INTEPRO SYSTEMS

Intepro Systems

ML1800 Series

Multiple Channel Programmable DC Electronic Load

User Manual

Version V1.00

2013

Introduction

Dear User,
Thank you very much for choosing the Intepro Systems ML1800 series multiple channel programmable DC electronic load. This manual is covers the use of the ML1800 series mainframe and load modules including the installation, operation and specifications of the loads.

Please read the user manual carefully, especially the notes on safety, to insure that you can use the load safely and correctly.

Please keep the manual, so that you can look up information as needed.

Announcement

For latest news on the product, updates to the manual, please visit Intepro System's website at www.inteproate.com.

Certification

Intepro Systems certifies that ML1800 series electronic load meets its published specifications. It also certifies that it adheres to it quality standards in its use of raw materials used and the manufacturing design to ensure the highest quality product.

Warranty

This hardware product is warranted against faults caused under the normal use and maintenance for a period of two years. Customer shall prepay shipping charges including duty and tax if required for products returned to our repair facility. Intepro will pay for return of products to customer.

Limitation of Warranty

The warranty is only limited to the mainframe (excluding protective tube). Any misuse, absentee control, unauthorized modification, operation outside of the environmental specifications for the products and damage from a major force is not covered and Intepro will not repair for free. Yearly calibration is also not covered. All repairs will offer an evaluation report before repair.

Only the warranty above is offered，no any other express or implied warranty is offered. Intepro Systems is not responsible for any special, occasional or indirect damage.

Safety Summary

The following general safety precautions must be observed during all phases of operation and repair, otherwise, the protection function of the product will be compromised .Intepro will not take any responsibility for any consequences caused by the non-observation of safety notes.

Safety Instruction

- Three-core cable is required for AC input of the load, and must be connected to ground; otherwise potential hazardous events can occur that could result in personal injury.
- Operating personnel must not remove the covers. Only trained and qualified personnel are allowed to do service or calibration or the warranty will be voided.
- Always ensure that AC input power is de-energized prior to connection or disconnecting any cable.
- Make sure the protection tube is assembled correctly before turning on the load.
- Do not operate in an explosive and flammable atmosphere.
- Do not assemble or replace any components alone or modify without authorization.
- To avoid fire or permanent damage, please make sure the input voltage is no more than 50% higher than the rated value.

Safety Symbols

Interpretation of international symbols used on the chassis and user manual is as the chart below:

Symbol		Symbol	
⎓	Direct Current (DC)	N	Neutral Line
~	Alternating Current (AC)	L	Line Voltage
⎓~	AC and DC	I	On (Load)
3~	3-Phase AC	O	Off (Load)
⏚	Earth (Ground) Terminal	⏻	Standby (Load)
⏚	Protective Conductor Terminal	⏻	On
⏚	Chassis Ground	⏻	Off
⊥		⚠	Warning - Risk of Electrical Shock
WARNING	Warning - Risk of Electrical Shock	⚠	Caution - Hot / Heat
Caution	Caution - refer to instructions	⚠	Caution - refer to instructions

Content

1 Overview

This manual mainly includes the specification, installation and use instruction etc of ML1800 series multiple channel electronic load.

1.1 Introduction

ML1800 series is the newly developed high end multiple programmable DC electronic loads. This series load offers powerful test functions and friend user interface. The ML1800 series loads can be applied to the test for DC power supply, battery, charger and other related devices, which can offer many solutions for your design and testing.

This series product include ML1800 chassis, 4 models of module such as 66103A (300W), 66105A (300W), 66106A (600W), 66108A (600W). The load chassis is designed with open bays to easily receive a maximum of 6 load modules, which is very applicable for configuring power supply test platform, and is cost efficient. The ML1800 series offers powerful functions, excellent performance, and good stability with an elaborate design that is perfect for your needs.

Unless otherwise noted, this manual describes the operation FT66100 series electronic loads, “chassis” means 66100A chassis, “Module” means 66103A, 66105A, 66106A, and 66108A electronic load.

1.2 Main Features

Main features of ML1800series electronic load are as below：

- Constant Current (CC), Constant Voltage (CV), Constant Resistance(CR), Constant Power (CP), and LED mode
- Up to 20KHz transient test speed，rise and fall slew rate can be set，and support user to change data online
- OVP, OCP, OPP, OTP and Reverse Polarity protection
- Two remote interfaces: GPIB and RS232
- 16bit ADC measurement
- Short circuit simulation allows double power when short circuit
- OCP test function
- Special useful battery CV charging function
- Programmable on current and power limit
- Save/call 100 groups of data, support fast call for the first 10 groups

- 10 groups of program can be linked for automated test so that the production efficiency can be raised
- TFT LCD color display, wise view angle, high brightness
- Simplified Chinese, traditional Chinese, and English are available
- Rotary knob and numeric keypad make the operation fast and flexible
- Voltage polarity display can be set to positive value (**+**) or negative value (**-**)
- GO/NG auto test function to test if the device under test meet the specification
- Rich SCPI commands facilitate to configure intellectualizing test platform and secondary development
- Intelligent fan control, saving power and lowering noise.

1.3 Chassis

ML1800 main box operates six modules installed, each module takes 1 to 2 installation positions. The size of the installation position is associated with a specific module. Specification of Chassis is as Table 1- 1.

Table 1- 1 chassis specification

Part Number	ML1800
Module installation position	6 from the bottom
Power（all modules installed）	1800W
Communication interface	RS232, GPIB (optional)
Module options	FT66103A, FT66105A
Power voltage	220V AC/50Hz
weight	16kg
size	570(D) × 433(W) ×190(H)
Operation temperature	0°C～40°C
Operation environment	Indoor operation and design, maximum humidity 90%

1.4 Panel Introduction

1.4.1 Front Panel Introduction

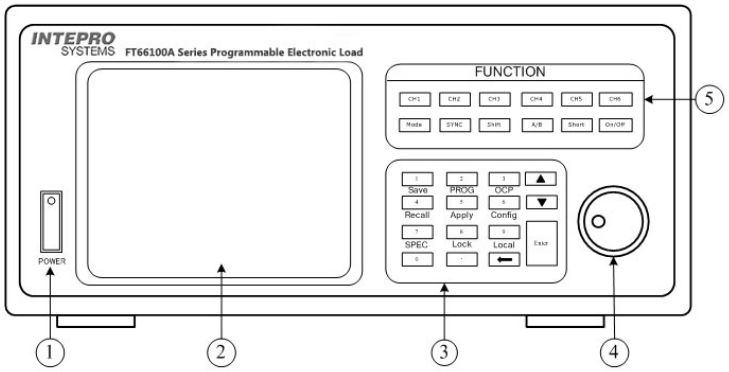


Figure 1- 1 Front Panel of Electronic Load

1. Power switch
2. Display
3. Numeric keypad
4. Rotary knob
5. Function keys

1.4.2 Rear Panel Introduction

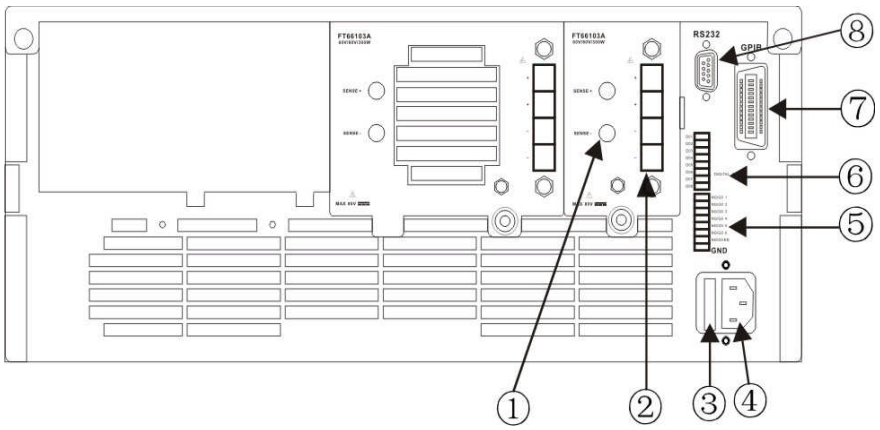


Figure 1- 2 Rear Panel of Electronic Load

1. SENSE input interface (positive and negative polarity)
2. Load input interface (positive and negative polarity)

3. Fuse
4. AC input connector
5. NG/GO output interface
6. DIGITAL I/O interface
7. GPIB bus interface
8. RS232 interface

1.5 Module Introduction

FT66103A and FT66105A can both be installed in ML1800. Each module has independent channel number and input terminal, and can be controlled separately or simultaneously by the chassis.

