



Programmable DC Electronic Load

44000 Series Operation & Programming Manual

Version A1
May 2010
150935

Legal Notices

The information in this document is subject to change without notice.

QuadTech, Inc. makes no warranty of any kind in regards to this manual, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. QuadTech, Inc. shall not be held liable for errors contained herein or direct, indirect, special, incidental or consequential damages in connection with the furnishing, performance, or use of this material.

QuadTech, Inc.

www.quadtech.com • 800-253-1230

Copyright Notices. Copyright 2009 QuadTech, Inc., all rights reserved. Reproduction, adaptation, or translation of this document without prior written permission is prohibited, except as allowed under the copyright laws.

Warranty

All QuadTech instruments are warranted against defects in material and workmanship for a period of one year after date of shipment. QuadTech agrees to repair or replace any assembly or component found to be defective, under normal use during this period. QuadTech's obligation under this warranty is limited solely to repairing any such instrument, which in QuadTech'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. Shipments should not be made without prior authorization by QuadTech.

This warranty does not apply to any products repaired or altered by persons not authorized by QuadTech, or not in accordance with instructions furnished by QuadTech. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

QuadTech assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. QuadTech assumes no liability for secondary charges or consequential damages and in any event, QuadTech's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by QuadTech for use of its products are based upon tests believed to be reliable, but QuadTech makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for QuadTech any liability in connection with the sale of our products other than set forth herein.

QuadTech, Inc.

Tel: 800-253-1230

Fax: 978-461-4295

<http://www.quadtech.com>

Material Contents Declaration

A regulatory requirement of The United States of America defined by specification SJ/T 11364-2006 mandates that manufacturers provide material contents declaration of electronic products, and for QuadTech, Inc. 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	×	○	○	○	○	○
CHASSIS	×	○	○	○	○	○
ACCESSORY	×	○	○	○	○	○
PACKAGE	○	○	○	○	○	○

“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. QuadTech, Inc. 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: 44040, 44020, 44001, 44002, 44003, 44004, 44005, 44006, 44007, 44009

Manufacturer's Name: QuadTech, Inc.

Manufacturer's Address: www.quadtech.com or 800-253-1230

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

U.S.A

May, 2010

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 in this manual will violate safety standards of the design, manufacturing, and intended use of the instrument.

QuadTech, Inc. assumes no liability for the customer's failure to comply with these requirements.

	BEFORE APPLYING POWER Verify that the power is set to match the rated input of this power supply.
	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. The instrument should be used in an environment of good ventilation.
	DO NOT REMOVE THE COVER OF THE INSTRUMENT Operating personnel must not remove the cover of the instrument. Component replacement and internal adjustment can be done only 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.



High temperature: This symbol indicates the temperature is now higher than the acceptable range of human. Do not touch it to avoid any personal injury.



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.



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.



The **CAUTION** sign denotes a hazard. It may result in personal injury or death if not noticed timely. It calls attention to procedures, practices and conditions.

Revision History

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

Date	Version	Revised Sections
May 2010	A1	Release

Table of Contents

PART 1: Operation

1. General Information	15
1.1 Introduction	15
1.2 Description	15
1.3 Overview of Key Features	16
1.4 Specifications	16
2. Installation	27
2.1 Introduction	27
2.2 Inspection	27
2.3 Installing the Modules	27
2.3.1 Channel Number	28
2.4 Installing the Mainframe	29
2.4.1 Changing Line Voltage	29
2.4.2 Turn-On Self-Test	30
2.5 Application Connection	31
2.5.1 Load Connections	31
2.5.2 Remote Sensing Connections	32
2.5.3 Parallel Connections	33
2.6 Remote Control Connection	33
3. Operation Overview	35
3.1 Introduction	35
3.2 Front Panel Description	35
3.3 Rear Panel Description	36
3.4 Local/Remote Control	37
3.5 Modes of Operation	37
3.5.1 Constant Current Mode	38
3.5.2 Constant Resistance Mode	41
3.5.3 Constant Voltage Mode	42
3.5.4 Constant Power Mode	43
3.6 OCP/OPP Mode of Operation	44
3.7 Load Synchronization	44
3.8 Measurements	45
3.9 Slew Rate & Minimum Transient Time	45
3.10 Start/Stop Sink Current	45
3.11 Short On/Off	46
3.12 Load On/Off	47
3.13 Protection Features	47
3.14 Save/Recall Setting	48
3.15 Program	49
4. Local Operation	51
4.1 Introduction	51
4.2 Local Operation of Load Mainframe	51
4.2.1 Selecting the Channel	53
4.2.2 Setting the Operation Mode	54
4.2.3 Setting the OCP/OPP Mode of Operation	58
4.2.4 Setting the Program	62
4.2.5 Running the Program	64
4.2.6 Setting the Specification	65
4.2.7 Setting the Configuration	66

4.2.8	Recalling Files/OCP Files/OPP Files.....	73
4.2.9	Saving File/OCP File/OPP File/Default/Program	73
4.2.10	Going To Local	74
4.2.11	Lock Operation	74
4.2.12	Setting System and RS-232C Connection.....	74
4.2.13	Connecting the GO/NG Output Port	75
4.2.14	Connecting the DIGITAL IO Port	76
4.2.15	Setting the GPIB Address.....	78
4.3	Local Operation of Load Module	78
4.3.1	Local Operation of Single Channel/Module (Panel A)	79
4.3.2	Local Operation of Double Channels/Module (Panel B).....	81
4.3.3	Switching of MEAS. Voltage, Current & Power on Module.....	83
4.3.4	Online Change Level	84
 PART 2: Programming		
5.	General Information for Programming	87
5.1	Introduction.....	87
5.2	DIP Switches on the GPIB Card.....	87
5.2.1	GPIB Address	87
5.2.2	Other DIP Switches	88
5.3	GPIB Capability of the Electronic Load	88
5.4	RS232C in Remote Control	89
6.	Introduction to Programming.....	91
6.1	Basic Definition.....	91
6.2	Numerical Data Formats.....	91
6.3	Character Data Formats	92
6.4	Separators and Terminators.....	93
7.	Language Dictionary	95
7.1	Common Commands.....	95
7.2	Specific Commands.....	99
7.2.1	ABORT Subsystem.....	99
7.2.2	CHANNEL Subsystem.....	99
7.2.3	CONFIGURE Subsystem.....	102
7.2.4	CURRENT Subsystem.....	109
7.2.5	FETCH Subsystem	112
7.2.6	LOAD Subsystem	115
7.2.7	MEASURE Subsystem	118
7.2.8	MODE Subsystem	121
7.2.9	PROGRAM Subsystem.....	123
7.2.10	RESISTANCE Subsystem	127
7.2.11	RUN Subsystem	128
7.2.12	SHOW Subsystem	128
7.2.13	SPECIFICATION Subsystem.....	130
7.2.14	STATUS Subsystem	133
7.2.15	VOLTAGE Subsystem	137
7.2.16	POWER Subsystem	139
7.2.17	OCP Subsystem	141
7.2.18	OPP Subsystem	145
8.	Status Reporting.....	149
8.1	Introduction.....	149
8.2	Register Information in Common.....	149
8.3	Channel Status	151

8.4	Channel Summary	151
8.5	Questionable Status	152
8.6	Output Queue	152
8.7	Standard Event Status.....	152
8.8	Status Byte Register	153
8.9	Service Request Enable Register.....	154
9.	An Example of Use	155

PART 1

Operation

1. General Information

1.1 Introduction

This manual contains specifications, installation, operation, and programming instructions for the 44040, 44020 electronic load mainframes, as well as, 44002, 44003, 44004 electronic load modules. In this instance, “Load” means the electronic load modules of the QuadTech, Inc. 44000 Series while “Mainframe” means the 44040, 44020 electronic load mainframes.

1.2 Description

The functions of the 44040 (4 Slots) and the 44020 (2 Slots) mainframes are the same. The functions of the 44002, 44003, 44004, etc., are all the same. The differences are with input voltage ratings, load current ratings, and power ratings. An individual module may have one or two channels depending on the model. Each channel has its own channel number, load and measurement connectors, and operates independently in constant current (CC) mode, constant resistance (CR) mode, constant voltage (CV) mode, or constant power (CP) mode.

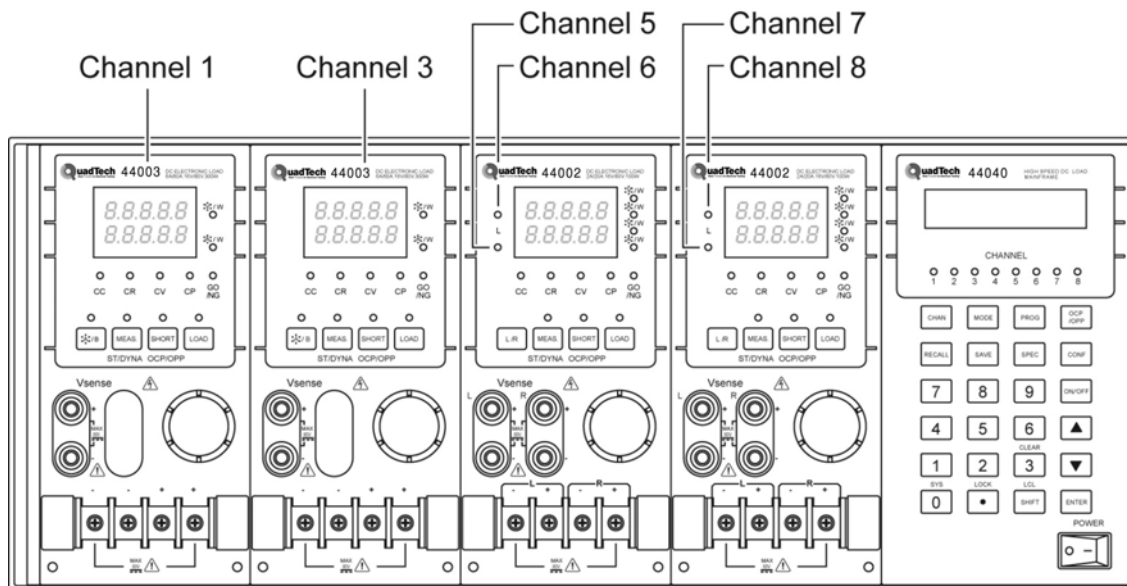


Figure 1-1 Front Panel of the Electronic Load

Press **MODE** on the frame, as shown in Figure 1-1, can switch to various modes (CC, CR, CV, CP) for operation.

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 optional GPIB/USB or standard RS-232C interface.
- Photocoupler isolation offers true floating Load.
- Automatic fan speed control to reduce noise.
- Up to 8 channels in 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 speeds up to 20kHz.
- Minimum input resistance allows load to sink high current even with low input voltage (1V).
- 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.
- 16-bit A/D converter offers precision measurements.
- Short circuit simulation.
- Automatic GO/NG inspection to confirm UUT is within spec.
- Independent GO/NG signals for each channel.

1.4 Specifications

Mainframe	:	44040/44020
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 (48.5lbs) / 15kg (33.1lbs)
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 44000 series is supplied from 44040/44020 mainframe.
- 8. The typical temperature coefficient is 100ppm.
- 9. The specifications of CR mode accuracy: mho(S) 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	44001		44004	
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	0~4A	0~40A	0~1A	0~10A
Range				
Resolution	1mA	10mA	0.25mA	2.5mA
Accuracy	0.1%+0.1%F.S.		0.1%+0.1%F.S.	0.1%+0.2%F.S.
CONSTANT RESISTANCE MODE	0.0375Ω~150Ω (200W/16V) 1.875Ω~7.5kΩ (200W/80V)		1.25Ω~5kΩ (300W/125V) 50Ω~200kΩ (300W/500V)	
Range				
Resolution	6.667m mho (200W/16V) 133μ mho (200W/80V)		200μ mho (300W/125V) 5μ mho (300W/500V)	
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	0~80V		0~500V	
Range				
Resolution	20mV		125mV	
Accuracy	0.05%±0.1%F.S.		0.05%±0.1%F.S.	
CONSTANT POWER MODE	0 ~ 20W	0 ~ 200W	0 ~ 30W	0 ~ 300W
Range				
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*2	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 Alarm*3	≈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/°C (Typical)		100ppm/°C (Typical)	
Power	Supply from 44000 Mainframe		Supply from 44000 Mainframe	
Dimension (H×W×D)	172×82×489.5mm / 6.77×3.23×19.27inch		172×82×489.5mm / 6.77×3.23×19.27inch	
Weight (Approx.)	4.2kg/9.25 lbs		4.2kg/9.25 lbs	
Operating Range	0~40°C		0~40°C	
EMC & SAFETY	CE		CE	

MODEL	44002(100W*2)		44003	
POWER	20W	100W	30W	300W
CURRENT	0~2A	0~20A	0~6A	0~60A
VOLTAGE	0~80V		0~80V	
MIN. OPERATING VOLTAGE (DC)*1(Typical)	0.4V@1A	0.4V@10A	0.4V@3A	0.4V@30A
	0.8V@2A	0.8V@20A	0.8V@6A	0.8V@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	3.333m mho (100W/16V) 66.667μ mho (100W/80V)		10m mho (300W/16V) 200μ mho (300W/80V)	
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	0~80V		0~80V	
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*2	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 Alarm*3	≈ 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/°C (Typical)		100ppm/°C (Typical)	
Power	Supply from 44040 Mainframe		Supply from 44040 Mainframe	
Dimension (H×W×D)	172×82×489.5mm / 6.77×3.23×19.27inch		172×82×489.5mm / 6.77×3.23×19.27inch	
Weight (Approx.)	4.2kg/9.25 lbs		4.2kg/9.25 lbs	
Operating Range	0~40°C		0~40°C	
EMC & SAFETY	CE		CE	

MODEL	44006(30W,250W)			44005	
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(Typical)	0.4V@2.5A	0.4V@2A	0.4V@20A	0.4V@6A	0.4V@60A
	0.8V@5A	0.8V@4A	0.8V@40A	0.8V@12A	0.8V@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)	0.0375Ω~150Ω (250W/16V) 1.875Ω~7.5kΩ (250W/80V)		12.5mΩ~50Ω (600W/16V) 0.625Ω~2.5kΩ (600W/80V)	
Resolution	833μ mho (30W/16V) 16.67μ mho (30W/80V)	6.667m mho (250W/16V) 133μ mho (250W/80V)		20m mho (600W/16V) 400μ mho (600W/80V)	
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	0~80V			0~80V	
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
Resolution	0.25mV	1.25mV	0.25mV	1.25mV	0.25mV
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*2	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 Alarm*3	≈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/°C (Typical)			100ppm/°C (Typical)		
Power	Supply from 44040 Mainframe			Supply from 44040 Mainframe		
Dimension (H×W×D)	172×82×489.5mm / 6.77×3.23×19.27inch			172×164.2×489.5mm / 6.77×6.46×19.27inch		
Weight (Approx.)	4.5kg/9.91 lbs			7.3kg/16.08 lbs		
Operating Range	0~40°C			0~40°C		
EMC & SAFETY	CE			CE		

MODEL	44007		44009	
POWER	60W	600W	120W	1200W
CURRENT	0~2A	0~20A	0~24A	0~240A
VOLTAGE	0~500V		0~80V	
MIN. OPERATING VOLTAGE (DC)*1(Typical)	1V@1A	1V@10A	0.4V@12A	0.4V@120A
	2V@2A	2V@20A	0.8V@24A	0.8V@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	400μ mho (600W/125V) 10μ mho (600W/500V)		40m mho (1200W/16V) 800μ mho (1200W/80V)	
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	0~500V		0~80V	
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*2	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 Alarm*3	≈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/°C (Typical)		100ppm/°C (Typical)	
Power	Supply from 44040 Mainframe		Supply from 44040 Mainframe	
Dimension(H×W×D)	172×164.2×489.5mm / 6.77×6.46×19.27inch		172×328.6×495mm / 6.77×12.94×19.49inch	
Weight (Approx.)	7.3kg/16.08 lbs		14kg/30.84 lbs	
Operating Range	0~40°C		0~40°C	
EMC & SAFETY	CE		CE	

* Before using CCL mode on model 44004, 44007, it needs to set **CC Vrange Select** in Configuration to “2. LOW” for access permission.

NOTE*1:

Low voltage operation, under 0.8 volt on terminal by 44001, 44002, 44003, 44005, 44006, 44007 load module, under 2 volt on terminal by 44004, 44007 load module, is possible at correspondingly reduced current level. Operating temperature range is 0°C to 40°C. All specifications apply for 25°C±5°C, except as noted.

NOTE*2:

Power F.S. = Vrange F.S. × Irange F.S.

NOTE*3:

When the operating voltage exceeds the rated voltage of 1.02 times, a warning will occur. If it exceeds 1.1 times of the rated voltage, it would cause permanent damage to the device. For instance, the rated voltage of 44003 is 80V, a warning will occur when the input voltage exceeds 81.6V and the device would be damaged if the input voltage exceeds 88V.

Mainframe MODEL	44020	44040
Dimension(H×W×D)	193.7×274.8×550mm / 7.63×10.82×21.65inch	193.7×439×550mm / 7.63×17.28×21.65inch
Weight (Approx.)	15kg/33.04 lbs	21.5kg/47.36 lbs

2. Installation

2.1 Introduction

This chapter describes how to install the Load module into the Mainframe and make connections to the Loads. It also discusses the turn-on check out 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 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 QuadTech, Inc. 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 disc and Quick Start Guide for the Mainframe
- * Measurement and Load Cables(75cm) for the Load Modules

2.3 Installing the Modules

 **CAUTION** The 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 QuadTech, Inc. 44040 Mainframe has room for four single-width Loads (44002, 44003), or two double-width Loads (44005). The Loads can be combined in the Mainframe in any order. The QuadTech, Inc. 44000 mainframe has room for only two single-width Loads or one double-width Load. The procedures for 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 with a screwdriver (see Figure 2-1).
6. Install each additional module in the slot next to the previous one, likewise if applicable.

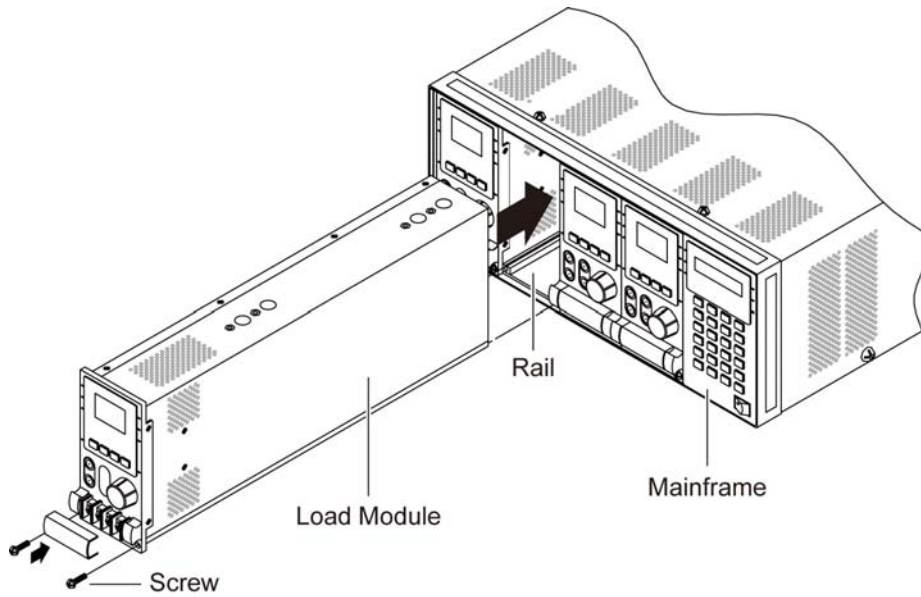


Figure 2-1 Installing Modules in the Electronic Load

⚠WARNING If the Mainframe is not installed with all modules, the empty one must be covered with the panel cover (QuadTech, Inc. part No: L00 002255) 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 position in the Mainframe. As some Loads (44002) 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 the Mainframe even if the Load module is empty. Figure 2-2 shows the channel assignments for a QuadTech, Inc. 44000 Mainframe containing two Loads, 44003 single channel/module, and two Loads 44020 double channel/module. Channel number is automatically assigned to each channel: 1, 3, 5, 6, 7, 8. In this example, channels 2 and 4 are not used because they are reserved for multiple channel modules and a single channel module is in that slot. The 44020 Mainframe has only four channels (1, 2, 3, 4).

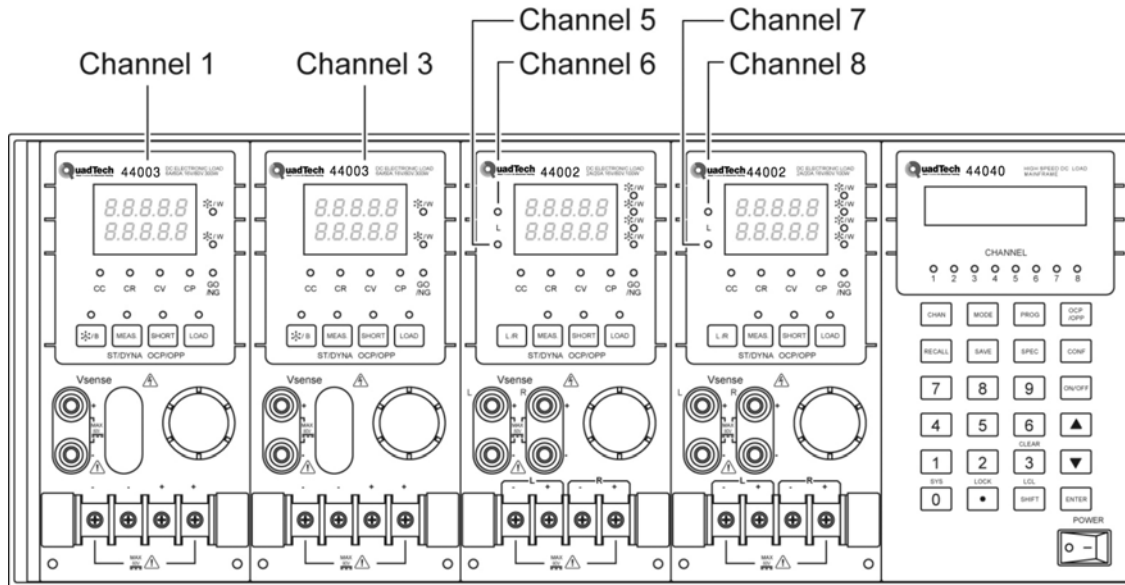


Figure 2-2 Channel Number Example

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, around the sides, and the rear of the unit for adequate air flow. At least 15 cm (5 inch) space above the unit is required for adequate air circulation. Please note, 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 equipment is installed on top of the electronic load in a cabinet, the user must install 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 voltage input settings.

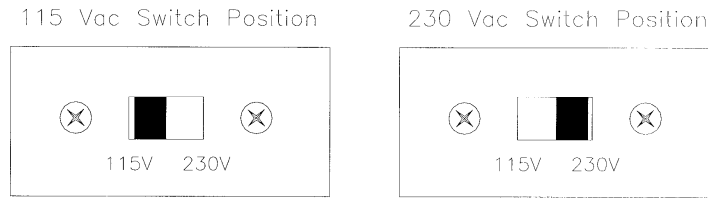


Figure 2-3 Line Voltage Switch

2.4.2 Turn-On Self-Test

Check the following things before turning on the Load.

1. The unit has been 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's 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 for 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 and checks the existing channels. 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 will have no display. When the self-test completes, the Mainframe will display the active channel.

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 connections if an error occurs. When the self-test completes, the 7-segment will display V and I measurements. The double channel/module goes to the L channel.

