It displays the measurement Voltage, Current and Power. Each display has five digits.

2. 7-segment Display Unit Indicators
   They indicate the 7-segment display measurement unit V, I and P.

3. Operation Mode and GO/NG indicators
   They indicate the operation modes of CC, CR, CV, CP and GO/NG in the Load module. GO/NG LED indicator has two colors. The green LED is on for GO (pass) while the red for NG (fail). The GO/NG LED is off when SPEC test is OFF.

4. Keypad Indicators
   The four LEDs indicate the keypad status. Each LED shows the key status under the LED. Refer to the next paragraph for LED on/off status.

5. Keypad
   There are four keys for you to select/control the operation of Load module. The **A/B** key is used to select static load level. Its LED will be on when the Load is in level1 (A) state and off when in level2 (B) state or others. The **A/B** key can be used to select Fix mode for rotary knob setting too. Please refer to 4.3.4.

   MEAS. key can select the measurement voltage (V), current (A) and power (W) using the 7-segment display. See section 4.3.4 for detail operation. The other function of this key is Static/DYNAmic mode, see 4.2.7 for detail description. Set ST/DYNA KEY to on in **CONF** can switch the **MEAS.** to **ST/DYNA**. The LED will be on when the Load is in DYNAmic mode. DYNAmic operation is only effective in CC mode. This key has no response in other modes.

   The **SHORT** key enables Load to simulate short function. Its LED will be on when the short function of Load is enabled. It operates only when the Load input is enabled. It will not respond if Load input is not enabled.

   The **LOAD** key controls the on/off of the Load module input. Its LED will be on when the Load input is enabled.

6. Vsense Connectors
   These two connectors are Vsense measurement input. Refer to 2.5.2 for remote sense connections.

7. Rotary Knob
   The knob changes the level when the Load input is enabled. Rotating the knob clockwise will increase level whereas counterclockwise decrease level. When you change Load level with the knob, the setting of Mainframe will not change. The changed Load level will hold unless the same setting is changed on Mainframe.

8. Load Terminals
   They are input connectors of the Load for connecting to the UUT. Each of them can carry 40 Amps at most. If the current is over 40 Amps, you must connect two or more terminals for load connection. The PLUS (+) must be connected to the high potential of UUT. Refer to 2.5.1 for load input connection.

Examples

The following examples illustrate how to operate the module in CC mode.

1. Select Level1 (A) and Level2 (B)
   There are two levels of each mode for you to select in static function. The level1 (A) and level2 (B) can be selected through **A/B** key. Press **A/B** key to select current level1 or level2. When level1 (A) is selected, the LED of **A/B** key will be active. Press this key again to select level2 (B), and the LED will be inactive.

2. Select Dynamic Function
   Set the ST/DYNA KEY in **CONF** to ON to change the function of **MEAS.** to **ST/DYNA**. There are two functions for CC mode: STATIC and DYNAmic. The two functions can be selected by **ST/DYNA** key. Press **ST/DYNA** key to select Dynamic function. Press this key again to select static function. When Dynamic function is selected, the LED of DYNA will be active.

3. Short the Load Input
   The Load can simulate a short circuit across the input. The short circuit will be enabled when **SHORT** is pressed, and Load input is active (on). If the input is shorted, the LED of short will be active. The **SHORT** key can be set in configuration of toggled on/off mode or active by pressing mode. If **SHORT** key frame is pressed when the frame is in OCP/OPP mode, it will conduct the OCP/OPP test. See 4.2.3 for the detail operation.

4. Load Input On/Off
   The input can be toggled on or off by pressing **LOAD**. When the input is turned on, the LED of load will be active.

4.3.2 Local Operation of Double Channels/Module (Panel B)

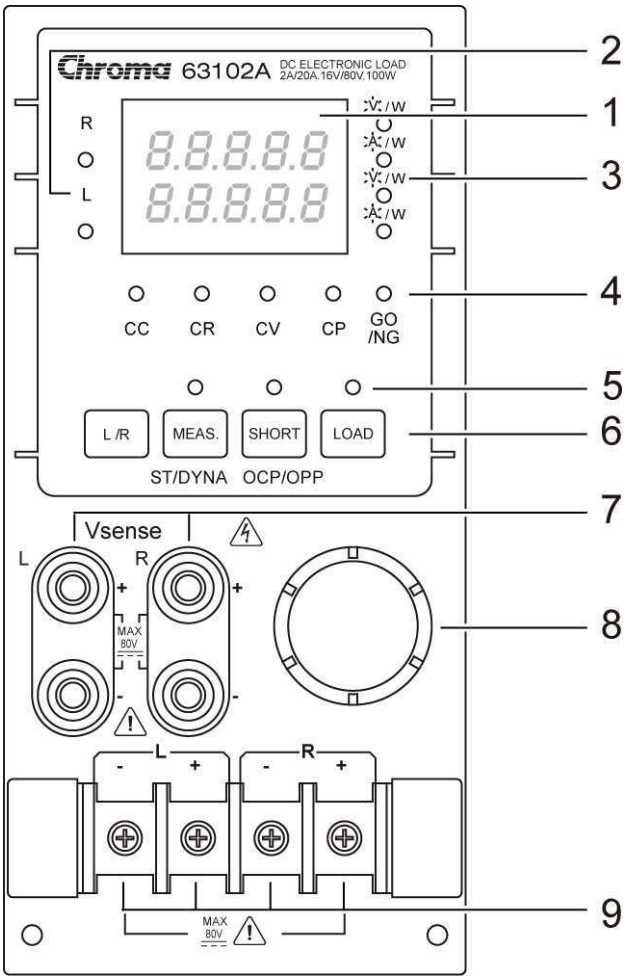


Figure 4-10 Double Channels/Module (Panel B)

The double channels/module means that there are two channels for one module. Each channel of module is isolated from the other. One set of display/keypad for the module can control both channels. The left channel is called channel L while the right one channel R. The 7-segment LED displays one or two channel status. The keypad and rotary knob can control both channels through **L/R** key.

1. 7-segment LED Display
   The 7-segment LED displays measurement Voltage, Current and Power of single or double channels. Each display has five digits.

2. The Channel LED Indicators
   There are two LEDs indicating the active right and/or left channel(s) of Load module. When the LED of channel R is on, the 7-segment display, mode, GO/NG indicators, and keypad are active on channel R. Channel L has the same function as channel R when its LED indicator is on.

   When the indicators of channel R and L are on, the 7-segment display selectively shows both channels' V or I or P. The indicators and keys, **SHORT**, **LOAD** in operation mode will be disabled when both channels are selected.

3. 7-segment Display Unit Indicators
   They indicate the 7-segment display measurement unit V, I and P.

4. Operation Mode and GO/NG Indicators
   When the LED of channel R or L is on, the operation and GO/NG LED has the same function as single channel/module. When the LEDs of channel R and L are on, the LED of operation mode indicators will be disabled (off). The GO/NG LED will be red when the check of any channel SPEC fails. It will be green when the check of both channels SPEC is all right.

5. Keypad Indicators
   There are three LEDs indicating the keypad status. Each LED shows the key status. It has the same function as single channel/module. The LED of LOAD will be active when any input of channel L or R is on.

6. Keypad
   There are four keys for you to select /control the operation of Load module. The **L/R** key is used to select the display of 7-segment LED, and the indicators of channel R and/or L. The **L/R** key can be used to select Fix mode for rotary knob setting too. Please refer to 4.3.4.

7. Vsense Connectors
   These four connectors are for Vsense measurement input. The two connectors on the right are for right channel while those on the left for left channel. Refer to 2.5.2 for remote sensing connections.

8. Rotary Knob
   The knob has the same function as single channel/module when channel R or L is selected. If the indicators of channel R and L are on, the knob will be disabled.

9. Load Terminals
   They are input connectors of the Load for connecting to the UUT. The two terminals on the left are for input of left channel while those on the right for that of right channel. The PLUS (+) sign of the input of each channel must connect the high potential. Refer to 2.5.1 for load input connections.

Examples

The following examples illustrate how to select the double channels/module in CC mode.

There are two channels/modules, so you have to select right or left channel for display & keypad. When channel R and L are selected, only **L/R** key is enabled. Other keys are disabled. During power-on, the pre-selected channel is channel L. It means that the 7-segment display, indicators and keypad are active at channel L. The double channels/ module has the same function as single channel/module. But it cannot select level 2(B).

1. The display sequence of **L/R** key is channel L -> channel R -> channels L+R display V -> channels L+R display I -> channels L+R display P back to channel L.

2. Select Dynamic Function
   Set the ST/DYNA KEY in **CONF** to ON to change the function of **MEAS.** to **ST/DYNA**. The static and dynamic function can be selected through the **ST/DYNA** key. Press this key to select Dynamic function, and press again to select static function. When Dynamic function is selected, the LED of DYNAmic will be active.

3. Short the Load Input
   The Load can simulate a short circuit across the input. The short circuit can be enabled when **SHORT** is pressed, and Load input is active. When the input is shorted, the LED of short will be active. The **SHORT** key can be set in configuration of toggled on/off mode or active by pressing mode. If **SHORT** key frame is pressed when the frame is in OCP/OPP mode, it will conduct the OCP/OPP test. See 4.2.3 for the detail operation.

4. Load Input On/Off
   The input can be toggled on or off by pressing **LOAD**. When the input is turned on, the LED of **LOAD** will be active.

4.3.3 Switching of MEAS. Voltage, Current & Power on Module

Press **MEAS.** key can switch the measurement modes via the 7-segment display. There are 3 types of measure modes - Mode 1: Voltage (V) and Current (A); Mode 2: Power (W) and Current (A); Mode 3: Voltage (V) and Power (W), see Figure 4-11.

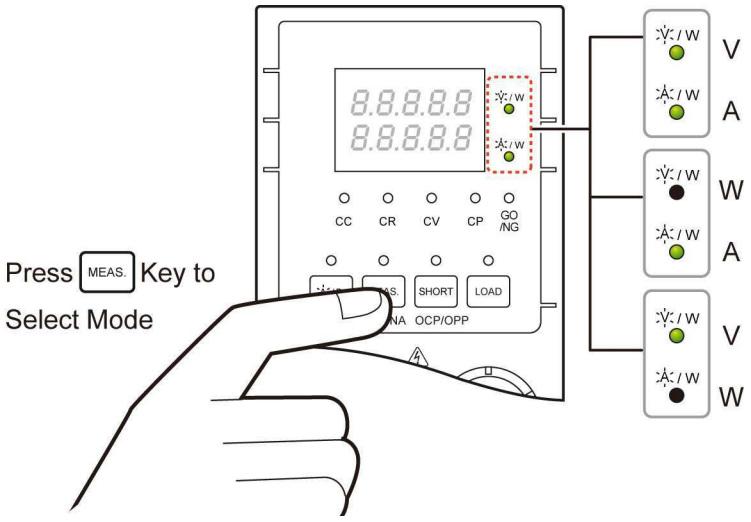


Figure 4-11 7-Segment Display for MEAS. V / A / W Switch

To view the voltage, current or power from the dual channel models - 63102A and 63107A, press L/R to switch the mode of two channels and press the MEAS. as Figure 4-12 shows to view the voltage, current or power.

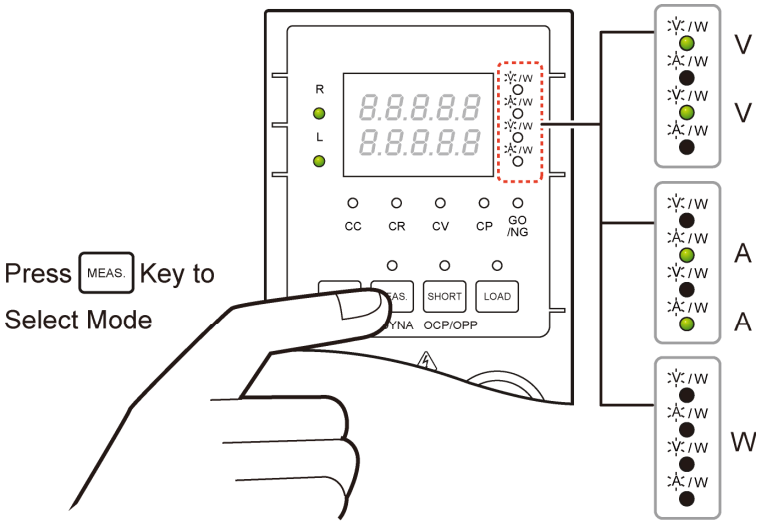


Figure 4-12 7-Segment Display for MEAS. V / A / W Switch at dual channel

4.3.4 Online Change Level

Load module provides you with two ways of online change level. They are convenient for you to change load directly with the rotary knob in LOADON. These two operation modes are described below.

Ratio Mode: In LOADON change load with the rotary knob.
When the rotary knob rotates clockwise, it means as follows.
CC mode: raise the current value.
CR mode: raise the resistance value.
CV mode: raise the voltage value.
CP mode: raise the power value.

When the rotary knob rotates counterclockwise, it means as follows.
CC mode: lower the current value.
CR mode: lower the resistance value.
CV mode: lower the voltage value.
CP mode: raise the power value.

The modulation is dependent on the rotating speed of the rotary knob.

Fixed Mode: In LOAD ON press **A/B** key (single channel/module) or **L/R** key (double channel/module) for over 2.5 seconds to enter this operation mode. Now V, I will be displayed in fixed positions in this mode. Press **A/B** /**L/R** or **STATIC/DYNA** key to shift a digit left or right. The resolution nearest to that digit will begin to change. The changed digit will be displayed glisteningly, and modulated by the rotary knob. To exit from this mode press **A/B** or **L/R** key for more than 2.5 seconds.

ⓘ NOTICE

The value of mainframe setting will not be changed if the setting is changed by the rotary knob. Therefore, when you change the value of setting with the rotary knob, the value of load module setting and that of mainframe setting will not be the same.

PART 2

Programming

5. General Information for Programming

5.1 Introduction

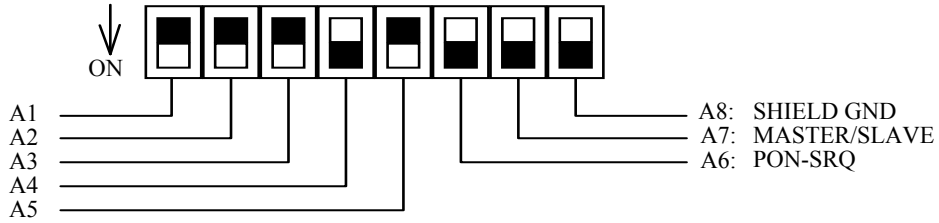
This section describes how to program the 6310A series electronic load remotely from a GPIB controller, or USB controller or RS232C. The command set introduced here can be applied to all electronic loads of 6310A series, including 63101A, 63102A, 63103A, etc. equipped with optional GPIB cards or USB cards or standard equipment, RS232C.

Either GPIB or USB or RS232C can be used at one time. They cannot be used simultaneously. If GPIB is used first in remote control, USB & RS232C will be disabled unless the machine is reset, and vice versa.

5.2 DIP Switches on the GPIB Card

5.2.1 GPIB Address

Before programming the electronic load remotely via a GPIB computer, you need to know the GPIB address. Each device connected to the GPIB interface has a unique address assigned to it. Such address allows the system controller to communicate with individual devices. Setting GPIB address of an individual mainframe, the Chroma 6312 or 6314, is done with an 8-bit DIP switch on a GPIB card at its rear panel. Five bits, from A1 to A5, are GPIB address bits, which offer addressing space from 0 to 30. For details please refer to the following illustration and table.



Address	A5	A4	A3	A2	A1	Address	A5	A4	A3	A2	A1
0	0	0	0	0	0	16	1	0	0	0	0
1	0	0	0	0	1	17	1	0	0	0	1
2	0	0	0	1	0	18	1	0	0	1	0
3	0	0	0	1	1	19	1	0	0	1	1
4	0	0	1	0	0	20	1	0	1	0	0
5	0	0	1	0	1	21	1	0	1	0	1
6	0	0	1	1	0	22	1	0	1	1	0
7	0	0	1	1	1	23	1	0	1	1	1
8	0	1	0	0	0	24	1	1	0	0	0
9	0	1	0	0	1	25	1	1	0	0	1
10	0	1	0	1	0	26	1	1	0	1	0
11	0	1	0	1	1	27	1	1	0	1	1

12	0	1	1	0	0	28	1	1	1	0	0
13	0	1	1	0	1	29	1	1	1	0	1
14	0	1	1	1	0	30	1	1	1	1	0
15	0	1	1	1	1						

Table 5-1 GPIB address

5.2.2 Other DIP Switches

The remaining bits on the DIP switch, A6-A8, preset the electronic load mainframe 6312A or 6314A to the following functions:

Bit	Meaning	Preset	Description
A6	Frame LOAD ON Link	OFF	When ON is set, two frames can act as LOAD Key ON/OFF through RS232C port.
A7		OFF	It must be “OFF”.
A8	SHIELD GND	OFF	It is the selection for enabling shield ground.

5.3 GPIB Capability of the Electronic Load

GPIB Capability	Response	Interface Functions
Talker/Listener	All electronic load functions except for setting the GPIB address are programmable over the GPIB. The electronic load can send and receive messages over the GPIB. Status information is sent using a serial poll.	AH1, SH1, T6, L4
Service Request	The electronic load will set the SRQ line true if there is an enabled service request condition.	SR1
Remote/Local	In local mode, the electronic load is controlled from the front panel but will also execute commands sent over the GPIB. The electronic load powers up in local mode and remains there until it receives a command over the GPIB. Once the electronic load is in remote mode, *REMOTE* will be shown on the front panel LCD, all front panel keys except LCL are disabled, and the load module display is in normal metering mode. Pressing LCL key on the front panel returns the electronic load to local mode. Local can be disabled using local lockout, so only the controller or the power switch	RL1

	can return the electronic load to local mode.	
Device Clear	The electronic load responds to the Device Clear (DCL) and Selected Device Clear (SDC) interface commands. These cause the electronic load to clear any activity that may prevent it from receiving and executing a new command. DCL and SDC do not change any programmed settings.	DCL, SDC

5.4 RS232C in Remote Control

When you use RS232C in remote control, you have to send the remote command of CONFigure:REMote ON first in order to let control procedure enter into remote state, and then do other command set. When control comes to an end, you have to send the command of CONFigure:REMote OFF so as to let control procedure return to the mode of local operation.

The control commands of RS232C are the same as those of GPIB. When the string comes to an end in the command sending of RS232C, <nl> must be added. Its ASCII code is 0A hexadecimal (or 10 decimal).

6. Introduction to Programming

6.1 Basic Definition

GPIB statement includes instrument control and query commands. A command statement sends an instruction to the electronic load, and a query command requests information from the electronic load.

Simple Command
The simplest command statement consists of a command or keyword usually followed by a parameter or data:

LOAD ON
or TRIG

Compound Command
When two or more keywords are connected by colons (:), it creates a compound command statement. The last keyword usually is followed by a parameter or data:

CURRent : STATic : L1 3
or CONFigure : VOLTage : RANGe H

Query Command
A simple query command consists of a keyword followed by a question mark:

MEASure : VOLTage?
MEASure : CURRent?
or CHAN?

Forms of Keywords
Every keyword has two forms:

Long-Form	The word is spelled out completely to identify its function. For instance, CURRENT, VOLTAGE, and MEASURE are long-form keywords.
Short-Form	The word contains only the first three or four letters of the long-form. For instance, CURR, VOLT, and MEAS are short-form keywords.

In keyword definitions and diagrams, the short-form part of each keyword is emphasized in UPPER-CASE letters to help you remember it. However, the electronic load will accept Volt, volt, voltage, VOLTAGE, volTAGE, etc. without regard to which form you apply. If the keyword is incomplete, for example, “VOL” or “curre”, it will not be recognized.

6.2 Numerical Data Formats

The Chroma 6310A electronic load accepts the numerical data type listed in Table 6-1. Numeric data may be followed by a suffix that dimensions the data. A suffix may be preceded

by a multiplier. The Chroma 6310A makes use of the suffixes listed in Table 6-2 and multipliers listed in Table 6-3.