Each module has two test input terminals (plus and minus) and remote sense terminal. General features and operation ranges are listed in Table 1- 2.

Table 1- 2 Module General Specification

Model Number	FT66103A	FT66105A	FT66106A	FT66108A
Input Current	0-60A	0-10A	0-120A	0-20A
Input Voltage	0-80V	0-500V	0-80V	0-500V
Max power	300W	300W	600W	600W
CC Range	6A/60A	1A/10A	12A/120A	2A/20A
CV Range	16V/80V	50V/500V	16V/80V	50V/500V
CR Range	0.025～100Ω(16V) 0.625～2500Ω(80V)	0.5～1875Ω(50V) 25～93600Ω(500V)	12. 5mΩ～50Ω(16V) 0.3125～1250Ω(80V)	0.25～937.5Ω(50V) 12.5～46.8KΩ(500V)
CP Range	300W	300W	600W	600W
LED Mode Range	16V/80V	50V/500V	16V/80V	50V/500V
Installation Position	1	1	2	2
Sampling	Local sampling or remote sampling			
Protection	OVP, OCP, OPP, OTP and input reverse connection protection			

2 Installation

This chart describes how to install ML1800 multiple channel programmable DC electronic load, and introduces the boot check procedures and cautions of application.

2.1 Inspection

After receiving the electronic load, please check the equipment according to the following steps：

- Check if any damage caused during the transport.

If the box or the protective pad is seriously damaged, please immediately contact an Intepro authorized dealer or customer service department.

Note：please do not send the equipment back before the offer.

■ Accessories inspection

Make sure you also receive the accessories as below：

Figure 2- 1 Accessories

Accessories	Description
Power cord and fuse	Access to 110 or 220V AC power supply
RS232 interface cable	Access to PC
User manual	Include installation, operation information
CD	Software and technical information
Warranty card and after sale service guide	Warranty and after sale service information

If there is anything missing or damaged, please immediately contact an Intepro authorized dealer or customer service department.

■ Machine inspection

If the load chassis is damaged or operates abnormally, please immediately contact an Intepro authorized dealer or customer service department.

2.2 Cleaning

If you need to clean the external card cage, please wipe gently with a dry or non-scented cloth, do not wipe the inside part.

⚠**Warning：Disconnect the power supply before cleaning！**

2.3 Installation

Electronic load dissipates heat through the cooling fan, please ensure there is at least a 15cm space from the upper side and all around with other objects for air circulation.

2.3.1 Module Installation

Module installation must start from the first slot position close to the main board, others are sequentially installed. The installation methods of all types of modules are the same.

⚠**Warning：When removing or installing module, please follow the standard anti-static work routine, avoid touching the connecting terminal and the circuit board.**

The installation method and steps are as follows：

1. Turn off the power supply of the chassis, disconnect the power line and all connection terminal
2. Release the screw cap with a screwdriver and remove the cover
3. Remove all the packing material inside the chassis
4. Wear anti-static bracelet, seize the module input terminal and fix the screw hole position
5. Install the module from the first slot position close to the main board sequentially as in figure 2-1
6. Install all screws to fix module
7. Connect the wire to the terminal, then insert the wire into the module ,and ensure a proper connection
8. If need to install other module, Please install the module according to steps 4 – 7 to the slot right next to the former one
9. After all the modules are installed, install the load cover
10. Reconnect the power line.

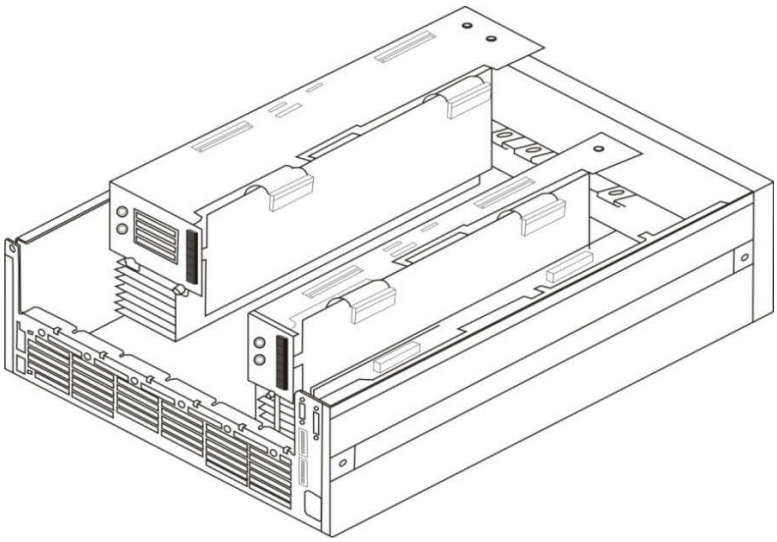


Figure 2- 1Module Installation

2.3.2 Channel Number

Module channel number is up to the installation position. Module channel number closest to the motherboard is always 1, the other modules in accordance with the motherboard distance from near to far are numbered 2 to 6. The module which occupies two positions will still have only one channel number.

As Figure 2- 2 shown：The channel number of the first module is 1. The second module occupies two positions and channel number is 2, if installation continues, the number is 3.

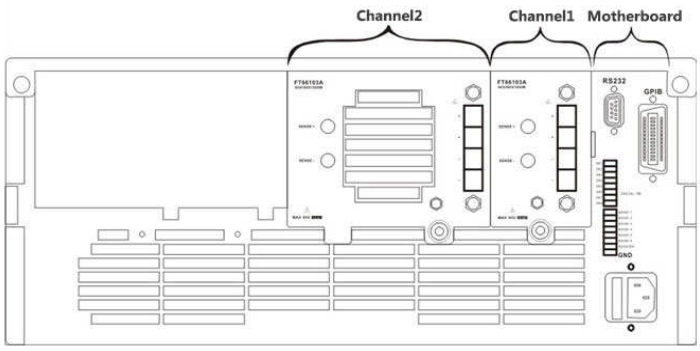


Figure 2- 2 module channel number

2.3.3 Mainframe Installation

The electronic load offers both workbench and rack mountable installation ways. Please ensure there is 15cm space at least from the upper side and all around with other objects for air circulation. For exact size of the chassis please refer to Figure Table 1- 1.

■ Workbench Installation

Put the electronic load on the workbench, than install the tripod to ensure there is enough vertical space between the chassis and the workbench for air circulation.

■ Rack mountable Installation

Electronic loads can be installed into 19” rack. Please make sure there is at least 15cm space between the load and the other instrument which will be mounted above the load for adequate air circulation.

For installation frame package, please contact an Intepro authorized sales agent.

2.3.4 Input Connection

⚠ Warning：To ensure the security and accuracy of test，the wire resistance between the electronic load and power supply under test should be as low as possible to ensure the wire is not overheat when short circuit current passing.

During the test，there will be higher current through the connection wire, which will produce a certain pressure drop and heat on the wire. When the connection load and unit are under test, the connection wire diameter needs to be considered in order to guarantee the measurement precision and test security. Two small wires will impact the test accuracy; the large heat dissipation may cause a safety hazard. Standard copper wire is ideal for connection wire, Table 2- 2 lists the maximum current that copper wires of different diameters can bear, please refer to the list of content to choose appropriate pressure drop wires, please ensure the connecting line is not more than 0.5V when load modules work.

Table 2- 2 Copper wire diameter and the maximum current it can bear

Diameter（mm^2）	Current（Unit A）	Remarks
2.5	25	1. If use aluminum wire, the maximum load current is

4.0	30	about 84% of the same diameter copper wire. 2. If a plurality of wires bundled together, the maximum load will be reduced. Calculation of actual load current of a plurality of wires as below： 2 wires：2×94%×rated current carrying capacity 3 wires：3×89%×rated current carrying capacity 4 wires：4×83%×rated current carrying capacity 5 wires：5×76%×rated current carrying capacity 3. Maximum temperature Ambient temperature：50℃ Connection wire temperature：85℃
6.0	40	
8.0	55	
14	70	
22	95	
30	100	
38	125	
50	145	
60	165	

2.4 AC Input Requirements

Rated input voltage of the electronic load is either 115VAC±10% OR 220VAC±10%; Frequency is 50 or 60 Hz.

The power supply input wire is 3 core cables with grounding protection. If there are no appropriate earth plug, do not connect the load.

There is a power supply molded cable matching your local voltage included in accessories. If the power input line and the power supply AC input end does not match, please immediately contact an Intepro authorized dealer or customer service department.

2.5 Power-on Self-test

Before operating the load, please confirm the following：

1. Mark of the AC input range for the AC input socket：Either 100-130 VAC or 200V～240V AC
2. Power line is connected to the AC input socket.