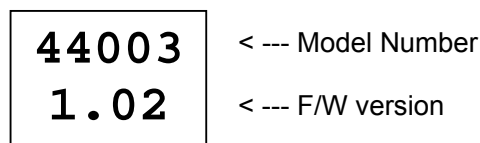


Figure 2-4 Module Panel Self-test Display

In case of failure, return the Mainframe or Load module to QuadTech, Inc. 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. Re-install the cover 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, so ensure that the wires are 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 by 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, you must use multiple terminals for connection. In case the MOSFETs in the electronic load fail in the short circuit status, there is no internal means of interrupting the current that is flowing from the Unit Under Test (UUT). User should consider added external circuit elements for protection as described below. MOSFET failures are rare when instruments are used within their rated voltage/current/power and temperature ranges.

Recommended safety precautions:

Ensure wiring, external circuit elements, etc are sized to the maximum rating of the LOAD even if intended UUTs are smaller. This provides protection in the event that users inadvertently apply full rated voltage, current or power or larger UUTs are tested in the future.

User should take into account the power dissipated in the output cable under worse case conditions to ensure the wire the gauge and cooling is adequate.

Ensure the load always receives adequate ambient cooling air at all times and air filters, ducts, etc are maintained regularly. If loads are used with a cabinet, precautions should be taken to minimize heating within the cabinet.

If the UUT may be damaged or an unsafe condition may occur in the event of a load short circuit (e.g. certain types of batteries), or if there is no means of de-energizing the UUT in the event of a load failure, user may consider including a suitably rated circuit breaker, fuse or other means of disconnecting the load from the UUT under emergency conditions.

- * If there are any questions regarding safe operation of the equipment or adding external protection circuits, please contact QuadTech, Inc.'s service personnel.

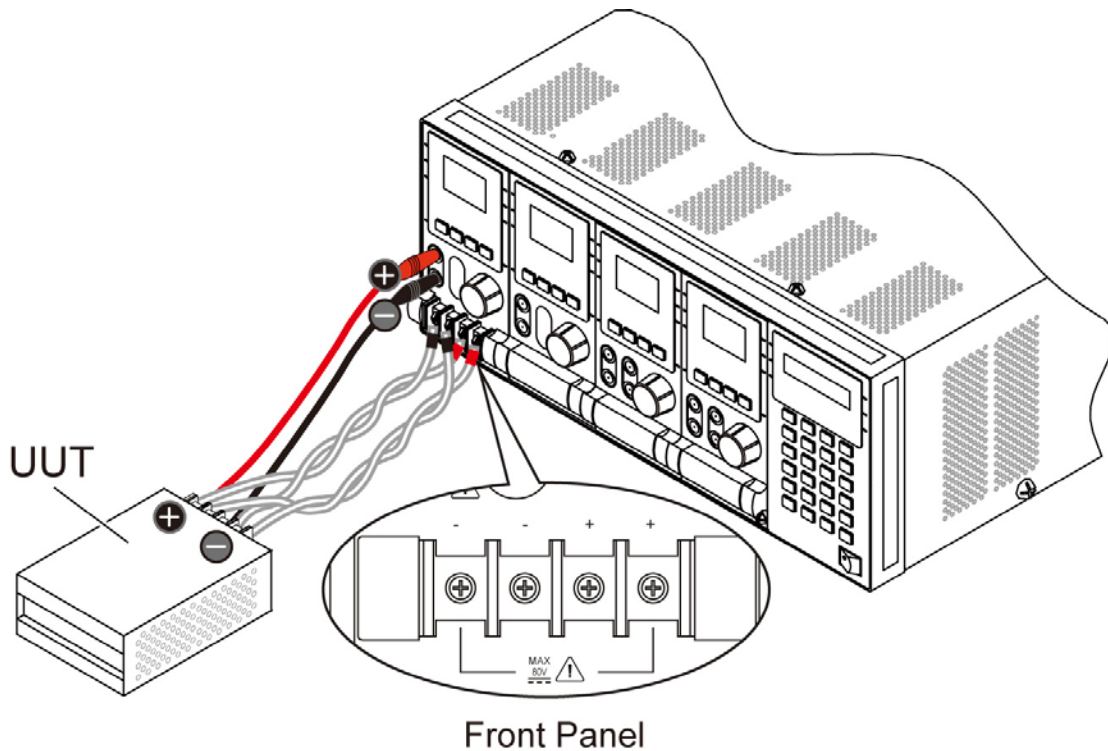


Figure 2-5 Load & Remote Sensing Connection

WARNING When connecting the load cable to the load module, do not use a load cable to connect a load module and short circuit other load modules, or it may cause the load cable to burn out when loading larger current.

2.5.2 Remote Sensing Connections

There are two sensing points on the electronic load module. One is the measurement at Load, terminal and the other 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 drops 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.



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.

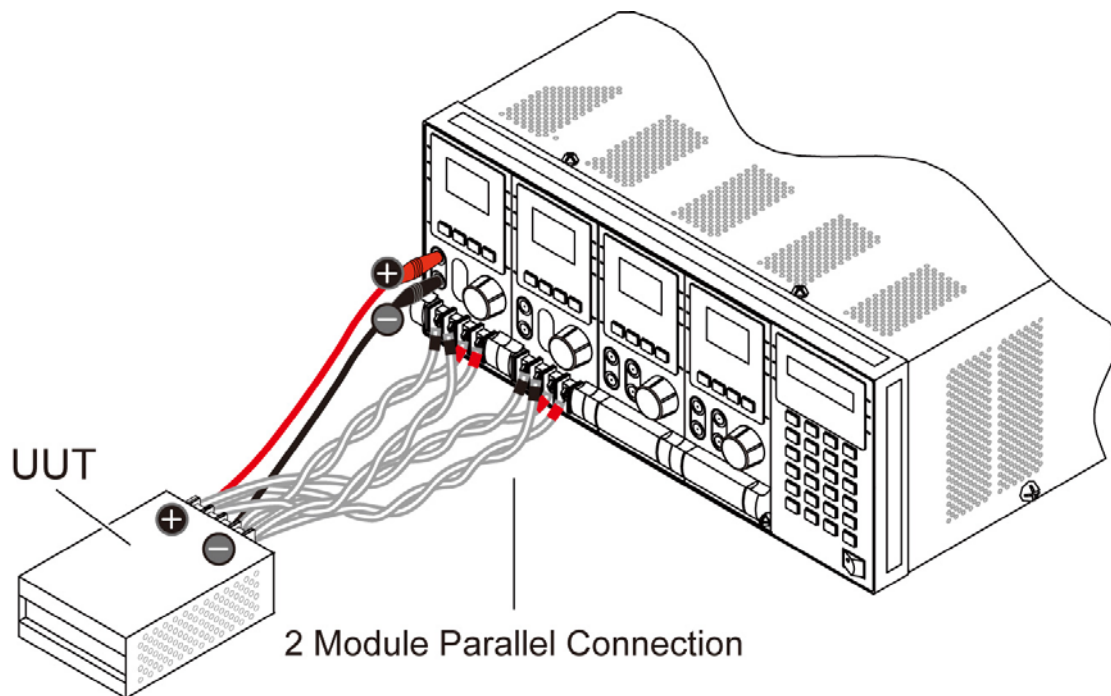


Figure 2-6 Parallel Connection

2.6 Remote Control Connection

The remote operation of the Load can be accomplished through GPIB, USB or RS-232C. The interface 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 44000 Series Remote Controller can control the load through RS-232C port standard. Connect the Remote Controller to the electronic load before powering on. If this is not done, the Load will shut down, or the fuse for the remote controller in the Mainframe will be broken.

3. Operation Overview

3.1 Introduction

The QuadTech, Inc. 44040 and 44020 multiple electronic load mainframes are used for design, manufacturing, testing and quality assurance. The Mainframe contains four (44040) or two (44020) slots for load modules. Load modules occupy either one or two slots depending on the power rating of the module. The Mainframe can dissipate up to 1200 watts when it is fully 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 and read back current, voltage and status. The SYNC function of the Mainframe synchronizes each module when module current/voltage level changes. The 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 (44040) or one (44020) cooling fans, and the module consists of one cooling fan. The fan speed automatically increases or decreases when the module's power dissipation 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 can connect the 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 until another channel is selected or addressed. Operation of all modules in the Mainframe is similar regardless of power ratings. The module also has a keypad to control itself independently.

3.2 Front Panel Description

The front panel of the mainframe includes a 16 × 2 character LCD display, 8 (4) channel indicators, and a keypad. All parameters of the load are set through mainframe. The LCD display also shows which function is being performed when you use the keypad. Three of the keys perform two functions. The alternative function is labeled in blue above the key. Select by pressing the blue **SHIFT** key and the function key simultaneously. Figure 3-1 shows the front panel of the mainframe 44020.

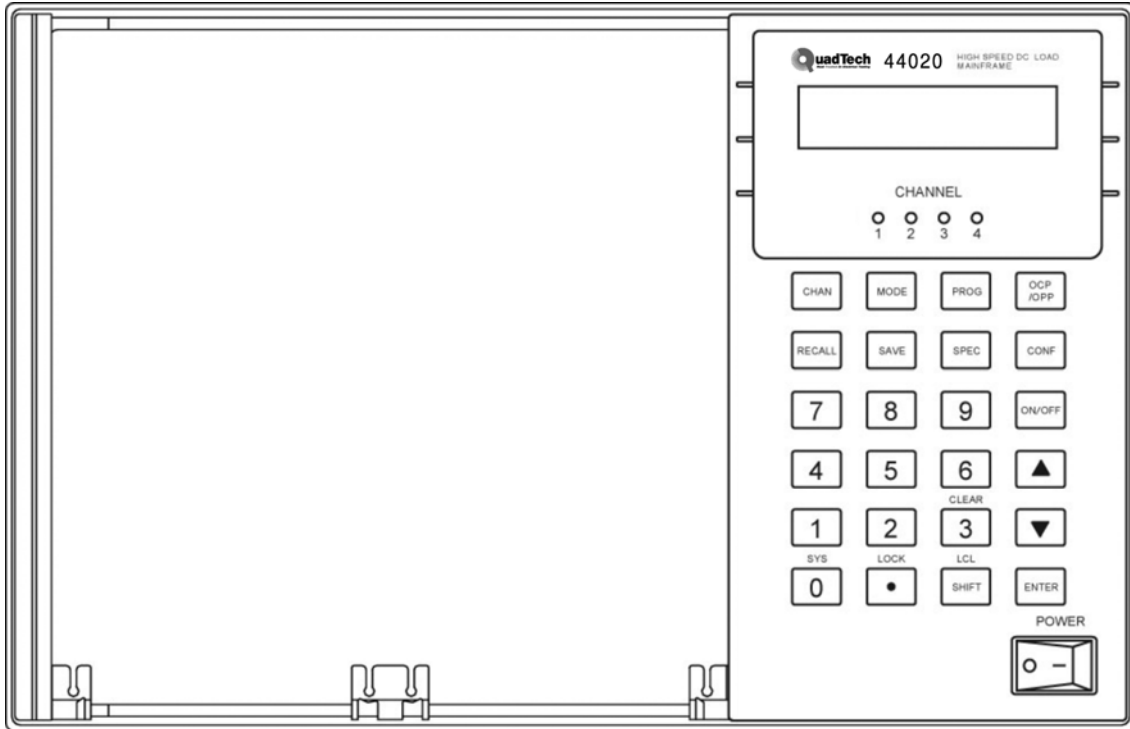


Figure 3-1 Front Panel of the Mainframe 44020

3.3 Rear Panel Description

The rear panel of the mainframe includes an RS-232C connector, a GO/NG output port, a DIGITAL 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 the mainframe 44040.

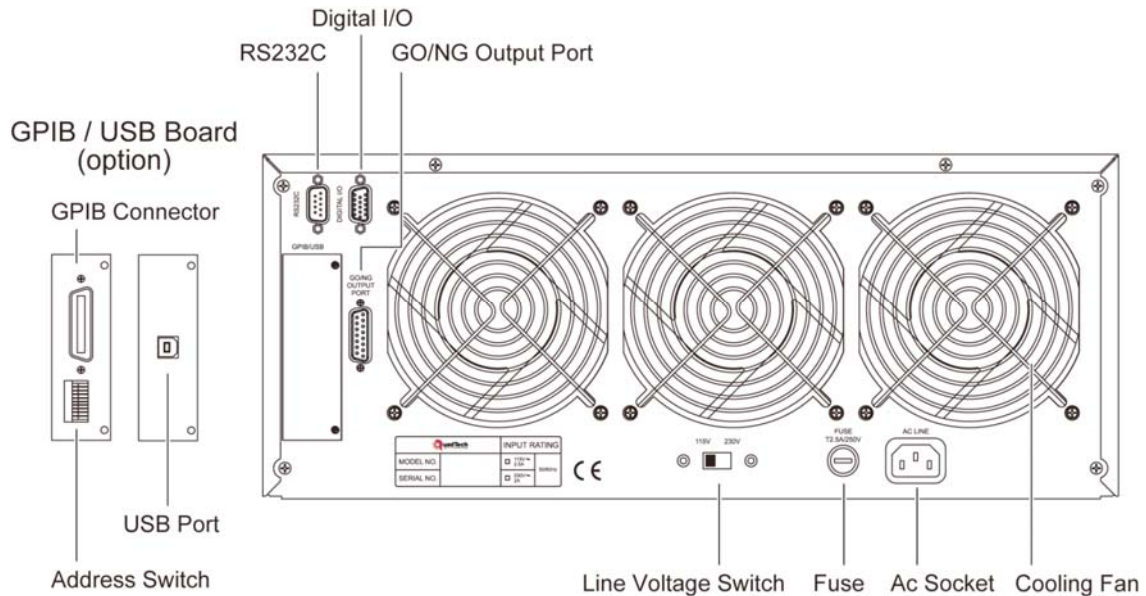


Figure 3-2 Rear Panel of the Mainframe 44040

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 modules when the 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 with the exception of the **LCL** key. You can return the load to local control from remote control by pressing the **LCL** key. The **SHIFT** key acts as the **LCL** when the load is in the remote state.

Most of the functions can be controlled both remotely and locally. The keypads on the module can control basic 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, QuadTech, Inc. 44000 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 the **ENTER** key to program to a mode, the module will change to a new mode. When changing modes, the module's input is momentarily disabled before the new mode is enabled. This ensures that there will be minimum overshoots when changing modes. It is easier to change the parameters of a given mode if that mode is presently selected.

All data set in CC/CR/CV/CP mode will be rescaled to fit the set resolution of current/voltage levels or slew rate. In local mode any value can be set to any module from the keypad. The mainframe automatically selects data, which is rescaled from the programmed value, truncates and checks high, low boundary before implementing. When programmed data are over the boundary, the mainframe will set the maximum or minimum level for the Load module. In remote mode the programmed value cannot be over boundary. An error will occur when data are over the maximum or under the minimum value.

3.5.1 Constant Current Mode

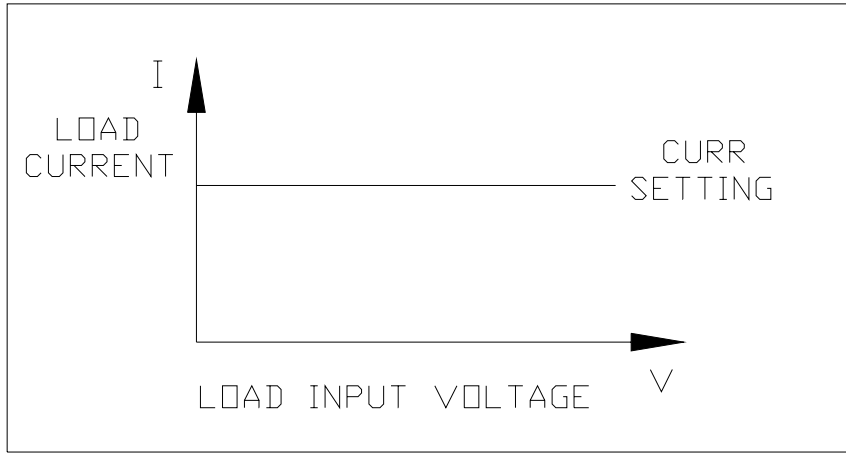


Figure 3-3 Constant Current Mode

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 the front panel key **MODE**. When **MODE SELECT** is displayed, the user must select static low range **CCL** or static high range **CCH**.

Current Ranges (Low, High)

Current can be programmed in one of the two ranges, low range and high range. The low range provides better resolution at low current settings. If any value is over the maximum of low range, you must select the high range. Press the **MODE** key first and then, use **▲** or **▼** keys 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 the 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) may be selected. The STATIC function checks the stability of the output voltage from a power supply. In some modules, (single channel/module) there are two current levels (A or B) for the static function. Both states A and B use the same range. The user can select A (CCL1 or CCH1) or B (CCL2 or CCH2) through the **A/B** key on the module's keypad or the mainframe keypad when level1 (A) or level2 (B) changes. Slew rate determines the rate at which the load level changes from one level to the other. Figure 3-3 shows the current level of the load module after pressing of **A/B** key.

CCL1:4A, CCL2:2A, CCL \nearrow : 0.2A/ μ S, CCL \searrow : 0.08A/ μ S

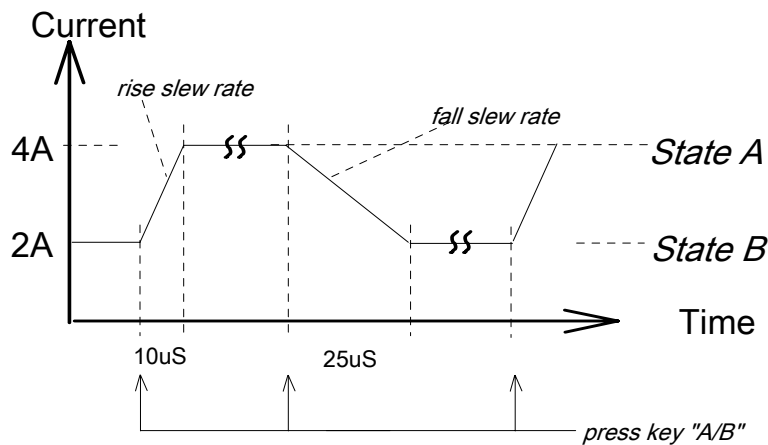


Figure 3-4 Load Level after Pressing A/B Key

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

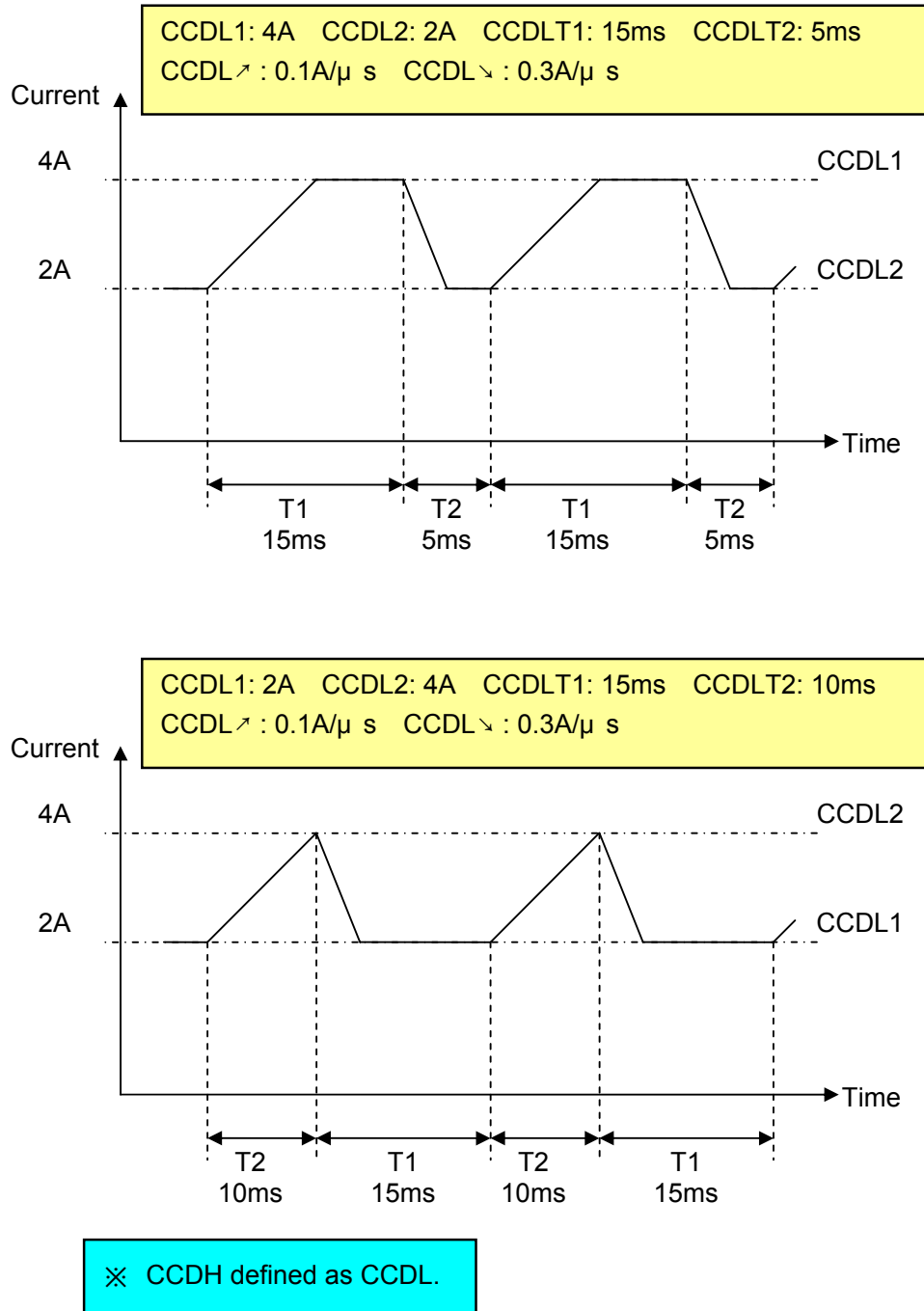


Figure 3-5 Dynamic Current Waveform

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/ μ S or mA/ μ S)

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 for low voltage measurements. If any value is over the maximum of low range, you must select the high range. The voltage range selection of the CC mode is in the configuration setting.

3.5.2 Constant Resistance Mode

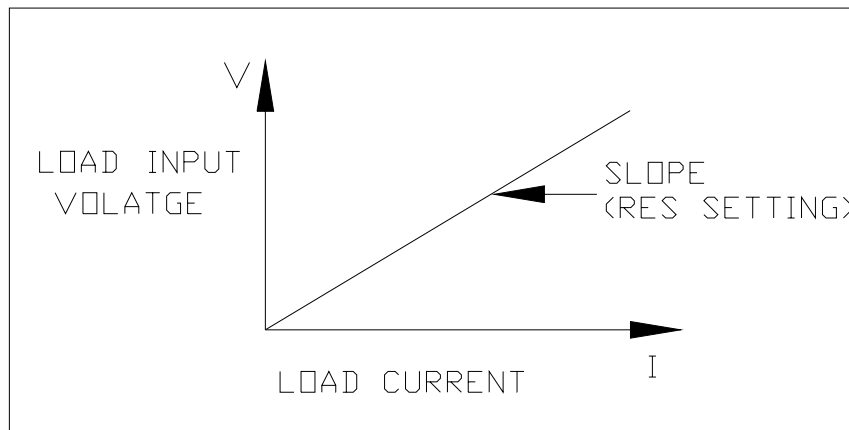


Figure 3-6 Constant Resistance Mode

In CR mode, the load will sink a current linearly proportional to the input voltage in accordance with the programmed resistance. When the input has high frequency noise voltage in the Load, the internal Active-filter will filter out the high frequency noise. The time constant of the low pass filter is about 47 μ s. The load sink current in CR mode is proportional 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 the remote sensing cable must be used to sense the load input voltage when a high sink current (low setting resistance) is programmed.