Symbol	Description	Example
NR1	Digits with no decimal point. The decimal point is assumed to be to the right of the least-significant digit.	123, 0123
NR2	Digits with a decimal point.	123., 12.3, 0.123, .123
NR3	Digit with a decimal point and an exponent.	1.23E+3, 1.23E-3
NRf	Flexible decimal form that includes NR1 or NR2 or NR3.	123, 12.3, 1.23E+3
NRf+	Expanded decimal form that includes NRf and MIN, MAX. MIN and MAX are the minimum and maximum limit values for the parameter.	123, 12.3, 1.23E+3, MIN, MAX

Table 6-1 Numerical Data Type

Mode	Class	Preferred Suffix	Secondary Suffix	Referenced Unit
CC	Current	A		Ampere
CR	Resistance	OHM		Ohm
CV	Amplitude	V		Volt
All	Time	S		Second
			MS	Millisecond
All	Slew Rate	A/μS		Amperes/micro Second

Table 6-2 Suffix Elements

Multiplier	Mnemonic	Definition
1E6	MA	mega
1E3	K	kilo
1E-3	M	milli
1E-6	U	micro
1E-9	N	nano

Table 6-3 Suffix Multipliers

6.3 Character Data Formats

For command statements, the <NRf+> data format permits entry of required characters. For query statements, character strings may be returned in either of the forms shown in the following table. It depends on the length of the returned string.

Symbol	Character Form
crd	Character Response Data. They permit the return up to 12 characters.
aard	Arbitrary ASCII Response Data. They permit the return of undelimited 7-bit ASCII. This data type is an implied message terminator (refer to “Separators and Terminators”).

6.4 Separators and Terminators

In addition to keywords and parameters, GPIB program statements require the following:

Data Separators:
Data must be separated from the previous command keyword by a space. This is shown in examples as a space (CURR 3) and on diagrams by the letters *SP* inside a circle.

Keyword Separators:
Keywords (or headers) are separated by a colon (:), a semicolon (;), or both. For example:

- **LOAD:SHOR ON**
- **MEAS:CURR?;VOLT?**
- **CURR:STAT:L1 3;:VOLT:L1 5**

Program Line Separators:
A terminator informs GPIB that it has reached the end of a statement. Normally, this is sent automatically by your GPIB programming statements. The termination also occurs with other terminator codes, such as EOI. In this manual, the terminator is assumed at the end of each example line of code. If it needs to be indicated, it is shown by the symbol <nl>, which stands for "new line" and represents the ASCII coded byte 0A hexadecimal (or 10 decimal).

Traversing the Command Tree:

- The colon ":" separates keywords from each other which represent changes in branch level to the next lower one. For example:
  CONF:VOLT:ON 5
  CONF is a root-level command, *VOLT* is the first branch, and *ON* is the second branch.
  Each ":" moves down command interpretation to the next branch.

- The semicolon ";" allows you to combine command statements into one line. It returns the command interpretation to the previous colon.
  For example: Combine the following two command statements:
  RES:RISE 100 <nl> and
  RES:L1 400 <nl>
  Which can be formed into one command line as follows:
  RES:RISE 100;L1 400 <nl>

- To return to the root-level form you can
  1. Enter a new-line character. This is symbolized by "<nl>" and can be linefeed "LF" or/and end-of-line "EOL". Or else,
  2. Enter a semicolon followed by a colon ";:".

  Please refer to the following.

1. (root):VOLT:L1: 30<nl>
   Starting a New Line returns to the Root.

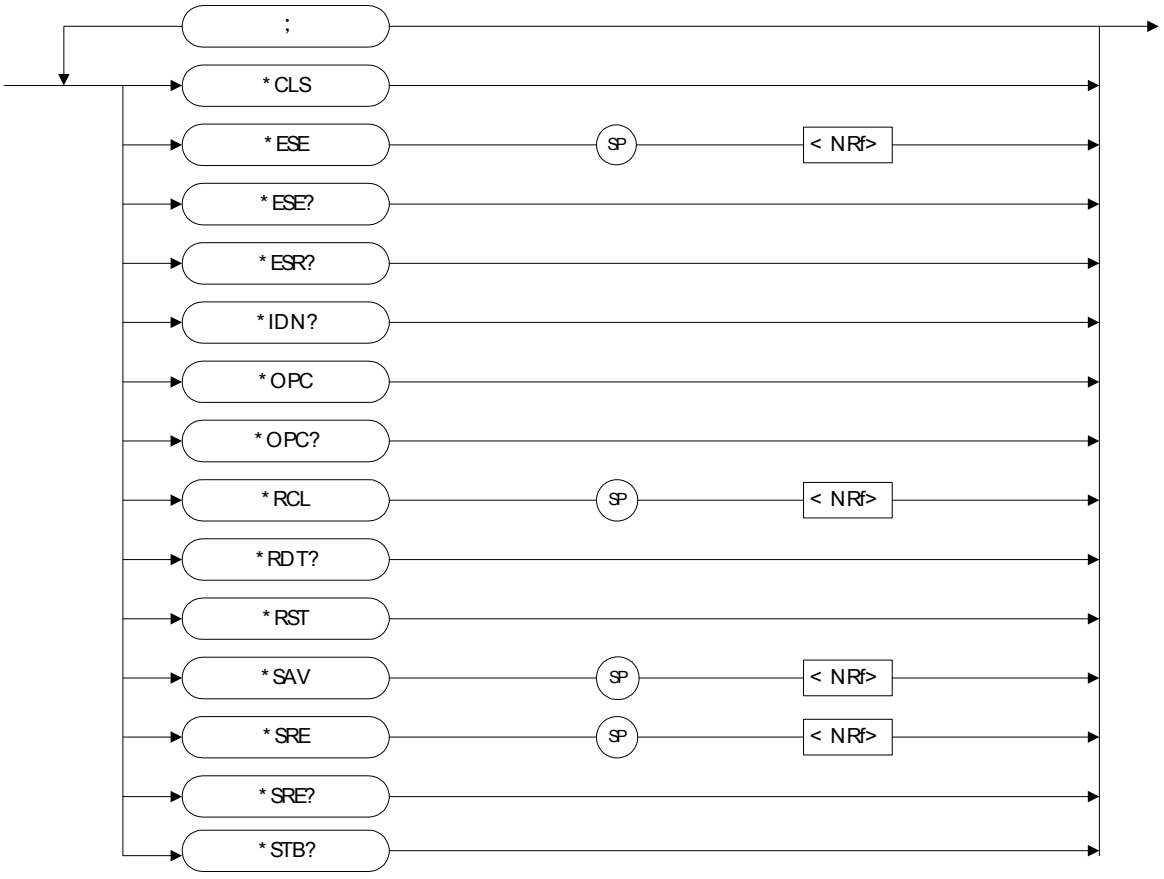
2. (root):SPEC:VOLT:H 30;
   :L 5;:
   (root):RES:L1 400;
   :RISE 1000;:

7. Language Dictionary

Commands for operating the 6310A Electronic Load remotely are grouped into subsystems. Each command belonging to the same subsystem is arranged in alphabetic order. A syntax chart of the subsystem, which includes the commands belonging to the same group, is given. Sub-systems are then ordered alphabetically according to their names in the following sections.

7.1 Common Commands

Common commands defined by the IEEE488.2 standard are generic commands and queries. The first part of the language dictionary covers these commands. Each of them has a leading "*".



CLS** ***Clear Status Command

Type : Device Status

Description : The *CLS command executes the following actions:

1. Clear these registers
   - <1> Channel Status Event registers for all channels
   - <2> Channel Summary Event register
   - <3> Questionable Status Event register

<4> Standard Event Status Event register
<5> Operation Status Event register

2. Clear the Error Queue
3. If "Clear Status Command" immediately follows a program message terminator (<nl>), the "Output Queue" and the MAV bit are also cleared.

Syntax : *CLS
Parameters : nil

****ESE Standard Event Status Enable Command/Query***

Type : Device Status
Description : This command sets the condition of the Standard Event Status Enable register, which determines which events of the Standard Event Status Event register (see *ESR?) are allowed to set the ESB (Event Summary Bit) of the Status Byte register. A "1" in the bit position enables the corresponding event. All of the enable events of the Standard Event Status Event register are logically ORed to cause the ESB (bit 5) of the Status Byte register to be set. See description of all three registers in *Chapter 8 Status Reporting*.
Syntax : *ESE <NRf>
Parameters : 0 to 255
Example : *ESE 48 This command enables the CME and EXE events of the Standard Event Status Event register.
Query Syntax : *ESE?
Return Parameters : <NR1>
Query Example : *ESE? This query returns current setting of "Standard Event Status Enable".

****ESR? Standard Event Status Register Query***

Type : Device Status
Description : This query reads the Standard Event Status register. Reading the register clears it. See detailed explanation of this register in *Chapter 8 Status Reporting*.

Standard Event Status Event register

Bit Position	7	6	5	4	3	2	1	0
Condition	0	0	CME	EXE	DDE	QYE	0	0
Bit Weight	128	64	32	16	8	4	2	1

Query Syntax : *ESR?
Return Parameters : <NR1>
Query Example : *ESR? Return the status readings of Standard Event Status register.
Return Example : 48

****IDN? Identification Query***

Type : System Interface
Description : This query requests the Electronic Frame (6314A) to identify itself.
Query Syntax : *IDN?
Return Parameters : <aard>
Query Example : *IDN?

String	Information
CHROMA	Manufacture
6314	Model
0	Always return zero
01.00	Revision level of the primary interference firmware
0	Customer's version

Return Example : CHROMA 6314A,0,01.00,0

OPC Operation Complete Command

Type : Device Status
Description : This command causes the interface to set the OPC bit (bit 0) of the Standard Event Status register when the Electronic Frame (6314) has completed all pending operations.
Syntax : *OPC
Parameters : nil

OPC? Operation Complete Query

Type : Device Status
Description : This query returns an ASCII "1" when all pending operations are completed.
Query Syntax : *OPC?
Return Parameters : <NR1>
Query Example : 1

RCL Recall Instrument State Command

Type : Device Status
Description : This command restores the electronic load to a state that was previously stored in memory with the *SAV command to the specified location (see *SAV).
Syntax : *RCL <NRf>
Parameters : 1 to 101
Example : *RCL 50

RDT? Resource Description Transfer Query

Type : System Interface
Description : This command returns the types of Electronic Frame (6314). If channel does not exist, it returns 0. If channel exists, it returns the types like 63103, 63102, 63107R, 63107L...
Query Syntax : *RDT?
Return Parameters : <aard>
Query Example : 63107L, 63107R, 63103, 0, 63102, 63102, 0, 0.

RST Reset Command

Type : Device State
Description : This command forces an ABORt, *CLS, LOAD=PROT=CLE command.
Syntax : *RST
Parameters : nil

SAV Save Command

Type : Device Status
Description : This command stores the present state of the single electronic load and the states of all channels of the multiple loads in a specified location in memory.
Syntax : *SAV <NRf>
Parameters : 1 to 100
Example : *SAV 50

SRE Service Request Enable Command/Query

Type : Device Status
Description : This command sets the condition of the Service Request Enable register, which determines which events of the Status Byte register (see *STB) are allowed to set the MSS(Master Status Summary) bit. A "1" in the bit position enable bits are logically ORed to cause Bit 6(the Master Summary Status Bit) of the Status Byte register to be set. See details concerning the Status Byte register in *Chapter 8 Status Reporting*.
Syntax : *SRE <NRf>
Parameters : 0 to 255
Example : *SRE 20 Enable the CSUM and MAV bit of the Service Request Enable.
Query Syntax : *SRE?
Return Parameters : <NR1>
Query Example : *SRE? Return the setting for "Service Request Enable".

STB? Read Status Byte Query

Type : Device Status
Description : This query reads the Status Byte register. Note that the MSS (Master Summary Status) bit instead of RQS bit is returned in Bit 6. This bit indicates if the electronic load has at least one reason for requesting service. *STB? does not clear the Status Byte register, which is cleared only when subsequent action has cleared all its set bits. Refer to *Chapter 8 Status Reporting* for more information about this register.

Status Byte Register

Bit Position	7	6	5	4	3	2	1	0

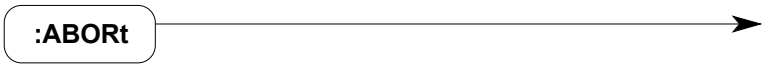
Condition	0	MSS	ESB	MAV	QUES	CSUM	0	0
Bit Weight	128	64	32	16	8	4	2	1

Query Syntax : *STB?
Return Parameters : <NR1>
Query Example : *STB? Return the contents of "Status Byte".
Return Example : 20

7.2 Specific Commands

The 6310 series products are equipped with the following specific GPIB commands.

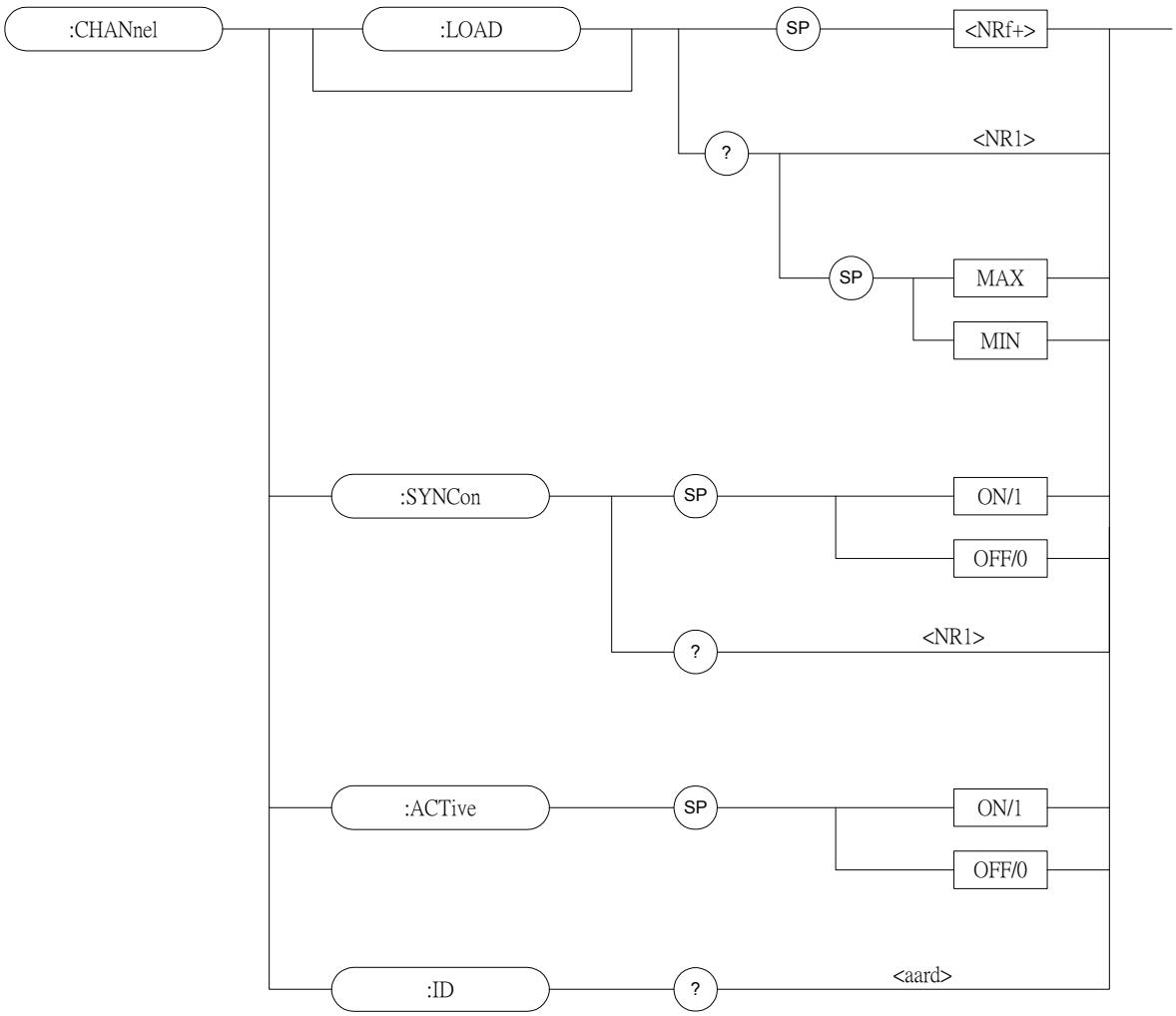
7.2.1 ABORT Subsystem



ABORt

Type : All Channels
Description : Set all electronic loads as "OFF".
Syntax : ABORt

7.2.2 CHANNEL Subsystem



CHANnel:[LOAD]

Type	: Channel Specific	
Description	: Select a specific channel by which the coming channel-specific command will be received and executed.	
Syntax	: CHANnel <NRf+>	
Parameters	: 1 ~ 8	
Example	: CHAN 1	Set specific channel as "1".
	CHAN MAX	Set specific channel as "8".
	CHAN MIN	Set specific channel as "1".
Query Syntax	: CHAN?	
	CHAN? MAX	
	CHAN? MIN	
Return Parameters	: <NR1>	
Query Example	: CHAN?	Return current specific channel.
Return Example	: 1	

CHANnel:ACTive

Type : Channel Specific
Description : Enable or disable the load module.
Syntax : CHANnel:ACTive ON. Enable the load module. The front panel displays the measurement of voltage and current.
CHANnel:ACTive OFF. Disable the load module. LCD on the front panel displays OFF.
Parameter : ON/1, OFF/0
Example : CHAN : ACT ON

CHANnel:SYNCon

Type : Channel Specific
Description : Set the load module to receive synchronized command action of RUN ABORT or not.
Syntax : CHANnel:SYNCon ON
CHANnel:SYNCon OFF
Parameters : ON/1, OFF/0
Example : CHAN:SYNC ON. Set the load module to receive synchronized command action.
CHAN:SYNC OFF. Set the load module not to receive synchronized command action.
Query Syntax : CHAN:SYNC?
Return Parameters : <NR1>
Query Example : CHAN:SYNC? Return to the load module and makes it receive synchronized command status.
Return Example : 0 The load module does not receive synchronized command status.
: 1 The load module receives synchronized command status.