⚠**Warning：Electronic load is chassis grounded through three core power line. Before load operating, please confirm the load good grounding.**

When the load power on, the screen will display the LOGO picture, and then displays the load model and the voltage and current monitor interface.

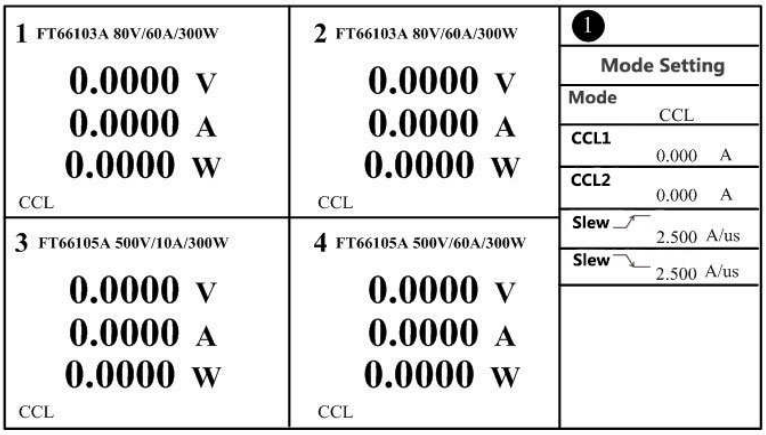


Figure 2- 3 Load Monitor Interface

If the monitoring interface prompt "**LOST**", it means the calibration data is lost.

If the load does not start, the following methods can help you find the possible problems：

1) Check if the power line is connected.
2) Check if the power line is connected and the power switch is turned on.
3) Check if the fuse of the load is burnt.

If fuse is burnt，please replace it.

Please open the small plastic cover, which is on the rear panel of the load and on the left side of the power source socket, than replace the fuse. The fuse position is as Figure 1-1 shown.

More information, Please contact the Intepro technical support department.

2.6 Connections

2.6.1 Input Connection

⚠**Warning：To meet the safety requirements, electronic load line must be sufficient to withstand the maximum short-circuit current connecting to other devices, but do not produce overheat phenomenon.**

The DC load input connection is made by the "**+**"and "**–**" on the real panel of the load and the equipment under test. With the input connection, attention must be paid on diameter, length and polarity of input connection wire. Wire diameter that is too small can affect the test precision, and excessive heat may cause a safety hazard. Copper line is normally used for connection line, and it must be short and thick to ensure the DC voltage drop is not more than 0.5V when the load is drawing current.

Warning：To meet the load requirements of higher performance and slope,the inductance of the wire between the equipment under test and load must be less than 5.0uh.

2.6.2 Sampling Connection

The load has two voltage measurement modes, which are remote sampling and local sampling. Sampling mode can be selected from "voltage sampling" for switch option under "system settings" menu.

- local sampling
  When the load is light, local sampling modes is available for input voltage measurements.
- remote sampling

When the load works, the input current will produce a certain voltage drop on the contact resistance of connection wires and port and wire, which will affect the accuracy of load voltage measurement. When the load is on the CV, CR, and CP function and need accurate measurement, remote sampling mode is recommended. Remote sampling terminal (SENSE＋ and SENSE－) need to be directly connected to the voltage output of the equipment under test for remote sampling Line connection as shown in Figure 2- 4.

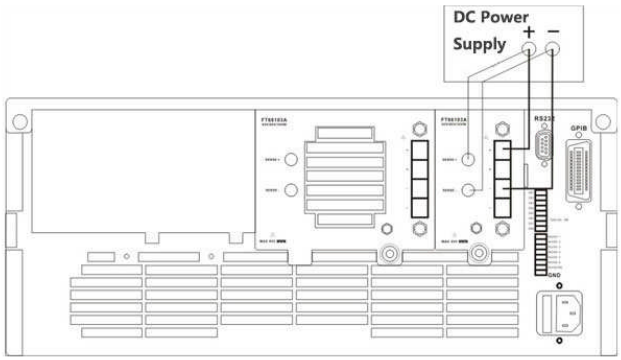


Figure 2- 4 remote sampling line connection

2.6.3 Parallel Connection

When the power or current of the power supply under test exceeds the specification of the electronic load, 2 or more electronic loads input can be paralleled to increase the current and power carry of the load. Electronic loads can be performed in parallel in the CC, CR and CP mode, but can't achieve the parallel operation in CV mode. During parallel operation, the measured output power is equal to the sum of all parallel load power consumption. To take the constant current function for instance, two loads connected in parallel, a principal value is set to 20A, the other one is set to 30A, than the measured power will be on the 50A output current.

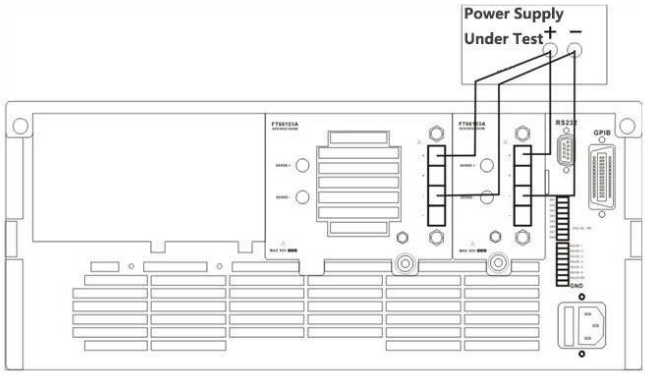


Figure 2- 5 load parallel line connection

3 Functions and Features

This chapter main describe the main functions and features of the electronic load. You will have deeper knowledge on ML1800 series electronic load by reading this chapter.

3.1 Control Mode

Electronic load offer two control modes：local control and remote control. Under local control mode, the user main operate and set through the panel of the electronic load and check the load status through the liquid display; Under remote control mode, the user main operate and set through various interfaces and program commands offered by the electronic load.

3.1.1 Local Control Mode

When the load turned on, default mode is local control mode. The user can operate the load through the panel keypad under local control mode. The liquid display provides users parameters, measurement display, and state indicator display function.

Some parameters only can be set under local control mode, which include：

- Remote communication interface of electronic load——RS232, GPIB (option)；
- GPIB address，serial baud rate and calibration mode.

3.1.2 Remote Control Mode

To enter the remote control mode of the electronic load，please select the right interface mode first：GPIB or RS232, and connect the wire between the control device and electronic load. The configured remote control parameters must be consistent with the settings of the control device. When receiving the programming commands, the electronic load will be switched to remote control mode automatically.

All the buttons on the panel of the load will be shielded under remote control mode, and the load only can be controlled by programming commands. If you want to return to local control mode, press "Shift" + "9" key.

3.2 Test Functions

5 modes are included in the test function of electronic load：

- Constant current mode(CC)
- Constant voltage mode (CV)
- Constant resistance mode (CR)
- Constant power mode (CP)
- LED mode

3.2.1 CC Mode

In the constant current mode, the load will consume constant current regardless of the input voltage. Working curve is as shown in Figure 3- 1.

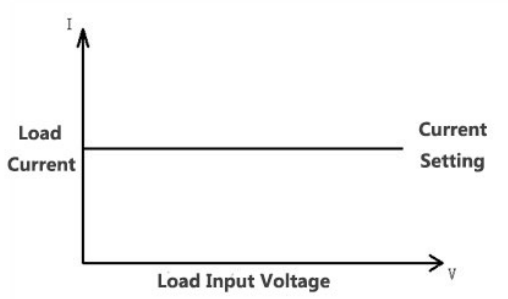


Figure 3- 1 constant current mode

The constant current mode is with high and low ranges. In low range, the input control accuracy and resolution is high; High range can achieve wide load range. The load range can be switched by changing the parameter in “mode settings” menu.

3.2.1.1 Steady State Test

Each range of steady state constant current mode has two values (A/B) for constant current mode. The A value and B value are switched by pressing "A/B" key. The rising / falling slope decide the speed of the load from one set value to another set value, as shown in Figure 3- 2.

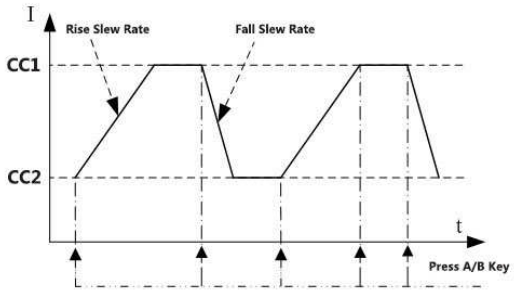


Figure 3- 2 steady state constant current mode

3.2.1.2 Transient Test

The transient test function allows the load to switch the set parameters (main value and transient value) according to the set rule, which is ideal for transient test of power supply. As shown in Figure 3- 3.