Voltage Ranges (Low, High)

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

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

Select the range by pressing the **ENTER** key.

If the input voltage is over the maximum of the low range, you must select the high range. Press the **MODE** key first and then, use **▲** or **▼** keys to select the voltage range. In some modules (single channel/module), there are two resistance levels (A or B) for the CR function. Both states A/B use the same range. You can select A (CRL1 or CRH1) or B (CRL2 or CRH2) through the **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/ μ S)

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

3.5.3 Constant Voltage Mode

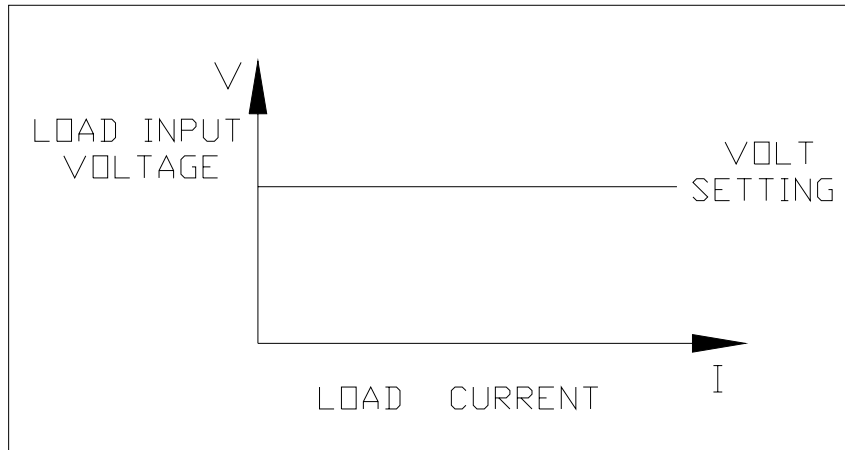


Figure 3-7 Constant Voltage Mode

In CV mode, the load will sink current to control the voltage of the source to the programmed value. In some modules (single channel/module), there are two voltage levels (A or B) for the CV function. You can select A (CV1) or B (CV2) through the **A/B** key on the module's keypad. There are two response speeds of the CV mode, fast and slow. The fast/slow response speed means the slew rate of the current change.

Voltage & Current Range (High)

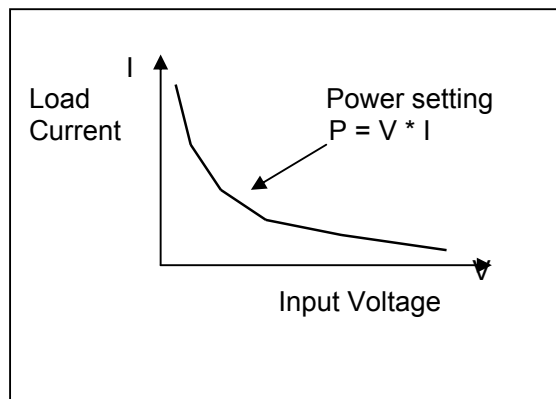
MODE SELECT
CV

Select Constant Voltage high voltage range

Select the range by pressing the **ENTER** key.

The voltage and current range in the CV mode is the high range.

3.5.4 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, which results in the I set value. High frequency parts will be removed as there is a lower pass filter for measuring the data.

Power can be programmed in either the low range or the 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 the range by pressing the **ENTER** key.

There are two power levels (A or B) for the CP function as in other modes. Both A and B states use the same range. You can select CPL1 or CPL2 using the **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

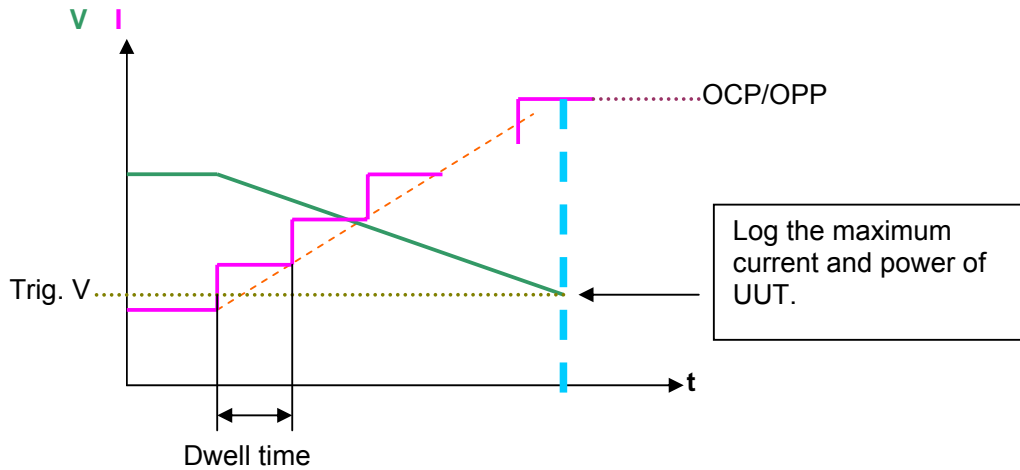


Figure 3-9 OCP/OPP Mode

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

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

CURRENT RANGE
1.CCH 2.CCL

Select the OCP mode of the current range.

Select the range by pressing the **ENTER** key.

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

POWER RANGE
1.CPH 2.CPL

Select the OPP mode of the power range.

Select the range by pressing the **ENTER** key.

3.7 Load Synchronization

The QuadTech, Inc. 44040/44020 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 the module to change synchronously through SYNC RUN in the configuration setting. If a channel is set to SYNC RUN ON, it means that the channel on/off or change of load level is synchronized with the other load modules. In other cases, the channel on/off can be controlled only by the module's **LOAD** key.

3.8 Measurements

Each module measures the current and voltage of the UUT. The sampling rate in fast mode is about 5 ms. Voltage and current measurements are performed with a 16-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 the 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 μ s to 6 ms, which depends on the 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. You may set the conducting voltage V_{on} to solve these problems. The Load will start or stop sinking current when the output voltage of the UUT reaches the V_{on} voltage. You can start sinking current when the setting is "load ON," and the input voltage of the module is over V_{on} voltage, but stop sinking when in "load OFF," or the input voltage is below the V_{on} voltage. For start and stop sinking current refer to Figure 3-10 and Figure 3-11 separately.

There are two operation modes for V_{on} control. One is latch, and the other is non-latch. Latch means that when voltage is over the V_{on} voltage, the load will start sinking current continuously even though the input voltage drop is below the V_{on} voltage. Non-latch means that when the input voltage is below the V_{on} voltage, the load will stop sinking current. The V_{on} voltage and operation mode of V_{on} is set in configuration.

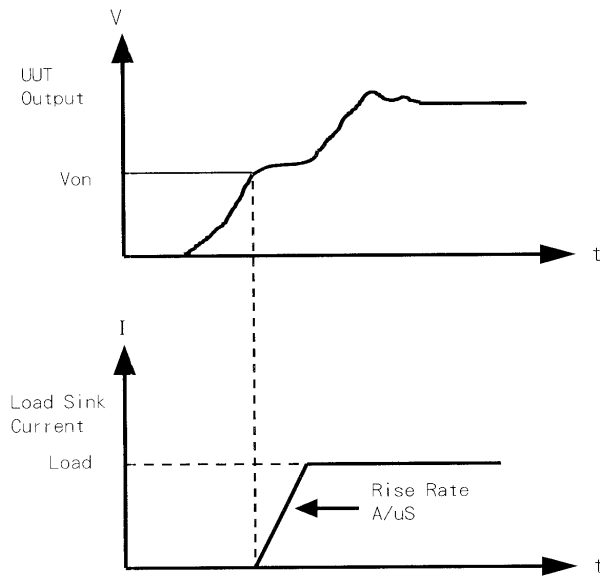


Figure 3-10 Start Sinking Current (Von Non-Latch)

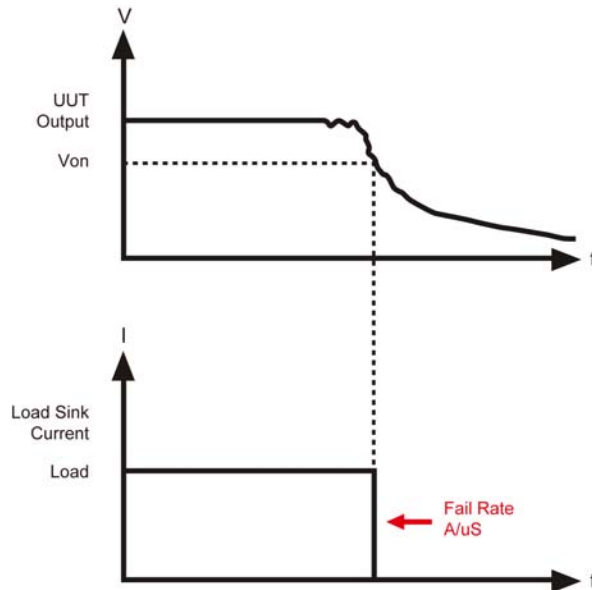


Figure 3-11 Stop Sinking Current (Von Non-Latch)

3.11 Short On/Off

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

“Toggled on/off” means pressing the **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 the electronic short is dependent on the mode and range that are active when the short is enabled. In CC mode, it is equivalent to the programmed value of the maximum current, as long as, it is under the maximum power limit. In CR mode, it is equivalent to the programmed value of the minimum resistance for the selected resistance range. In CV mode, it is the same as programming the load to zero volts. In CP mode, it is equivalent to the programming of the maximum power for the selected range. Turning on the short circuit does not affect the programmed setting, and the 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, the load will follow the setting made in OCP mode or OPP mode and perform current or power loading step-by-step until the trigger voltage stops.

Note: Turning on the short circuit may cause the load to sink enough current to trigger the protection circuitry, and that will turn off the load. In addition, the short circuit will not function when operating in the low range of the 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, the **LOAD** key on the module or the remote control. The on/off change of input is done in accordance with 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: Over-Voltage, Over-Current, Over-Power, Over-Temperature, and Reverse Voltage.


The appropriate bits in the Mainframe’s status registers are set when any of the protection features mentioned above are active. In addition, the Load’s buzzer will produce a beep sound to inform you until the protection status is reset. When any protection is triggered, it will cause the load’s input to be turned off.

- **Over-Voltage**
The over-voltage alarm circuit is set at a level slightly above the selected voltage range. The over-voltage (OV) and voltage fault (VF) status register bits are set when an OV condition occurs. They will remain set until they are reset. The load module will display OVP when the over-voltage alarm is triggered.
- **Over-Current**
When the load is operating in CR or CV mode, it is possible for a module to attempt to sink a current more than it is rated for. The limit level of the current is set at a level slightly above the current of the load. The over-current (OC) and current error (CE)

status register bits are set when an OC condition occurs, and will remain set until they are reset. The Load module will display OCP when over current protection is triggered.

- **Over-Power**
The over-power protection circuit is set at a level slightly above the full scale power range specified. The over-power (OP) and power error (PE) status register bits are set when an OP condition is triggered, and will remain set until they are reset. The Load module will display OPP when over-power protection is triggered.
- **Over-Temperature**
Each Load has an over-temperature protection circuit, which will turn off the load if the internal temperature exceeds the safe limit. The over-temperature (OT) and temperature error (TE) status register bits are set when the OT protection is triggered, and will remain set until they are reset. The Load module will display OTP when over-temperature protection is triggered.
- **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 the load. If the reverse current of the 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 the 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 until they are reset. The Load module will display REV when reverse voltage protection is triggered.

All of the protection features will latch when they are tripped. When any protection is triggered the module will turn off the load input, and produce “beep” sound until you remove the condition and reset protection by pressing the **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 settings of the electronic load for all channels can be saved and recalled for use in various test setups. This simplifies the repetitive programming of multiple setups. 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 the **SAVE** key. Later, you can recall the settings from the specified file using the **RECALL** key. The **SAVE** and **RECALL** keys affect all channels simultaneously.

3.15 Program

The program feature is very powerful. It allows you to simulate various test conditions. There are ten programs in the electronic load each with 10 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 programs, 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 detail. 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 the mainframe can be used to view the programmed setting of a selected channel. The input voltage/current is displayed on the module's display. The mainframe will scan module type at power-on, and memorize it for channel setting.

**Notice**

When you edit the 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 the 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 display REMOTE.

**Notice**

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

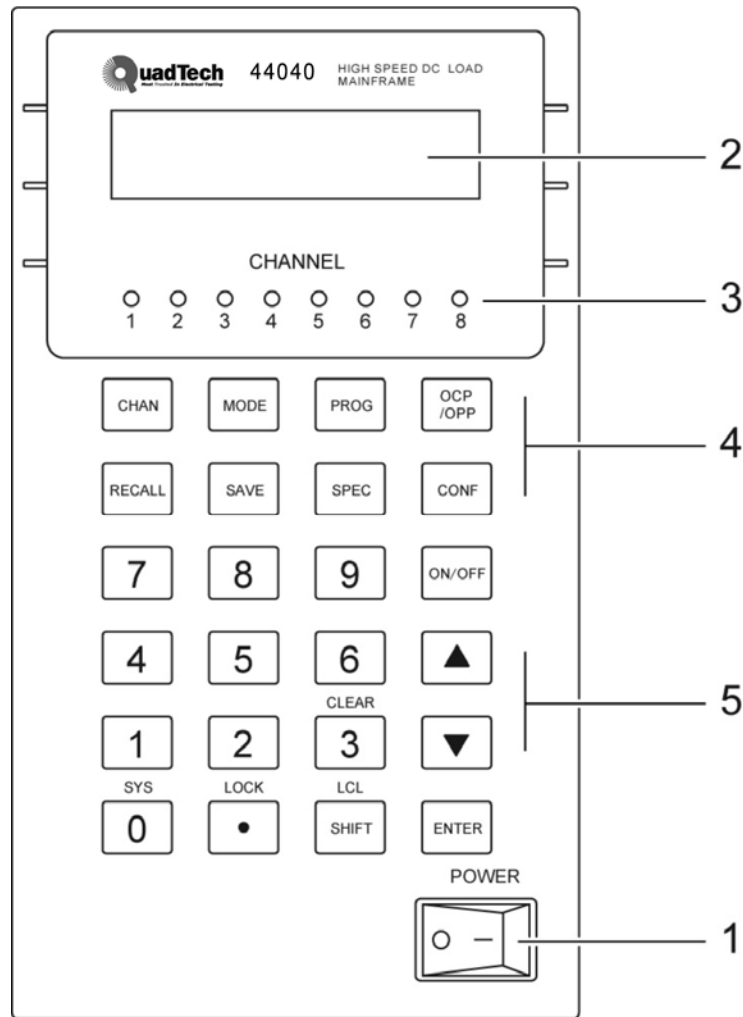


Figure 4-1 Front Panel of Mainframe

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Line switch 2. LCD display 3. Channel indicator 4. Function keys | <p>Turn the AC power on/off.</p> <p>Display channel information normally.</p> <p>Indicate the active channel settings.</p> |
| <p>CHAN</p> | <p>To select a channel for settings.</p> |
| <p>MODE</p> | <p>To select a mode for settings.</p> |
| <p>PROG</p> | <p>To select a program for settings or running.</p> |
| <p>OCP/OPP</p> | <p>To select OCP or OPP mode.</p> |
| <p>RECALL</p> | <p>To recall the saved settings from Memory, 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 recalls the factory default settings. Recalling program is from PROG, number 1 to 10.</p> |
| <p>SAVE</p> | <p>To save all of the present mode settings of all channels in the</p> |

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 saves the status of all channels for the next time the electronic load is turned on. All saved settings are stored in Memory and will not be lost when the 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 the local key.

SHIFT + **3**

The "CLEAR" key allows you to 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 a 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 types at power-on, and memorize them for channel editing.

4.2.2 Setting the Operation Mode

The **MODE** key and **▲**, **▼** keys are used to select the modes of channels for local control. Press **MODE** to display the selected channel's active mode. The active mode can be changed by using the **▲** 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 the **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 Memory (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/modules in the CC, CR, CV and CP modes. They can be switched by the module's **A/B** key.

Setting CC Values

There are four modes of CC operation: CCL, CCH, CCDL and CCDH. The current levels are programmed in Amps and the slew rate levels are programmed in milliamps/μS at low range and in Amps/μS at high range. The timings are programmed in milliseconds, while the buffer settings 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 modules for model number 44003. Before observing the examples, select the channel.

1. Select Range/Function

Press **MODE**, and use the **▲** or **▼** key to select CCL followed by the **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 the **ENTER** key, and the blinking data does 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 the **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 for load module model number 44003.

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 the **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 the load module for model number 44003. Before observing the examples, select the channel.

1. **Select Range**

Press **MODE** and use the **▲** 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 for different UUT tests, fast and slow. Refer to Figure 4-2 and Figure 4-3 for transfer functions.

CV RESPONSE
1:FAST 2:SLOW

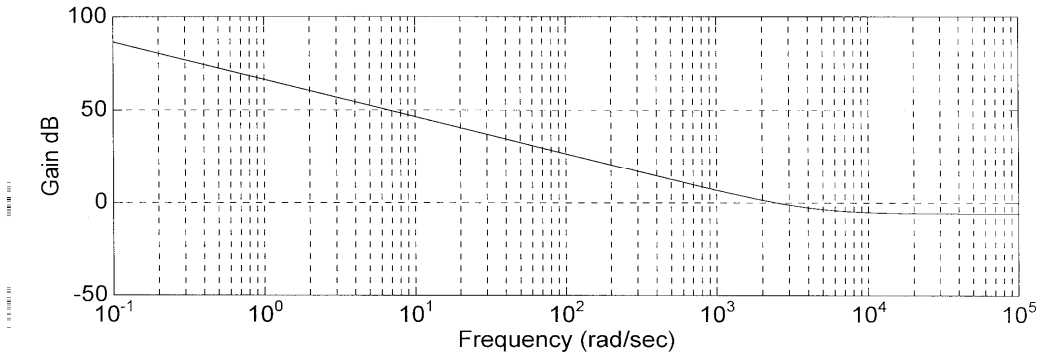


Figure 4-2 CV Response Transfer Function (FAST)

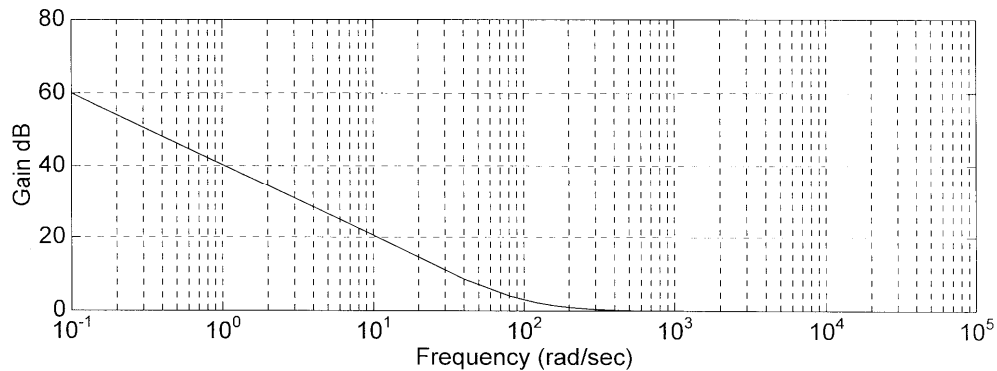


Figure 4-3 CV Response Transfer Function (SLOW)

Setting CP Values

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

The following examples illustrate how to set the CP values of load module for model number 44003.

1. Select Range

Press **MODE** and use the **▲** or **▼** key to select CPL followed by the **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 resistance level1 (A) to 20 watts by pressing **2**, **ENTER**. Set the level2 (B) resistance level to 10 watts by pressing **1**, **ENTER**.

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

3. Set Slew Rate

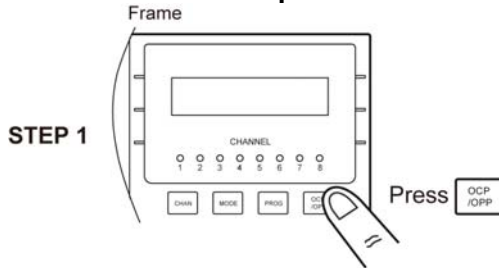
There are 250 discrete steps in each range. Set the rise and fall slew rates to 0.1 W/μS by pressing **.**, **1**, **ENTER** for the rise slew rate and **.**, **2**, **ENTER** for the fall slew rate.

```
CPL : 0.10W/μS
CPL : 0.20W/μS
```

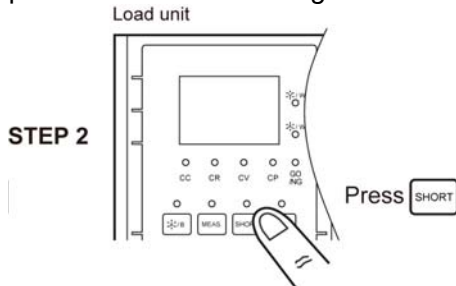
4.2.3 Setting the OCP/OPP Mode of Operation

The **OCP/OPP** key has OCP and OPP modes for users to test the UUT voltage to ensure that it reaches the trigger voltage level and determine if the OCP or OPP protection is acting normally.

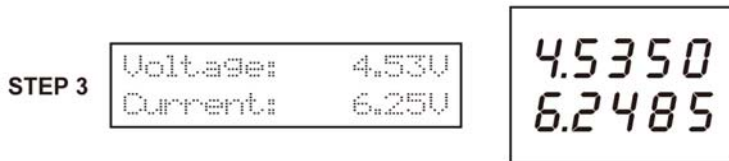
Note: Follow the steps below for OCP/OPP mode operation.



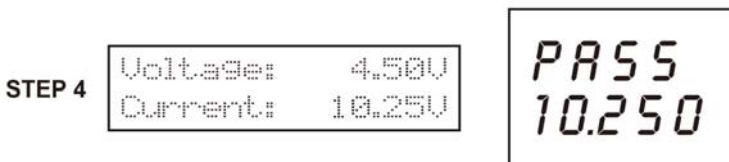
First, select the channel to be tested and press **OCP/OPP** key to set the related parameters. See *Setting OCP/OPP Values* for detailed information.



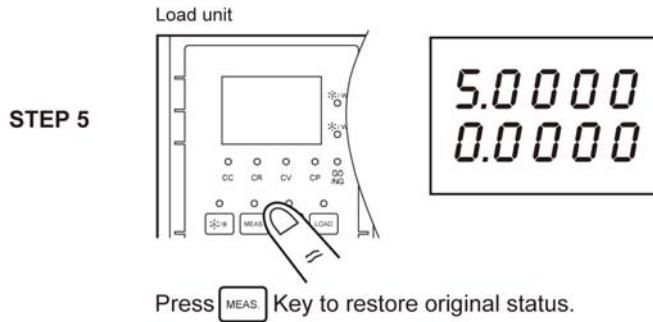
Once STEP 1 is done, go to the Channel and press the **SHORT** key to execute OCP or OPP. If operating the R channel of the 44002 and the 44006 models, first press the **L/R** key of the module and switch to the R channel, then press the **SHORT** key to execute OCP or OPP.



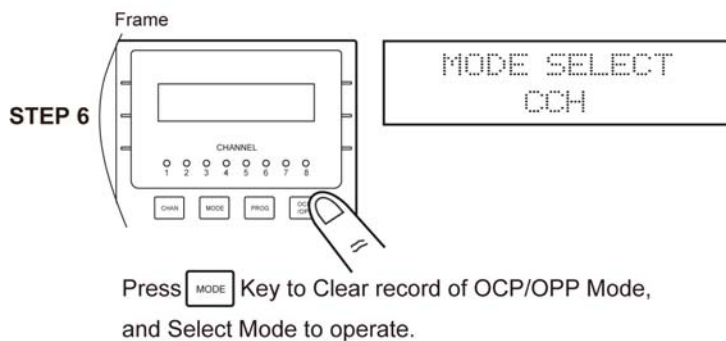
Once STEP 2 is executed, the LCD on the mainframe and the 7-segment display on the module will show the OCP/OPP execution status in real time so the user receives the current information.