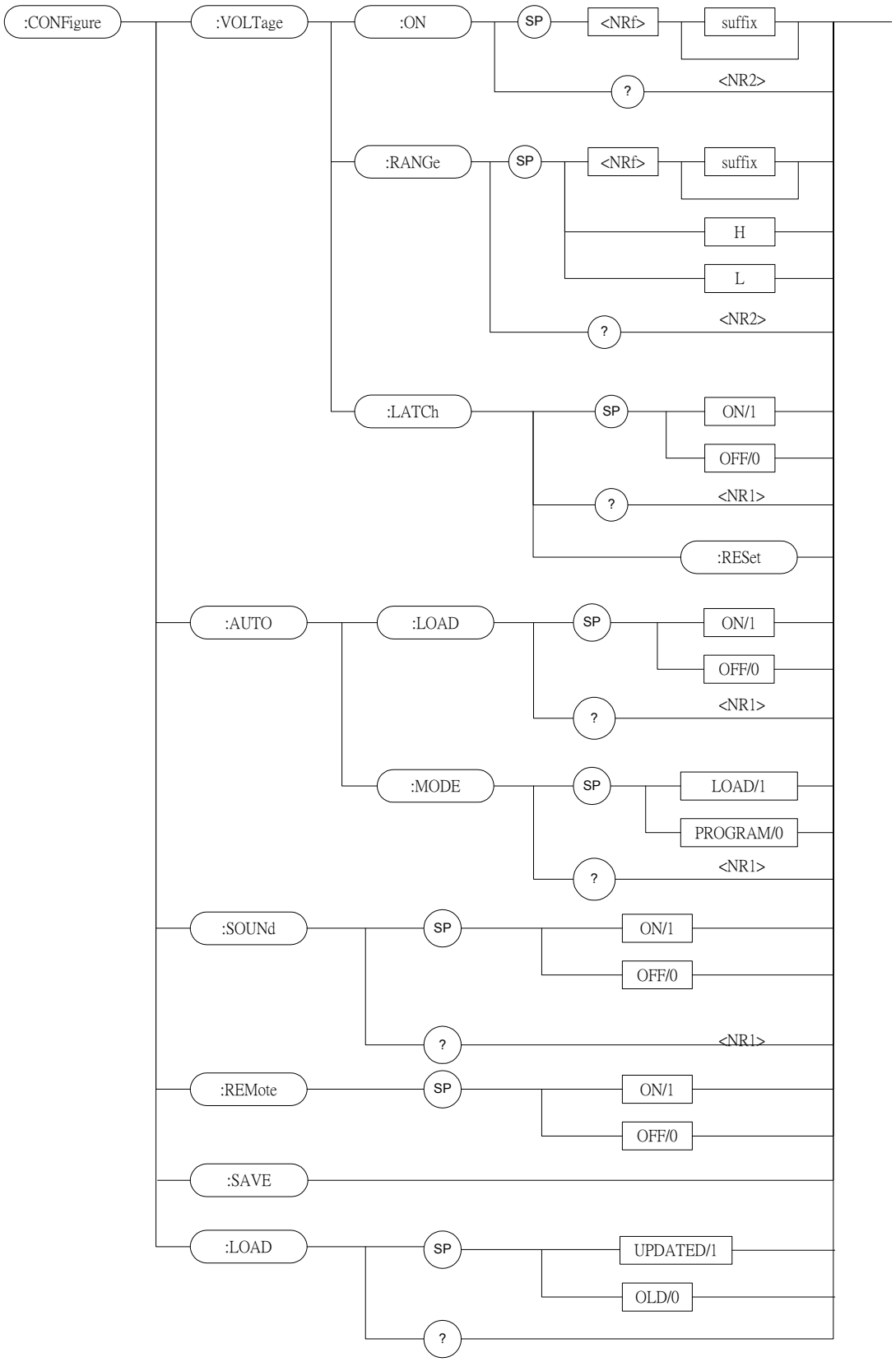
CHAN:ID?

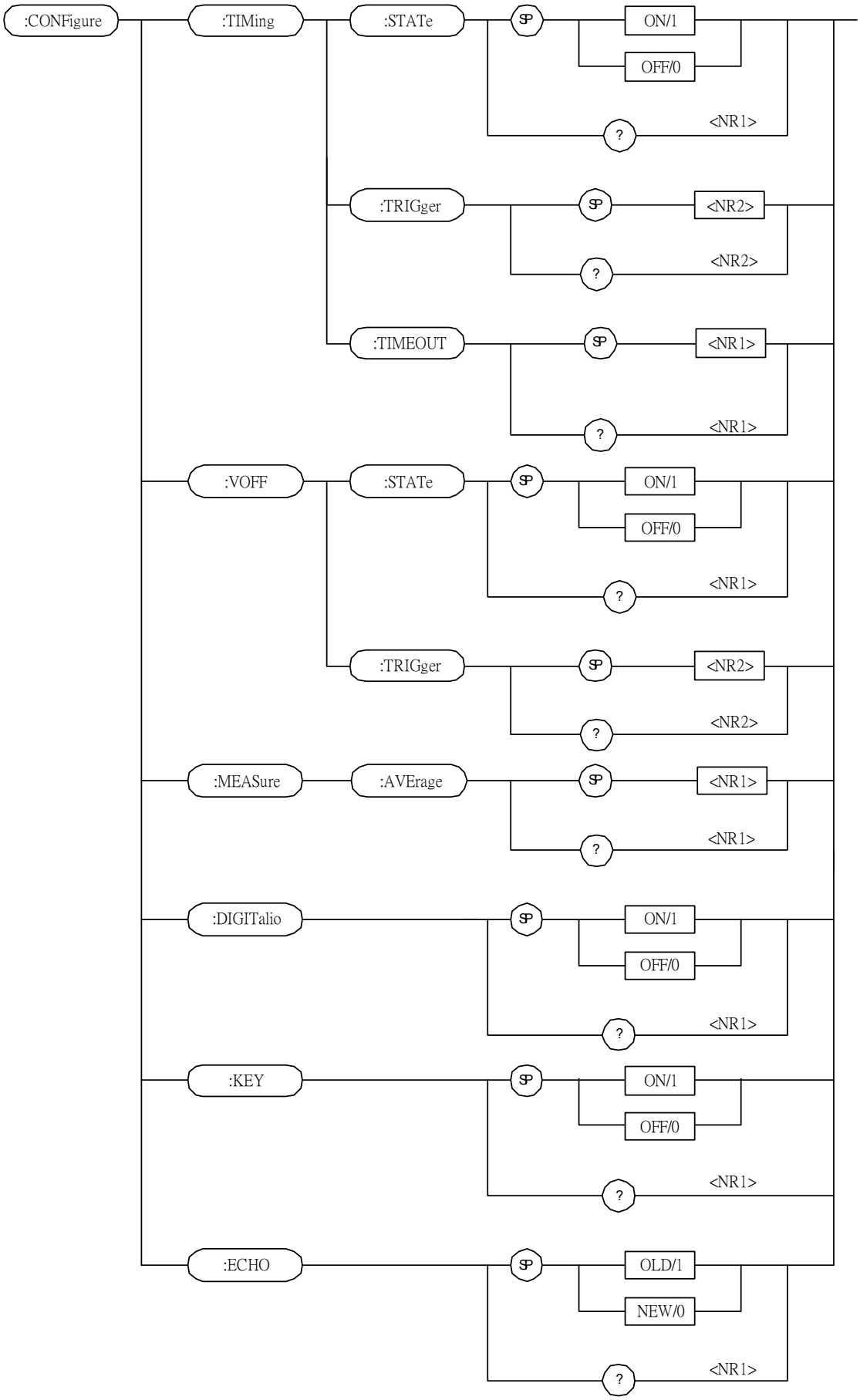
Type : Channel-Specific
Description : This query requests the module to identify itself.
Query Syntax : ID?
Return Parameters : <aard>
Query Example : ID?

String	Information
CHROMA	Manufacturer
6310XA	Model
0	Always return zero
xx.xx	Revision of the primary interface firmware
0	Customer's Version

Return Example : CHROMA,63102A,0,01.00,0

7.2.3 CONFIGURE Subsystem





CONFigure:VOLTage:ON

Type	: Channel-Specific
Description	: Set voltage of sink current on.
Syntax	: CONFigure:VOLTage:ON <NRf> [suffix]
Parameters	: For valid voltage range refer to respective specification.
Example	: CONF:VOLT:ON 1 Set Von=1V.
	CONF:VOLT:ON 300mV Set Von=300mV.
Query Syntax	: CONFigure:VOLTage:ON?
Return Parameters	: <NR2> [Unit=Voltage]
Query Example	: CONF:VOLT:ON? Return the setting Von value.
Return Example	: 3.5

CONFigure:VOLTage:RANGe

Type	: Channel-Specific
Description	: Set voltage measurement range in CC mode.
Syntax	: CONFigure:VOLTage:RANGEe <NRf> [suffix]
Parameters	: Value ranges depend on Load Module. For details refer to specification.
Example	: CONF:VOLT:RANG 16 Set full-range as Low, for example, in 63103A.
	CONF:VOLT:RANG 80V Set full-range as High, for example, in 63103A.
	CONF:VOLT:RANG H Set full-range as High.
	CONF:VOLT:RANG L Set full-range as Low.
Query Syntax	: CONFigure:VOLTage:RANGe?
Return Parameters	: <NR2> [Unit = Voltage]
Query Example	: CONF:VOLT:RANG? Return Voltage range.
Return Example	: 16

CONFigure:VOLTage:LATCh

Type	: Channel-Specific
Description	: Set the action type of Von.
Syntax	: CONFigure:VOLTage:LATCh ON
	CONFigure:VOLTage:LATCh OFF
Parameters	: ON/1, OFF/0
Example	: CONF:VOLT:LATC ON Set the action type of Von as Latch.
	CONF:VOLT:LATC OFF Set the action type of Von as Non Latch (For detailed action refer to the user's manual).
Query Syntax	: CONFigure:VOLTage:LATCh?
Return Parameters	: <NR1>
Query Example	: CONF:VOLT:LATC?
Return Example	: 0 (non latch), 1 (latch) Return the action type of Von.

CONFigure:VOLTage:LATCh:RESet

Type : channel-specific
Description : Reset Von signal
Syntax : CONFigure:VOLTage:LATCh:RESet
Example : CONF:VOLT:LATC:RES Reset the Von signal

CONFigure:AUTO:LOAD

Type : All Channels
Description : Set if the load module will do Auto Load On during power-on.
Syntax : CONFigure:AUTO:LOAD ON
CONFigure:AUTO:LOAD OFF
Parameters : ON/1, OFF/0
Example : CONF:AUTO:LOAD ON Start Auto Load On during power-on.
CONF:AUTO:LOAD OFF Close Auto Load On during power-on.
Query Syntax : CONFigure:AUTO:LOAD?
Return Parameters : <NR1>
Query Example : CONF:AUTO:LOAD?
Return Example : 0 or 1 Return the status of Auto Load On

CONFigure:AUTO:MODE

Type : All Channels
Description : Set the Auto Load On to LOAD ON or PROGRAM z.
Syntax : CONFigure:AUTO:MODE LOAD
CONFigure:AUTO:MODE PROGRAM
Parameters : LOAD/1, PROGRAM/0
Example : CONF:AUTO:MODE LOAD Set Auto Load On as general LOAD ON.
CONF:AUTO:MODE PROGRAM Set Auto Load On as PROGRAM RUN.
Query Syntax : CONFigure:AUTO:MODE?
Return Parameters : <NR1>
Query Example : CONF:AUTO:MODE? Return the execution
Return Example : 0 or 1 type of Auto Load On.

CONFigure:SOUND

Type : Channel-Specific
Description : Set the buffer sound of load module to ON or OFF.
Syntax : CONFigure:SOUND ON
CONFigure:SOUND OFF
Parameters : ON/1, OFF/0
Example : CONF:SOUND ON
CONF:SOUND OFF
Query Syntax : CONFigure:SOUND?
Return Parameters : <NR1>
Query Example : CONF:SOUND? Return the control status of the load module's buzzer sound.

Return Example : 0 or 1

CONFigure:REMote

Type : All Channels
Description : Set the status of remote control (only effective in RS232C).
Syntax : CONFigure:REMote ON
CONFigure:REMote OFF
Parameters : ON/1, OFF/0
Example : CONF:REM ON Set to remote control.

CONFigure:SAVE

Type : All Channels
Description : Store the data of CONFigure into EEPROM.
Syntax : CONFigure:SAVE
Parameters : none
Example : CONF:SAVE

CONFigure:LOAD

Type : All Channels
Description : The value at the setting of load module as LOADON is the one changed by the rotary knob (UPDATED/1) or the original set value (OLD/0).
Syntax : CONFigure:LOAD UPDATED
CONFigure:LOAD OLD
Parameters : UPDATED/1, OLD/0
Example : CONF:LOAD UPDATED Set the value of LOADON as that changed by the rotary knob.
CONF:LOAD OLD Set the value of LOADON as the original set value.
Query Syntax : CONFigure:LOAD?
Return Parameters : <NR1>
Query Example : CONF:LOAD?
Return Example : 1 (UPDATED) or 0 (OLD)

CONFigure:TIMinge:STATe

Type : Channel-Specific
Description : Set timing function ON or OFF
Syntax : CONFigure:TIMing <NRf>
Parameters : ON/1, OFF/0.
Example : CONFigure:TIMing ON Set the timing function to ON.
Query Syntax : CONFigure:TIMing?
Return Parameters : <NR2>
Query Example : CONFigure:TIMing? Return the timing function setting to be ON or OFF.
Return Example : 1

CONFigure:TIMinge:TRIG

Type	: Channel-Specific	
Description	: Set the voltage for Timing function at time out.	
Syntax	: CONFigure:TIMing :TRIG <NRf>	
Parameters	: .	
Example	: CONFigure:TIMing:TRIG 3	Set the voltage to 3V at timeout.
Query Syntax	: CONFigure:TIMing:TRIG?	
Return Parameters	: <NR2>[Unit=Voltage]	
Query Example	: CONFigure:TIMing:TRIG?	Return the voltage set at timeout.
Return Example	: 3	

CONFigure:TIMinge:TIMEOUT

Type	: Channel-Specific	
Description	: Set timeout for Timing function	
Syntax	: CONFigure:TIMing :TIMEOUT <NRf>	
Parameters	: Value ranges depend on Load Module. For details refer to specification.	
Example	: CONFigure:TIMing : TIMEOUT 1000	Set the timeout.
Query Syntax	: CONFigure:TIMing: TIMEOUT?	
Return Parameters	: <NR2>[Unit=ms]	
Query Example	: CONFigure:TIMing:TRIG?	Return the timeout set.
Return Example	: 1000	

CONFigure:VOFF:STATe

Type	: Channel-Specific	
Description	: Set VOFF function ON or OFF	
Syntax	: CONFigure:VOFF :STATe <NR1>	
Parameters	: ON/1, OFF/0	
Example	: CONFigure:VOFF:STATe ON	Set VOFF function to ON.
Query Syntax	: CONFigure:VOFF:STATe?	
Return Parameters	: <NR1>	
Query Example	: CONFigure:VOFF:STATe?	Return the VOFFunction setting to be ON or OFF.
Return Example	: 1	

CONFigure:VOFF:FINALVOLTage

Type	: Channel-Specific	
Description	: Set the final loading voltage.	
Syntax	: CONFigure:VOFF:FINALVOLTage <NRf>	
Parameters	: Value ranges depend on Load Module. For details refer to specification.	
Example	: CONFigure:VOFF:FINALVOLTage 1.8	Set the final loading voltage to 1.8V
Query Syntax	: CONFigure:VOFF:FINALVOLTage?	
Return Parameters	: <NR2>[Unit=Voltage]	
Query Example	: CONFigure:VOFF:FINALVOLTage	Return the final loading voltage set.

Return Example : 1.8

CONFigure:MEASure:AVErage

Type : Channel-Specific
Description : Set the average number of times for measurement.
Syntax : CONFigure:MEASure:AVErage <NR1>
Parameters : 1~64
Example : CONFigure:MEASure:AVErage 24 Set the average to 24 times for measurement.
Query Syntax : CONFigure:MEASure:AVErage?
Return Parameters : <NR1>
Query Example : CONFigure:TIMing:AVE? Return the average times set.
Return Example : 24

CONFigure:DIGITalio

Type : All Channels
Description : Set the Digital IO to ON or OFF
Syntax : CONFigure:DIGITalio <NR1>
Parameters : ON/1, OFF/0
Example : CONFigure:DIGITalio ON Set the Digital IO to ON.
Query Syntax : CONFigure:DIGITalio?
Return Parameters : <NR1>
Query Example : CONFigure:VOFF:STATe? Return the Digital IO setting to be ON or OFF
Return Example : 1

CONFigure:KEY

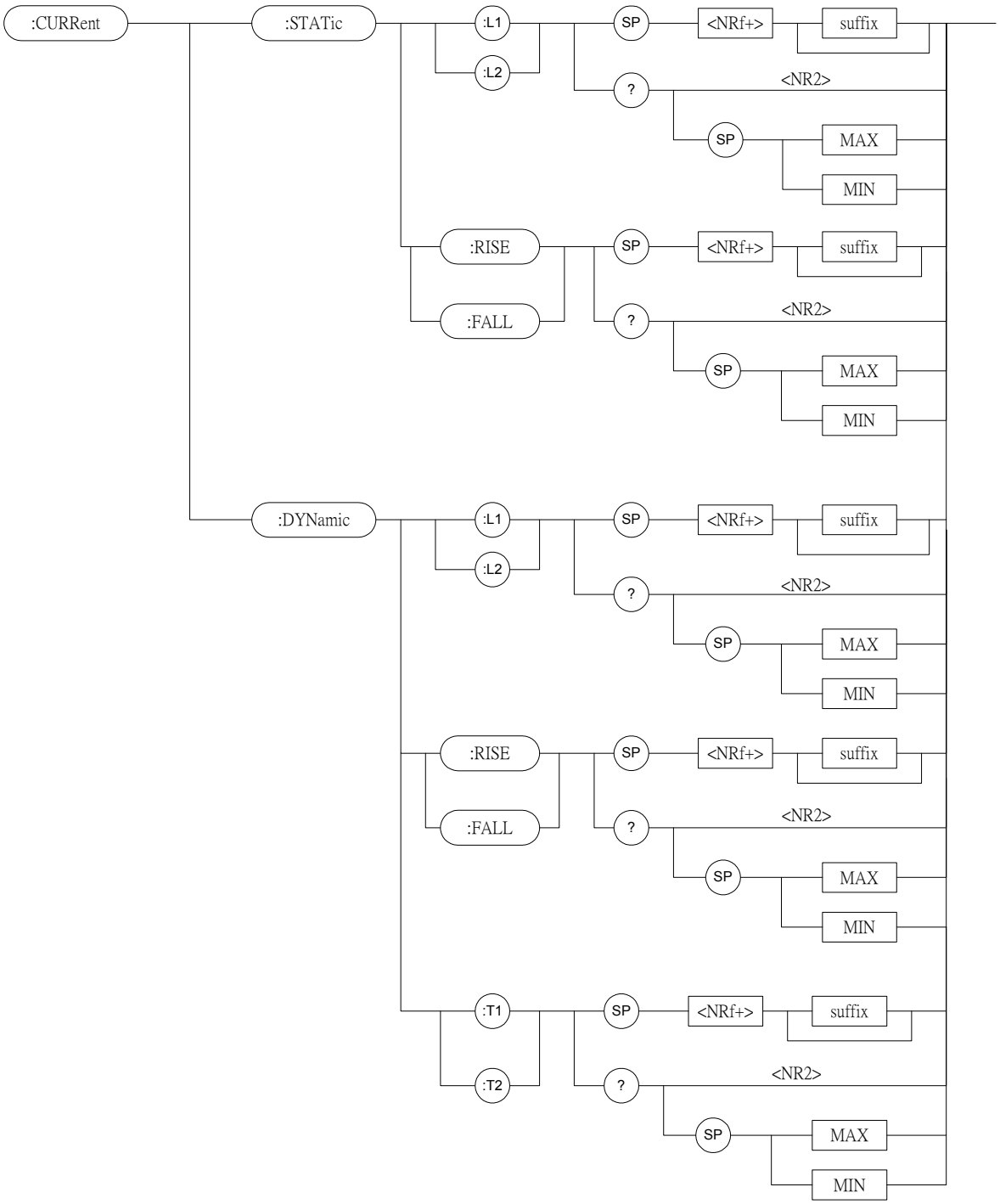
Type : Channel-Specific
Description : Set if change the MEAS key on the Module to Static/Dynamic.
Syntax : CONFigure:KEY <NR1>
Parameters : ON/1, OFF/0
Example : CONFigure:KEY ON Change the function of MEAS key to Static/Dynamic.
Query Syntax : CONFigure:KEY?
Return Parameters : <NR1>
Query Example : CONFigure:VOFF:STATe? Return the key setting.
Return Example : 1

CONFigure:ECHO

Type : All Channels
Description : Set to reply new or old Model Name when querying the device's model name.
Syntax : CONFigure:ECHO <NR1>
Parameters : OLD/1, NEW/0
Example : CONFigure:ECHO NEW Set to reply the new Model Name.
Query Syntax : CONFigure:ECHO?
Return Parameters : <NR1>

Query Example	: CONFigure:ECHO?	Return the ECHO setting to be NEW or OLD.
Return Example	: 0	

7.2.4 CURRENT Subsystem



CURRent:STATic:L1/L2

Type : Channel-Specific
Description : Set the Static Load Current of constant current mode.
Syntax : CURRent:STATic:L1 <NRf+>[suffix]
CURRent:STATic:L2 <NRf+>[suffix]
Parameters : For valid value range refer to respective specification.
Example : CURR:STAT:L1 20 Set Constant Current = 20A for Static Load L1.