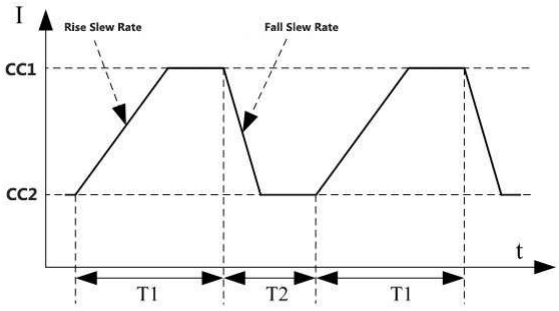


Figure 3- 3 transient constant current mode

3.2.2 Constant Voltage Mode (CV)

In the constant voltage mode, the load will consume enough current to make input voltage maintained at the set value, the working curve as shown in figure 3-4.

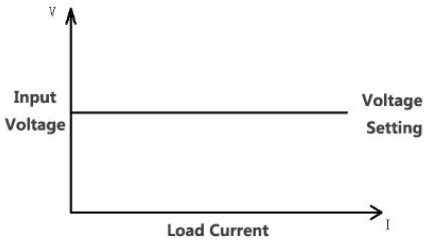


Figure 3- 4 constant voltage mode

The constant voltage mode is with high and low ranges (CVL and CVH), which can be

switched by the parameters in the “mode settings” menu. Two voltage values can be switched by pressing “A/B” key under constant voltage.

3.2.3 Constant Resistance Mode (CR)

In the constant resistance mode, the load is equivalent to a constant resistor, the input current of which will be adjusted according to the change of the input voltage. Working curve shown in figure 3-5.

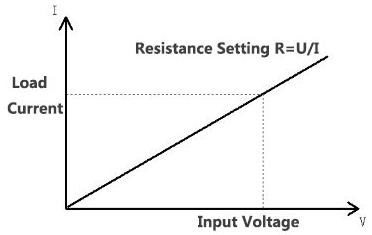


Figure 3- 5 constant resistance mode

Constant resistance mode has high and low ranges (CRH and CRL), corresponding to the two range of the voltage range under CV mode. Load range can be switched by changing the parameters in “setting mode” menu. Two resistance values can be switched by pressing “A/B” key.

3.2.4 Constant Power Mode (CP)

In the constant power mode, the load will consume a certain constant power. The input current will be adjusted linearly according to the change of the input voltage to ensure power consumption is unchanged, working curve as shown in Figure 3-6.

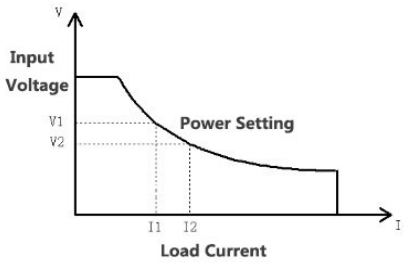


Figure 3- 6 constant power mode

Constant power mode only has one range. Two power value can be switched by pressing “A/B” key.

3.2.5 LED Mode

LED mode is mainly used for LED driver test. When the UUT voltage exceeds a certain limited value Vf, the load will operate in approximately constant resistance mode. The working curve is shown in Figure 3-7.

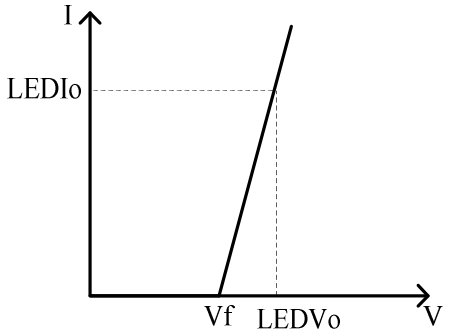


Figure 3- 7 LED mode

LED mode has high and low ranges (LEDH and LEDL)，corresponding to the working voltage. Load range can be switched by changing the parameters in “setting mode” menu.

3.3 Apply Function

FT66100 offers a variety of application mode to adapt to the tests under special cases, Including four modes：

- Constant current soft starting mode (CC Rise)
- Constant voltage soft starting mode (CV Rise)
- Constant current to constant voltage mode (CC TO CV)
- Constant resistance to constant voltage mode (CR TO CV)

3.3.1 Constant Current Soft Starting Mode (CC Rise)

Constant current soft starting mode is equivalent to an inductive load, and the simulated inductance is proportional to the rise time of the soft starting. The working curve is shown in Figure 3- 8.

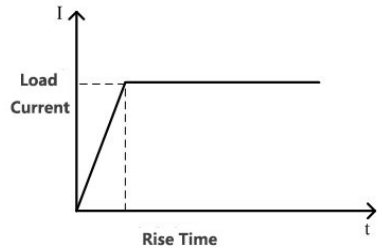


Figure 3- 8 constant current soft starting mode

Constant current soft starting mode has two ranges (CCL Rise and CCH Rise).

3.3.2 Constant Voltage Soft Starting Mode（CV Rise）

Constant current soft start mode is equivalent to a capacitive load and the simulated capacitance is proportional to the rise time of the soft start. The UUT might be impacted instantly by high current in this mode. The working curve is shown in Figure 3-9.

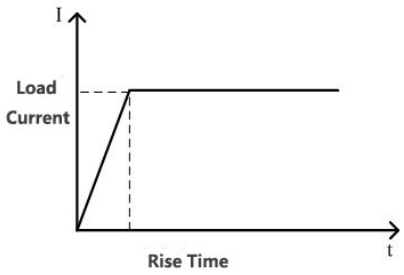


Figure 3- 9 constant current soft start mode

Constant current soft starting mode has two ranges (CVL Rise and CVH Rise).

3.3.3 CC To CV

Constant current to constant voltage mode can make the battery discharge more fully. The working curve is shown in Figure 3-10.

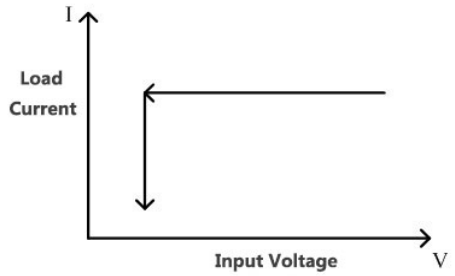


Figure 3- 10 CC to CV

CC to CV mode has two ranges (CCL To CV and CCH To CV).

3.3.4 Constant Resistance to Constant Voltage Mode (CR To CV)

Constant resistance to constant voltage mode can make the battery discharge more. The working curve is shown in Figure 3- 11.

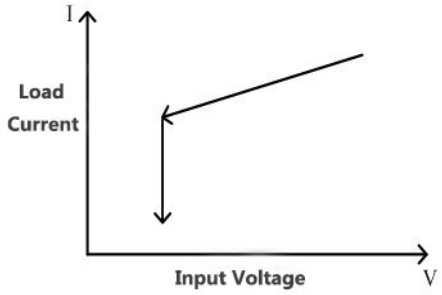


Figure 3- 11 CR to CV

CR to CV mode has two ranges (CRL To CV and CRH To CV).

3.4 Programming Function

Under programming mode, load executes many test items on the equipment according to the file. After the test, Pass or Fail will be displayed for test result. The advantage of programming mode is particularly evident in the product inspection， which can significantly improve the efficiency of product inspection. Load can store up to 10 programs, each program contains 10 series, a total of 100 archives. If a single program sequence is not enough to test the UUT, program chain function can help get more sequence for test.

3.5 OCP Function

The load provides rising slope current to test if the voltage of the UUT can reach the end potential in order to determine the normal OCP protection. This test checks the output response of the UUT when it is overloaded.

3.6 Load Synchronization

FT66100 electronic load comprises a plurality of modules. In the "Systems Settings" menu, setting the "sync enable" open can realize multi-module On/Off loading synchronously. Load synchronization only effects in the mode and program.

Key "SYNC" is used to enable the synchronization function. When setting the synchronization function of each channel, press "SYNC" key, synchronization function effects.

3.7 Battery Charge Test Function

Battery charging test includes constant current charging, constant voltage charging. and constant current to constant voltage charging. The wiring diagram when the battery is charging is shown in figure 3- 12.