When the OCP/OPP execution is done, a message of Pass or Fail and OCP or OPP power will show on the module.



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



When the OCP/OPP execution is done, to clear the OCP/OPP loading message on the LCD of the mainframe, press the **MODE** key to clear the screen and select a new mode for operation.

Setting OCP Values

OCP mode can be executed in any mode. Press the **OCP/OPP** key to set the Current Range (CCH, CCL) of the OCP mode and follow the options to the 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).

Notice

- Set the start current (Istart) and end current (Iend): Set based on the option of CCH or CCL selected for each mode. The 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 the UUT voltage.
- OCP current low limit (SPEC_L) and high limit (SPEC_H): Set based on the user's request.

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

The following examples illustrate how to set OCP values of the load module for model number 44003.

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

CURRENT RANGE
1.CCH 2.CCL

2. Set the start and end current
Press **1**, **.**, **5**, **ENTER** keys to set the start current (Istart) and press **6**, **ENTER** keys 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** keys to set the number of steps (No. step) and press **2**, **0**, **0**, **ENTER** keys to set the dwell time (DwellIT).

No. step : 100
DwellIT : 200 mS

4. Set the trigger voltage
Press **3**, **.**, **6**, **ENTER** keys 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** keys to set the current low limit (SPEC_L) and press **6**, **ENTER** keys 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 the **OCPP/OPP** key to set the Power Range (CPH, CPL) of the OPP mode and follow the related option values including start power (Pstart), end power (Pend), step no. (No. step), dwell time (DwellIT), trigger voltage setting (SET Trig. Voltage), OPP low limit (SPEC_L) and OPP high limit (SPEC_H).

Notice

- Set the start power (Istart) and the end power (Iend): Set based on range selected CPH or CPL for each mode. The OPP mode only acts when Pstart < Pend.
- Range of the step no. (No. step): 1 ~ 1000
- Range of the dwell time (DwellIT): 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.

$$OPP \text{ Accuracy (Typical)} = \frac{P_{end} - P_{start}}{no. \text{ Step}}$$

The following examples illustrate how to set the OPP values of the load module for 44003.

1. **Enter into the OPP mode and Select POWER Range**

Press the **OC/OPP** key to enter into the Power mode and select the power range.

Press **2**, **ENTER** keys to select the CPL Range for operation.

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

2. **Set the start and end power**

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

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

3. **Set the number of steps and dwell time**

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

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

4. **Set the trigger voltage**

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

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

5. **Set the low and high limit for OPP.**

Press **1**, **5**, **ENTER** keys to set the power low limit (SPEC_L) and press **3**, **0**, **ENTER** keys 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 provides the ability to select customized basic tests, and link them into a program test for automatic execution.

The **PROG** key is used to select a program, or recall a 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 the program chain function to get more sequences.

Press the **PROG** key, and the LCD will display as below. Press number 1 -10 followed by **ENTER** to recall the program from the 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 programming enables you to chain programs to get more sequences for testing. Setting the program chain number to 0 results in no program chain. The program chain function can chain itself for a loop test, or chain with other programs. Press **1**, **ENTER** keys to set chain 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 the load condition changes. The failure status of the sequence will latch when a program is executed. It means that any failure will be logged even when the UUT becomes stable within specification. The range of the P/F delay time is from 0 to 60 seconds. Press **1**, **ENTER** keys to set the sequence P/F delay time to 1 second. The default setting is 0 second.

```
SEQ. P/F DELAY
TIME: 10Sec
```

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 the OFF time to 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** instructs the load to go to sequence 10.

Press the **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 the  key and select EXT to key in **3**.

```
EXT=3
```

6. Setting the Short Channel

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

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

7. Setting the Short Time

The range of the short time is from 0 to 30 Sec. The short time must be \leq the 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 the **ON/OFF** key to run programs 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 displays load status, 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 results compared with SPEC setting.

When a program is executed, the setting of the sequence will recall files from Memory, and the SPEC function is always ON. All function keys are disabled until the **ON/OFF** key is pressed to stop the program's execution, or program's run finishes. When the program run stops or finishes, the LCD will display the following:

```
PROGRAM OFF
RESULT :PASS
```


This means that all of the sequences in the program have passed. If the test fails, the LCD will show the following:

```

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

PROG. XX stands for the file number of the program that failed, 1 to 10. Also, 1, 2, 3...10 shown by LCD stands for the failed sequence. The failed sequences are the results of all failed channels. The LED of the 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 the **▲** **▼** to read the contents of the 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 for HIGH and LOW limits when the SPEC TEST is ON, and the LED, GO/NG, is lighted on the module panel. To set specifications for the module, you must go to mode editing by pressing the **MODE**, **ENTER** keys, and then the **SPEC** key. In other operating modes, pressing the **SPEC** key is to enable/disable the SPEC TEST function. The SPEC TEST ON/OFF function is global. This means that all modules installed on the Mainframe will perform a GO/NG comparisons. There are two ranges, Value and Per cent for setting the SPEC, see 4.2.7 for detail description. The CENTER level must be set by the value of the channel input reference level. The HIGH and LOW levels can be set by value or percentage selected in the configuration SPEC. ENTRY MODE. The HIGH/LOW percentage range is from 0 to 100%.

Press **MODE**, **ENTER**, **SPEC** keys to set the specifications of the 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 the configuration setup. This procedure is only needed for the initial setup of a test operation. The configuration of each channel is stored independently in the Memory of the 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 for better performance of 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 operating modes for Von control. Von latch ON means that Load will sink current continuously when Von voltage is reached. Von latch OFF means that the load will stop sinking current when the UUT voltage is under the 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 the absence of a UUT. This will get overshoot spike. If a UUT is applied, the overshoot may damage the UUT in spite of a small setting of the load current. So, do not set Von to 0V.

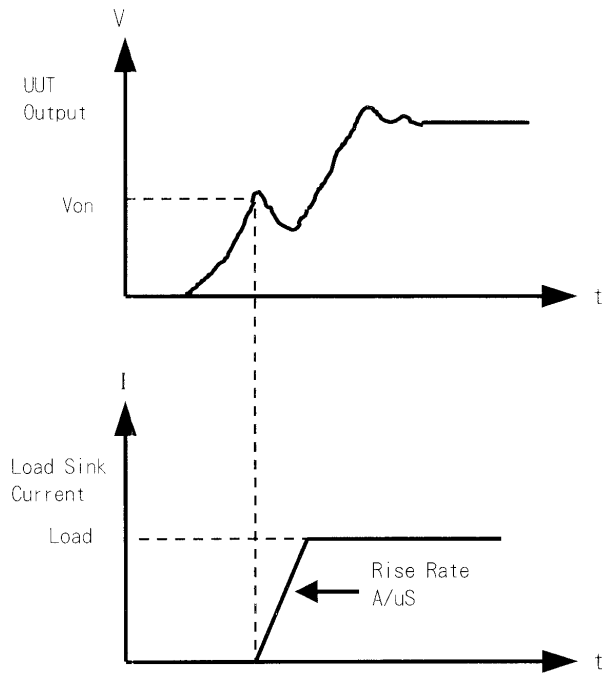


Figure 4-4 Von LATCH ON Current Waveform

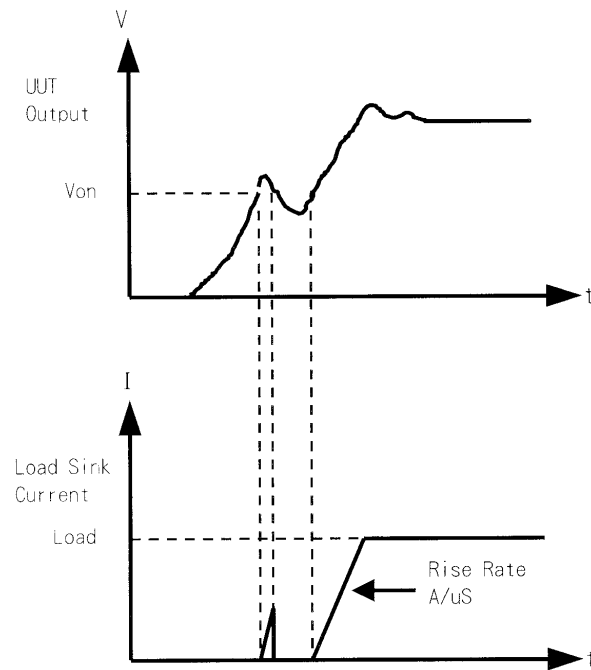


Figure 4-5 Von LATCH OFF Current Waveform

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 the VOFF Final Voltage and the 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

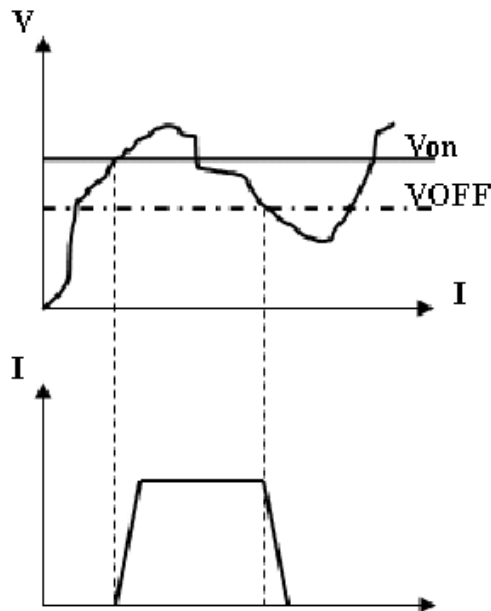


Figure 4-6 Von and VOFF Loading Current Waveform

Set CV mode CURR_LIMIT. It limits the current sinking of the load to protect the 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 44000.

CV SLOW TYPE
 1: MOST 2: MORE

If slower RESPONSE is desired, 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 44000. The operation will be kept to the slowest CV RESPONSE.

Set the 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. Four digits will be displayed.

SIGN OF VOLT. 1:PLUS 2:MINUS

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

SPEC. ENTRY MODE 1:VALUE 2:PCet

Set SYNChronous run mode. When SYNC run is set to ON, the Load on/off is controlled by the **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 the 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 on the same line for you to change it again and again. The default setting is ON.

Enter Data Next 1:ON 2:OFF

Select the module SOUND on/off. When you press the key on the module, it will produce a sound if sound = ON. The default setting for the 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 the 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 values 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 modes for you to change the 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 the **LOAD** key to set the 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 remains 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 the load module. The default setting of the 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 10.

VI MEASURE
AVERAGE: 10

Set Timing Function mode

The 44000 Series Loads have a unique timing and 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 and timeout value for battery discharge testing and similar applications.

For example, the Figure 4-7 below shows the 44000'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 the 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

```

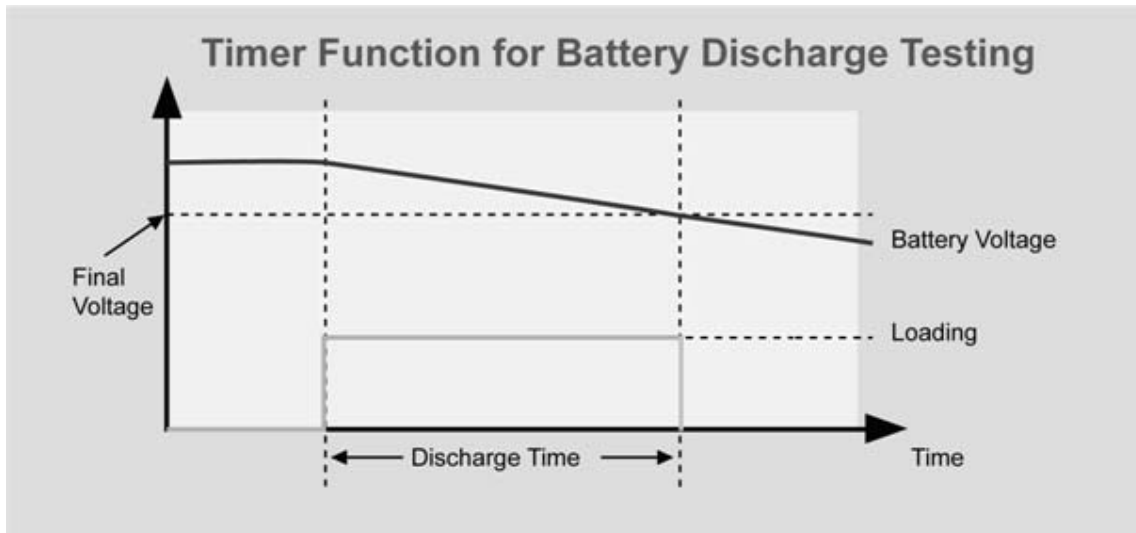


Figure 4-7 Battery Discharge Testing

⚡ CAUTION Timing function cannot be operated under CV mode, but only valid in CC, CR and CP mode.

Set **DIGITAL IO**

It sets the external signal (High > 4.3V, Low < 0.7V) to control the mainframe and module through the Digital I/O Port, as well as, 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 the mainframe and module for the 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 the mainframe and module via an external I/O, be sure to set the TIMING FUNCTION to OFF. When DIGITAL IO is set to ON, all the 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 the 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 directly on the module. The default setting of ST/DYNA KEY is OFF. Press **1**, **ENTER** to change the MEAS. function to the ST/DYNA function.

ST / DYNA KEY
1: ON 2: OFF

Select ECHO MODELNAME.

It gives users the ID for PC by changing the 44040 mainframe ID to 44040 mainframe so that the 44040 GPIB commands edited previously can be used to operate the PC. The default setting of ECHO MODELNAME is NEW.

ECHO MODELNAME
1: OLD 2: NEW

Display the versions of load module and mainframe.

LOAD MODEL
Version: 1.00

Press **▼** key.

FRAME BOOT PROG.
Version: 1.00

Press **▼** key.

FRAME DOWN PROG.
Version: 1.00

Press **▼** key.

FRAME EXEC PROG.
Version: 1.00

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

4.2.11 Lock Operation

The lock operation disables the ability to change settings. When the data are locked, all settings cannot be changed. The operation of the **ON/OFF** and **SPEC** keys will not be affected by the 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 the RS-232C interface 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	RxD
3	Output	TxD
4	Output	DTR
5	Output	GND
6	Input	DSR

7	NC	
8	NC	
9	NC	

Note Pin 1 (+5V) is for 44000 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.

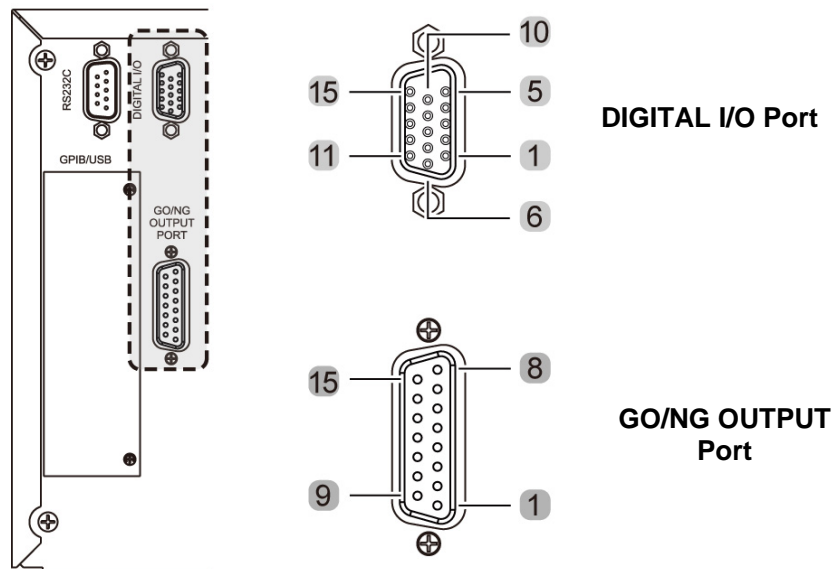


Figure 4-8 Pin Assignment of DIGITAL I/O Port and GO/NG OUTPUT Port

4.2.14 Connecting the DIGITAL IO Port

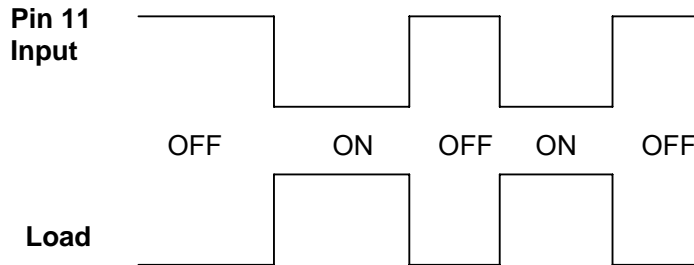
The Digital I/O is a 15 Pin Connector (DR3-15ST, Female) interface controlled by a TTL signal (sink current 10mA max.) The external TTL signal input controls contain External ON/OFF, External Trig., For Sequences Run and the Pass/Fail messages received through this interface including Load ON/OFF, Total 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 detailed 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.

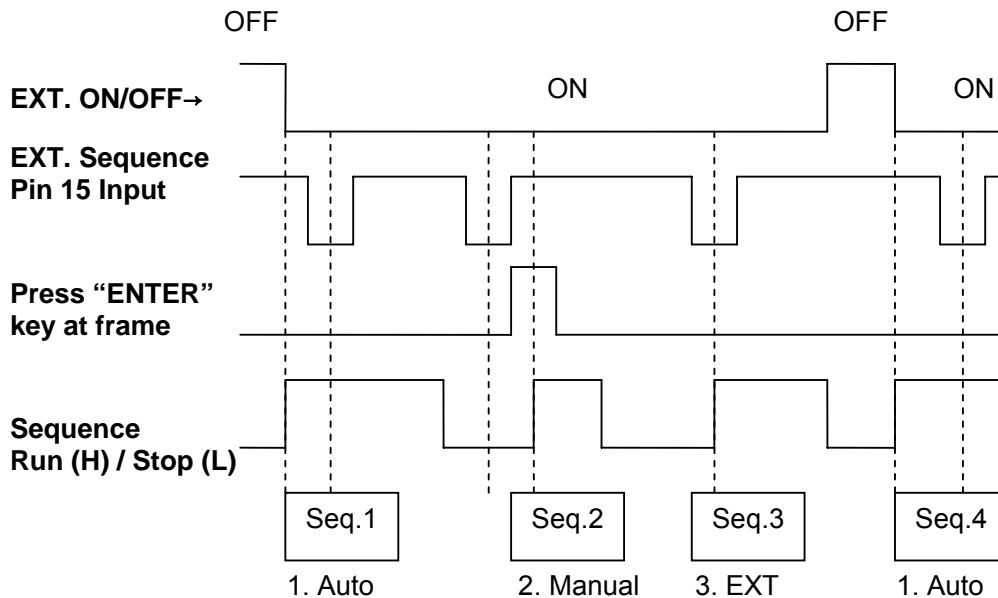
External ON/OFF (I/P) : <50ms (Level)

Uses the TTL input signal (High > 4.3V, Low < 0.7V) to control the mainframe **ON/OFF** key to perform Sync. Run loading on the load module.



External Trig. For Sequences Run (I/P) <100ms (Pulse)

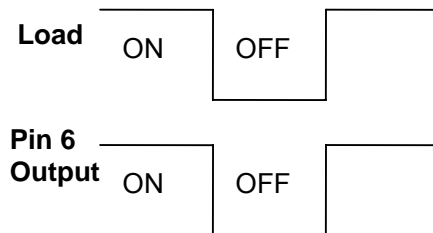
This signal is for external control program use only. It can only work when External ON/OFF input is **ON**. To execute the program loading test, select [3.EXT] in the control items (0.Skip, 1.Auto, 2.Manual, 3.EXT) for program selection. When the sequence is executed, the one requires [EXT] key in,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



⚡ CAUTION When executing the program with the DIGITAL IO set to ON, the SQENCE can be controlled via remote signal if it is set to [EXT] control. Also, press **ENTER** on the FRAME is able to control the SQENCE for SHORT.

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 a High Level and outputs a Low Level when OFF.



Total Pass (O/P): <100ms (Pulse)

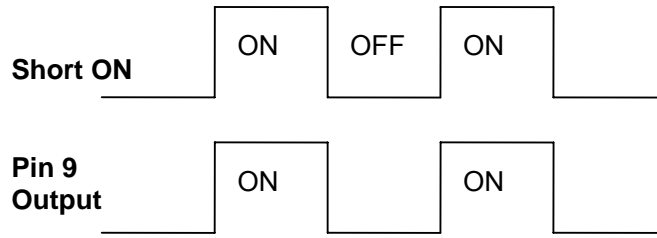
This signal is for Program Seq. only. If all channel test items are Pass, the Pin7 on the Connector will output a High pulse signal to notify that all tests are Pass.

Total Fail (O/P): <100ms (Pulse)

This signal is for Program Seq. only. If one or more of all the channel test items are Fail, the Pin 8 on the Connector will output a High pulse to notify the tests are Fail.

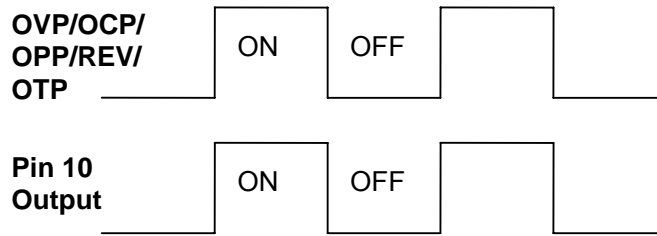
Short Signal (O/P): <100ms (Level)

When executing the Short command, Short ON will output High Level and Short OFF will output Low Level.



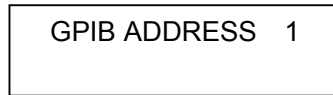
Protection Signal (O/P) : <100ms (Level)

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, QuadTech, Inc. 44000 Programming Manual. GPIB address displays after RS-232C parameters in the system. You can use this feature to check the GPIB address.



4.3 Local Operation of Load Module

There are two kinds of panels in the 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 4-69 shows the single channel/module front panel.

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

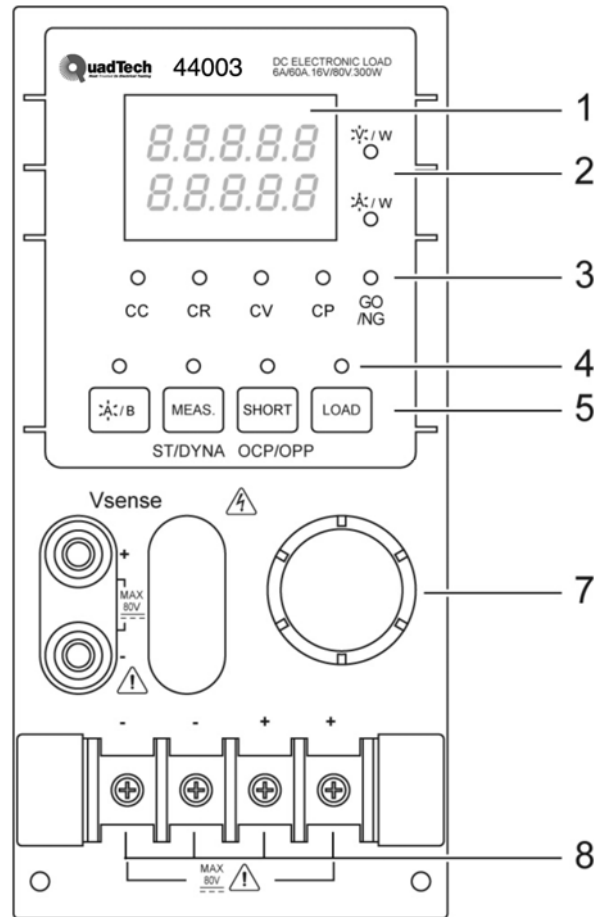


Figure 4-9 Single Channel/Module (Panel A)

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 also be used to select Fix

mode for rotary knob setting. Please refer to 4.3.4.