	CURR:STAT:L2 10	Set Constant Current = 10A for Static Load L2.
	CURR:STAT:L1 MAX	Set Constant Current = maximum value for Static Load L1.
	CURR:STAT:L2 MIN	Set Constant Current = minimum value for Static Load L2.
Query Syntax	: CURRent:STATic:L1?	
	CURRent:STATic:L2?	
	CURRent:STATic:L1? MAX	
	CURRent:STATic:L2? MIN	
Return Parameters	: <NR2> [Unit=Ampere]	
Query Example	: CURR:STAT:L1?	Return set current value of the Static Load L1.
Return Example	: 3.12	

CURRent:STATic:RISE/FALL

Type	: Channel-Specific	
Description	: Set current slew rate of constant current static mode.	
Syntax	: CURRent:STATic:RISE <NRf+> [suffix]	
	CURRent:STATic:FALL <NRf+> [suffix]	
Parameters	: For valid value range refer to respective specification.	
Example	: CURR:STAT:RISE 2.5	Set rise slew rate as 2.5A/μS of static load.
	CURR:STAT:FALL 1A/μS	Set fall slew rate as 1A/μS of static load.
Query Syntax	: CURRent:STATic:RISE?	
	CURRent:STATic:FALL?	
	CURRent:STATic:RISE? MAX	
	CURRent:STATic:FALL? MIN	
Return Parameters	: <NR2> [Unit=A/μS]	
Query Example	: CURR:STAT:RISE?	Return rise slew rate of static load.
Return Example	: 2.5	

CURRent:DYNamic:L1/L2

Type	: Channel-Specific	
Description	: Set the Dynamic Load Current during constant current mode.	
Syntax	: CURRent:DYNamic:L1 <NRf+>[suffix]	
	CURRent:DYNamic:L2 <NRf+>[suffix]	
Parameters	: For valid value range refer to respective specification.	
Example	: CURR:DYN:L1 20	Set dynamic load parameter L1 = 20A.
	CURR:DYN:L2 10	Set dynamic load parameter L2 = 10A.
	CURR:DYN:L1 MAX	Set dynamic load parameter L1 = maximum value.
	CURR:DYN:L2 MIN	Set dynamic load parameter L2 = minimum value.
Query Syntax	: CURRent:DYNamic:L1?	

CURRent:DYNamic:L2?
CURRent:DYNamic:L1? MAX
CURRent:DYNamic:L2? MIN

Return Parameters : <NR2> [Unit=Ampere]

Query Example : CURR:DYN:L1? Return setting current in dynamic load L1.

Return Example : 35.6

CURRent:DYNamic:RISE/FALL

Type : Channel-Specific

Description : Set the current slew rate of constant current dynamic mode.

Syntax : CURRent:DYNamic:RISE <NRf+> [suffix]
CURRent:DYNamic:FALL <NRf+> [suffix]

Parameters : For valid value range refer to respective specification.

Example : CURR:DYN:RISE 2.5 Set rise slew rate as 2.5A/μS.
CURR:DYN:FALL 1A/μS Set fall slew rate as 1A/μS.
CURR:DYN:RISE MAX Set rise slew rate as maximum value of dynamic load.
CURR:DYN:FALL MIN Set fall slew rate as minimum value of dynamic load.

Query Syntax : CURRent:DYNamic:RISE?
CURRent:DYNamic:FALL?
CURRent:DYNamic:RISE? MAX
CURRent:DYNamic:FALL? MIN

Return Parameters : <NR2> [Unit=A/μS]

Query Example : CURR:DYN:RISE? Return rise slew rate of dynamic load.

Return Example : 2.5

CURRent:DYNamic:T1/T2

Type : Channel-Specific

Description : Set the duration parameter T1 or T2 of dynamic load.

Syntax : CURRent:DYNamic:T1 <NRf+> [suffix]
CURRent:DYNamic:T2 <NRf+> [suffix]

Parameters : For valid value range refer to respective specification.

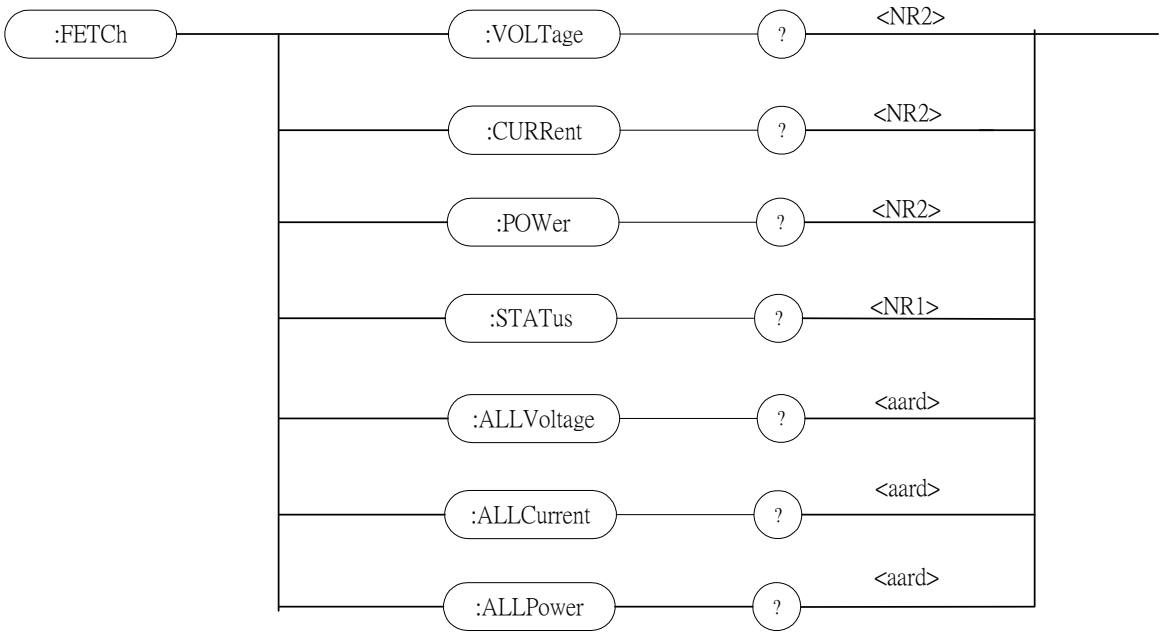
Example : CURR:DYN:T1 10mS Set dynamic duration T1 = 10mS.
CURR:DYN:T2 2S Set dynamic duration T2 = 2S.
CURR:DYN:T1 MAX Set dynamic duration T1 as maximum value.
CURR:DYN:T2 MIN Set dynamic duration T2 as minimum value.

Query Syntax : CURRent:DYNamic:T1?
CURRent:DYNamic:T2?
CURRent:DYNamic:T1? MAX
CURRent:DYNamic:T2? MIN

Return Parameters : <NR2> [Unit=Sec]

Query Example	: CURR:DYN:T1?	Return the dynamic duration parameter T1.
Return Example	: 0.15	

7.2.5 FETCH Subsystem



FETCh:VOLTage?

Type	: Channel-Specific
Description	: Return the real time voltage measured at the input of the load module.
Query Syntax	: FETCh:VOLTage?
Return Parameters	: <NR2> [Unit=Voltage]
Query Example	: FETC:VOLT?
Return Example	: 8.12

FETCh:CURRent?

Type	: Channel-Specific
Description	: Return the real time current measured at the input of the load module.
Query Syntax	: FETCh:CURRent?
Return Parameters	: <NR2> [Unit=Ampere]
Query Example	: FETC:CURR?
Return Example	: 3.15

FETCh:POWer?

Type	: Channel-Specific
Description	: Return the real time power measured at the input of the load module.
Query Syntax	: FETCh:POWer?
Return Parameters	: <NR2> [Unit=Watt]
Query Example	: FETC:POW?
Return Example	: 5.28

FETCh:STATus?

Type : Channel-Specific
Description : Return the real time status of the load module.
Query Syntax : FETCh:STATus?
Return Parameters : <NR1>

FETCh:ALLVoltage?

Type : Channel-Independent
Description : Return the real time voltage measured at the input of the all load module.
Query Syntax : FETCh:ALLVoltage?
Return Parameters : <aard> [Unit=Voltage]
Query Example : FETC:ALLV?
Return Example : 1.2, 2, 0, 0, 10.2, 0, 0, 0

FETCh:ALLCurrent?

Type : Channel-Independent
Description : Return the real time current measured at the input of the all load module.
Query Syntax : FETCh:ALLCurrent?
Return Parameters : <aard> [Unit=Ampere]
Query Example : FETC:ALLC?
Return Example : 0, 0, 0, 0, 5.12, 0, 12, 0

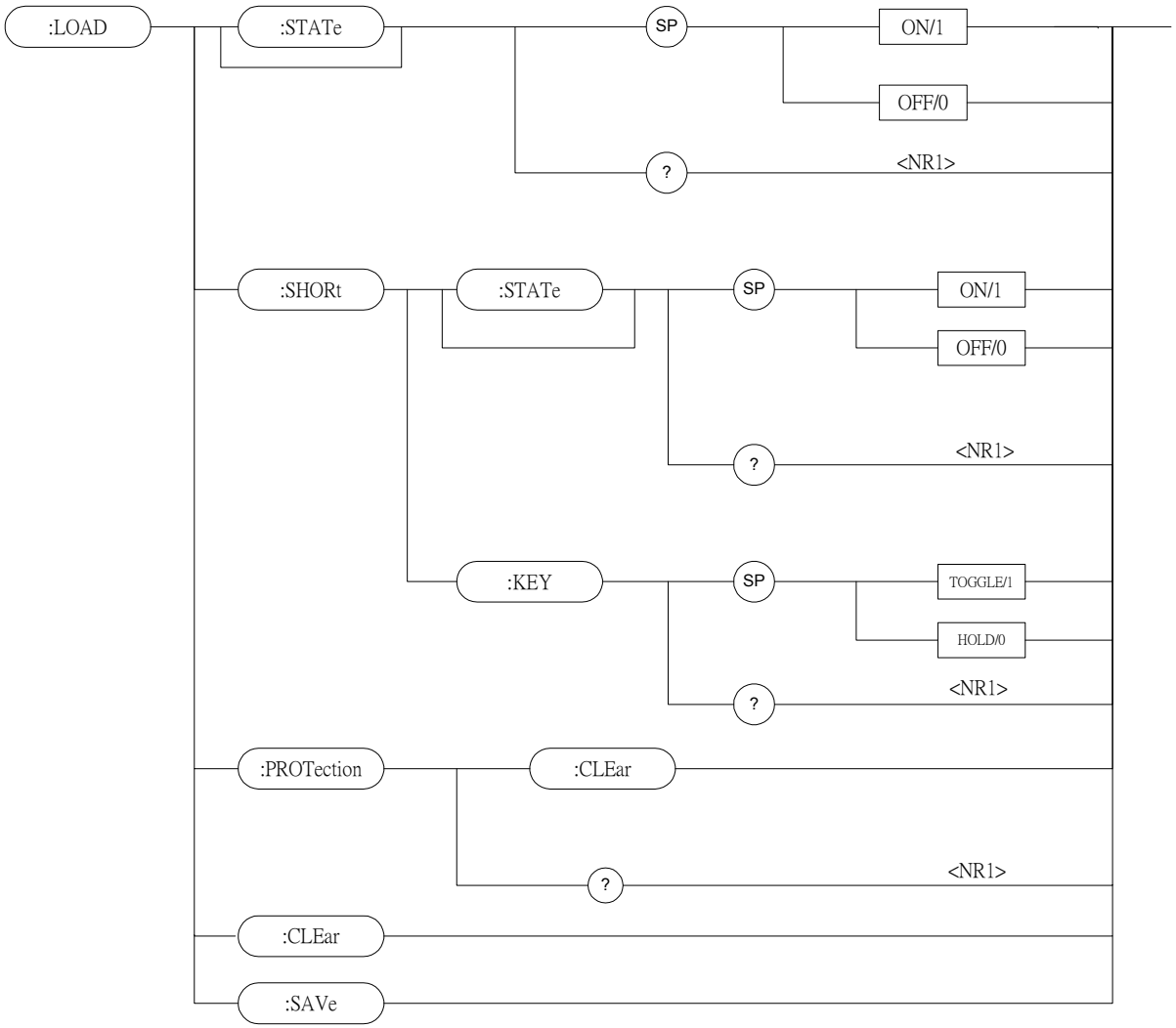
Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition												OT	RV	OP	OV	OC
Bit Weight												16	8	4	2	1

Query Example : FETC:STAT? Read back the present status of load module.
Return Example : 4

FETCh:ALLPower?

Type : Channel-Independent
Description : Return the real time power measured at the input of the all load module.
Query Syntax : FETCh:ALLPower?
Return Parameters : <aard> [Unit=Watt]
Query Example : FETC:ALLP?
Return Example : 5.28, 2, 0, 0, 10.2, 0, 0, 0

7.2.6 LOAD Subsystem



LOAD:[STATe]

Type : Channel-Specific
Description : The LOAD command makes the electronic load active/on or inactive/off.
Syntax : LOAD:[STATe] ON
LOAD:[STATe] OFF
Parameters : ON/1, OFF/0
Example : LOAD ON Activate the electronic load.
LOAD OFF Inactivate the electronic load.
Query Syntax : LOAD:[STATe]?
Return Parameters : <NR1>
Query Example : LOAD? Return if the electronic load is active.
Return Example : 1

LOAD:SHORt:[STATe]

Type : Channel-Specific
Description : Activate or inactivate short-circuited simulation.
Syntax : LOAD:SHORt:[STATe]
Example : LOAD:SHOR ON — Activate short-circuited simulation.
LOAD:SHOR OFF — Inactivate short-circuited simulation.
Parameters : ON/1, OFF/0
Query Syntax : LOAD:SHORt:[STATe]?
Return Parameters : <NR1>
Query Example : LOAD:SHOR? — Returns the short-circuit simulation state.
Return Example : 1

LOAD:SHORt:KEY

Type : Channel-Specific
Description : Set the mode of short key in the electronic load.
Syntax : LOAD:SHORt:KEY TOGGLE
Parameters : TOGGLE/1, HOLD/0
Example : LOAD:SHOR:KEY TOGGLE — Set short key mode as Toggle.
LOAD:SHOR:KEY HOLD — Set short key mode as Hold.
Query Syntax : LOAD:SHORt:KEY?
Return Parameters : <NR1>
Query Example : LOAD:SHOR:KEY? — Return the mode of short key in the electronic load.
Return Example : 1

LOAD:PROTection:CLEar

Type : Channel-Specific
Description : This command resets or returns status of the electronic load.
Syntax : LOAD:PROTection:CLEar
Parameters : For valid value range refer to respective specification.
Example : LOAD:PROT:CLE
Query Syntax : LOAD:PROTection:CLEar?
Return Parameters : <NR1>

Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition	0	0	0	0	0	0	0	0	0	0	0	OT	RV	OP	OV	OC
Bit Weight												16	8	4	2	1

Query Example : LOAD:PROT? — Return the electronic load status.
Return Example : 0

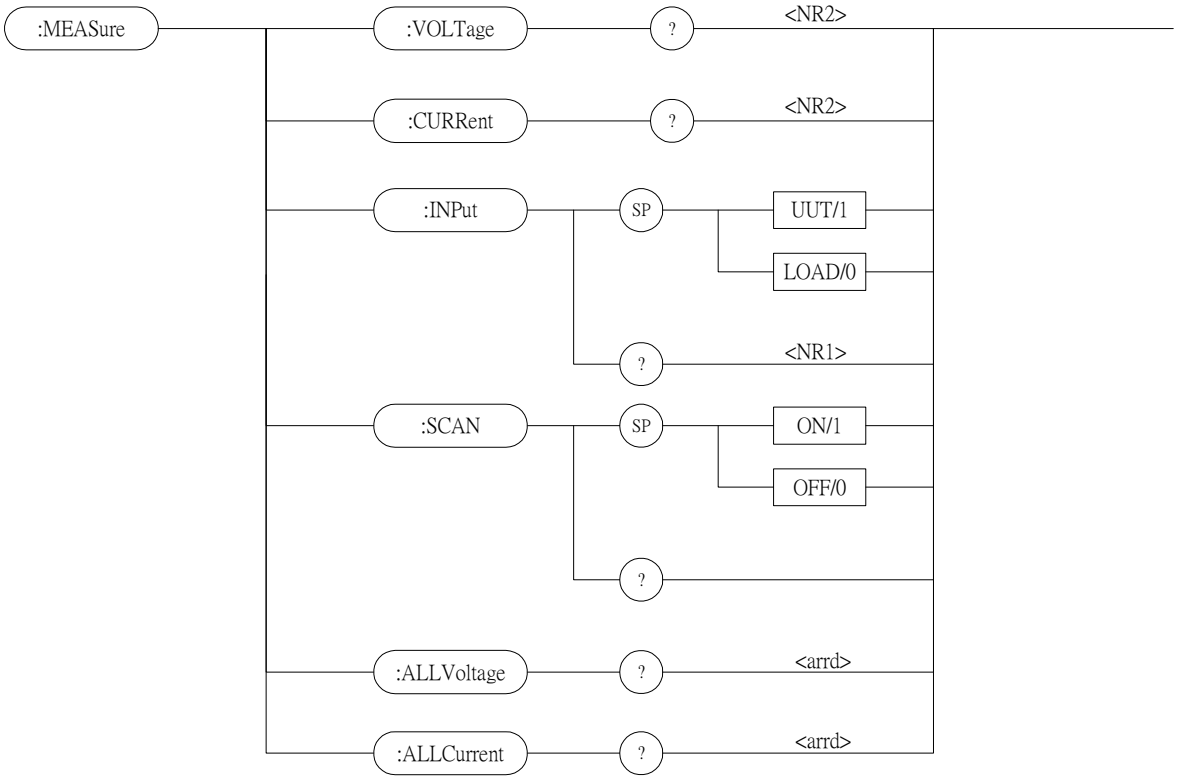
LOAD:CLEar

Type:	All Channels
Description:	Clear all data and return it to default.
Syntax:	LOAD:CLEar
Parameters:	None
Example:	LOAD:CLE

LOAD:SAVe

Type:	All Channels
Description:	Save the current data as default.
Syntax:	LOAD:SAVe
Parameters:	None
Example:	LOAD:SAV

7.2.7 MEASURE Subsystem



MEASure:VOLTage?

Type	: Channel-Specific
Description	: Return the voltage measured at the input of electronic load.
Query Syntax	: MEASure:VOLTage?
Return Parameters	: <NR2> [Unit=Voltage]
Query Example	: MEAS:VOLT?
Return Example	: 8.12

MEASure:CURRent?