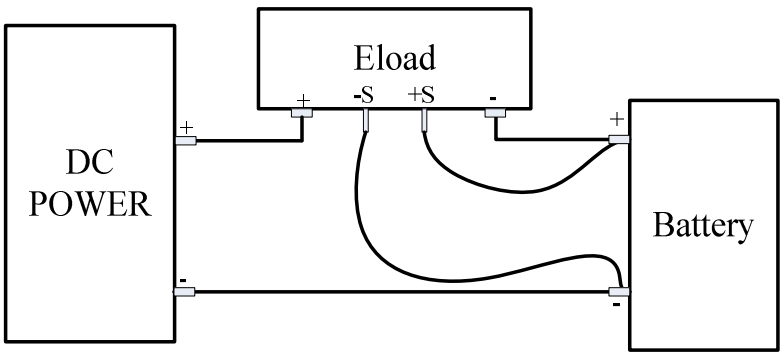


Figure 3- 12 battery charging test wiring diagram

When it works in constant current mode, the electronic load can be used for battery constant current charging. When working in battery mode of CV, the load can be used for battery voltage charge. To turn on the battery voltage mode settings, please refer to the manual section 4.8. ML1800 series electronic load can be used for charging and discharging test of the battery. The loads are easy to control by software, and easily achieve life cycling test of the battery.

3.8 Input Control

3.8.1 Turn on/off the load

Press “**On/Off**” key to change the input state of the electronic load.

3.8.2 Short Circuit

Electronic load can be simulated to test the protection performance of the UUT. When the load is short circuited, the current it consumed depends on the current operation mode and current range. Under CC and CP modes, the maximum short circuit current is 105% of the current range; Under CV modes, short circuit operation is equivalent to setting the constant voltage value of the load 0V. Short circuit operation does not change the current settings. The load will return to the previous state when exiting short circuit operation. When short circuit, during the first 200ms the maximum power the load consumes is 2 times of the rated power.
FT66100 has two short circuit modes: Hold and Toggle

- Press the "Short" load short-circuit to select Hold, releasing the button will exit the short-circuit condition.
- Press the "Short" load short circuit to select Toggle, then press "Short" again to exit the short-circuit condition.

Short circuit operation only effect in Mode. If you press the “SYNC” key, the short circuit operation is only valid for the current module.

3.8.3 Loading/Unloading Voltage

When the UUT voltage rise or fall speed is slow, setting the "load voltage" can implement UUT protection. When set, only when the measured power supply voltage rises to higher than the set “load voltage” will the load starts drawing current. When the “load voltage” drops below the setting, load stops drawing current. When the "load latch" and "unload enable" are turned on; When voltage drops below the “unloading voltage”, the load will stop drawing current. The working curve is shown below. Loading / unloading voltage setting is only useful in CC Mode.

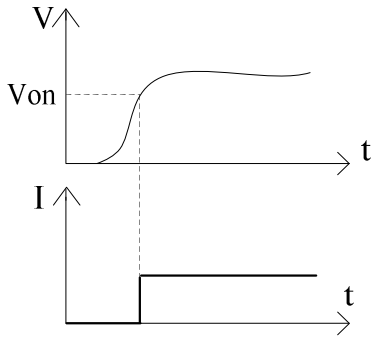


Figure 3- 13 Von Loading（Von non-locking）

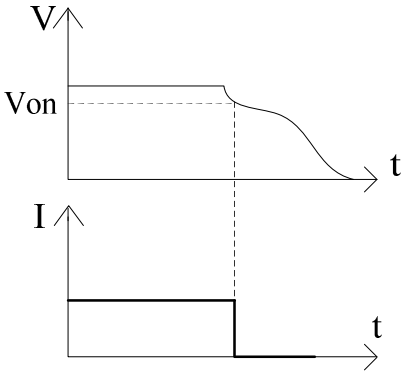


Figure 3- 14 Von Unloading（Von non-locking）

3.9 Protection Features

ML1800 series provide protection functions including: over current protection, over voltage protection, over power protection, reverse voltage protection and over temperature protection:

- **Over Current Protection (OCP)**
  If the input current is 105% higher than the rated value, the load will enter the over current protection state. VFD displays the information as “OC”.

- **Over Voltage Protection (OVP)**
  If the input voltage is 105% higher than the rated value, the load will enter the over voltage protection state. VFD displays the information as “OV”.

- **Over Power Protection (OPP)**
  Over power protection is mainly used to protect the hardware to avoid components aging quickly or damaged caused by being in long time state of over power. When the input power is 105% higher than the rated value, the input will be turned off, VFD displays the information as “OP”.

- **Reverse Voltage Protection (rEVP)**
  When the polarity of the power supply to be measured is not connected properly, VFD displays the information as "rEV", and an alarm sound can be heard. The electronic load will be in a conducting state. The maximum permissible reverse current is the same as the rated current of the load. If the reverse current exceeds the rated current, it may cause damage to the electronic load.

- **Over Temperature Protection (OT)**
  The load is with internal temperature detection circuit, when the internal temperature exceeds the safety limit, the load will close the input and “OT” will be prompted on the screen. A fan will be at full load operation as soon as possible to cool the load.

⚠**Warning：Please do not place the AC power output end to the input end of the load, and ensure the input voltage should not exceed the maximum rated input voltage.**

3.10 Slew Rate and Minimum Transition Time

Conversion slew rate defines the switching speed between value A and value B in the constant current, constant resistance, and constant power function of the load. The slew rate of the CC, CR, and CP functions can be set up. The time of one x value converted to another setting value can be set by changing slew rate of the electronic load. Figure 3-15 describes the relationship between slew rate set value and actual converting time.

In CC, CR, and CP functions; Rise and fall slew rate can be set up. If the constant current transient mode is on, the load will convert between the rise slew rate and fall slew rate. Slope value will determine the minimum conversion time between the principal value and the transient value. When the slew rate is set to the maximum value, the conversion time between the principal value and the transient value is the minimum.

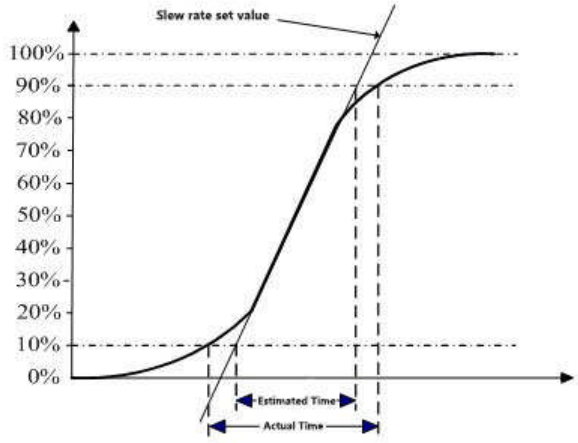


Figure 3- 15 relationship between slew rate and actual conversion time

3.11 Remote Sampling

SENSE＋and SENSE－ are remote sampling terminals, which provide the internal measurement system of the load with remote voltage signal.

When the load operates on the CV, CR, and CP function or need to measure the output voltage of the UUT accurately, remote sampling mode is recommended. When remote sampling rate, terminal SENSE＋and SENSE－ are connected directly to the output end of the UUT, which eliminates the voltage drop on the connection wire, so as to reach higher measurement accuracy.

Note：If select remote mode for sampling way,but remote sampling terminal SENSE ＋ and SENSE － has not been connected to the output end of the UUT, the load will not be able to measure the port voltage correctly, and cannot work.

3.12 System Language

Languages load provides: simplified Chinese, traditional Chinese and English. The user can press "Shift" + "6" to enter the "system settings" menu for settings.

3.13 Fast Recall

When “**Fast Recall**” is on，press 0～9 to call corresponding schema file, in which number 10 schema file is called by pressing 0.

3.14 Turn-On Keypad Lock

FT66100 electronic load support keyboard lock function. Press "Shift" + "8" key, open/close the keyboard lock. When Keyboard is locked, only “**On/Off**”, “**Short**”, “**Shift**” and “**SYNC**” can be operated. Keyboard lock state can be configured by setting “**Boot Keypad Lock**” option in “**System Settings**” menu.

3.15 Restore Factory Settings

The load provides restore factory setting function. Detailed factory settings with parameters are as shown in table 3-1.

Table 3- 1 restore factory default parameters table

Item	Parameters
Sync enable	On
Remote sampling	Off
CC voltage range	High
Current sampling range	High
Power, current limit	Maximum
Load/unload voltage	0V
Load latch/unload enable	Off
Power load	Off
Power up mode	Mode
Load time	0s
Battery constant voltage	Off
Keyboard sound	On
Short circuit key	Toggle
Digital port / fast call / boot keyboard lock	Off

Steps of restore factory default settings are as follows：

1. Press “**Shift**”+“**4**” into document call interface；

2. In “**Schema File**” option，enter 101，and press Enter to confirm.

Note：After restoring factory settings, need power on again。

4 Operation

This chapter describes operation methods of ML1800 electronic load.