The **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. Another function of this key is the Static/DYNAMIC mode, see 4.2.7 for a detailed description. Set ST/DYNA KEY to “on” in **CONF** to 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 the load to simulate the short function. Its LED will be on when the short function of the load is enabled. It operates only when the load input is enabled. It will not respond if the 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 the Vsense measurement input. Refer to 2.5.2 for remote sense connections.

7. Rotary Knob

This knob changes the level when the Load input is enabled. Rotating the knob clockwise will increase the level and counterclockwise will decrease the level. When you change the load level with the knob, the setting of Mainframe will not change. The changed load level will remain unless the same setting is changed on Mainframe.

8. Load Terminals

These are the input connectors of the Load for connecting to the UUT. Each of them can carry 40 Amps maximum. 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. These two functions can be selected by **ST/DYNA** key. Press **ST/DYNA** key to select Dynamic function. Press this key again to select the 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 short LED will be active. The **SHORT** key can be set in the configuration of toggled

on/off mode or by pressing mode. If the **SHORT** key mainframe is pressed when the mainframe is in OCP/OPP mode, it will perform 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 the load will be active.

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

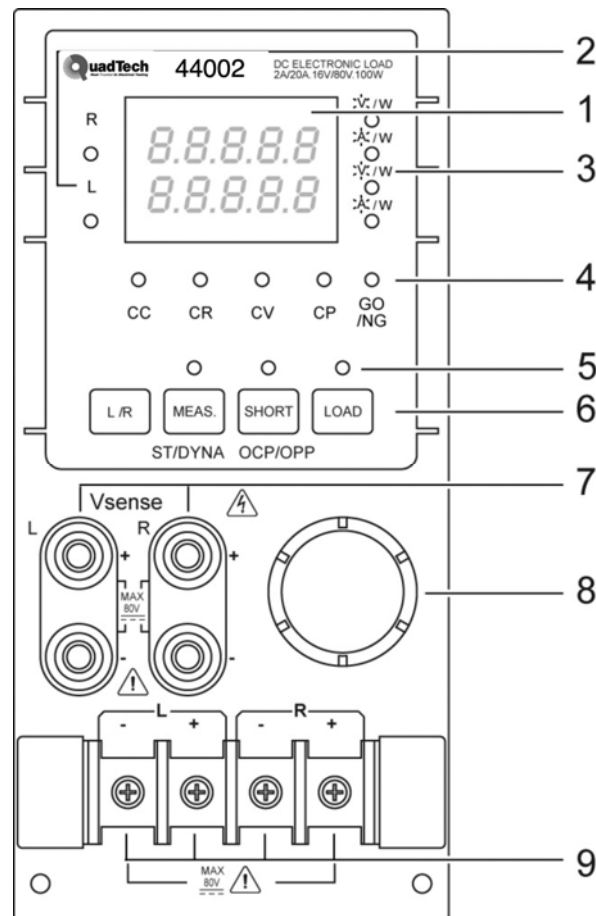


Figure 4-10 Double Channels/Module (Panel B)

The double channels/module means that there are two channels per 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 the **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 the 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 the 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 the 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 the left channel while those on the right for that of the right channel. The PLUS (+) sign of the input of each channel must be connected to 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 the right or left channel for display and 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. This means, 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 functions can be selected through the **ST/DYNA** key. Press this key to select the Dynamic function, and press again to select the 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 the load's input is active. When the input is shorted, the LED of short will be active. The **SHORT** key can be set in the configuration of toggled on/off mode or active by pressing mode. If the **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 detailed 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 and Power on Module

Pressing the **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.

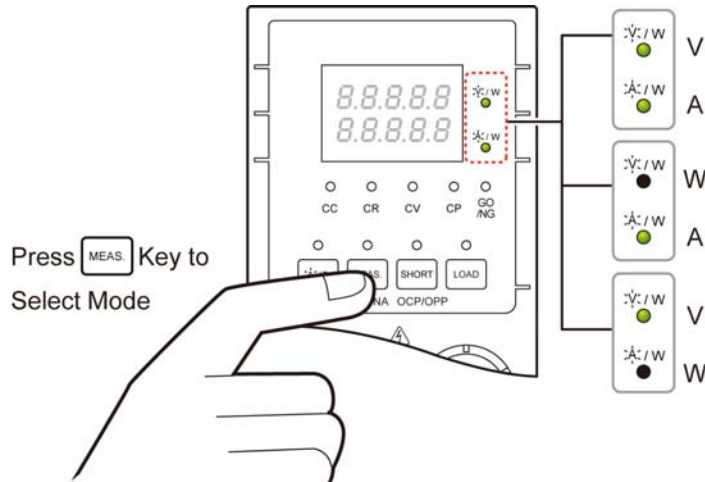


Figure 4-11 7-Segment Display for MEAS. V / A / W Switch

4.3.4 Online Change Level

The load module provides the user with two ways to change level. They make it convenient to directly change the load with the rotary knob in LOAD ON. These two operation modes are described below.

Ratio Mode: In LOAD ON change load with the rotary knob.
 When the rotary knob rotates clockwise, it operates 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 operates 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 the fixed positions. 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 boldly and modulated by the rotary knob. To exit from this mode press, the **A/B** or **L/R** key for more than 2.5 seconds.