Type	: Channel-Specific
Description	: Return the current measured at the input of electronic load.
Query Syntax	: MEASure:CURRent?
Return Parameters	: <NR2> [Unit=Ampere]
Query Example	: MEAS:CURR?
Return Example	: 3.15

MEASure:INPut

Type : Channel-Specific
Description : Select the input port of electronic load to measure the voltage.
Syntax : MEASure:INPut?
Parameters : UUT/1, LOAD/0
Example : MEAS:INP UUT
MEAS:INP LOAD
Query Syntax : MEASure:INPut? Return the input port which has been set.
Return Parameters : <NR1>
Query Example : MEAS:INP?
Return Example : 0

MEASure:SCAN

Type : All Channels
Description : Set the scanning mode of frame to load module.
Syntax : MEASure:SCAN ON Enable the frame to scan the load module.
MEASure:SCAN OFF Disable the frame to scan the load module.
Parameters : ON/1, OFF/0
Example : MEAS:SCAN ON
MEAS:SCAN OFF
Query Syntax : MEASure:SCAN? Return the scanning mode of the frame.
Return Parameters : <NR1>
Query Example : MEAS:SCAN?
Return Example : 1

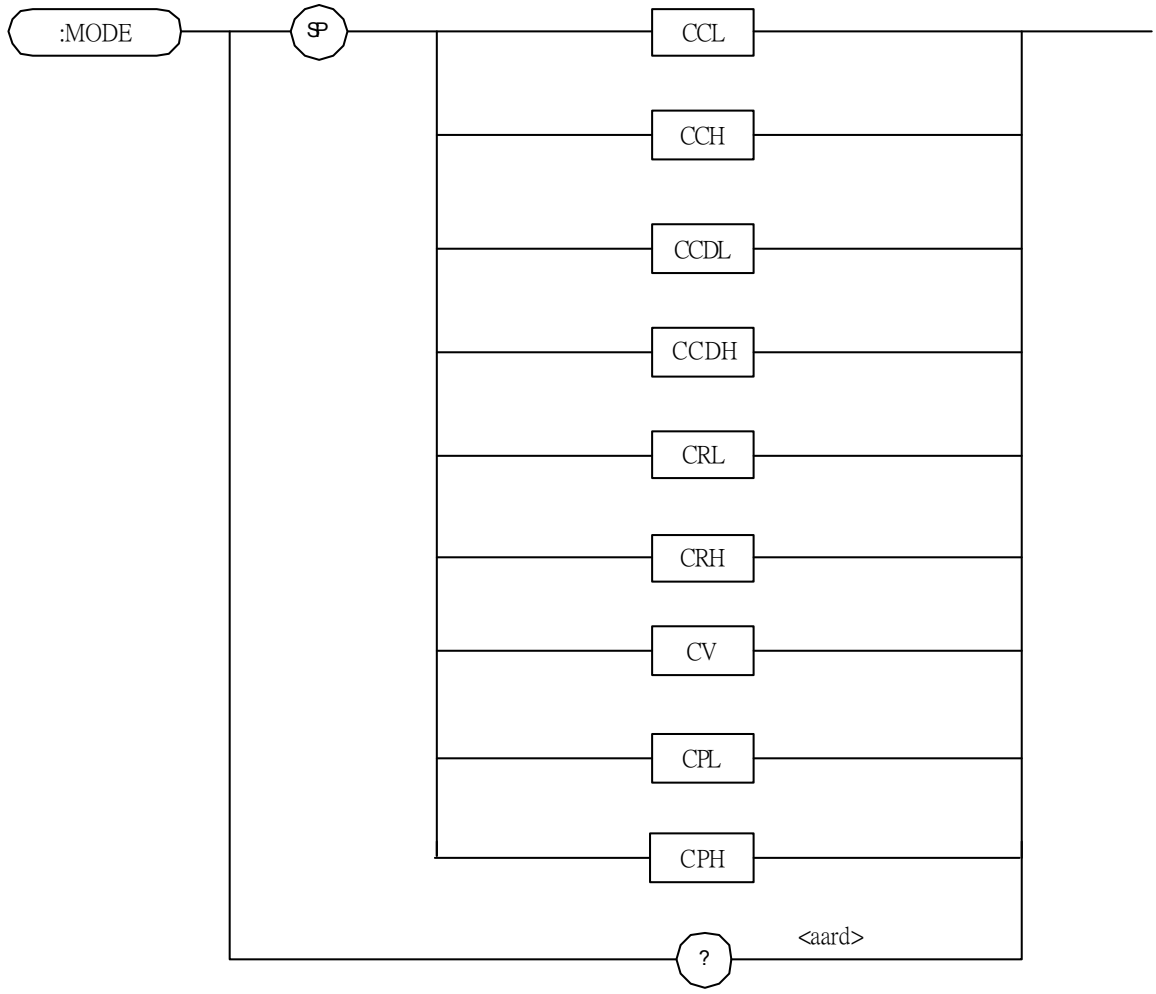
MEASure:ALLVoltage?

Type : Channel-Independent
Description : Return the voltage measured at the input of all load modules.
Query Syntax : MEASure:ALLVoltage?
Return Parameters : <aard> [Unit=Voltage]
Query Example : MEAS:ALLV?
Return Example : 1.2, 2, 0, 0, 10.2, 0, 0, 0

MEASure:ALLCurrent?

Type : Channel-Independent
Description : Return the current measured at the input of all load modules.
Query Syntax : MEASure:ALLCurrent?
Return Parameters : <aard> [Unit=Ampere]
Query Example : MEAS:ALLC?
Return Example : 0, 0, 0, 0, 5.12, 0, 12, 0

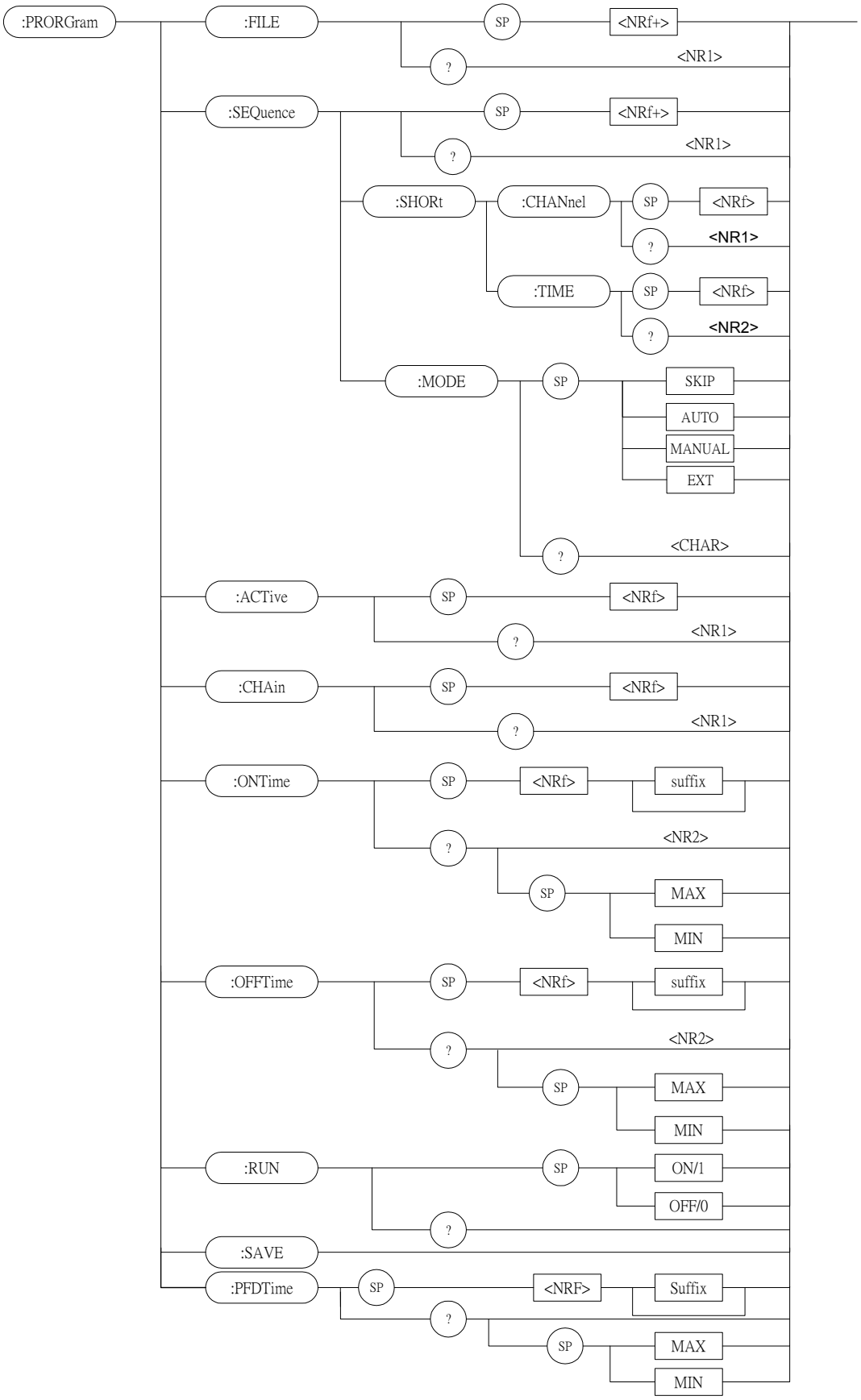
7.2.8 MODE Subsystem



MODE

Type	: Channel-Specific	
Description	: This command sets operational modes of the electronic load.	
Syntax	: MODE CCL	Set CC mode of low range.
	MODE CCH	Set CC mode of high range.
	MODE CCDL	Set CC dynamic mode of low range.
	MODE CCDH	Set CC dynamic mode of high range.
	MODE CRL	Set CR mode of low range.
	MODE CRH	Set CR mode of high range.
	MODE CV	Set CV mode.
	MODE CPL	Set CP mode of low range.
	MODE CPH	Set CP mode of high range.
Parameters	: CCL, CCH, CCDL, CCDH, CRL, CRH, CV	
Example	: MODE CCL	
Query Syntax	: MODE?	Return the operational mode of the electronic load.
Return Parameters	: <aard>	
Query Example	: MODE?	
Return Example	: CCL	

7.2.9 PROGRAM Subsystem



PROGram:FILE

Type	: By program file	
Description	: Set the program number.	
Syntax	: PROGram:FILE <NRf+>	
Parameters	: 1 to 10	
Example	: PROG:FILE 10	
Query Syntax	: PROGram:FILE?	Return the active program number.
Return Parameters	: <NR1>	
Query Example	: PROG:FILE?	
Return Example	: 10	

PROGram:SEQuence

Type	: By program file
Description	: Set the sequence of program file.
Syntax	: PROGram:SEQuence <NRf+>
Parameters	: 1 to 10
Example	: PROG:SEQ3
Query Syntax	: PROGram:SEQuence?
Return Parameters	: <NR1>
Query Example	: PROG:SEQ?
Return Example	: 3

PROGram:SEQuence:MODE

Type	: By program file
Description	: Set the type of sequence.
Syntax	: PROGram:SEQuence:MODE SKIP PROGram:SEQuence:MODE AUTO PROGram:SEQuence:MODE MANUAL PROGram:SEQuence:MODE EXT
Parameters	: SKIP, AUTO, MANUAL, EXT
Example	: PROG:SEQ:MODE SKIP PROG:SEQ:MODE AUTO PROG:SEQ:MODE MANUAL PROG:SEQ:MODE EXT
Query Syntax	: PROGram:SEQ:MODE?
Return Parameters	: SKIP, AUTO, MANUAL
Query Example	: PROG:SEQ:MODE?
Return Example	: AUTO

PROGram:SEQuence:SHORt:CHANnel

Type	: By program file
Description	: Set the short channel of program file sequence.
Syntax	: PROGram:SEQuence:SHORt:CHANnel <NRf>
Parameters	: 0 – 255

Channel	8	7	6	5	4	3	2	1
Bit Weight	128	64	32	16	8	4	2	1

Example : PROG:SEQ:SHOR:CHAN 3
Query Syntax : PROGram:SEQuence:SHORt:CHANnel?
Return Parameter : <NR1>
Query Example : PROG:SEQ:SHOR:CHAN?
Return Example : 3

PROGram:SEQuence:SHORt:TIME

Type : By program file
Description : Set the short time of program file sequence.
Syntax : PROGram:SEQuence:SHORt:TIME
Parameters : 0 - 30.0
Example : PROG:SEQ:SHOR: TIME 10
Query Syntax : PROGram:SEQuence:SHORt:TIME?
Return Parameter : <NR2>
Query Example : PROG:SEQ:SHOR:TIME?
Return Example : 10

PROGram:ACTive

Type : By program file
Description : Select the active load modules.
Syntax : PROGram:ACTive <NRf>
Parameters : 0 - 255

Channel	8	7	6	5	4	3	2	1
Bit Weight	128	64	32	16	8	4	2	1

Example : PROG:ACT 12
Query Syntax : PROGram:ACTive?
Return Parameters : <NR1>
Query Example : PROG:ACT?
Return Example : 12

PROGram:CHAin

Type : By program file
Description : Set the type of program file in serial execution.
Syntax : PROGram:CHAin <NRf>
Parameters : 0 to 10 0 does not chain.
Example : PROG:CHA 7
Query Syntax : PROGram:CHAin?
Return Parameters : <NR1>
Query Example : PROG:CHA?
Return Example : 7

PROGram:ONTime

Type	: By program file
Description	: Set the load on time of program file.
Syntax	: PROGram:ONTime <NRf>
Parameters	: For valid value range refer to respective specification.
Example	: PROG:ONT 10 PROG:ONT 100mS
Query Syntax	: PROGram:ONTime?
Return Parameters	: <NR2> [Unit=Sec]
Query Example	: PROG:ONT?
Return Example	: 10

PROGram:OFFTime

Type	: By program file
Description	: Set the load off time of program file.
Syntax	: PROGram:OFFTime <NRf>
Parameters	: For valid value range refer to respective specification.
Example	: PROG:OFFT 20 PROG:OFFT 200mS
Query Syntax	: PROGram:OFFTime?
Return Parameters	: <NR2> [Unit=Sec]
Query Example	: PROG:OFFT?
Return Example	: 0.2

PROGram:PFDTime

Type	: By program file
Description	: Set the pass/fail delay time of program file.
Syntax	: PROGram:PFDTime <NRf>
Parameters	: For valid value range refer to respective specification.
Example	: PROG:PFDT 1
PROG	: PFDT 200mS
Query Syntax	: PROGram:PFDTime?
Return Parameters	: <NR2> [Unit=Sec]
Query Example	: PROG:PFDT?
Return Example	: 0.2

PROGram:SAVE

Type	: By program file
Description	: Save the setting of program.
Syntax	: PROGram:SAVE
Parameters	: NONE
Example	: PROG:SAVE

PROGram:RUN

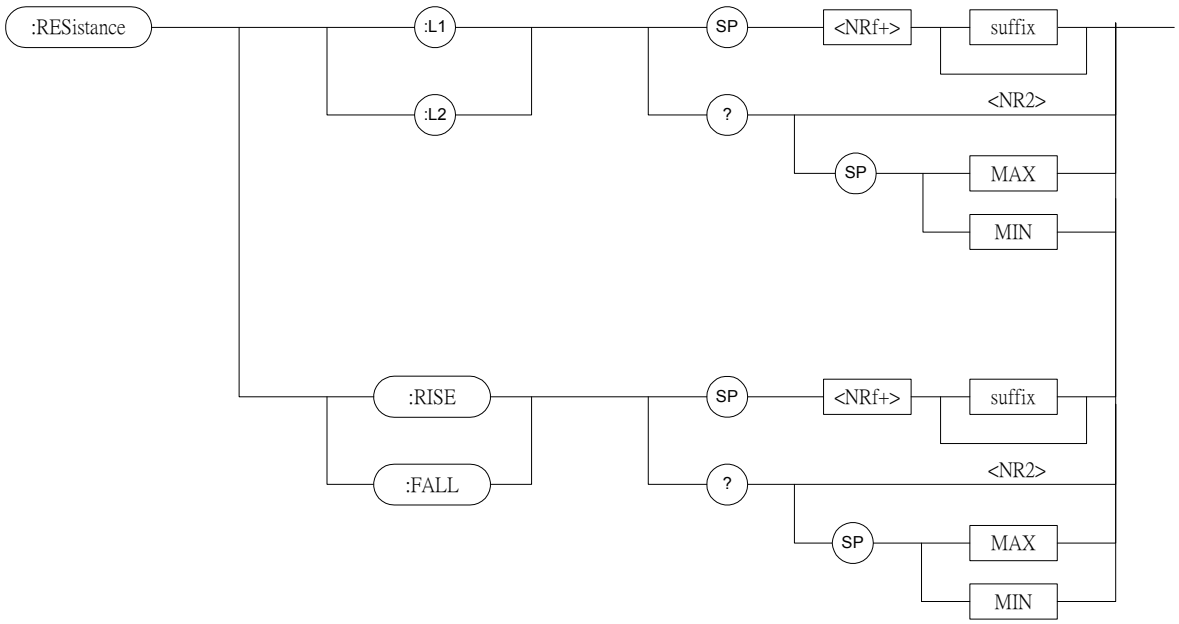
Type	: By program file
Description	: Execute the program
Syntax	: PROGram:RUN ON

PROGram:RUN OFF
Parameters : ON/1, OFF/0
Example : PROG:RUN ON
Query Syntax : PROGram:RUN?
Return Parameter : <NR1>
Query Example : PROGram:RUN?
Return Example : 1

PROGram:KEY

Type : By program file
Description : Echo the manual key code
Syntax : PROGram:KEY <NR1>
PROGram:RUN OFF
Parameters : 0 – 9 -> K0 -> K9
10 -> Kup
11 -> Kdown
Example : PROG:KEY 11

7.2.10 RESISTANCE Subsystem



RESistance:L1/L2

Type : Channel-Specific
Description : Set static resistance level of constant resistance mode.
Syntax : RESistance:L1 <NRf+> [suffix]
RESistance:L2 <NRf+> [suffix]
Parameters : For valid value range refer to respective specification.
Example : RES:L1 20 OHM Set constant resistance = 20 ohm for Load L1.
RES:L2 10 OHM Set constant resistance = 10 ohm for Load L2.
RES:L1 MAX Set constant resistance = maximum L1 value for Load L1.
RES:L2 MIN Set constant resistance = minimum L2 value for Load L2.
Query Syntax : RESistance:L1?
RESistance:L2?
RESistance:L1? MAX
RESistance:L2? MIN
Return Parameters : <NR2> [Unit=OHM]
Query Example : RES:L1? Return the set resistance of the value of Load L1.
Return Example : 10

RESistance:RISE/FALL

Type : Channel-Specific
Description : Set resistive slew rate of constant resistance.
Syntax : RESistance:RISE <NRf+> [suffix]
RESistance:FALL <NRf+> [suffix]
Parameters : For valid value range refer to respective specification.