4.1 Keypad

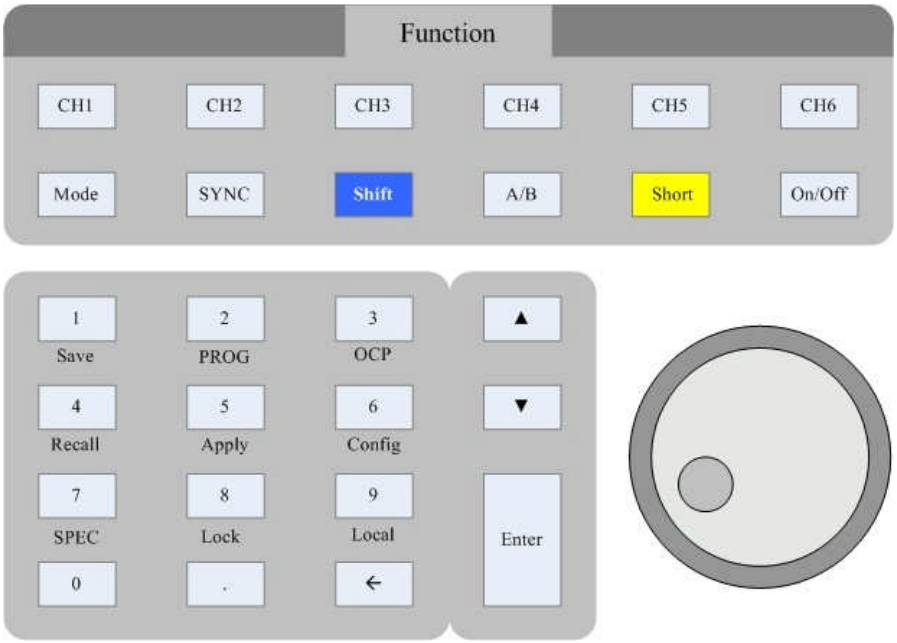


Figure 4- 1keypad of electronic load

Electronic load keypad is divided into three areas: numeric keypad, function keypad, knob. The following are introduced in detail.

4.1.1 Numeric Keypad

Figure 4- 1 Numeric keys introduction

Key	Function
0 ～ 9	0 through 9 are used for entering numeric values
.	Decimal point
▲ ▼	Scrolling keys let you move through the commands in the present select function menu, bring up the next command in the list. On setting parameters, these two keys are used to control the movement of a cursor among digital.

Enter	Confirmation key，is used to enter setup option or confirm input and exit the settings.
←	Remove the set data

4.1.2 Function Keys

Function keys compromise single function keys and composite function keys, the introduction is as follows.

Figure 4- 2 single function keys introduction

Key	Function
CH1～CH6	Select channel need to be edited
Mode	Enter "**Mode Settings**" menu
SYNC	Synchronization key, press this key, all modules with sync enable on can do On/Off, Short and save in the recall synchronously.
Shift	Second function switching key
Esc	Return to the previous menu.
A/B	Select steady state operation, switch A/B
Short	Short circuit key, press this key will make all channels of the electronic load to enter short circuit state.
On/Off	Input switch

Figure 4- 3 Composite function keys introduction

Composite keys	Function
Shift+1 (Save)	Enter the save menu
Shift+2 (Prog)	Enter the program edit menu
Shift+3 (OCP)	Enter OCP menu
Shift+4 (Recall)	Enter recall menu
Shift+5 (Apply)	Enter application settings menu
Shift+6 (Config)	Enter system setup menu
Shift+7 (SPEC)	Enter specification check menu
Shift+8 (Lock)	Enter / Exit the keyboard lock mode
Shift+9 (Local)	Return to the local control mode

4.2 Channel Selection

Press **"CH1" to "CH6"** and select one channel for manual operation. You can find

channel number at section 2.3.2. The host will scan the installed module and module type after boot. If there are no modules installed in the mainframe, "**Can not find any module**" will be shown on the display. Edit channel setting, you must first select the channel. If the channel does not exist, you can not operate.

4.3 Setting up Operation Mode

Press "**Mode**" to enter "**Mode**" menu. Users can set the load working modes: CC, CV, CR, CP or LED mode.

4.3.1 Constant Current Operation (CC)

There are four levels for constant current (CC) operation:

- Static low range(CCL)
- Static high range (CCH)
- Transient low range (CCDL)
- Transient high range (CCDH)

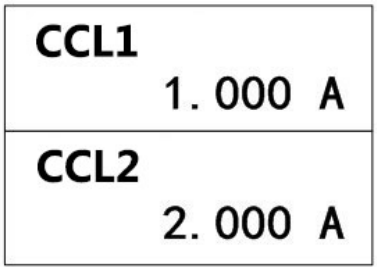
The following will demonstrate the constant current operation process. Before the operation, first select the channel, and enter the "**Mode** " menu.

1. Select CC range

Press▲▼ or knob to choose "**Mode**", and press **Enter** key to confirm. Choose "**CCL**" or press numeric key "1" and confirm.

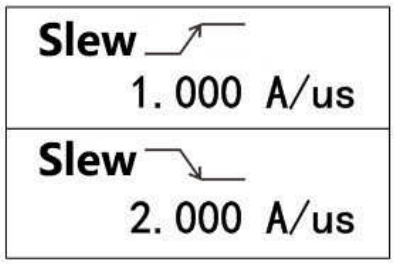
2. Setting Current Value

Press▲▼ or knob to choose "**CCL1**", enter 1 and confirm. Choose "**CCL2**", enter 2 and confirm.



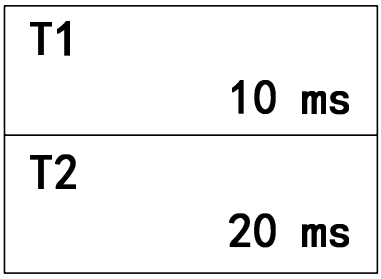
3. Setting Slew Rate

Press ▲▼or knob to choose “**rise slew rate**”, enter 1 and confirm. Choose “**fall slew rate**”, enter 2 and confirm.



4. Setting Transient Functional Cycle

In CCDL or CCDH mode, main value / transient pulse width need to be set, the range is 0.025ms ~ 50000ms. Press▲▼ or know to choose “**T1**”, enter 10 and confirm. Choose “**T2**”, enter 20 and confirm.



4.3.2 Constant Voltage Operation (CV)

Constant voltage has (CV) high and low ranges:

- CV low level (CVL)
- CV high level (CVH)

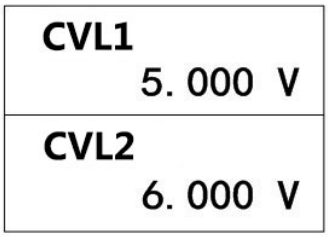
Voltage is in volts (V) as a unit, the response rate can be set as fast (Fast), medium (Medium) and slow (Slow). The following will demonstrate the constant voltage operation process. Before the operation, first select the channel, and enter the "mode" menu.

1. Select Constant Voltage Range

Press▲▼ or knob to choose “**Mode**”, and press **Enter** key to confirm. Choose “**CVL**” or press numeric key “**7**” and confirm.

2. Setting Voltage Value

Press▲▼ or knob to choose "**CVL1**", input, and press **Enter** to confirm. Choose "**CVL2**", enter 6 and confirm.



3. Setting Response Rate

Press▲▼ or knob to choose "**Response**", Press▲▼ keys or knob to choose response rate "**Slow**", and press **Enter** to confirm.

4.3.3 Constant Resistance Operation (CR)

Constant resistance has (CV) high and low ranges:

- CR low level (CRL)
- CR high level (CRH)

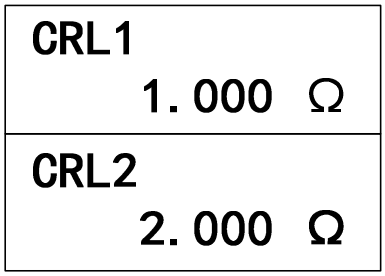
The resistance is in ohms (Ω) as a unit, and the slew rate is in the amp / S (A/us) as a unit. The following will demonstrate the operation process of constant resistance. Before the operation, first select the channel, and enter the "**Mode**" menu.

1. Select Constant Voltage Range

Press▲▼ or knob to choose "**Mode**", and press **Enter** key to confirm. Choose "**CRL**" or numeric key"**5**"and confirm.