 **Notice**

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

PART 2

Programming

5. General Information for Programming

5.1 Introduction

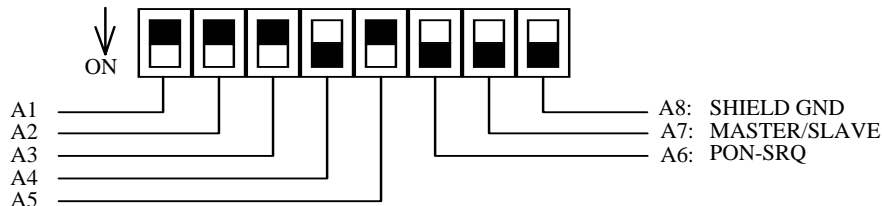
This section describes how to program the 44000 series electronic load remotely from a GPIB controller, or USB controller or RS232C. The command set introduced here can be applied to all electronic loads of 44000 series, including 44001, 44002, 44003, etc. equipped with optional GPIB cards or USB cards 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 an address allows the system controller to communicate with individual devices. Setting GPIB address of an individual mainframe, the QuadTech, Inc. 44020 or 44040, 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 offers 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 44020 or 44040 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, <i>REMOTE</i> 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 can return the electronic load to local mode.	RL1
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 it will control the procedure and 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 QuadTech, Inc. 44000 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 QuadTech, Inc. 44000 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>
```

These 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.

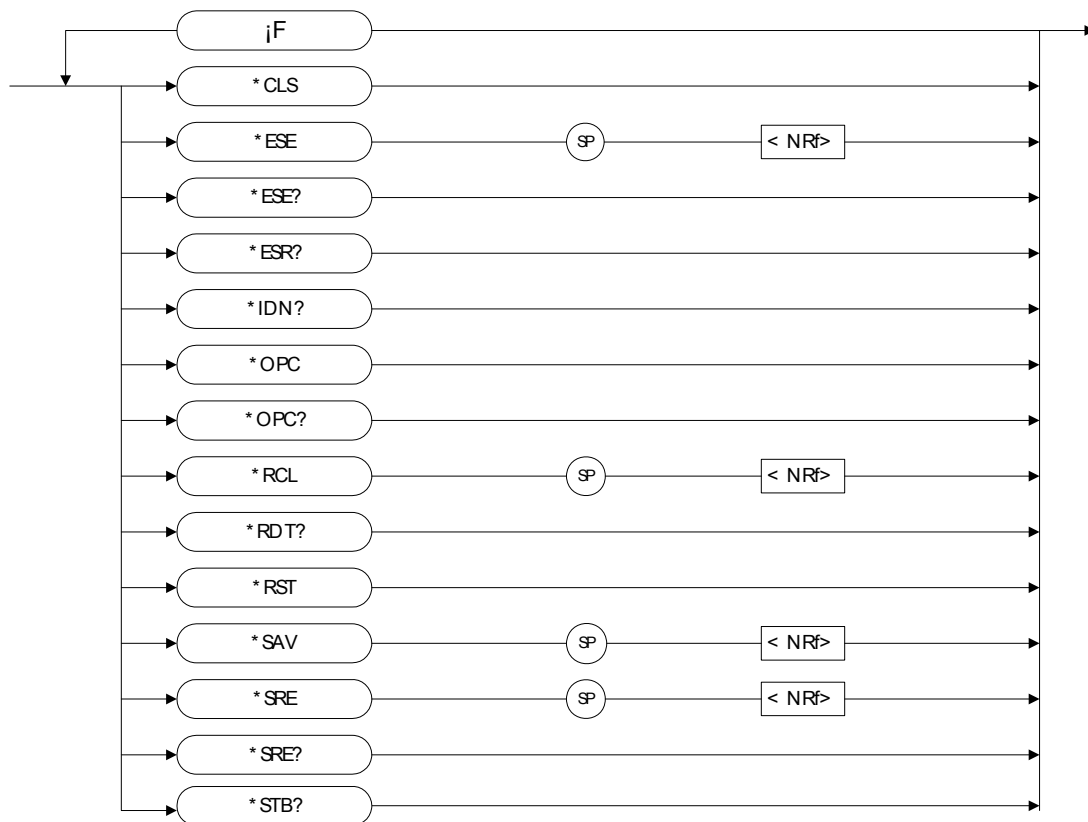
2. (root):SPEC:VOLT:H 30;
:L 5;:
(root):RES:L1 400;
:RISE 1000;:

7. Language Dictionary

Commands for operating the 44000 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? It returns the status readings of Standard Event Status register.
 Return Example : 48

***IDN? Identification Query**

Type : System Interface
 Description : This query requests the Electronic Frame (44040) to identify itself.
 Query Syntax : *IDN?
 Return Parameters : <aard>
 Query Example : *IDN?
 String Information

QuadTech Manufacture
 44000 Model
 0 Always return zero
 01.00 Revision level of the primary interference firmware
 0 Customer's version
 Return Example : QuadTech, Inc. 44000,0,01.00,0

***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 (44040) 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 (6314A). If channel does not exist, it returns 0. If channel exists, it returns the types like 44003, 44002, 63107R, 63107L...
 Query Syntax : *RDT?
 Return Parameters : <aard>
 Query Example : 63107L, 63107R, 63103A, 0, 44003, 44002, 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 It enables the CSUM and MAV bit of the Service Request Enable.
 Query Syntax : *SRE?
 Return Parameters : <NR1>
 Query Example : *SRE? It returns the setting for "Service Request Enable."

***STB? Read Status Byte Query**

Type : Device Status
 Description : This query reads the Status Byte register. Please note, 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? It returns the contents of "Status Byte".
 Return Example : 20

7.2 Specific Commands

The 44000 series products are equipped with the following specific GPIB commands.

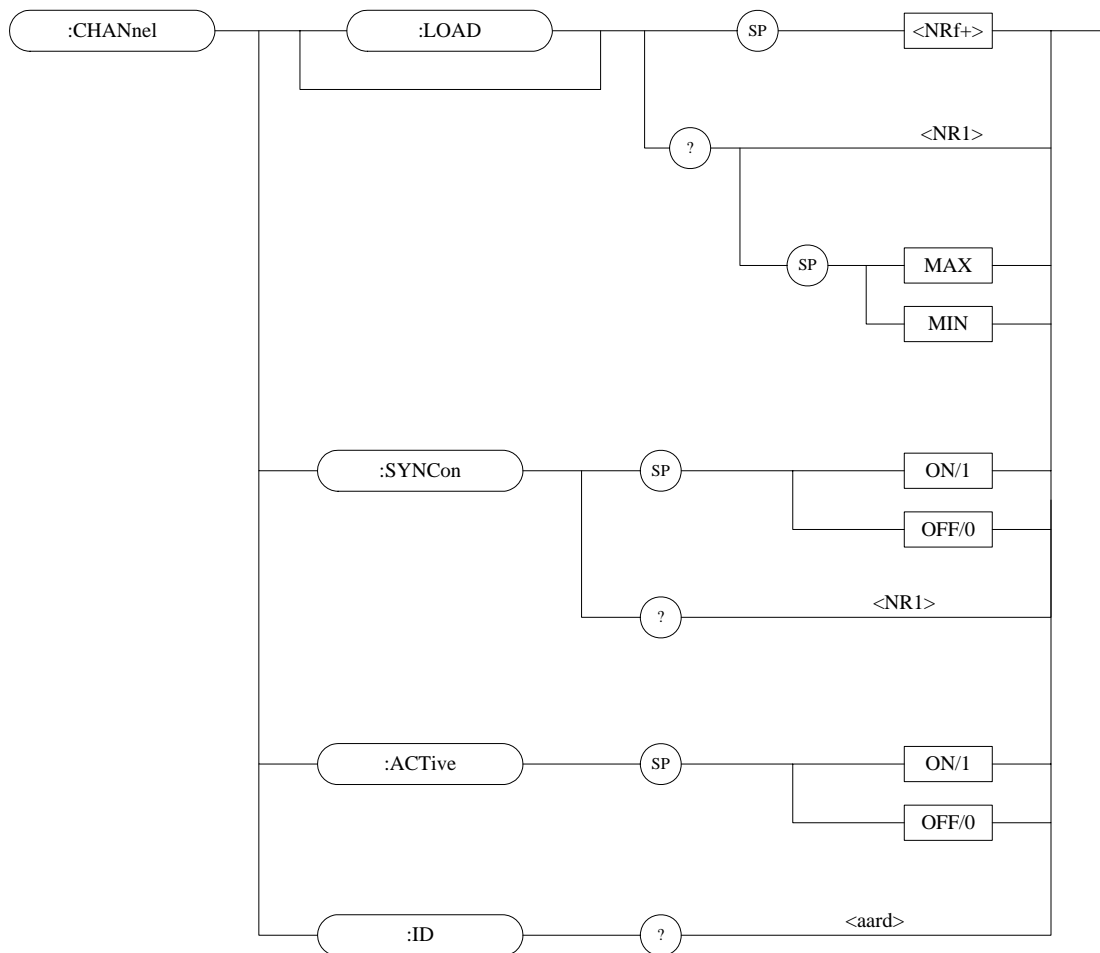
7.2.1 ABORT Subsystem



ABORT

Type : All Channels
 Description : It sets all electronic loads to "OFF."
 Syntax : ABORT

7.2.2 CHANNEL Subsystem



CHANnel:[LOAD]

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

CHANnel:ACTive

Type : Channel Specific
 Description : It enables or disables the load module.
 Syntax : CHANnel:ACTive ON. It enables the load module. The front panel displays the measurement of voltage and current.
 CHANnel:ACTive OFF. It disables 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 : It sets 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. It sets the load module to receive synchronized command action.
 CHAN:SYNC OFF. It sets the load module not to receive synchronized command action.
 Query Syntax : CHAN:SYNC?
 Return Parameters : <NR1>
 Query Example : CHAN:SYNC? It returns 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.

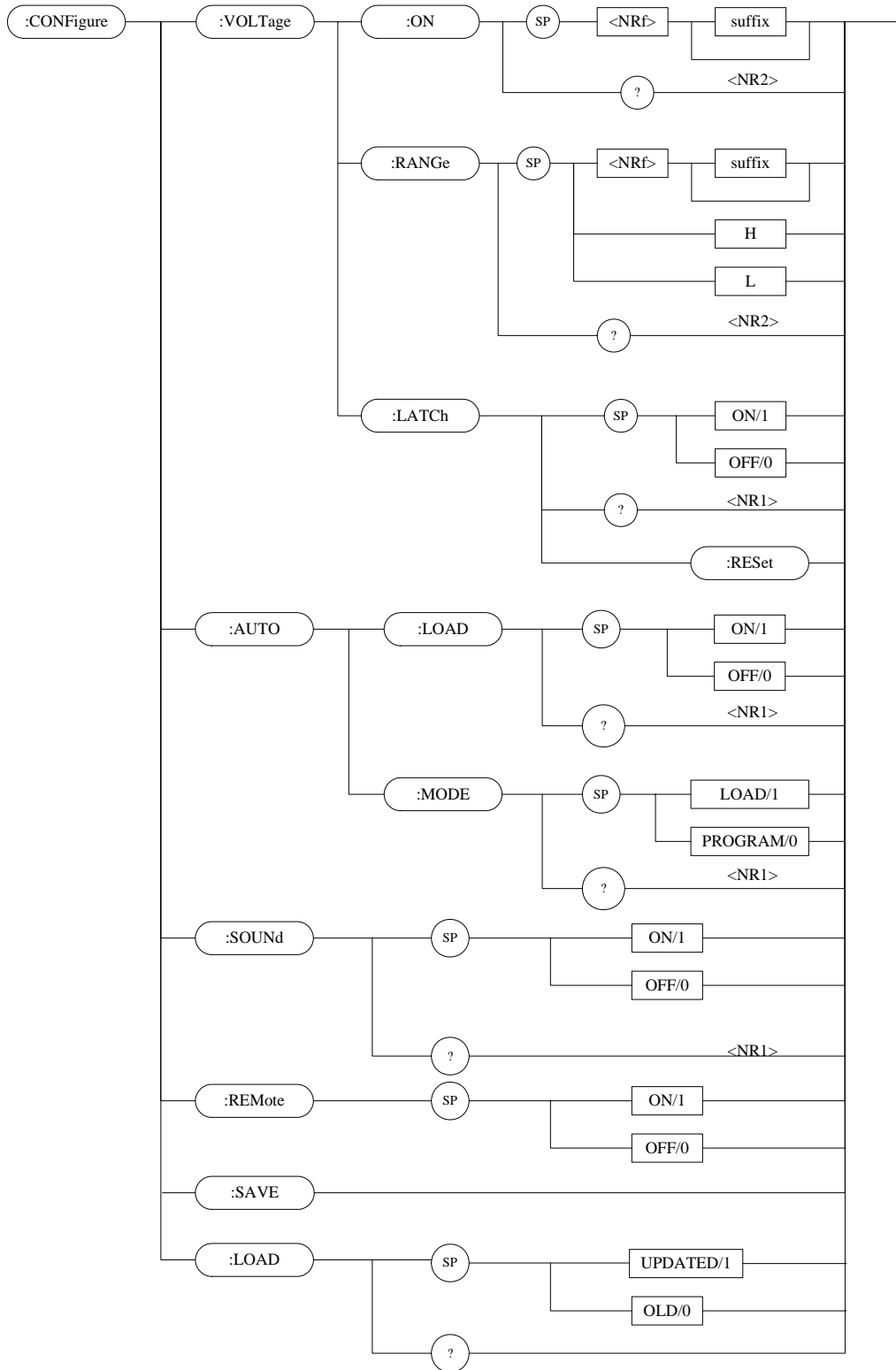
CHAN:ID?

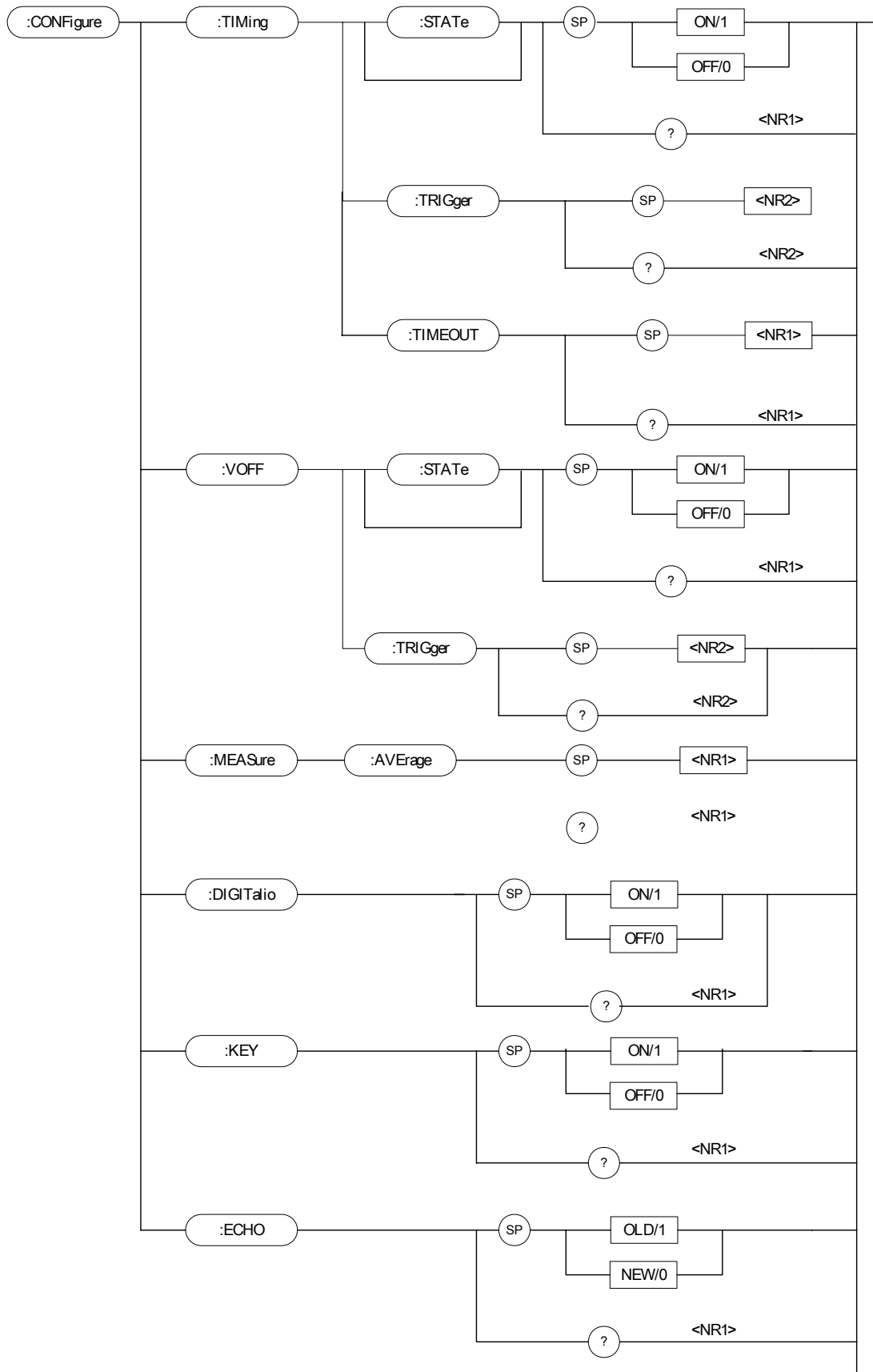
Type : Channel-Specific
 Description : This query requests the module to identify itself.
 Query Syntax : ID?
 Return Parameters : <aard>
 Query Example : ID?

String	Information
QuadTech	Manufacturer
44000	Model
0	Always return zero
xx.xx	Revision of the primary interface firmware
0	Customer's Version

Return Example : QuadTech, Inc., 44002,0,01.00,0

7.2.3 CONFIGURE Subsystem





CONFigure:VOLTage:ON

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

CONFigure:VOLTage:RANGe

Type : Channel-Specific
 Description : It sets the voltage measurement range in CC mode.
 Syntax : CONFigure:VOLTage:RANGe <NRf> [suffix]
 Parameters : Value ranges depend on Load Module. For details refer to specification.
 Example : CONF:VOLT:RANG 16 It sets the full-range as Low, for example, in 44003.
 CONF:VOLT:RANG 80V It sets the full-range as High, for example, in 44003.
 CONF:VOLT:RANG H It sets 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? It returns the Voltage range.
 Return Example : 16

CONFigure:VOLTage:LATCh

Type : Channel-Specific
 Description : It sets the action type of Von.
 Syntax : CONFigure:VOLTage:LATCh ON
 CONFigure:VOLTage:LATCh OFF
 Parameters : ON/1, OFF/0
 Example : CONF:VOLT:LATC ON It sets the action type of Von as Latch.
 CONF:VOLT:LATC OFF It sets 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) It returns the action type of Von.

CONFigure:VOLTage:LATCh:RESet

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

CONFigure:AUTO:LOAD

Type : All Channels
 Description : It sets 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 It starts Auto Load On during power-on.
 CONF:AUTO:LOAD OFF It closes Auto Load On during power-on.
 Query Syntax : CONFigure:AUTO:LOAD?
 Return Parameters : <NR1>
 Query Example : CONF:AUTO:LOAD?
 Return Example : 0 or 1 It returns the status of Auto Load On.

CONFigure:AUTO:MODE

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

CONFigure:SOUND

Type : All Channels
 Description : It sets 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? It returns the control status of the load module's buzzer sound.
 Return Example : 0 or 1

CONFigure:REMOte

Type : All Channels
 Description : It sets 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 : It stores the data of CONFigure into Memory.
 Syntax : CONFigure:SAV
 Parameters : none
 Example : CONF:SAV

CONFigure:LOAD

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

CONFigure:TIMing:STATe

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

CONFigure:TIMing:TRIG

Type	: Channel-Specific	
Description	: It sets the voltage for Timing function at time out.	
Syntax	: CONFigure:TIMing :TRIG <NRf>	
Parameters	: Value ranges depend on Load Module. For details, please refer to specifications.	
Example	: CONFigure:TIMing:TRIG 3	It sets the voltage to 3V at timeout.
Query Syntax	: CONFigure:TIMing:TRIG?	
Return Parameters	: <NR2>[Unit=Voltage]	
Query Example	: CONFigure:TIMing:TRIG?	It returns the voltage set at timeout.
Return Example	: 3	

CONFigure:TIMing:TIMEOUT

Type	: Channel-Specific	
Description	: It sets timeout for Timing function from 1ms to 24 hr.	
Syntax	: CONFigure:TIMing :TIMEOUT <NR1>	
Parameters	: 1-86400000	
Example	: CONFigure:TIMing : TIMEOUT 1000	It sets the timeout.
Query Syntax	: CONFigure:TIMing: TIMEOUT?	
Return Parameters	: <NR2>[Unit=ms]	
Query Example	: CONFigure:TIMing:TRIG?	It returns the timeout set.
Return Example	: 1000	

CONFigure:VOFF:STATe

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

CONFigure:VOFF:FINALVOLTage

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

CONFigure:MEASure:AVErage

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

CONFigure:DIGITalio

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

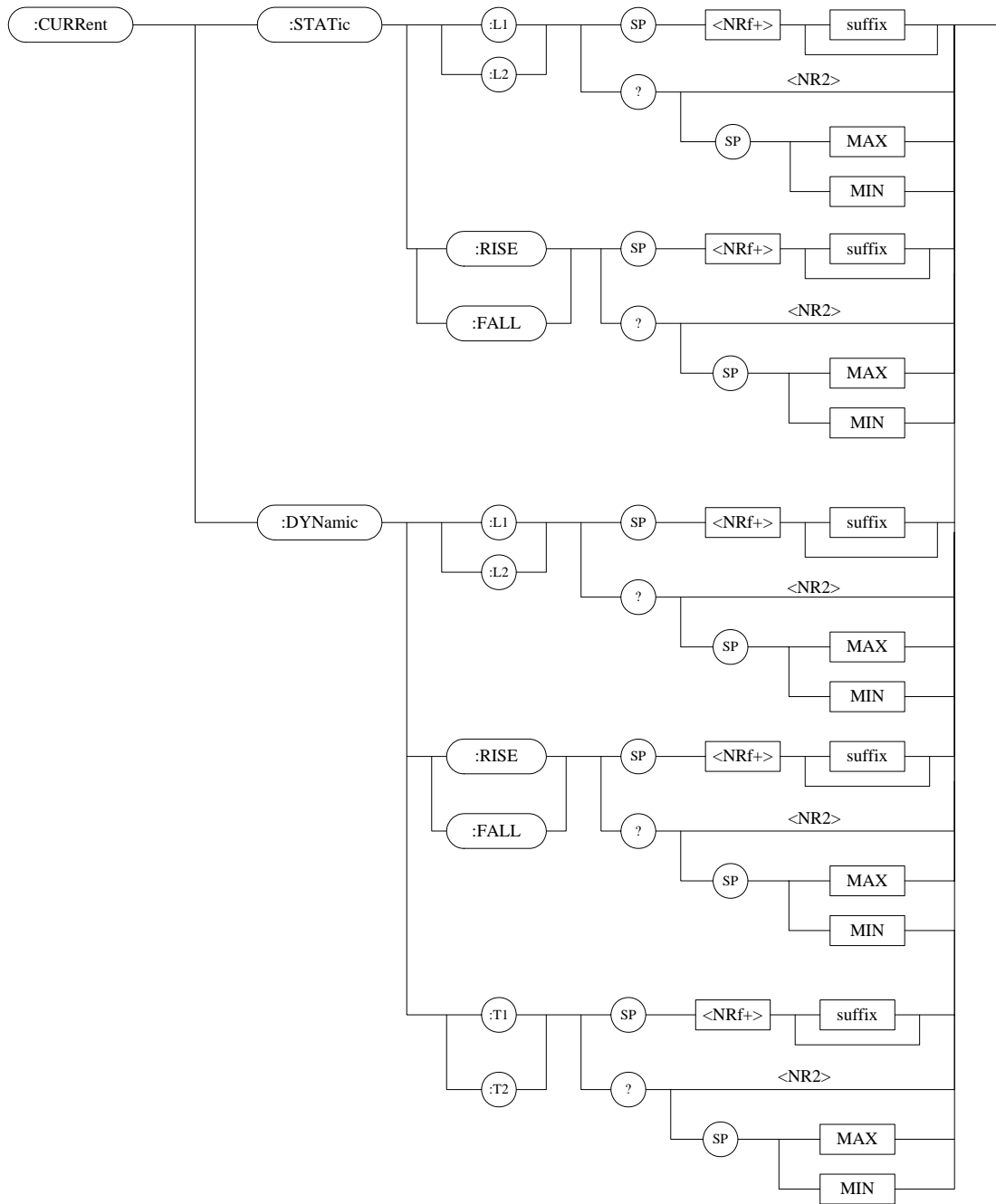
CONFigure:KEY

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

CONFigure:ECHO

Type : All Channels
 Description : It sets 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 It sets to reply the new Model Name.
 Query Syntax : CONFigure:ECHO?
 Return Parameters : <NR1>
 Query Example : CONFigure:ECHO? It returns the ECHO setting to be NEW or OLD.
 Return Example : 0

7.2.4 CURRENT Subsystem



CURRent:STATic:L1/L2

Type	: Channel-Specific
Description	: It sets 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 It sets the Constant Current = 20A for Static Load L1. CURR:STAT:L2 10 It sets the Constant Current = 10A for

	CURR:STAT:L1 MAX	Static Load L2. It sets the Constant Current = maximum value for Static Load L1.
	CURR:STAT:L2 MIN	It sets the 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?	It returns the set current value of Static Load L1.
Return Example	: 3.12	

CURRent:STATic:RISE/FALL

Type	: Channel-Specific	
Description	: It sets the 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	It sets the rise slew rate to 2.5A/μS for static load.
	CURR:STAT:FALL 1A/μS	It sets the fall slew rate to 1A/μS for 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?	It returns the rise slew rate of static load.
Return Example	: 2.5	

CURRent:DYNamic:L1/L2

Type	: Channel-Specific	
Description	: It sets 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	It sets the dynamic load parameter L1 = 20A.
	CURR:DYN:L2 10	It sets the dynamic load parameter L2 = 10A.
	CURR:DYN:L1 MAX	It sets the dynamic load parameter L1 = maximum value.
	CURR:DYN:L2 MIN	It sets the 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?	It returns the setting current in dynamic load L1.

Return Example : 35.6

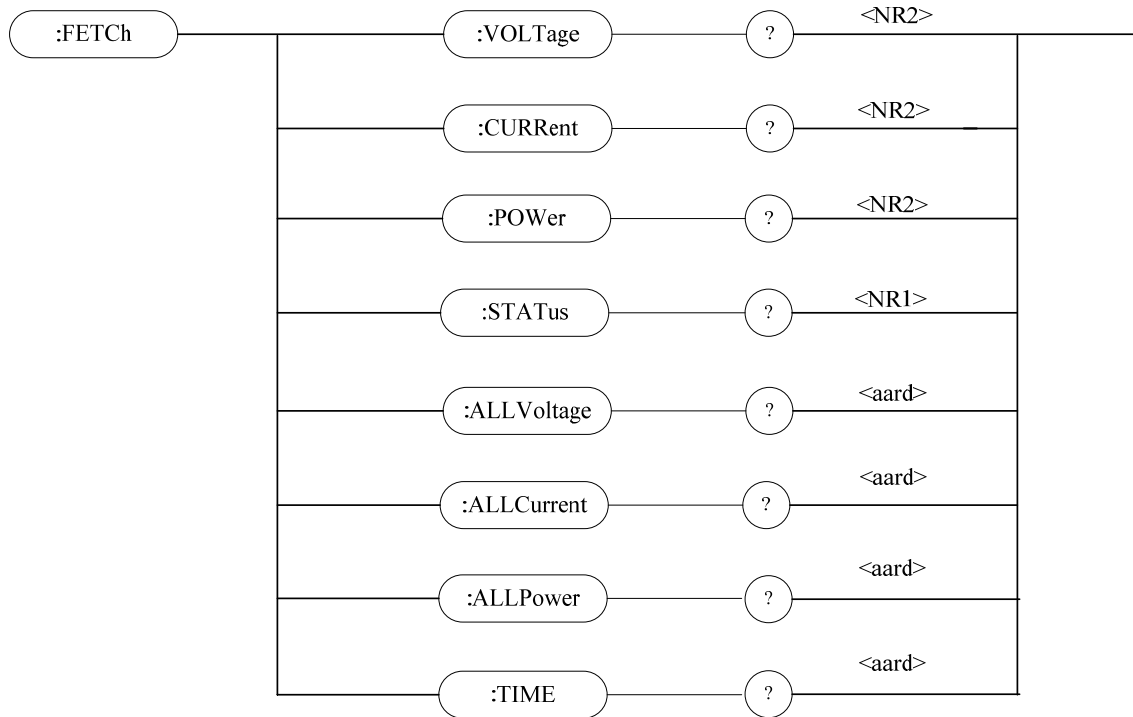
CURRent:DYNamic:RISE/FALL

Type : Channel-Specific
 Description : It sets 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 It sets the rise slew rate to 2.5A/μS.
 CURR:DYN:FALL 1A/μS It sets the fall slew rate to 1A/μS.
 CURR:DYN:RISE MAX It sets the rise slew rate as maximum
 value of dynamic load.