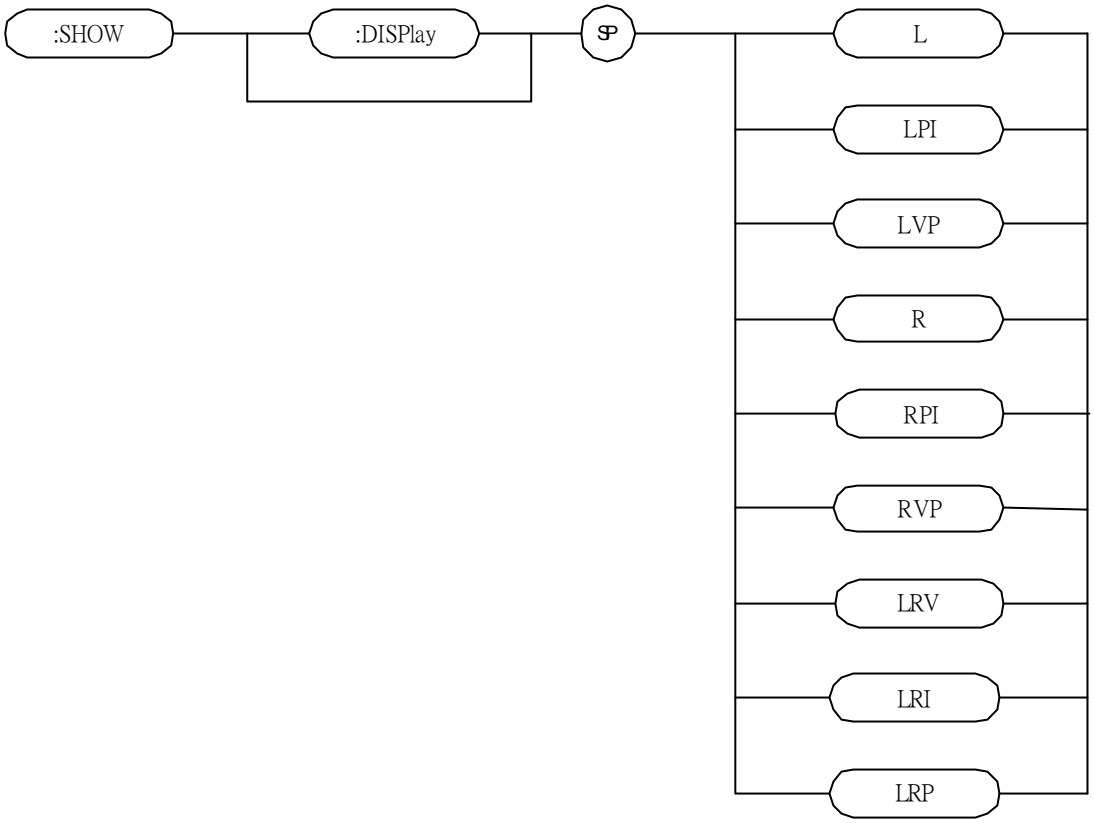
Example	: RES:RISE 2.5	Set CR rise slew rate as 2.5A/μS.
	RES:FALL 1A/μS	Set CR fall slew rate as 1A/μS.
	RES:RISE MAX	Set CR rise slew rate as the maximum programmable value.
	RES:FALL MIN	Set CR fall slew rate as the minimum programmable value.
Query Syntax	: RESistance:RISE?	
	RESistance:FALL?	
	RESistance:RISE? MAX	
	RESistance:FALL? MIN	
Return Parameters	: <NR2> [Unit=OHM]	
Query Example	: RES:RISE?	Return CR rise slew rate.
Return Example	: 2.5	

7.2.11 RUN Subsystem

:RUN

Type	: All Channels
Description	: Set all electronic loads as “ON”.
Syntax	: RUN

7.2.12 SHOW Subsystem

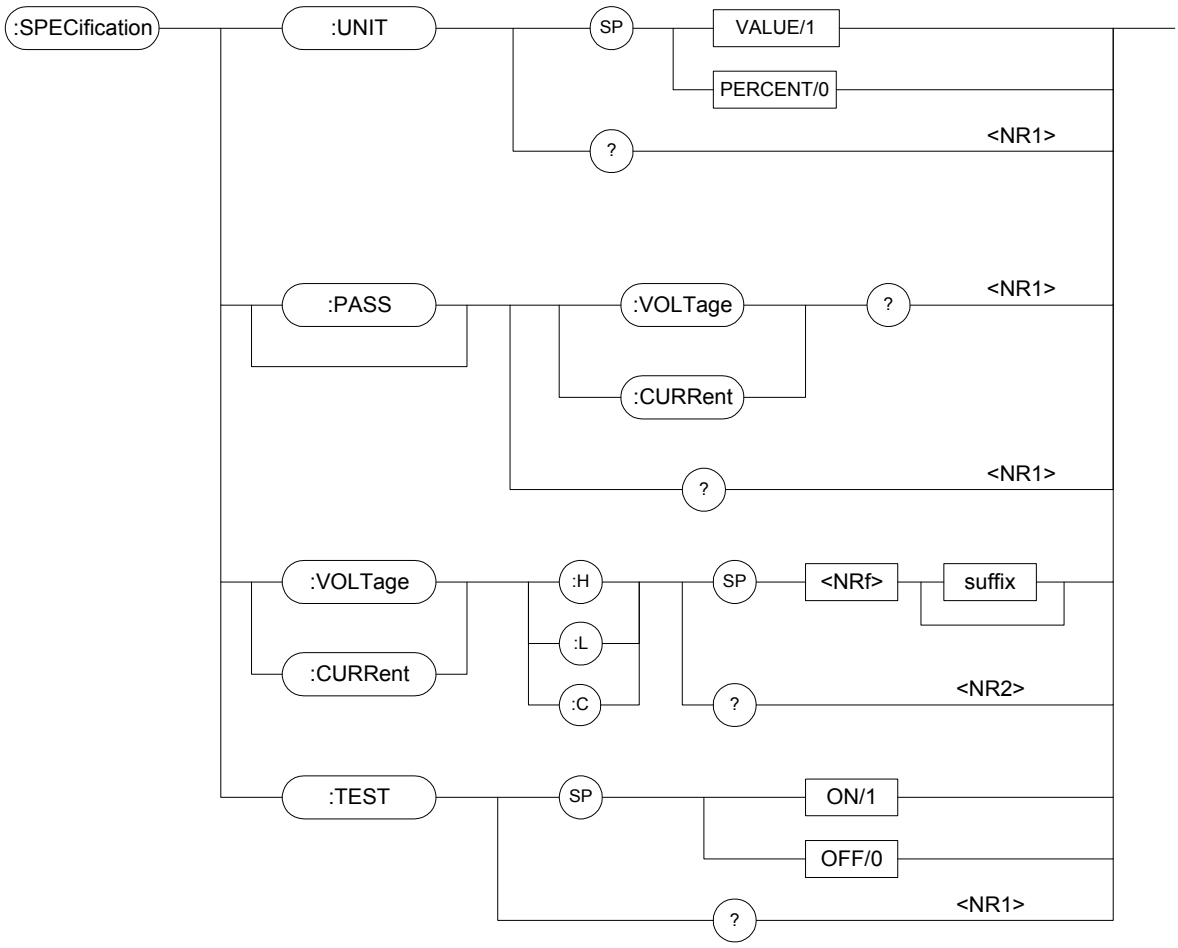


SHOW:DISPlay

Type : Channel-Specific (Double Channel Module Only)
Description : Set the display mode of the electronic load.
Syntax : SHOW:DISPlay L
SHOW:DISPlay LPI
SHOW:DISPlay LVP
SHOW:DISPlay R
SHOW:DISPlay RPI
SHOW:DISPlay RVP
SHOW:DISPlay LRV
SHOW:DISPlay LRI
SHOW:DISPlay LRP
Parameters : L, LPI, LVP, R, RPI, RVP, LRV, LRI, LRP.
Example : SHOW:DISP L Display the voltage and current values of channel L.
SHOW:DISP LPI Display the power and current values of channel L.
SHOW:DISP LVP Display the voltage and power values of channel L.
SHOW:DISP R Display the voltage and current values of channel R.
SHOW:DISP RPI Display the power and current values of channel R.
SHOW:DISP RVP Display the voltage and power

	values of channel R.
SHOW:DISP LRV	Display the voltage value of channel L and channel R.
SHOW:DISP LRI	Display the current value of channel L and channel R.
SHOW:DISP LRP	Display the power value of channel L and channel R.

7.2.13 SPECIFICATION Subsystem



SPECification:UNIT

Type : All Channels
Description : Set the specific entry mode.
Syntax : SPECification:UNIT VALUE
SPECification:UNIT PERCENT
Parameters : VALUE/1, PERCENT/0
Example : SPEC:UNIT VALUE
SPEC: UNIT PERCENT
Query Syntax : SPECification:UNIT?
Query Example : SPEC:UNIT?
Return Parameters : <NR1>
Return Example : 0

SPECification:VOLTage?

Type : Channel-Specific
Description : Request GO-NG result reference to voltage specification.
Query Syntax : SPECification:VOLTage?
Query Example : SPEC:VOLT? Returns voltage GO-NG result to CC and CR modes.
Return Parameters : <NR1>
Return Example : 0 (NG), 1 (GO)

SPECification:CURRent?

Type	: Channel-Specific	
Description	: Request GO-NG result reference to current specification.	
Query Syntax	: SPECification:CURRent?	
Query Example	: SPEC:CURR?	Return the current GO-NG result to CC mode.
Return Parameters	: <NR1>	
Return Example	: 0 (NG), 1 (GO)	

SPECification?

Type	: All Channels	
Description	: Request GO-NG result reference to all channel specification.	
Query Syntax	: SPECification?	
Query Example	: SPEC?	Returns all channel GO-NG result.
Return Parameters	: <NR1>	
Return Example	: 0 (NG), 1 (GO)	

SPECification:VOLTage

Type	: Channel-Specific
Description	: Set the voltage specification.
Syntax	: SPECification:VOLTage:H SPECification:VOLTage:L SPECification:VOLTage:C
Parameters	: For valid value range refer to respective specification.
Example	: SPEC:VOLT:H <NRf+> [suffix] SPEC:VOLT:L <NRf+> [suffix] SPEC:VOLT:C <NRf+> [suffix]
Query Syntax	: SPECification:VOLTage:H? SPECification:VOLTage:L? SPECification:VOLTage:C?
Query Example	: SPEC:VOLT:H?
Return Parameters	: <NR2> [Unit=Voltage]
Return Example	: 4.75

SPECification:CURRent

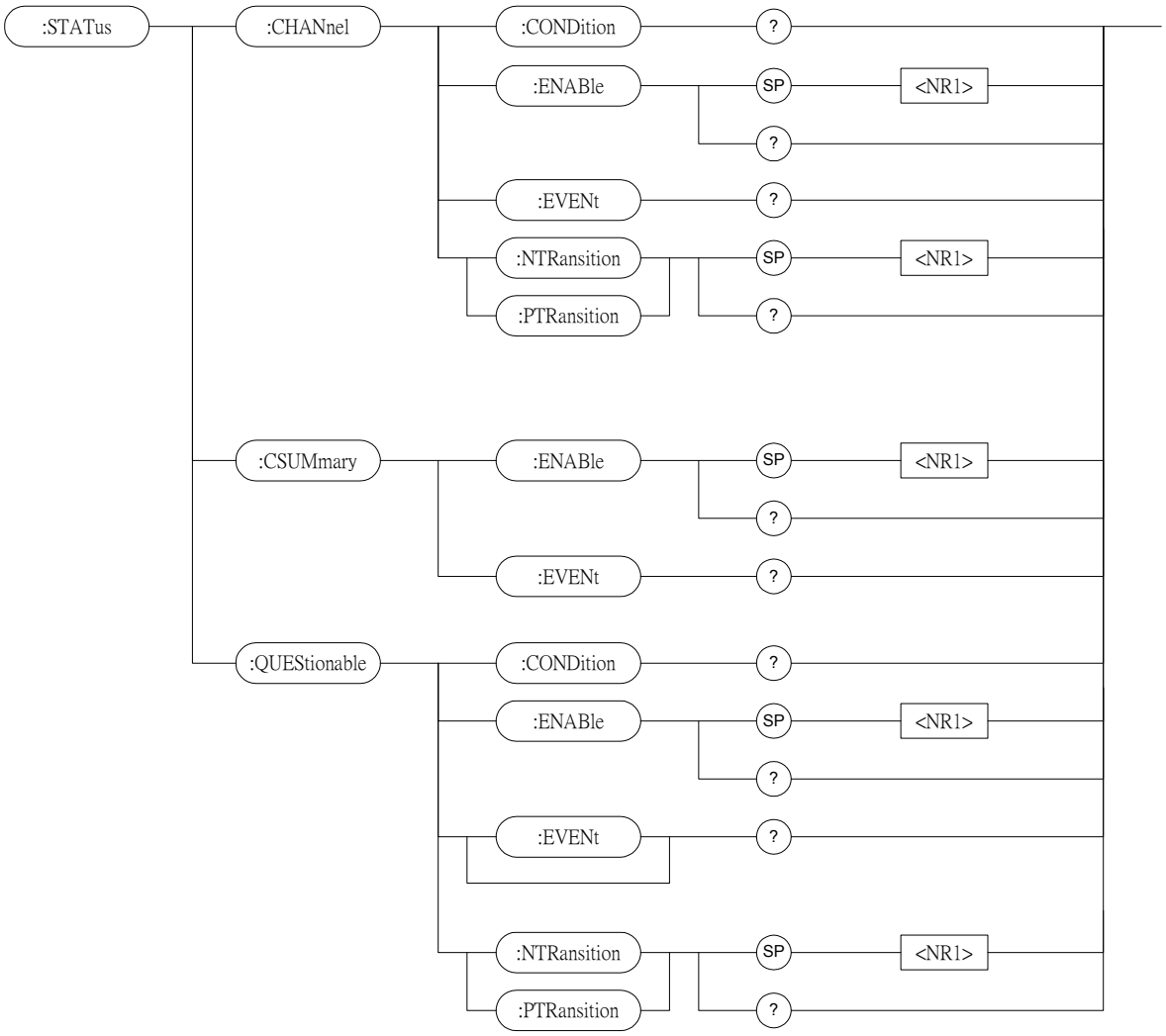
Type	: Channel-Specific
Description	: Set the current specification.
Syntax	: SPECification:CURRent:H SPECification:CURRent:L SPECification:CURRent:C
Parameters	: For valid value range refer to respective specification.
Example	: SPEC:CURR:H <NRf+> [suffix] SPEC:CURR:L <NRf+> [suffix] SPEC:CURR:C <NRf+> [suffix]
Query Syntax	: SPECification:CURR:H? SPECification:CURR:L? SPECification:CURR:C?
Query Example	: SPEC:CURR:H?

Return Parameters : <NR2> [Unit=Current]
Return Example : 4.75

SPECification:TEST

Type : Channel-Specific
Description : Start or close the specification test.
Syntax : SPECification:TEST ON
SPECification:TEST OFF
Parameters : ON/1, OFF/0
Example : SPEC:TEST ON
SPEC:TEST OFF
Query Syntax : SPECification:TEST?
Query Example : SPEC:TEST?
Return Parameters : <NR1>
Return Example : 1

7.2.14 STATUS Subsystem



STATus:CHANnel:CONDition

Type : Channel-Specific
Description : Return the channel status in real time.
Query Syntax : STATus:CHANnel:CONDition?
Return Parameters : <NR1>

Bit Configuration of Channel Status register

Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition	0	0	0	0	0	0	0	0	0	0	0	OT	RV	OP	OV	OC
Bit Weight												16	8	4	2	1

Query Example : STAT:CHAN:COND? Return status of the electronic load.
Return Example : 2048

STATus:CHANnel:ENABle

Type : Channel-Specific
Description : Masks for selecting which bits in the Event register are allowed to be summed into the corresponding channel bit of the Channel Summary Event register.
Syntax : STATus:CHANnel:ENABle
Parameters : 0 ~ 65535
Example : STAT:CHAN:ENABl 24
Query Syntax : STATus:CHANnel:ENABle
Return Parameters : <NR1>
Query Example : STAT:CHAN:ENABL? Return the contents of the Status Channel Enable register.
Return Example : 24

STATus:CHANnel:EVENt?

Type : Channel-Specific
Description : Record all channel events that have occurred since last time the register was read, and resets the Channel Event register.
Query Syntax : STATus:CHANnel:EVENt?
Return Parameters : <NR1>
Query Example : STAT:CHAN:EVEN? Read and reset Channel Event register.
Return Example : 24

STATus:CHANnel:PTRansition/NTRansition

Type : Channel-Specific
Description : Programmable filters that determine what type of transition (0-to-1 or 1-to-0) in the Condition register will set the corresponding bit of the Event register.
Syntax : STATus:CHANnel:PTRansition/NTRansition <NRf>
Parameters : 0 ~ 65535
Example : STAT:CHAN:PTR 4 Sets OP(over power bit 2) as 0-to-1.
STAT:CHAN:NTR 4 Sets OP(over power bit 2) as 1-to-0.
Query Syntax : STATus:CHANnel:PTRansition?
STATus:CHANnel:NTRansition?
Return Parameters : <NR1>
Query Example : STAT:CHAN:PTR? Inquires setting of Channel PTRansition.
Return Example : 4

STATus:CSUMmary:ENABle

Type : Channel-Specific
Description : Masks for selecting which bits in the Channel Event register are allowed to be summed into the CSUM (Channel Summary) bit of the Status Byte register.
Syntax : STATus:CSUMmary:ENABle
Parameters :

Bit Configuration of Channel Summary register

Bit Position	7	6	5	4	3	2	1	0
Channel	8	7	6	5	4	3	2	1
Bit Weight	128	64	32	16	8	4	2	1

Example : STAT:CSUM:ENAB 3
Query Syntax : STATus:CSUMmary:ENABle?
Return Parameters : <NR1>
Query Example : STAT:CSUM:ENAB? Return the setting of Channel Summary Enable register.
Return Example : 3

STATus:CSUMmary:EVENt

Type : Channel-Specific
Description : Indicate all channels on which an enable STAT:CHAN Event has occurred since last time the register was read.
Syntax : STATus:CSUMmary:EVENt
Parameters :

Bit Configuration of Channel Summary register

Bit Position	7	6	5	4	3	2	1	0
Channel	8	7	6	5	4	3	2	1
Bit Weight	128	64	32	16	8	4	2	1

Example : STAT:CSUM:EVEN 3
Query Syntax : STATus:CSUMmary:EVENt?
Return Parameters : <NR1>
Query Example : STAT:CSUM:EVEN? Return the value of the Channel Summary Event register.
Return Example : 3

STATus:QUEStionable:CONDition

Type : Channel-Specific
Description : Real-time ("live") recording of Questionable data
Query Syntax : STATus:QUEStionable:CONDition?
Return Parameters : <NR1>
Query Example : STAT:QUES:COND? Return the channel status.
Return Example : 6

STATus:QUEStionable:ENABle

Type : Channel-Specific
Description : Masks for selecting which bits on the Event register are allowed to be summed into the QUES bit of the Status Byte register.
Syntax : STATus:QUEStionable:ENABle
Parameters :

Bit Configuration of Questionable Status register

Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition	0	0	0	0	0	0	0	0	0	0	0	TE	RV	PE	VE	CE
Bit Weight												16	8	4	2	1

Example : STAT:QUES:ENAB 24
Query Syntax : STATus:QUEStionable:ENABle?
Return Parameters : <NR1>
Query Example : STAT:QUES:ENAB Return the setting of the Status Questionable Enable register.
Return Example : 24

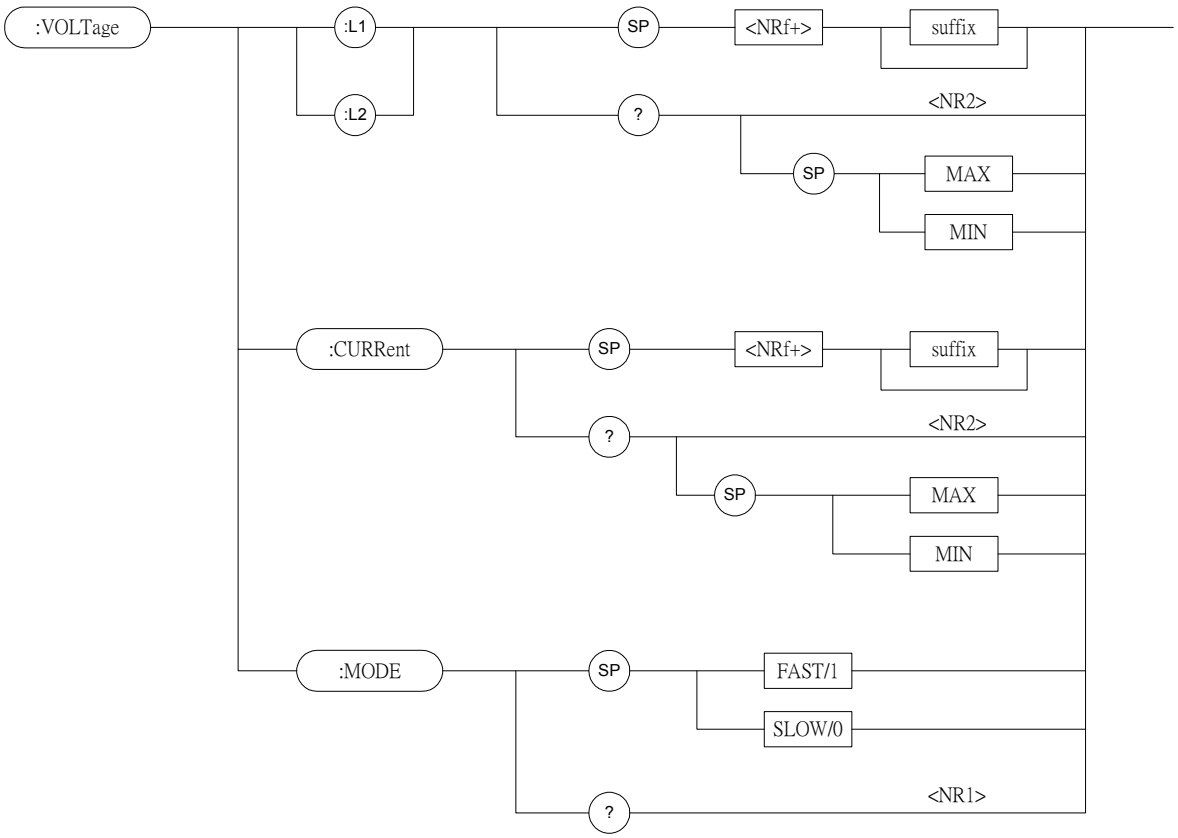
STATus:QUEStionable:EVENt?