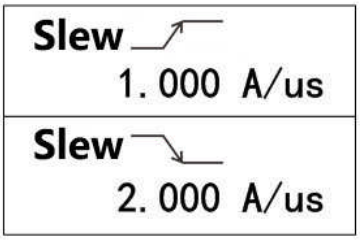
2. Setting Resistance Value

Press▲▼ or knob to choose “**CRL1**”, enter 1 and confirm. Choose “**CRL 2**”, enter 2 and confirm.



3. Setting Slew Rate

Press ▲▼or knob to choose “**rise slew rate**”，input 1 and confirm. Choose “**fall slew rate**”, enter 2 and confirm.

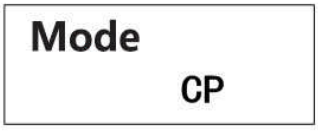


4.3.4 Constant Power Operation (CP)

The power is in watts (W) as a unit, and the slew rate is in the amp / S (A/us) as a unit. The following will demonstrate the operation process of constant power. Before the operation, first select the channel, and enter the "**Mode**" menu.

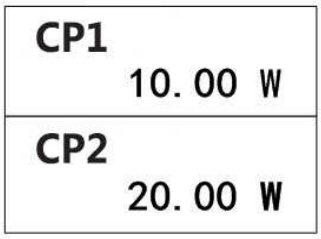
1. Select Constant Power Mode

Press▲▼ or knob to choose “**Mode**”, and press **Enter** key to confirm. Choose “**CP**” or numeric key“**9**”and confirm.



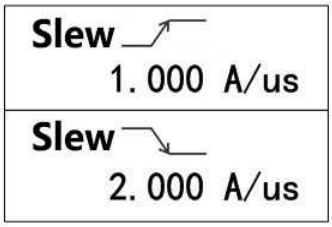
2. Setting Power Value

Press▲▼ or knob to choose “**CP1**”, enter 10 and confirm. Choose “**CP2**”, enter 20 and confirm.



3. Setting Slew Rate

Press ▲▼or knob to choose “**rise slew rate**”, enter 1 and confirm. Choose “**fall slew rate**”, enter 2 and confirm.



4.3.5 LED Operation

LED mode has high and low ranges:

- LED low level (LEDL)
- LED high level (LEDH)

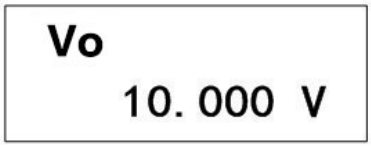
The following will demonstrate the operation process of LED mode. Before the operation, first select the channel, and enter the "**Mode**" menu.

1. Select LED Level

Press▲▼ or knob to choose “**Mode**”, Press **Enter** key to confirm. Choose “**LEDL**”, or press numeric key “0” and confirm.

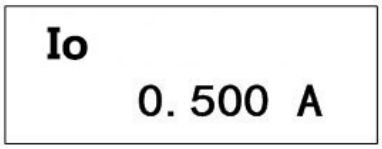
2. Setting Output Voltage

Set LED driver test voltage. Press▲▼ or knob to choose “**Vo**”, enter 10，and press **Ente**r to confirm.



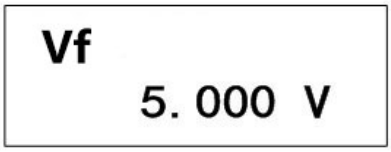
3. Setting Output Current

Set LED driver test current. Press▲▼ or knob to choose "**Io**", enter 0.5, and press **Enter** to confirm.



4. Setting Forward Bias

Press▲▼ or knob to choose "**Vf**", enter 5, and press **Enter** to confirm.



4.4 Setting Application Settings

Press"**Shift**"+"**5**"key to enter "**Apply**" menu. Users can set the load working modes: CC soft start, CV soft start, CC to CV, or CR to CV.

4.4.1 Constant Current Soft Start Operation (CC Rise)

Constant current soft start operation has high and low ranges：

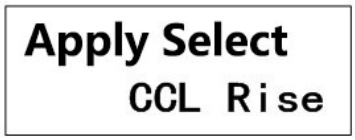
- Constant current soft start low range (CCL Rise)
- Constant current soft start high range (CCH Rise)

Current is in Amp (A) as a unit, the slew in the Amp / Microsecond (A/us) as a unit, voltage in volts (V) as a unit, and the rise time in milliseconds (MS) as the unit, its time setting range: 0.1 ~ 10000ms.

The following will demonstrate the operation process of constant current soft start. Before the operation, first select the channel, and enter the "**Application**" menu.

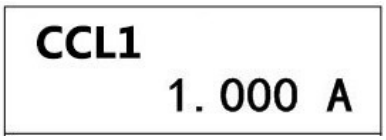
1. Select Constant Current Soft Start Function

Press▲▼ or knob to choose “**Apply Select**” and confirm. Choose “**CCL Rise**” and confirm.



2. Setting Current Value

Press▲▼ or knob to choose “**CCL1**”, enter 1 and confirm.

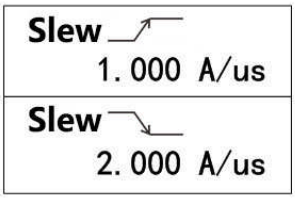


3. Setting Rise Time

Press▲▼ or knob to choose “**CCL Rise Time**”, enter 1000，and press **Enter** key to confirm.

4. Setting Slew Rate

Press ▲▼or knob to choose “**rise slew rate**”, enter 1 and confirm. Choose “**fall slew rate**”, enter 2 and confirm.



4.4.2 Constant Voltage Soft Start Operation (CV Rise)

Constant voltage soft start operation has high and low ranges:

- Constant voltage soft start low range (CVL Rise)
- Constant voltage soft start high range (CVH Rise)

The response rate is set as Fast, Medium and Slow, rise time setting range:

0.1~10000ms.

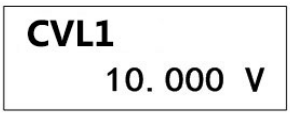
The following will demonstrate the operation process of constant voltage soft start. Before the operation, first select the channel, and enter the "**Application**" menu.

1. Select Constant Voltage Soft Start Function

Press▲▼ or knob to choose "**Apply Select**" and confirm. Choose "**CVL Rise**" and confirm.

2. Setting Voltage Value

Press▲▼ or knob to choose "**CVL1**", enter 10 and press **Enter** key to confirm.



3. Setting Rise Time

Press▲▼ or knob to choose "**CVL Rise Time**", enter 1000, and press **Enter** key to confirm.

4. Setting Response Rate

Press▲▼ or knob to choose "**Response Rate**", then choose response rate to be "Fast" through ▲▼ or knob, and press **Enter** key to confirm.

4.4.3 Constant Current to Constant Voltage Operation (CC To CV)

CC to CV operation has two ranges:

- CC（low range）to CV（CCL To CV）
- CC（high range）to CV（CCH To CV）

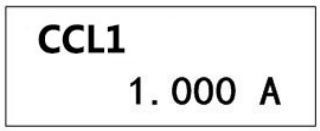
The following will demonstrate the operation process of CC (low range) to CV. Before the operation, first select the channel, and enter the "**Apply**" menu.

1. Select CC to CV Function

Press▲▼ or knob to choose "**Apply Select**" and confirm. Choose "**CCL to CV**" and confirm.

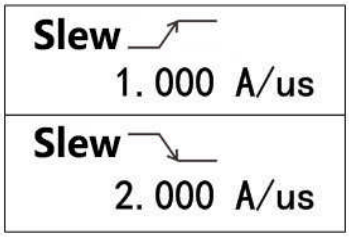
2. Setting Current Value

Press▲▼ or knob to choose "**CCL1**", enter 1 and press **Enter** key to confirm.



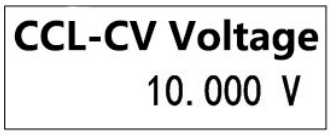
3. Setting Slew Rate

Press ▲▼or knob to choose "**rise slew rate**", enter 1 and confirm. Choose "**fall slew rate**", enter 2 and confirm.



4. Setting Mode Conversion Voltage

Press ▲▼ or knob to choose "**Conversion Voltage**", enter 10 and press **Enter** key to confirm.



5. Setting Response Rate

Press▲▼ or knob to choose "**Response**", then choose response rate to be "**Fast**" and press **Enter** key to confirm.

4.4.4 Constant Resistance to Constant Voltage Operation (CR To CV)

CR to CV operation has two ranges:

- CR (low range) to CV (CRL To CV)
- CR (high range) to CV (CRH To CV)

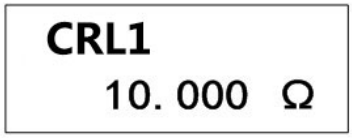
The following will demonstrate the operation process of CR (low range) to CV. Before the operation, first select the channel, and enter the "**Apply**" menu.