 CURR:DYN:FALL MIN It sets the 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? It returns the rise slew rate of
 dynamic load.
 Return Example : 2.5

CURRent:DYNamic:T1/T2

Type : Channel-Specific
 Description : It sets 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 It sets the dynamic duration
 T1 = 10mS.
 CURR:DYN:T2 2S It sets the dynamic duration
 T2 = 2S.
 CURR:DYN:T1 MAX It sets the dynamic duration
 T1 as maximum value.
 CURR:DYN:T2 MIN It sets the 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? It returns the dynamic duration
 parameter T1.
 Return Example : 0.15

7.2.5 FETCH Subsystem



FETCh:VOLTage?

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

FETCh:ALLVoltage?

Type : Channel-Independent
 Description : It returns 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 : It returns 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? It reads back the present status of load module.
 Return Example : 4

FETCh:ALLPower?

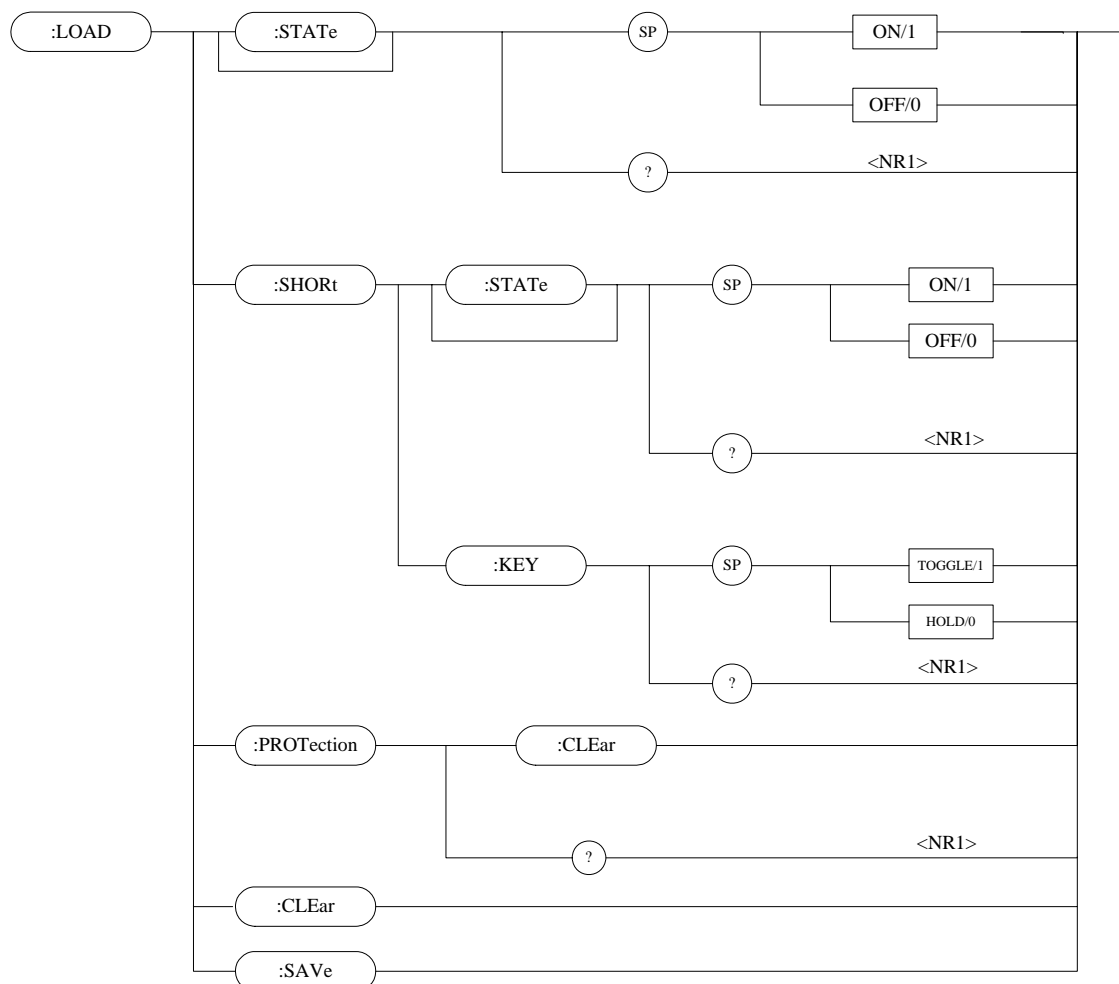
Type : Channel-Independent
 Description : It returns the real time power measured at the input of the all load module.
 Query Syntax : FETCh:ALLPower?
 Return Parameters : <aard> [Unit=Watt]
 Query Example : FETC:ALLP?
 Return Example : 5.28, 2, 0, 0, 10.2, 0, 0, 0

FETCh:TIME?

Type : Channel-Independent
 Description : Return the time measured in timing mode.
 Query Syntax : FETCh:TIME?
 Query Example : FETC:TIME?
 Return Parameters : It returns the parameter composed of <arg1>, <arg2>
 <arg1>
 -1 denotes the Timing Function test is stop.
 -2 denotes the Timing Function test is ready to execute what wait for Von or other condition.
 -3 denotes the Timing Function test is execute.
 -4 denotes the Timeout.
 -5 denotes the input voltage is lower than TRIGer voltage.
 <arg2>

The time count in the format of hr : min : sec . ms
If the parameter of arg1 is -1 or -2, it does not return arg2.

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 LOAD OFF	Activate the electronic load. Inactivate the electronic load.
Query Syntax	: LOAD:[STATe]?	
Return Parameters	: <NR1>	
Query Example	: LOAD?	It returns if the electronic load is active.
Return Example	: 1	

LOAD:SHORT:[STATe]

Type	: Channel-Specific
Description	: It activates or inactivates the short-circuited simulation.

Syntax : LOAD:SHORT:[STATe]
 Example : LOAD:SHOR ON It activate the short-circuited simulation.
 LOAD:SHOR OFF It inactivates the short-circuited simulation.
 Parameters : ON/1, OFF/0
 Query Syntax : LOAD:SHORT:[STATe]?
 Return Parameters : <NR1>
 Query Example : LOAD:SHOR? It returns the short-circuit simulation state.
 Return Example : 1

LOAD:SHORT:KEY

Type : All Channels
 Description : It sets the mode of short key in the electronic load.
 Syntax : LOAD:SHORT:KEY TOGGLE
 Parameters : TOGGLE/1, HOLD/0
 Example : LOAD:SHOR:KEY TOGGLE It sets the short key mode to Toggle.
 LOAD:SHOR:KEY HOLD It sets the short key mode to Hold.
 Query Syntax : LOAD:SHORT:KEY?
 Return Parameters : <NR1>
 Query Example : LOAD:SHOR:KEY? It returns 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? It returns the electronic load status.
 Return Example : 0

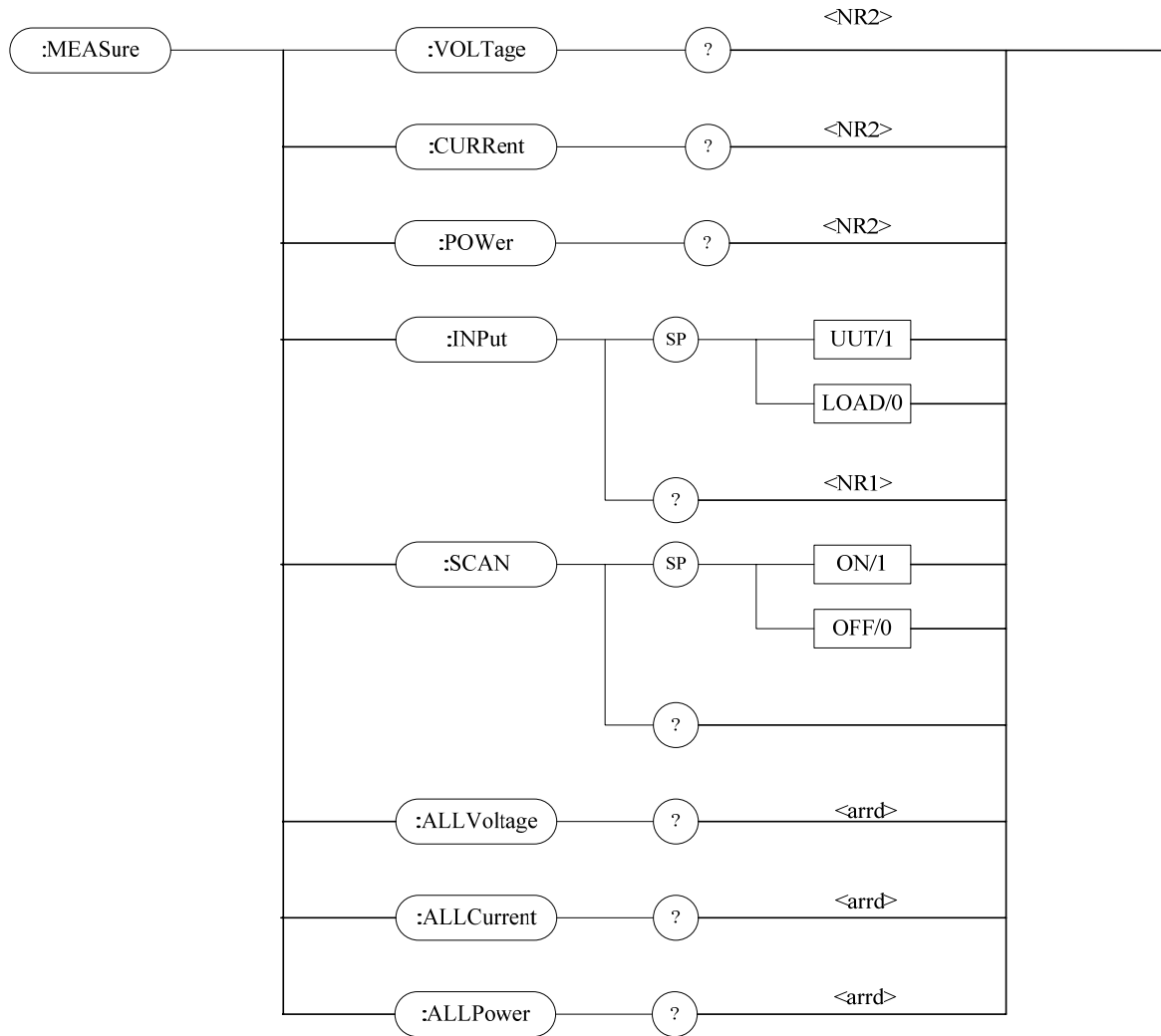
LOAD:CLEAr

Type: All Channels
 Description: It clears all data and return it to default.
 Syntax: LOAD:CLEAr
 Parameters: None
 Example: LOAD:CLE

LOAD:SAVe

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

7.2.7 MEASURE Subsystem



MEASure:VOLTage?

Type : Channel-Specific
 Description : It returns 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 : It returns 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:POWer?

Type : Channel-Specific
Description : It returns the power measured at the input of electronic load.
Query Syntax : MEASure:POWer?
Return Parameters : <NR2> [Unit=Watt]
Query Example : MEAS:POW?
Return Example : 3.15

MEASure:INPut

Type : Channel-Specific
Description : It selects 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? It returns the input port which has been set.
Return Parameters : <NR1>
Query Example : MEAS:INP?
Return Example : 0

MEASure:SCAN

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

MEASure:ALLVoltage?

Type : Channel-Independent
Description : It returns 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

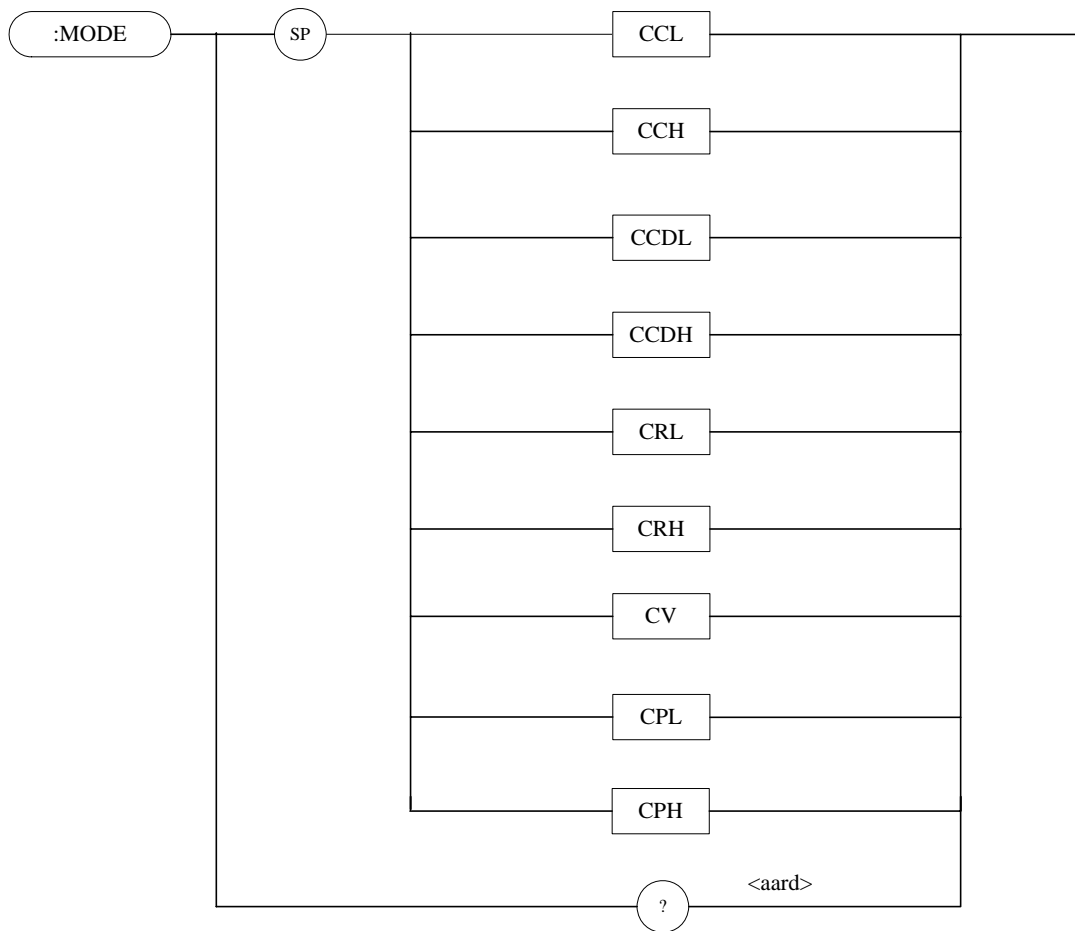
MEASure:ALLCurrent?

Type : Channel-Independent
Description : It returns 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

MEASure:ALLPower?

Type : Channel-Independent
Description : It returns the power measured at the input of all load modules.
Query Syntax : MEASure:ALLPower?
Return Parameters : <aard> [Unit=Watt]
Query Example : MEAS:ALLP?
Return Example : 0, 0, 0, 0, 5.08, 0, 12, 0

7.2.8 MODE Subsystem

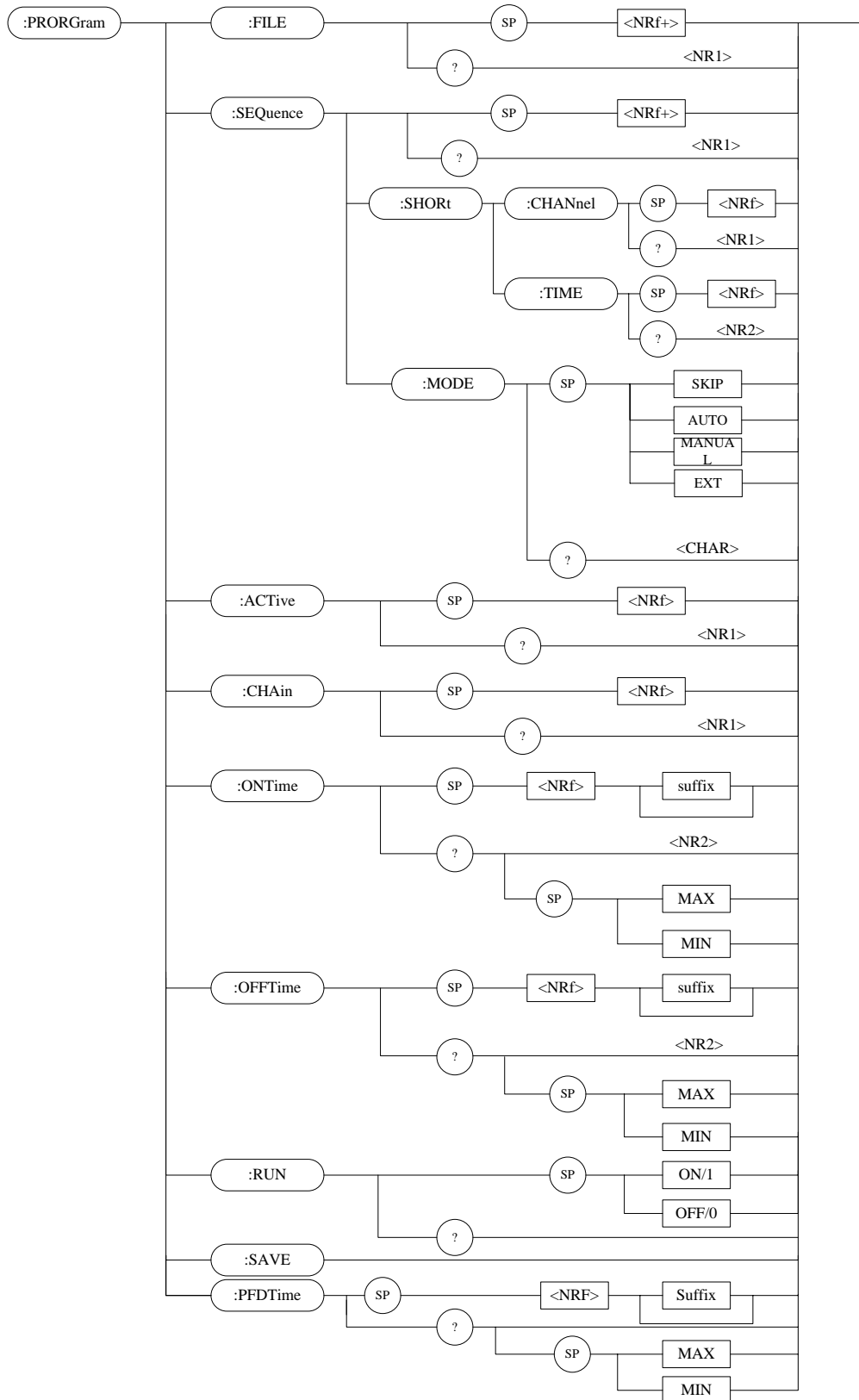


MODE

Type	: Channel-Specific
Description	: This command sets operational modes of the electronic load.
Syntax	: MODE CCL It sets the CC mode of low range.
	MODE CCH It sets the CC mode of high range.
	MODE CCDL It sets the CC dynamic mode of low range.
	MODE CCDH It sets the CC dynamic mode of high range.
	MODE CRL It sets the CR mode of low range.
	MODE CRH It sets the CR mode of high range.
	MODE CV It sets the CV mode.
	MODE CPL It sets the CP mode of low range.
	MODE CPH It sets the CP mode of high range.

Parameters : CCL, CCH, CCDL, CCDH, CRL, CRH, CV
Example : MODE CCL
Query Syntax : MODE? It returns the operational mode
of the electronic load.
Return Parameters : <aard>
Query Example : MODE?
Return Example : CCL

7.2.9 PROGRAM Subsystem



PROG:FILE

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

PROG:SEQUENCE

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

PROG:SEQUENCE:MODE

Type : By program file
 Description : It sets the the type of sequence.
 Syntax : PROG:SEQUENCE:MODE SKIP
 PROG:SEQUENCE:MODE AUTO
 PROG:SEQUENCE:MODE MANUAL
 PROG: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 : PROG:SEQ:MODE?
 Return Parameters : SKIP, AUTO, MANUAL
 Query Example : PROG:SEQ:MODE?
 Return Example : AUTO

PROG:SEQUENCE:SHORT:CHANNEL

Type : By program file
 Description : It sets the the short channel of program file sequence.
 Syntax : PROG: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 : PROG:SEQUENCE:SHORT:CHANNEL?
 Return Parameter : <NR1>
 Query Example : PROG:SEQ:SHOR:CHAN?
 Return Example : 3

PROG:SEQ:SHOR:TIME

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

PROG:ACT

Type : By program file
 Description : It selects the active load modules.
 Syntax : PROG:ACT <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 : PROG:ACT?
 Return Parameters : <NR1>
 Query Example : PROG:ACT?
 Return Example : 12

PROG:CHA

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

PROG:ONT

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

PROG:OFF

Type : By program file
 Description : It sets 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:PFDTTime

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

PROGram:SAVe

Type : By program file
Description : It saves the setting of program.
Syntax : PROGram:SAV
Parameters : NONE
Example : PROG:SAV

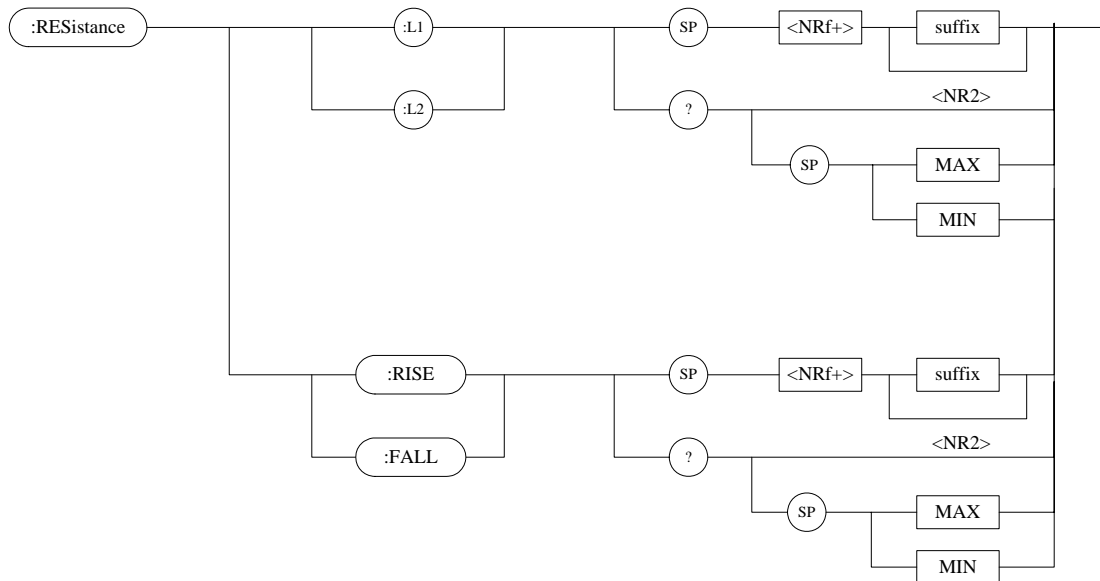
PROGram:RUN

Type : By program file
Description : It executes 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 : It echoes 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

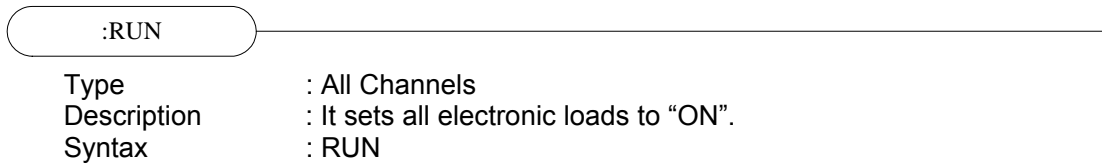
Type	: Channel-Specific
Description	: It sets the static resistance level of constant resistance mode.
Syntax	: RESistance:L1 <NRf+> [suffix] RESistance:L2 <NRf+> [suffix]
Parameters	: For valid value range refer to respective specification.
Example	: RES:L1 20 OHM It sets the constant resistance = 20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

RESistance:RISE/FALL

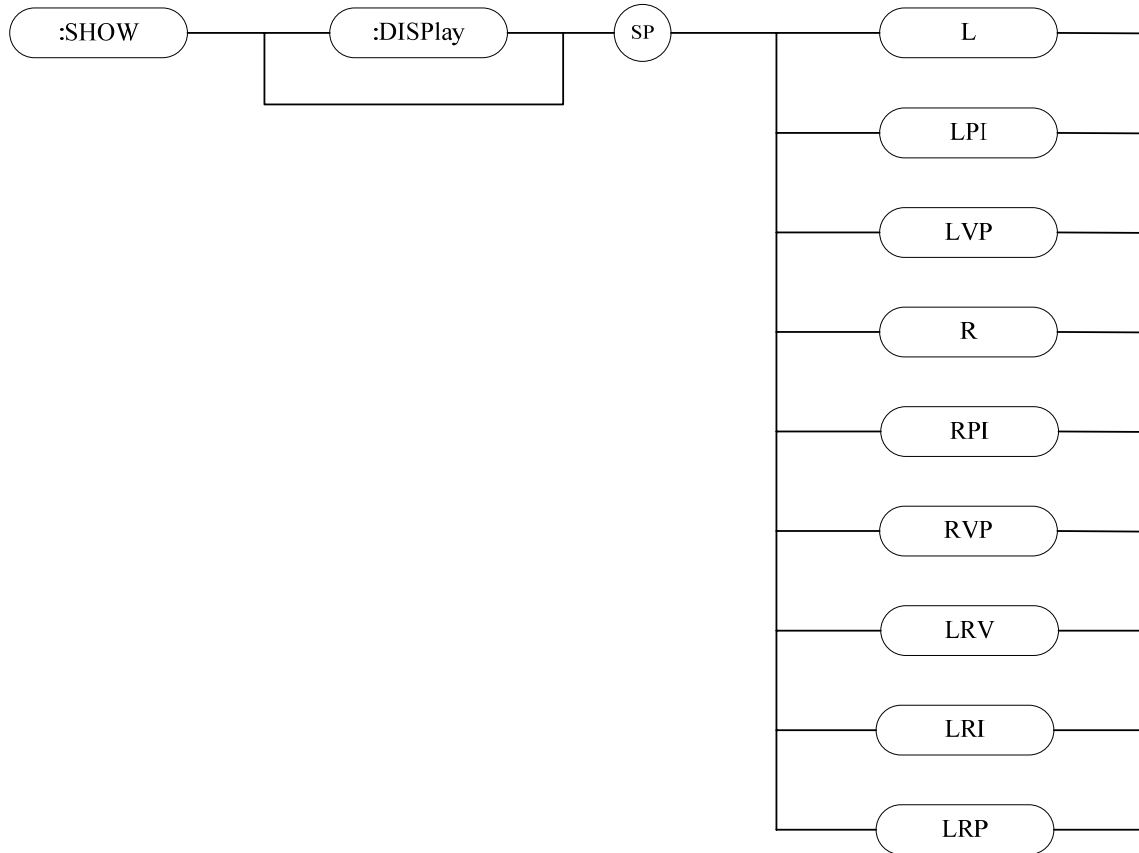
Type	: Channel-Specific
Description	: It sets the resistive slew rate of constant resistance.
Syntax	: RESistance:RISE <NRf+> [suffix] RESistance:FALL <NRf+> [suffix]
Parameters	: For valid value range refer to respective specification.
Example	: RES:RISE 2.5 It sets the CR rise slew rate to 2.5A/μS. RES:FALL 1A/μS It sets the CR fall slew rate to 1A/μS. RES:RISE MAX It sets the CR rise slew rate to the

	RES:FALL MIN	maximum programmable value. It sets the CR fall slew rate to 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?	It returns the CR rise slew rate.
Return Example	: 2.5	

7.2.11 RUN Subsystem



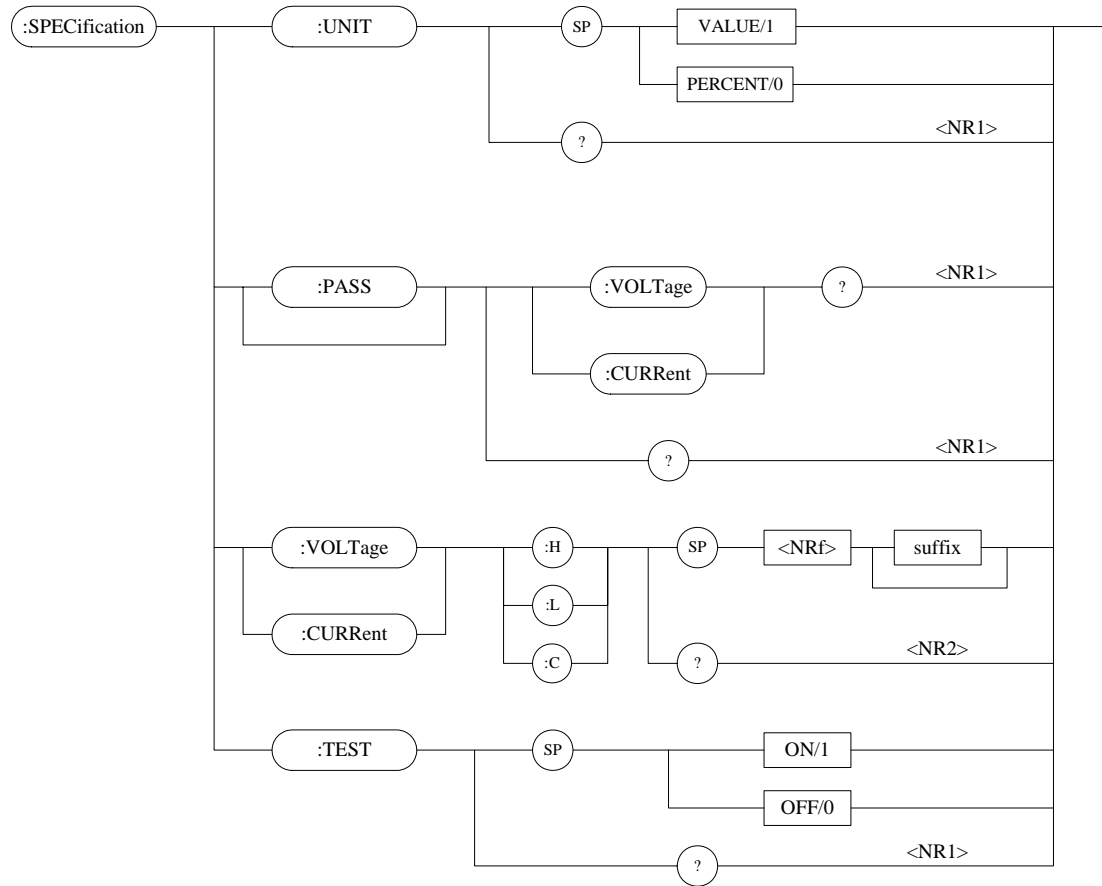
7.2.12 SHOW Subsystem



SHOW:DISPlay

Type	: Channel-Specific (Double Channel Module Only)
Description	: It sets the 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 It displays the voltage and current values of channel L. SHOW:DISP LPI It displays the power and current values of channel L. SHOW:DISP LVP It displays the voltage and power values of channel L. SHOW:DISP R It displays the voltage and current values of channel R. SHOW:DISP RPI It displays the power and current values of channel R. SHOW:DISP RVP It displays the voltage and power values of channel R. SHOW:DISP LRV It displays the voltage value of channel L and channel R. SHOW:DISP LRI It displays the current value of channel L and channel R. SHOW:DISP LRP It displays the power value of channel L and channel R.

7.2.13 SPECIFICATION Subsystem



SPECification:UNIT

Type : All Channels
 Description : It sets 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 : It requests the GO-NG result refer to the voltage specification.
 Query Syntax : SPECification:VOLTage?
 Query Example : SPEC:VOLT? It 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 : It requests the GO-NG result refer to the current specification.
 Query Syntax : SPECification:CURRENT?
 Query Example : SPEC:CURR? It returns the current GO-NG result to CC mode.
 Return Parameters : <NR1>
 Return Example : 0 (NG), 1 (GO)

SPECification?

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

SPECification:VOLTage

Type : Channel-Specific
 Description : It sets 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