Type : Channel-Specific
Description : Record all Questionable conditions that have occurred since last time the register was read.
Query Syntax : STATus:QUEStionable:EVENt?
Return Parameters : <NR1>
Query Example : STAT:QUES:EVEN? Return the contents of the Questionable Event register.
Return Example : 24

STATus:QUEStionable:PTRansition/NTRansition

Type : Channel-Specific
Description : Programmable filters determine what type of transition (0-to-1 or 1-to-0) in the Condition register will set the corresponding bit of the Event register.
Syntax : STATus:QUEStionable:PTRansition/NTRansition <NRf>
Parameters : 0 ~ 65535
Example : STAT:QUES:PTR 4 Sets OP(over power bit 2) as 0-to-1.
STAT:QUES:NTR 4 Sets OP(over power bit 2) as 1-to-0.
Query Syntax : STATus:QUEStionable:PTRansition?
STATus:QUEStionable:NTRansition?
Return Parameters : <NR1>
Query Example : STAT:QUES:PTR? Return the setting on the QUEStionable Ptransition/ Ntransition.
Return Example : 4

7.2.15 VOLTAGE Subsystem



VOLTage:L1/L2

Type	: Channel-Specific	
Description	: Sets voltage of static load during constant voltage mode.	
Syntax	: VOLTage:L1 VOLTage:L2	
Parameters	: For valid value range refer to respective specification.	
Example	: VOLT:L1 8V	Set voltage of load L1 as 8V.
	VOLT:L2 24V	Set voltage of load L2 as 24V.
	VOLT:L1 MAX	Set voltage of load L1 as the maximum value.
	VOLT:L2 MIN	Set voltage of load L2 as the minimum value.
Query Syntax	: VOLTage:L1? VOLTage:L2? VOLTage:L1? MAX VOLT:L2? MIN	
Return Parameters	: <NR2> [Unit=Voltage]	
Query Example	: VOLT:L1?	Return the set voltage value of load L1.
Return Example	: 0	

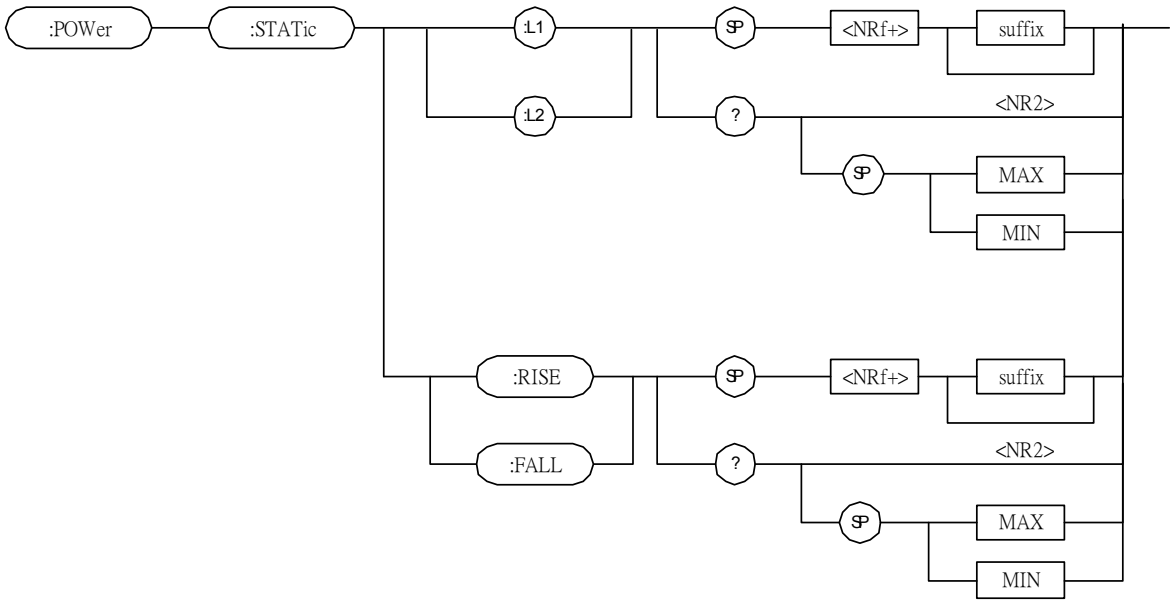
VOLTage:CURRent

Type	: Channel-Specific	
Description	: Set the current limit of constant voltage mode.	
Syntax	: VOLTage:CURRent	
Parameters	: For valid value range refer to respective specification.	
Example	: VOLT:CURR 3	Set loading current limit as 3A during constant voltage mode.
	VOLT:CURR MAX	Set loading current limit as the maximum value during constant voltage mode.
	VOLT:CURR MIN	Set loading current limit as the minimum value during constant voltage mode.
Query Syntax	: VOLTage:CURRent?	
Return Parameters	: <NR2> [Unit=Amper]	
Query Example	: VOLT:CURR?	
Return Example	: 3	

VOLTage:MODE

Type	: Channel-Specific
Description	: Sets the response speed of CV mode.
Syntax	: VOLTage:MODE FAST VOLTage:MODE SLOW
Parameters	: FAST/1, SLOW/0
Example	: VOLT: MODE FAST VOLT:MODE SLOW
Query Syntax	: VOLTage:MODE?
Return Parameters	: <NR1>
Query Example	: VOLT:MODE?
Return Example	: 0

7.2.16 POWER Subsystem



POWer:L1/L2

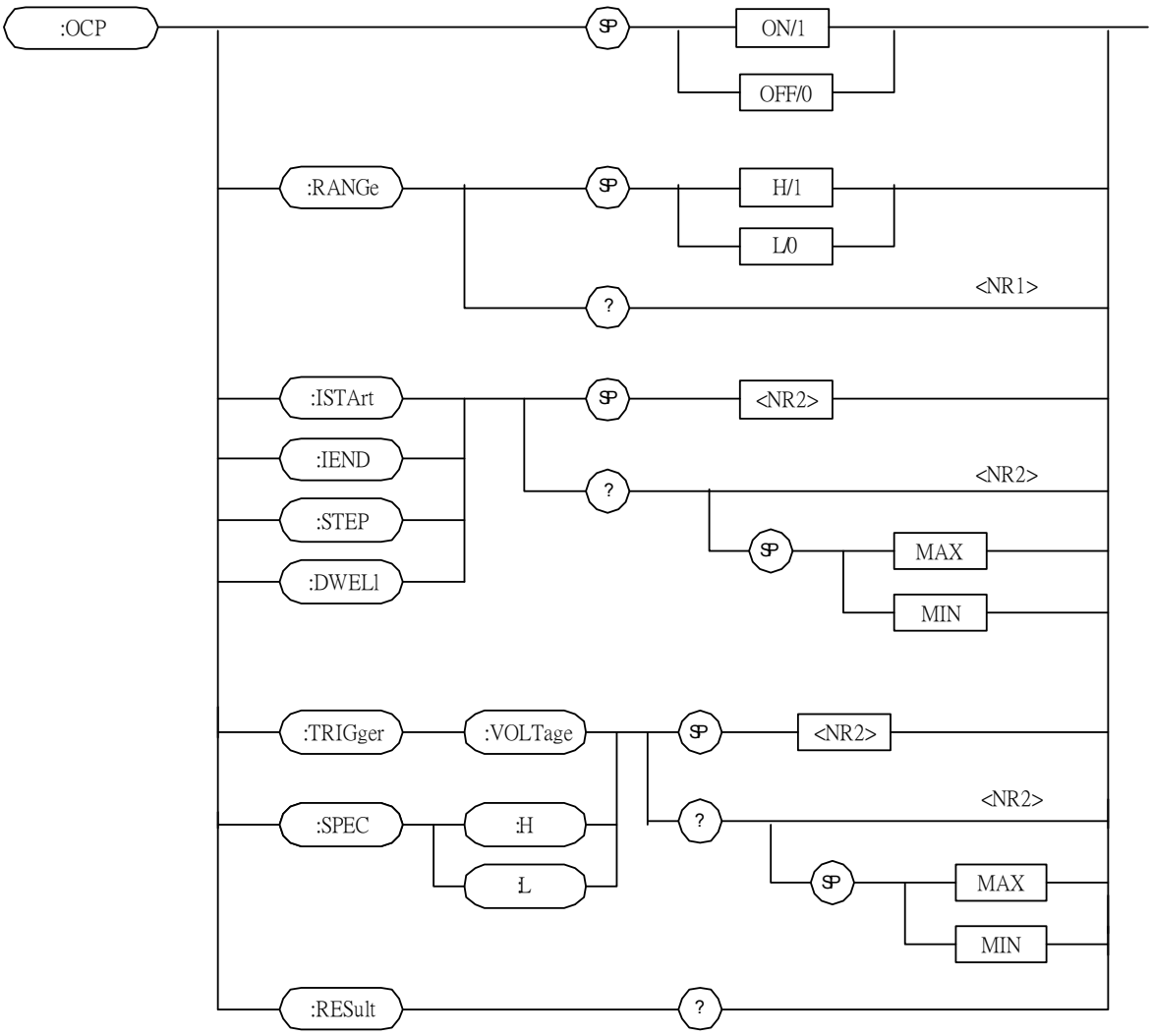
Type : Channel-Specific
Description : Set static power level of constant power mode.
Syntax : POWer:L1 <NR2> [suffix]
POWer:L2 <NR2> [suffix]
Parameters : For valid value range refer to respective specification.
Example : POW:L1 20 W Set constant power = 20 w for Load L1
POW:L2 10 W Set constant power = 10 w for Load L2.
POW:L1 MAX Set constant power= maximum L1 value for Load L1.
POW:L2 MIN Set constant resistance = minimum L2 value for Load L2.
Query Syntax : POW:L1?
POW:L2?
POW:L1? MAX
POW:L2? MIN
Return Parameters : <NR2> [Unit=W]
Query Example : POW:L1? Return the set power of the value of Load L1.
Return Example : 20

POWer e:RISE/FALL

Type : Channel-Specific
Description : Set resistive slew rate of constant power
Syntax : POWer:RISE<NR2> [suffix]
POWer:FALL <NR2> [suffix]
Parameters : For valid value range refer to respective specification.
Example : POW:RISE 2.5 Set CP rise slew rate as 2.5w/μS.
POW:FALL 1A/μS Set CP fall slew rate as 1wμS.
POW:RISE MAX Set CP rise slew rate as the

		maximum programmable value.
	POW:FALL MIN	Set CP fall slew rate as the minimum programmable value.
Query Syntax	: POWer:RISE?	
	POWer:FALL?	
	POWer:RISE? MAX	
	POWer:FALL? MIN	
Return Parameters	: <NR2> [Unit=W]	
Query Example	: POW:RISE?	Return CP rise slew rate.
Return Example	: 2.5	

7.2.17 OCP Subsystem



OCP

Type	: Channel-Specific	
Description	: Execute or cancel OCP Test.	
Syntax	: OCP <NR1>	
Parameters	: ON/1, OFF/0.	
Example	: OCP ON	Execute the OCP Test.

OCP:RANGe

Type	: Channel-Specific	
Description	: Set the range for OCP execution.	
Syntax	: OCP:RANGe <NR1>	
Parameters	: H/1, L/0.	
Example	: OCP:RANG H	Set the range to High for OCP.
Query Syntax	: OCP:RANGe?	
Return Parameters	: <NR1>	
Query Example	: OCP:RANG?	Return the range set for OCP.
Return Example	: 1	

OCP:ISTArt

Type : Channel-Specific
Description : Set starts current for OCP test mode.
Syntax : OCP:ISTArt <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OCP:ISTA 0.5 Set starts current = 0.5A
OCP:ISTA MAX Set starts current = maximum value.
OCP:ISTA MIN Set starts current = minimum value.
Query Syntax : OCP:ISTArt?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Ampere]
Query Example : OCP:ISTA?
OCP:ISTA? MAX
OCP:ISTA? MIN
Return Example : 0.5

OCP:IEND

Type : Channel-Specific
Description : Set end current for OCP test mode.
Syntax : OCP:IEND <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OCP:IEND 3 Set end current = 3A
OCP:IEND MAX Set end current = maximum value.
OCP:IEND MIN Set end current = minimum value.
Query Syntax : OCP:IEND?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Ampere]
Query Example : OCP:IEND?
OCP:IEND? MAX
OCP:IEND? MIN
Return Example : 3

OCP:STEP

Type : Channel-Specific
Description : Set step count for OCP test mode.
Syntax : OCP:STEP <NR1>
Parameters : 1~1000.
Example : OCP:STEP 100 Set step = 100
OCP:STEP MAX Set step = maximum value.
OCP:STEP MIN Set step = minimum value.
Query Syntax : OCP:STEP?[<MAX | MIN>]
Return Parameters : <NR1>
Query Example : OCP:STEP?
OCP:STEP? MAX
OCP:STEP? MIN
Return Example : 100

OCP:DWELl

Type : Channel-Specific
Description : Set dwell time for OCP test mode.
Syntax : OCP:DWELl <NR1>
Parameters : 1~1000.
Example : OCP:DWEL 100 Set dwell time = 100
OCP:DWEL MAX Set dwell time = maximum value.
OCP:DWEL MIN Set dwell time = minimum value.
Query Syntax : OCP:DWEL?[<MAX | MIN>]
Return Parameters : <NR1>[Unit = ms]
Query Example : OCP:DWEL?
OCP:DWEL? MAX
OCP:DWEL? MIN
Return Example : 100

OCP:TRIGger:VOLTage

Type : Channel-Specific
Description : Set trigger voltage for OCP test mode.
Syntax : OCP:TRIGger:VOLTage <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OCP:TRIGger:VOLTage 4.5 Set start current = 4.5V
OCP:TRIGger:VOLTage MAX Set start current = maximum value.
OCP:TRIGger:VOLTage MIN Set start current = minimum value.
Query Syntax : OCP: TRIGger:VOLTage?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Voltage]
Query Example : OCP:TRIGger:VOLTage?
OCP:TRIGger:VOLTage? MAX
OCP:TRIGger:VOLTage? MIN
Return Example : 4.5

OCP: SPECification:L

Type : Channel-Specific
Description : Set low level current of specification for OCP test mode
Syntax : OCP:SPECification:L <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OCP:SPECification:L 1.5 Set low level current = 1.5A
OCP:SPECification:L MAX Set low level current = maximum value.
OCP:SPECification:L MIN Set low level current = minimum value.
Query Syntax : OCP:SPECification:L?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Ampere]
Query Example : OCP:SPECification:L?
OCP:SPECification:L? MAX
OCP:SPECification:L? MIN
Return Example : 1.5

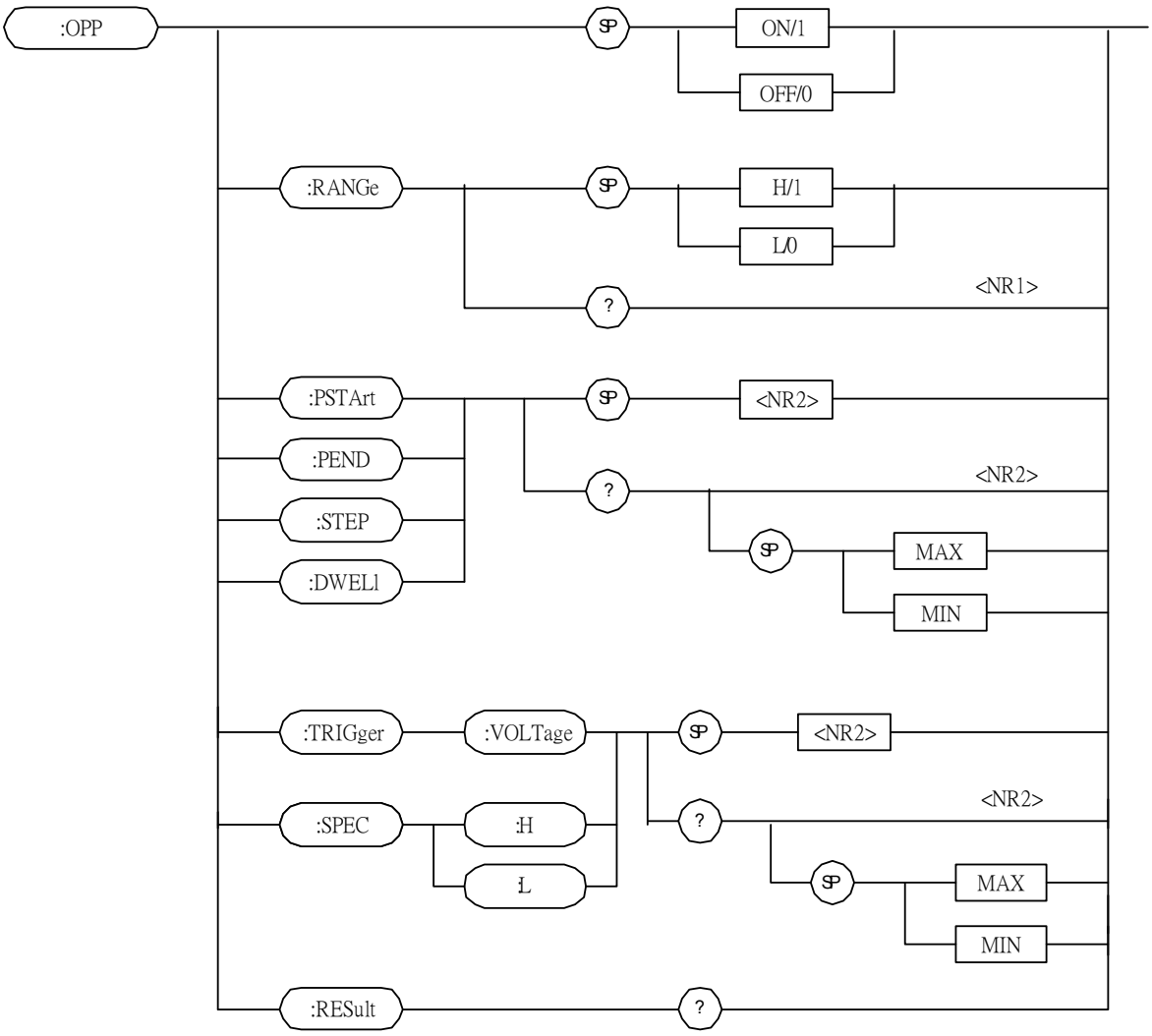
OCP: SPECification:H

Type : Channel-Specific
Description : Set high level current of specification for OCP test mode
Syntax : OCP:SPECification:H <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OCP:SPECification:H 2.8 Set high level current = 2.8A
OCP:SPECification:H MAX Set high level current = maximum value.
OCP:SPECification:H MIN Set high level current = minimum value.
Query Syntax : OCP:SPECification:H?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Ampere]
Query Example : OCP:SPECification:H?
OCP:SPECification:H? MAX
OCP:SPECification:H? MIN
Return Example : 2.8

OCP:RESult?

Type : Channel-Specific
Description : Returns the result of OCP test function.
Syntax : None
Parameters : None
Example : None
Query Syntax : ADVance:OCP:RESult?
Return Parameters : When the returns are
-1 denotes OCP test is stop.
-2 denotes OCP test is ready to execute what wait for Von or other condition.
-3 denotes OCP test is execute.
<arg1>,<arg2>,<arg3>
<arg1>: Pass/Fail. <NR1>, 0: PASS 1: FAIL [Unit = None]
<arg2>: OCP current. <NR2>, [Unit = Ampere]
Query Example : ADV:OCP:RES?

7.2.18 OPP Subsystem



OPP

Type : Channel-Specific
Description : Execute or cancel the OPP Test.
Syntax : OPP <NR1>
Parameters : ON/1, OFF/0.
Example : OPP ON Execute the OPP Test.