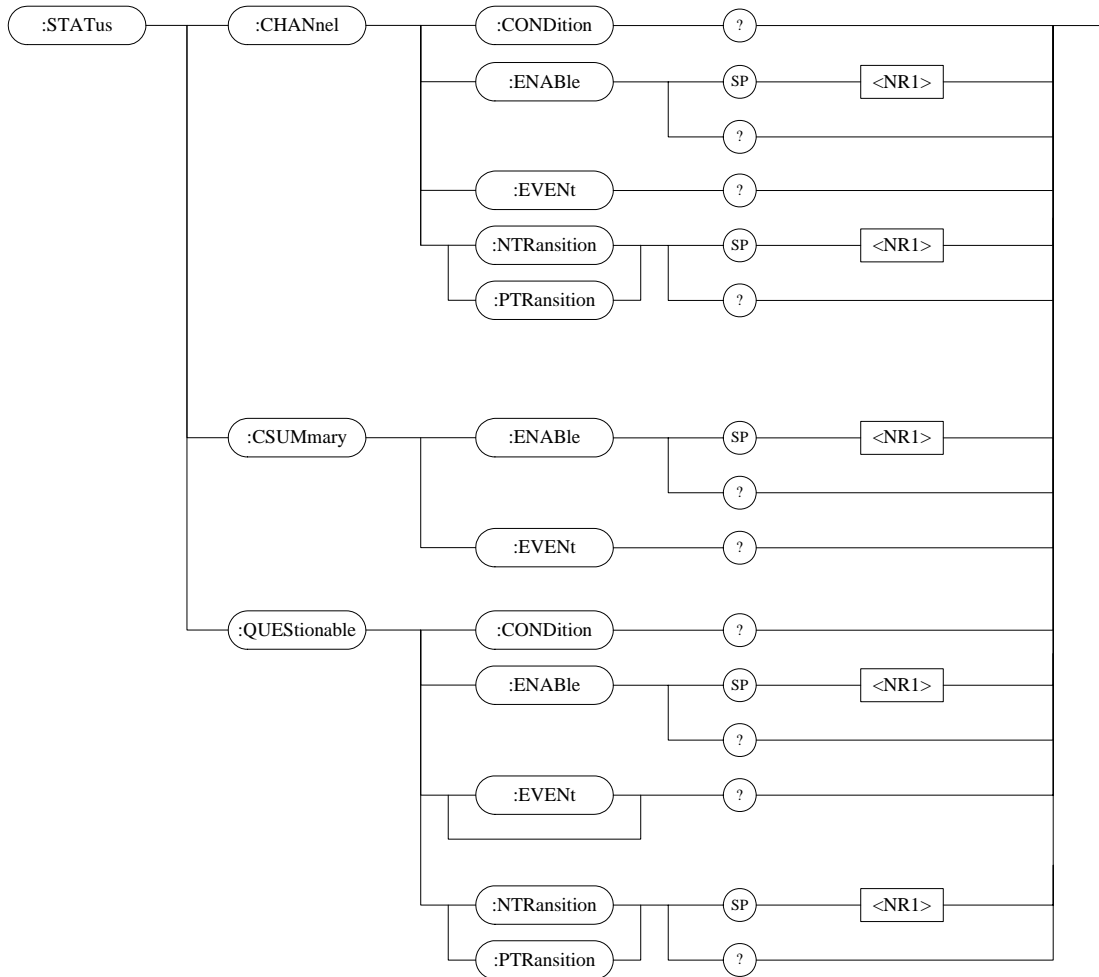
SPECification:CURRENT

Type : Channel-Specific
 Description : It sets 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 : It starts or closes 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 : It returns 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? It returns status of the electronic load.
 Return Example : 2048

STATus:CHANnel:ENABLE

Type : Channel-Specific
 Description : It 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:ENAB 24
 Query Syntax : STATus:CHANnel:ENABLE
 Return Parameters : <NR1>
 Query Example : STAT:CHAN:ENAB? It returns the contents of Status Channel Enable register.
 Return Example : 24

STATus:CHANnel:EVENT?

Type : Channel-Specific
 Description : It records 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:EVENT? It reads and resets 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 It sets the OP(over power bit 2) to 0-to-1.
 STAT:CHAN:NTR 4 It sets the OP(over power bit 2) to 1-to-0.
 Query Syntax : STATus:CHANnel:PTRansition?
 STATus:CHANnel:NTRansition?
 Return Parameters : <NR1>
 Query Example : STAT:CHAN:PTR? It inquires setting of Channel PTRansition.
 Return Example : 4

STATus:CSUMmary:ENABLE

Type : Channel-Specific
 Description : It 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? It returns the setting of Channel
 Summary Enable register.
 Return Example : 3

STATus:CSUMmary:EVENT?

Type : Channel-Specific
 Description : It Indicates 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:EVENT 3
 Query Syntax : STATus:CSUMmary:EVENT?
 Return Parameters : <NR1>
 Query Example : STAT:CSUM:EVENT? It returns the value of the Channel
 Summary Event register.
 Return Example : 3

STATus:QUEStionable:CONDition?

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

STATus:QUEStionable:ENABLE

Type : Channel-Specific
 Description : It 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 It returns the setting of Status
 Questionable Enable register.
 Return Example : 24

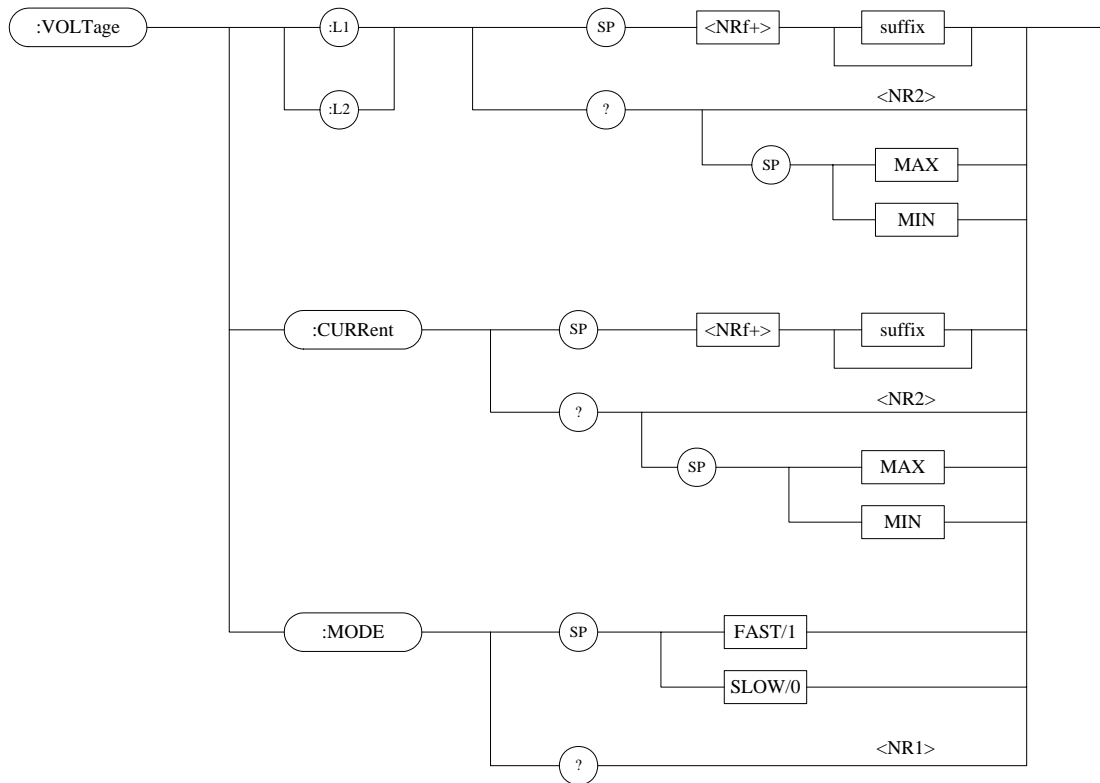
STATus:QUESTIONable:EVENT?

Type : Channel-Specific
Description : It records 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? It returns the contents of 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 It sets the OP(over power bit 2) to 0-to-1.
STAT:QUES:NTR 4 It sets the OP(over power bit 2) to 1-to-0.
Query Syntax : STATus:QUESTIONable:PTRansition?
STATus:QUESTIONable:NTRansition?
Return Parameters : <NR1>
Query Example : STAT:QUES:PTR? It returns the setting on the Questionable Ptransition/Ntransition.
Return Example : 4

7.2.15 VOLTAGE Subsystem



VOLTage:L1/L2

Type	: Channel-Specific
Description	: It sets the 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 It sets the voltage of load L1 to 8V. VOLT:L2 24V It sets the voltage of load L2 to 24V VOLT:L1 MAX It sets the voltage of load L1 to the maximum value. VOLT:L2 MIN It sets the voltage of load L2 to the minimum value.
Query Syntax	: VOLTage:L1? VOLTage:L2? VOLTage:L1? MAX VOLT:L2? MIN
Return Parameters	: <NR2> [Unit=Voltage]
Query Example	: VOLT:L1? It returns the set voltage value of load L1.
Return Example	: 0

VOLTage:CURREnt

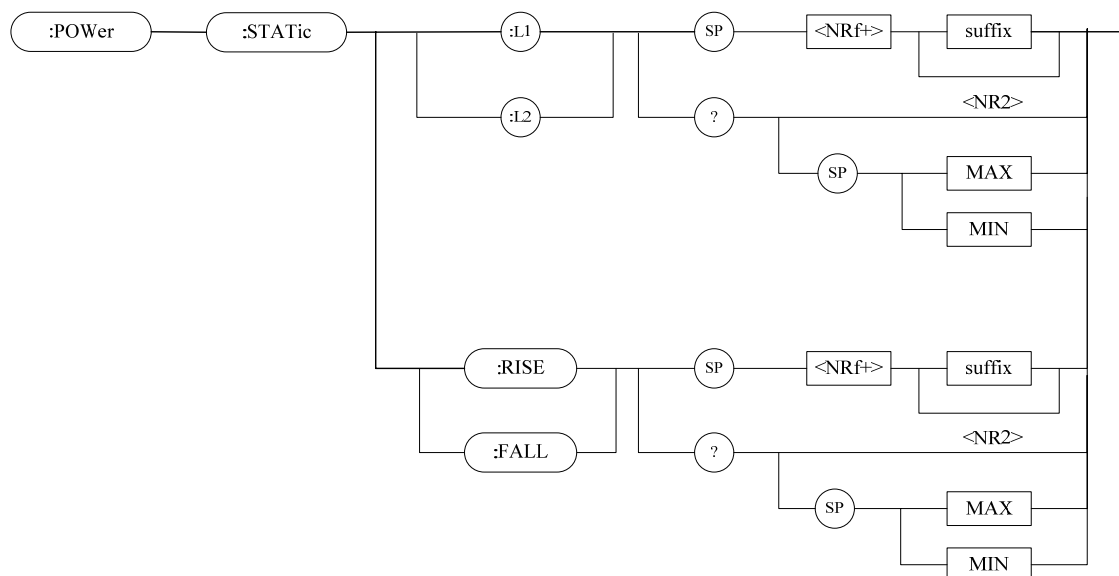
Type	: Channel-Specific
Description	: It sets the current limit of constant voltage mode.
Syntax	: VOLTage:CURREnt

Parameters : For valid value range refer to respective specification.
Example : VOLT:CURR 3 It sets the loading current limit as 3A during constant voltage mode.
VOLT:CURR MAX It sets the loading current limit as the maximum value during constant voltage mode.
VOLT:CURR MIN It sets the 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 : It 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: STATic:L1/L2

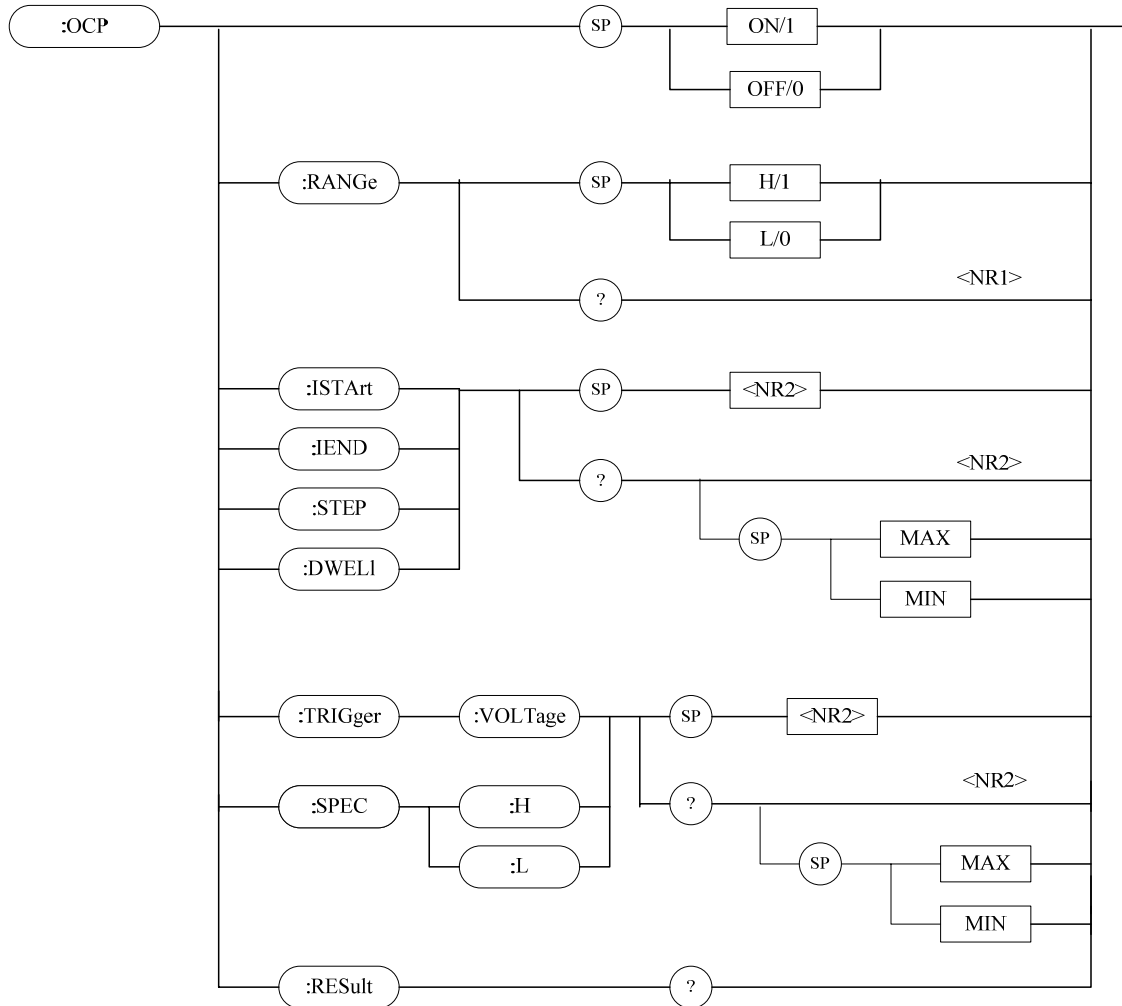
Type	: Channel-Specific
Description	: It sets the static power level of constant power mode.
Syntax	: POWer:STATic:L1 <NR2> [suffix] POWer:STATic:L2 <NR2> [suffix]
Parameters	: For valid value range refer to respective specification.
Example	: POW:STAT:L1 20 W It sets the constant power = 20 w for Load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

POWer: STATic:RISE/FALL

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

	POW:STAT:FALL 1A/ μ S	It sets the CP fall slew rate to 1w μ S.
	POW:STAT:RISE MAX	It sets the CP rise slew rate to the maximum programmable value.
	POW:STAT:FALL MIN	It sets the CP fall slew rate to the minimum programmable value.
Query Syntax	: POWER:STAT:RISE? POWER:STAT:FALL? POWER:STAT:RISE? MAX POWER:STAT:FALL? MIN	
Return Parameters	: <NR2> [Unit=W]	
Query Example	: POW:STAT:RISE?	It returns the CP rise slew rate.
Return Example	: 2.5	

7.2.17 OCP Subsystem



OCP

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

OCP:RANGe

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

OCP:ISTArt

Type : Channel-Specific
 Description : It sets the start current for OCP test mode.
 Syntax : OCP:ISTArt <NR2>
 Parameters : Refer to respective specification for valid value range.
 Example : OCP:ISTA 0.5 It sets the starts current = 0.5A
 OCP:ISTA MAX It sets the starts current = maximum value.
 OCP:ISTA MIN It sets the 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 : It sets the end current for OCP test mode.
 Syntax : OCP:IEND <NR2>
 Parameters : Refer to respective specification for valid value range.
 Example : OCP:IEND 3 It sets the end current = 3A
 OCP:IEND MAX It sets the end current = maximum value.
 OCP:IEND MIN It sets the 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 : It sets the step count for OCP test mode.
 Syntax : OCP:STEP <NR1>
 Parameters : 1~1000.
 Example : OCP:STEP 100 It sets the step = 100
 OCP:STEP MAX It sets the step = maximum value.
 OCP:STEP MIN It sets the 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:DWELI

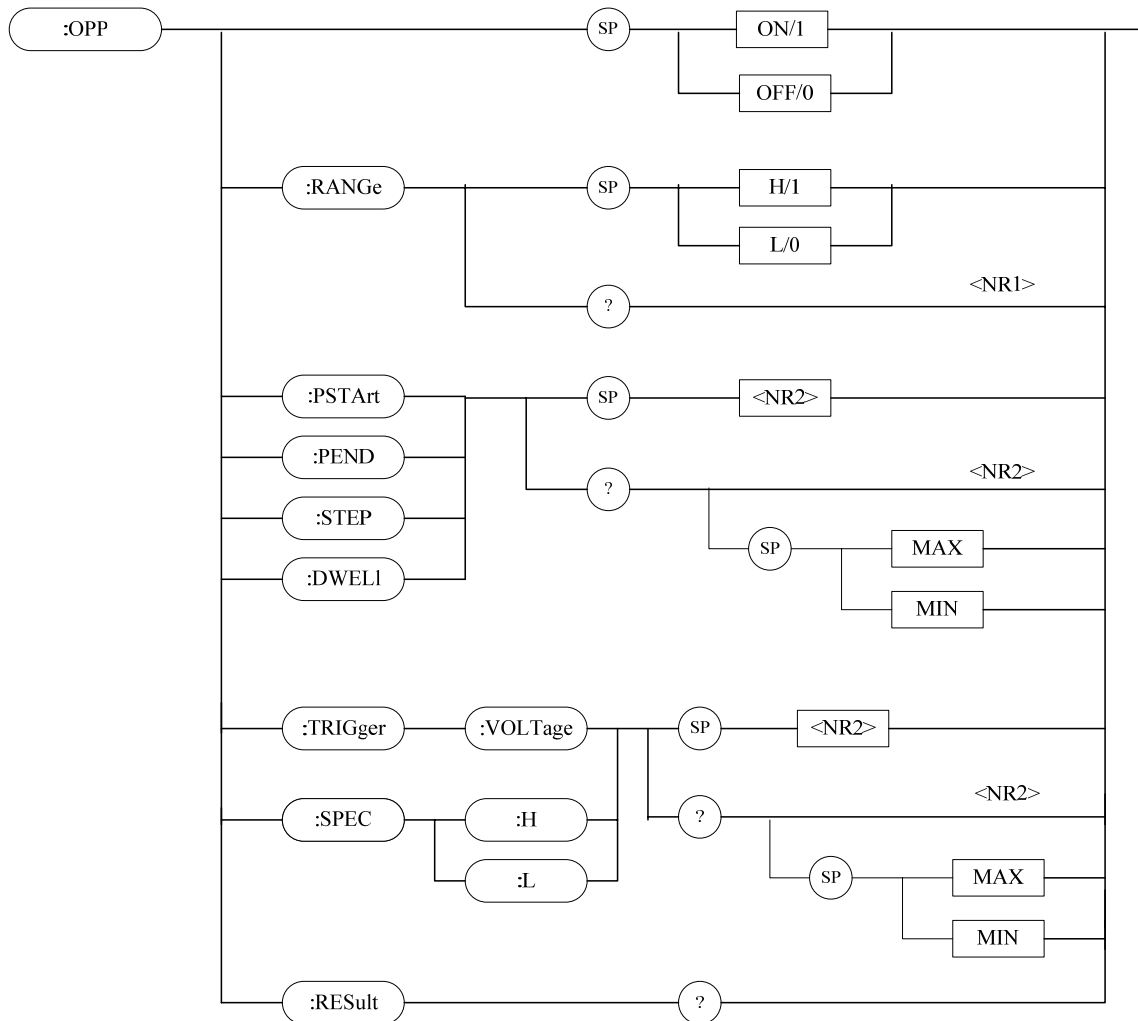
Type : Channel-Specific
 Description : It sets the dwell time for OCP test mode.
 Syntax : OCP:DWELI <NR1>
 Parameters : 1~1000.
 Example : OCP:DWEL 100 It sets the dwell time = 100

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

7.2.18 OPP Subsystem



OPP

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

OPP:RANGe

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

OPP:PStArt

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

OPP:PEnd

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

OPP:StEP

Type : Channel-Specific
 Description : It sets the step count for OPP test mode.
 Syntax : OPP:StEP <NR1>
 Parameters : 1~1000.
 Example : OPP:StEP 100 It sets the step = 100
 OPP:StEP MAX It sets the step = maximum value.
 OPP:StEP MIN It sets the 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:DWELI

Type : Channel-Specific
 Description : It sets the dwell time for OPP test mode.
 Syntax : OPP:DWELI <NR1>
 Parameters : 1~1000.
 Example : OPP:DWEL 100 It sets the dwell time = 100
 OPP:DWEL MAX It sets the dwell time = maximum value.

OPP:DWEL MIN It sets the 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 : It sets the 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 It sets the start power = 4.5V
 OPP:TRIGger:VOLTage MAX It sets the start power = maximum
 value.
 OPP:TRIGger:VOLTage MIN It sets the 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 : It sets the 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 It sets the low level power = 5W
 OPP:SPECification:L MAX It sets the low level power =
 maximum value.
 OPP:SPECification:L MIN It sets the 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 : It sets the 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 It sets the high level power = 10W
 OPP:SPECification:H MAX It sets the high level power =
 maximum value.
 OPP:SPECification:H MIN It sets the 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 : It returns the result of OPP test function.
Syntax : None
Parameters : None
Example : None
Query Syntax : OPP:RESult?
Return Parameters : When the returns are
-1 denotes the OPP test is stop.
-2 denotes the OPP test is ready to execute what wait for Von or
other condition.
-3 denotes the OPP test is executed.
<arg1>, <arg2>
<arg1>: Pass/Fail. <NR1>, 0: PASS 1: FAIL [Unit = None]
<arg2>: OPP power. <NR2>, [Unit = Ampere]
Query Example : OPP:RES?

8. Status Reporting

8.1 Introduction

This chapter discusses the status data structure of the QuadTech, Inc. 44000 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.

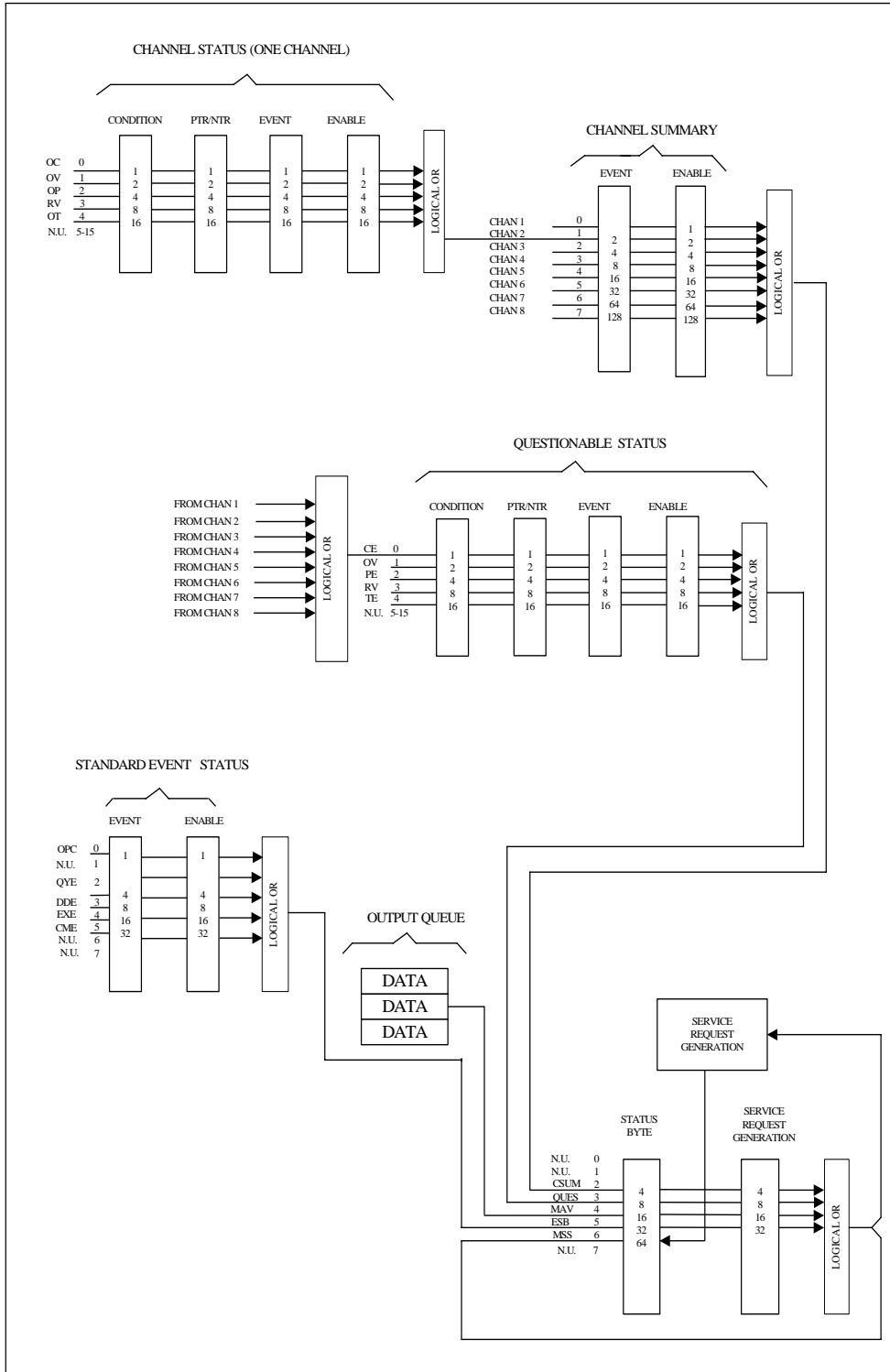


Figure 8-1 The Status Registers of Electronic Load

Mnemonic	Bit	Value	Meaning
OC	0	1	<i>Over-current.</i> When an over-current condition has occurred on a channel, Bit 0 is set and remains set until the over-current condition is removed and LOAD:PROT:CLE is programmed.
OV	1	2	<i>Over-voltage.</i> When an overvoltage condition has occurred on a channel, Bit 1 is set and remains set until the over-voltage condition is removed and LOAD:PROT:CLE is programmed.
OP	2	4	<i>Over-power.</i> An overpower condition has occurred on a channel, Bit 2 is set and remains set until the over-power condition is removed and LOAD:PROT:CLE is programmed.
RV	3	8	<i>Reverse voltage on input.</i> 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	<i>Over-temperature.</i> When over temperature 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 over-temperature 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 what way the 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 what the 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 indicates 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 what way the 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 the 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 (Over-power)
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 bit 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 the 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 the 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 <string.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
    
```