OPP:RANGe

Type : Channel-Specific
Description : Set the range for OPP execution.
Syntax : OPP:RANGe <NR1>
Parameters : H/1, L/0.
Example : OPP:RANG H Set the range to High for OPP.
Query Syntax : OPP:RANGe?
Return Parameters : <NR1>
Query Example : OPP:RANG? Return the set range for OCP.
Return Example : 1

OPP:ISTArt

Type : Channel-Specific
Description : Set starts power for OPP test mode.
Syntax : OPP:ISTArt <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OPP:ISTA 5 Set starts power = 5W
OPP:ISTA MAX Set starts power = maximum value.
OPP:ISTA MIN Set starts power = minimum value.
Query Syntax : OPP:ISTArt?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Watt]
Query Example : OPP:ISTA?
OPP:ISTA? MAX
OPP:ISTA? MIN
Return Example : 5

OPP:IEND

Type : Channel-Specific
Description : Set end power for OPP test mode.
Syntax : OPP:IEND <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OPP:IEND 10 Set end power = 10W
OPP:IEND MAX Set end power = maximum value.
OPP:IEND MIN Set end power = minimum value.
Query Syntax : OPP:IEND?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Watt]
Query Example : OPP:IEND?
OPP:IEND? MAX
OPP:IEND? MIN
Return Example : 10

OPP:STEP

Type : Channel-Specific
Description : Set step count for OPP test mode.
Syntax : OPP:STEP <NR1>
Parameters : 1~1000.
Example : OPP:STEP 100 Set step = 100
OPP:STEP MAX Set step = maximum value.
OPP:STEP MIN Set step = minimum value.
Query Syntax : OPP:STEP?[<MAX | MIN>]
Return Parameters : <NR1>
Query Example : OPP:STEP?
OPP:STEP? MAX
OPP:STEP? MIN
Return Example : 100

OPP:DWELl

Type : Channel-Specific
Description : Set dwell time for OPP test mode.
Syntax : OPP:DWELl <NR1>
Parameters : 1~1000.
Example : OPP:DWEL 100 Set dwell time = 100
OPP:DWEL MAX Set dwell time = maximum value.
OPP:DWEL MIN Set dwell time = minimum value.
Query Syntax : OPP:DWEL?[<MAX | MIN>]
Return Parameters : <NR1>[Unit = ms]
Query Example : OPP:DWEL?
OPP:DWEL? MAX
OPP:DWEL? MIN
Return Example : 100

OPP:TRIGger:VOLTage

Type : Channel-Specific
Description : Set trigger voltage for OPP test mode.
Syntax : OPP:TRIGger:VOLTage <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OPP:TRIGger:VOLTage 4.5 Set start power = 4.5V
OPP:TRIGger:VOLTage MAX Set start power = maximum value.
OPP:TRIGger:VOLTage MIN Set start power = minimum value.
Query Syntax : OPP:TRIGger:VOLTage?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Voltage]
Query Example : OPP:TRIGger:VOLTage?
OPP:TRIGger:VOLTage? MAX
OPP:TRIGger:VOLTage? MIN
Return Example : 4.5

OPP: SPECification:L

Type : Channel-Specific
Description : Set low level power of specification for OPP test mode
Syntax : OPP:SPECification:L <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OPP:SPECification:L 5 Set low level power = 5W
OPP:SPECification:L MAX Set low level power = maximum value.
OPP:SPECification:L MIN Set low level power = minimum value.

Query Syntax : OPP:SPECification:L?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Watt]
Query Example : OPP:SPECification:L?
OPP:SPECification:L? MAX
OPP:SPECification:L? MIN
Return Example : 5

OPP: SPECification:H

Type : Channel-Specific
Description : Set high level power of specification for OPP test mode
Syntax : OPP:SPECification:H <NR2>
Parameters : Refer to respective specification for valid value range.
Example : OPP:SPECification:H 10 Set high level power = 10W
OPP:SPECification:H MAX Set high level power = maximum value.
OPP:SPECification:H MIN Set high level power = minimum value.
Query Syntax : OPP:SPECification:H?[<MAX | MIN>]
Return Parameters : <NR2>, [Unit = Watt]
Query Example : OPP:SPECification:H?
OPP:SPECification:H? MAX
OPP:SPECification:H? MIN
Return Example : 10

OPP:RESult?

Type : Channel-Specific
Description : Returns the result of OPP test function.
Syntax : None
Parameters : None
Example : None
Query Syntax : ADVance:OPP:RESult?
Return Parameters : When the returns are
-1 denotes OPP test is stop.
-2 denotes OPP test is ready to execute what wait for Von or other condition.
-3 denotes OPP test is execute.
<arg1>,<arg2>,<arg3>
<arg1>: Pass/Fail. <NR1>, 0: PASS 1: FAIL [Unit = None]
<arg2>: OPP power. <NR2>, [Unit = Ampere]
Query Example : ADV:OPP:RES?

8. Status Reporting

8.1 Introduction

This chapter discusses the status data structure of the Chroma 6310 series electronic load as shown in Figure 8-1 (on the next page). The standard registers, such as the Event Status register group, the Output Queue, the Status Byte and Service Request Enable registers perform standard GPIB functions and are defined in IEEE-488.2 Standard Digital Interface for Programmable Instrumentation. Other status register groups implement the specific status reporting requirements of the electronic load. The Channel Status and Channel Summary groups are used by multiple channel of electronic load to enable status information to be kept at its own Status register of each channel.

8.2 Register Information in Common

- *Condition register*
  The condition register represents the present status of electronic load signals. Reading the condition register does not change the state of its bits. Only changes in electronic load conditions affect the contents of this register.

- *PTR/NTR Filter, Event register*
  The Event register captures changes in conditions corresponding to condition bits in a condition register, or to a specific condition in the electronic load. An event becomes true when the associated condition makes one of the following electronic load-defined transitions:
  Positive TRansition (0 - to - 1)
  Negative TRansition (1 - to - 0)
  Positive or Negative TRansition (0-to-1 or 1-to-0)

  The PTR/NTR filters determine what type of condition transitions set the bits in the Event register. Channel Status, Questionable Status allow transitions to be programmed. Other register groups, i.e. Channel Summary, Standard Event Status register group use an implied Rise (0-to-1) condition transition to set bits in the Event register. Reading an Event register clears the register (all bits set to zero).

- *Enable register*
  The Enable register can be programmed to enable which bit in the corresponding Event register is logically-ORed into the Channel Summary bit.

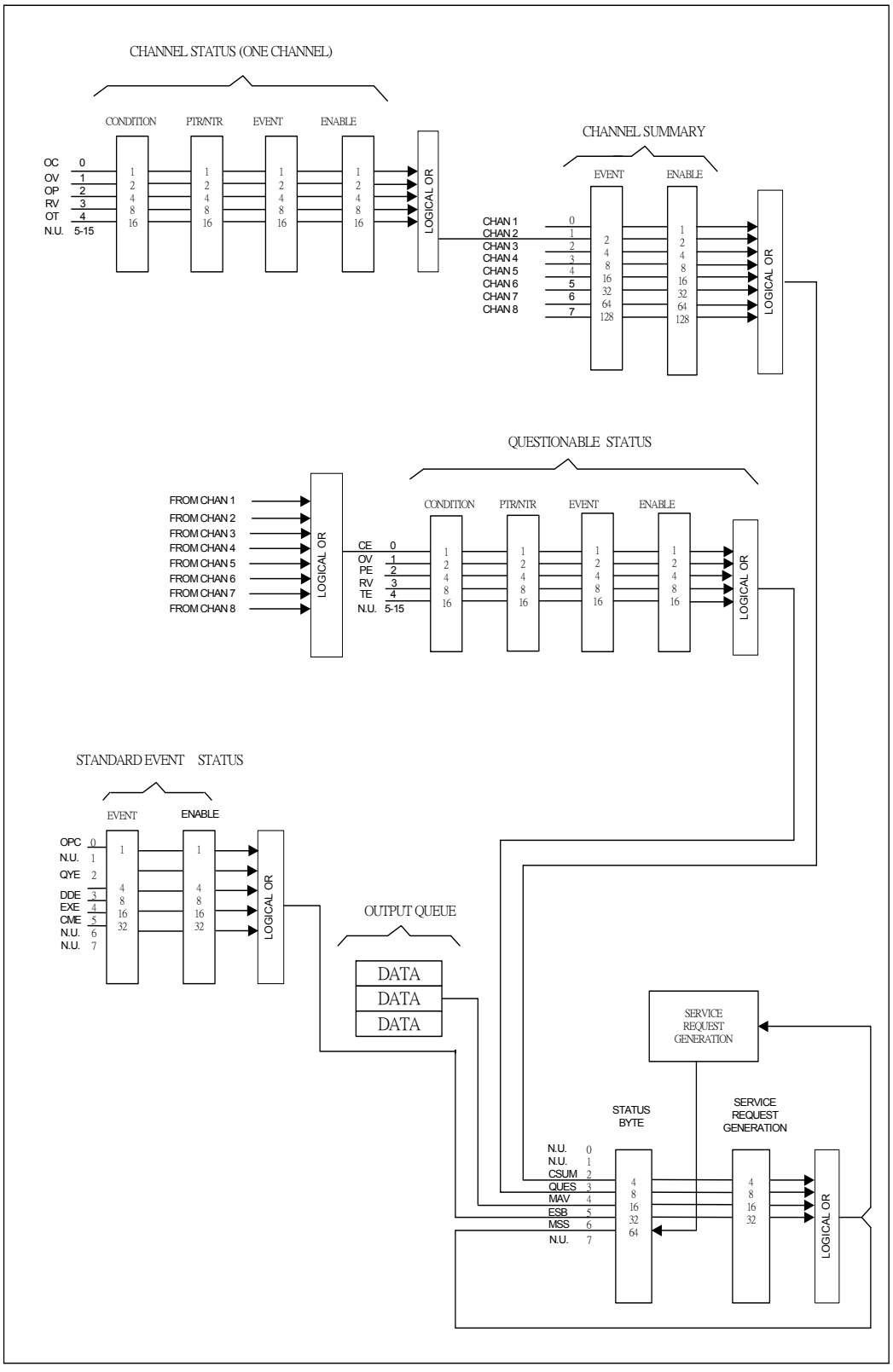


Figure 8-1 The Status Registers of Electronic Load

Mnemonic	Bit	Value	Meaning
OC	0	1	*Overcurrent*. When an overcurrent condition has occurred on a channel, Bit 0 is set and remains set until the overcurrent condition is removed and LOAD:PROT:CLE is programmed.
OV	1	2	*Overvoltage*. When an overvoltage condition has occurred on a channel, Bit 1 is set and remains set until the overvoltage condition is removed and LOAD:PROT:CLE is programmed.
OP	2	4	*Overpower.* An overpower condition has occurred on a channel, Bit 2 is set and remains set until the overpower condition is removed and LOAD:PROT:CLE is programmed.
RV	3	8	*Reverse voltage on input.* When a channel has a reverse voltage applied to it, Bit 3 is set. It remains set until the reverse voltage is removed and LOAD:PROT:CLE is programmed.
OT	4	16	*Overtemperature*. When overtemperature condition has occurred on a channel, Bit 4 is set and the channel is turned off. It remains set until the channel has cooled down well below the overtemperature trip point and LOAD:PROT:CLE is programmed.

Table 8-1 Bit Description of Channel Status

8.3 Channel Status

- The Channel Status register offers you one or more channel status conditions, which indicate certain errors or faults have occurred on specific channel. Table 8-1 describes the channel status conditions that are applied to the electronic load.

- When the bits of the Channel Status Condition register are set, the corresponding condition is true.

- Program the PTR/NTR filter to select which way of a condition transition on a bit in the Channel Status Condition register will set the corresponding bit in the Event registers. Reading of the Channel Status Event register resets itself to zero.

- The Channel Status Enable register can be programmed to specify which channel status event bit is logically-ORed to become the corresponding channel bit in the Channel Summary Event register.

8.4 Channel Summary

- The Channel Summary registers summarize the channel status conditions of up to 8 channels.
- When an enabled bit in the Channel Status Event register is set, it causes the corresponding channel bit in the Channel Summary Event register to be set.
- Reading of the Event register will reset it to zero.
- The Channel Summary Enable register can be programmed to specify which channel

summary event bit from the existing channels is logically-ORed to become Bit 2 (CSUM bit) in the Status Byte register.

8.5 Questionable Status

- The Questionable Status registers offer you one or more questionable status conditions, which indicate certain errors or faults have occurred on at least one channel. Table 8-2 lists the questionable status conditions that are applied to the electronic load. These conditions are the same as the channel status conditions. Refer to Table 8-1 for a complete description.
- When corresponding bit of Questionable Status Condition register is set, the indicated condition is true.
- Program the PTR/NTR filter to select which way of a condition transition on a bit in the Questionable Status Condition register will set the corresponding bit in the Event registers.
- Reading of the Questionable Status Event register will reset it to zero.
- The Questionable status Enable register can be programmed to specify which questionable status event bit is logically-ORed to become Bit 3 (QUES bit) in the Status Byte register.

Mnemonic	Bit	Value	Meaning
CE/OC	0	1	*Current Error (Over current)*
OV	1	2	*Over voltage*
PE/OP	2	4	*Power Error (Overpower)*
RV	3	8	*Reverse voltage on input*
TE/OT	4	16	*Temperature Error (Over temperature)*

Table 8-2 Bit Description of Questionable Status

8.6 Output Queue

- The Output Queue stores output messages until they are read from the electronic load.
- The Output Queue stores messages sequentially on a FIFO (First-In, First-Out) basis.
- When there are data in the queue, it sets it 4 (MAV bit) in the Status Byte register.

8.7 Standard Event Status

- All programming errors that have occurred will set one or more of the error bits in the Standard Event Status register. Table 8-3 describes the standard events that apply to the electronic load.
- Reading of the Standard Event Status register will reset it to zero.
- The Standard Event Enable register can be programmed to specify which standard event bit is logically-ORed to become Bit 5 (ESB bit) in the Status Byte register.

Mnemonic	Bit	Value	Meaning

OPC	0	1	*Operation Complete.* This event bit generated is responding to the *OPC command. It indicates that the device has completed all selected pending operations.
QYE	2	4	*Query Error*. The output queue was read when no data were present or the data in the queue were lost.
DDE	3	8	*Device Dependent Error.* Memory was lost, or self-test failed.
EXE	4	16	*Execution Error*. A command parameter was outside the legal range or inconsistent with the electronic load's operation, or the command could not be executed due to some operating condition.
CME	5	32	*Command Error.* A syntax or semantic error has occurred, or the electronic load has received a <GET> within a program message.

Table 8-3 Bit Description of Standard Event Status

8.8 Status Byte Register

- The Status Byte register summarizes all of the status events from all status registers. Table 8-4 describes the status events that are applied to the electronic load.
- The Status Byte register can be read with a serial poll or *STB? query.
- The RQS bit is the only bit that is automatically cleared after a serial poll.
- When the Status Byte register is read with a *STB? query, Bit 6 of the Status Byte register will contain the MSS bit. The MSS bit indicates that the load has at least one reason for requesting service. *STB? does not affect the status byte.
- The Status Byte register is cleared by *CLS command.

Status Byte Bit Description

Mnemonic	Bit	Value	Meaning
CSUM	2	4	*Channel Summary*. It indicates if an enabled channel event has occurred. It is affected by Channel Condition, Channel Event and Channel Summary Event registers.
QUES	3	8	*Questionable*. It indicates if an enabled questionable event has occurred.
MAV	4	16	*Message Available.* It indicates if the Output Queue contains data.
ESB	5	32	*Event Status Bit*. It indicates if an enabled standard event has occurred.
RQS/MSS	6	64	*Request Service/Master Summary Status.* During a serial poll, RQS is returned and cleared. For an *STB? query, MSS is returned without being cleared.

Table 8-4 Bit Description of Status Byte

8.9 Service Request Enable Register

- The Service Request Enable register can be programmed to specify which bit in the Status Byte register will generate service requests.

9. An Example of Use

In this chapter a basic example of controlling electronic load are provided for use of GPIB. The GPIB used here is made by NI (National Instruments).

Examples:

```
#include “dec1.h”

#include <stdio.h>
#include <stdlib.h>
#include <sring.h>
#include <iostream.h>
#include <time.h>

static int MTA,
           MLA;

static int bd;

const char LA = 0x20,
           TA = 0x40;

static void setNi( int pad, char *cardName )
{
    MTA = TA + pad;
    MLA = LA + pad;
    if ( (bd = ibfind ( cardName ) ) < 0 )    {
       puts ( “GPIB Card Found Error” );
       exit ( 1 );
    }
    if ( ibpad ( bd, pad ) & ERR )    {
        puts ( “GPIB Card Address Assignment Error” );
        exit ( 3 );
    }
    ibtmo ( bd, 10 );
  ibsic ( bd );
  ibsre ( bd, 1 );
}

static void Niwrite( int pad, char *cmdStr )
{
   char cmd[4];

  cmd[0] = UNL;
  cmd[1] = UNT;
  cmd[2] = MTA;
```

```
    cmd[3] = LA + pad;
    //
    ibcmd( bd, cmd, 4 );
    ibwrt ( bd, cmdStr, _fstrlen( cmdStr ) );
    ibcmd( bd, cmd, 2 );
}

static char rxBuf[ 64 ]

static void Niread( int pad, char *queryStr )
{
    char cmd[ 4 ];

     Niwrite( pad, queryStr );
     cmd[ 0 ] = UNL;
     cmd[ 1 ] = UNT;
     cmd[ 2 ] = TA + pad;
     cmd[ 3 ] = MLA;
     //
ibcmd( bd, cmd, 4 );
     ibrd( bd, rxBuf, sizeof( rxBuf ) - 1 );
     rxBuf[ ibcnt ] = ' \0 ';
     ibcmd( bd, cmd, 2);
}



void main( )
{
    setNi( 0, "GPIB" );                  // Set the status of PC's GPIB CARD.
    //
    Niread( 8, "*IDN?" );                // Read back identity code of 6314.
    cout << rxBuf << " \n\r ";           // Display on the screen of PC.
    //
    Niwrite( 8, "CHAN 1" );              // Set CHANNEL as 1.
    //
    Niread( 8,    "CHAN:ID?" );          // Read back identity code of channel 1.
    cout << rxBuf << " \n\r ";           // Display on the screen of PC.
    //
    Niwrite( 8, "MODE CCL" );            // Set CHANNEL 1 MODE as CCL.
    Niwrite ( 8, "CURR:STATIC:L1 1" ):   // Set L1 current of CCL as 1A.
    //
    Niread( 8,    "LOAD ON" );           // Start sinking current.
    //
    Niread( 8, "MEAS:VOLT?" );           // Measure the readings of voltage.
    cout << rxBuf << " \n\r ";           // Display on the screen of PC.
    //
    Niread( 8, "MEAS:CURR?" );           // Measure the readings of current.
    cout << rxBuf << " \n\r ";           // Display on the screen of PC.
```

```
    Niread( 8, "LOAD OFF" );                    // Stop sinking current.
    //
    ibsic ( bd );
    ibon1( bd, 0 );
    ibsre ( bd, 0 );
}
```

For the above example please refer to *Chapter 3*, and add corresponding commands according to setting and control.

Example of PROGRAM RUN

You can use the following control procedures to run the PROGRAM.

```
<1> PROGram:FILE 1                  // Set the PROGRAM FILE to be run
<2> PROGram:ACTive 15               // Set the mapping action for Module Channel
                                    // chan 1 - chan 8 mapping value weights are
                                    // 1, 2, 4, 8, 16, 32, 64,128
<3> PROGram:CHAIN 0                 // program chain file No.
<4> PROGram:ONTime 3                // on time setting
<5> PROGram:OFFTime 2               // off time setting
<6> PROGram:SEQuence 1              // Sequence No. setting
<7> PROGram:SEQuence:MODE AUTO          // Sequence mode setting
<8> PROGram:SEQuence:SHORt:CHANnel 1    // Sequence short channel setting
<9> PROGram:SEQuence:SHORt:TIME 1       // Sequence short setting

<10> PROGram:SEQuence 2                 // sequence 2,sequence 3,....setting
.
.
.
<11> PROGram:SAVE                       // Save program setting data
.
.
<12> PROGram:RUN                        // Run PROGRAM
.
.
.
<13> PROGram:RUN?                       // Check if PROGRAM is running
```