1. Select CR to CV Function

Press▲▼ or knob to choose "**Apply Select**" and confirm. Choose "**CRL to CV**" and confirm.

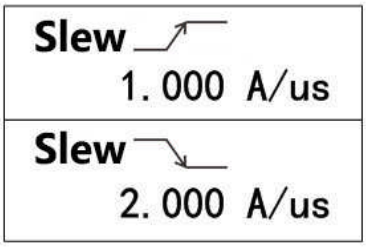
2. Setting Resistance Value

Press▲▼ or knob to choose "**CRL1**", enter 10 and press **Enter** key to confirm.



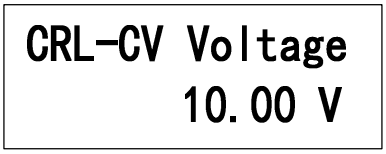
3. Setting Slew Rate

Press ▲▼or knob to choose "**rise slew rate**", enter 1 and confirm. Choose "**fall slew rate**", enter 2 and confirm.



4. Setting Mode Conversion Voltage

Press ▲▼or knob to choose "**Conversion Voltage**", enter 10 and press **Enter** key to confirm.



5. Setting Response Rate

Press▲▼ or knob to choose "**Response**", then choose response rate to be "**Fast**", and press **Enter** key to confirm.

4.5 Setting OCP

Press "**Shift**" "**3**"key to enter "**OCP**" menu. Parameters need to be set include: **Start current (I-Start), End current (I-End):** they are set up according to the selection of CCH or CCL. OCP only work when I-Start＜I-End.

Increasing step No.(NO.Step）： 1～100

Dwell Time（DwellT）： 500～1000ms

Step current OCP test：

$$\text{OCP Accuracy} = \frac{I_{End} - I_{Start}}{NO.Step}$$

Trigger voltage (VOLT-Trig): set according to the user's requirements, only work when the trigger voltage is lower than the measured voltage.

Specify low limit (SPEC_L), Specify Upper Limit (SPEC_H): set according to the user's requirements.

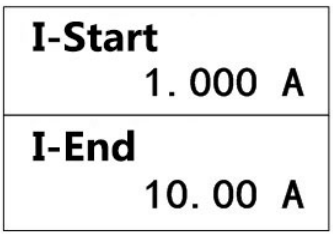
After parameters are set, press "**On/Off**"key to start test.

Test results are up to the current when the measured voltage reachesthe measured voltage：When the current is within the range, "Pass" shown on the screen, otherwise screen shows "Fail".

The following will demonstrate the operation process of OCP.

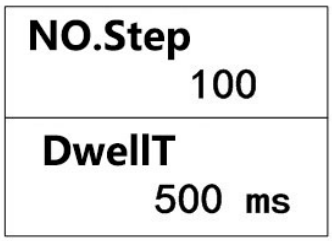
1. Setting Start and End Current

Press▲▼ or knob to choose "**I-Start**", enter 1 and confirm. Choose "**I-end**", enter 10 and confirm.



2. Setting Increasing Step Numbers and Dwell Time

Press▲▼ or knob to choose "**NO.Step**", enter 100 and confirm. Choose "**DwellT**", enter 500 and confirm.

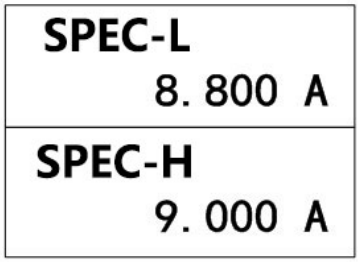


3. Setting Trigger Voltage

Press▲▼ or knob to choose "**Trigger Voltage**", then press Enter key. Enter 3.6 and confirm.

4. Setting Specified Upper and Lower Limit of OCP

Press▲▼ or knob to choose "**SPEC-L**", enter 8.8 and press **Enter** key. Press▲▼ or knob to choose "**SPEC-H**", enter 9 and press **Enter** key.



When parameter setting is completed, press "On/Off" to start the OCP test. When the test is completed, test results **Pass** or **Fail** as well as OCP voltage and current value will be shown. Press "Shift" + "Clear" can remove the test results; press "On/Off" to start a test again.

4.6 Programming

Electronic load can save the mode test into file, then executed automatically by programming.

A total of 10 programs (1 ~ 10), each program has 10 sequences, which is marked from 1 to 100 in schema archives. The table below shows the relationship between program sequence and the corresponding schema archives.

Table 4- 4 Relationship between program sequence and the corresponding schema archives

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

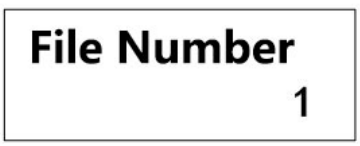
During programming operation, corresponding file parameters must be set first. If a program sequence is not sufficient to complete the test, you can use the program chain function to get more sequences.

4.6.1 Program Edit

Press“**Shift**”+“**2**”key to enter “**Program Edit**” menu. The following will demonstrate the process of program edit.

1. Recall Program Files

Input 1～10 means to recall program 1～program 10. In "program files" option to recall program 1 and confirm.



2. Channel Activation

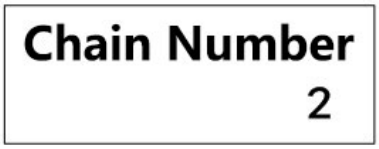
Only when the module exists and the synchronization (SYNC.RUN) option in configuration menu is set to on, program test can be run.

Press ▲▼ or knob to select "**Active CHAN**"，Press 1～6 to choose active channel to be effective or ineffective, and confirm.

3. Setting Program Chains

Program chains function help get more test sequences. Enter **1 ~ 10** implies that the link program 1~ program 10, enter 0 represents no program chain.

To choose "**Chain Number**" option and enter 2 represents linking to program **2**, then press **Enter** to confirm.



4. Setting Check Time Delay

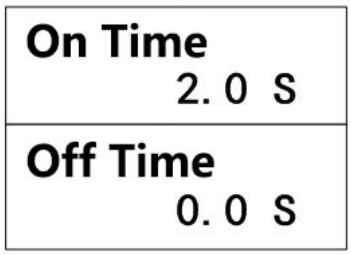
Sequence **Pass/Failure** delay time is used to set delay time for P/F detection, the range is 0 to 30 seconds (S).

Input 1 at "**P/F delay**", which means detection delay time is set to 1s and confirm.

5. Setting Load ON/OF Time

When the program is executed, with and without load time sequence control load on / off, On/Off time range is 0 ~ 60 seconds (s).

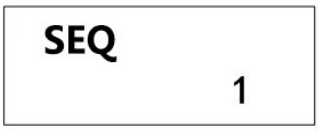
Press▲ ▼ button or knob to select **"On time"**, enter 2 and confirm. Select the "O**ff Time"** option, enter 0 and confirm.



6. Setting Edit Steps

Input 1 ~ 10 represents calling sequence 1～ sequence 10.

Press▲ ▼ button or knob to select "**SEQ**", enter 1, and press **Enter** key to confirm.



7. Setting Sequence Mode

Three modes to control the execution ways of sequences:

Skip: Skip sequence and the input state of the load will be kept the same.

Auto: Use loading/unloading time to control the loading and unloading of the load. When loading/unloading time pass, the load will skip to the next sequence automatically.

Manual: Use ▲ ▼ or 0 to 9 number keys to control the execution sequence. Press numeric key to select random execution sequence number. 0 represents sequence 10.

External：When triggering signal, D7 of DIGITAL I/O is for external triggering to control execution sequence.

8. Setting Short Circuit Channel

Press▲ ▼ button or knob to select **"Short CHNN"**, and press **Enter** to confirm, Press 1～6 keys to turn on/off the short circuit function of corresponding modules and then confirm.

9. Setting Short Time

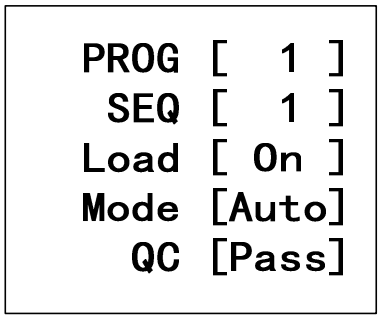
The short time range is 0 ~ 60 seconds (s).

Press▲ ▼ button or knob to select **"Short Time"**, enter 1and confirm, set the short time to 1s.

10. Repeat step 6 to 9 until the program editing is finished

4.6.2 Program Operation

When the program function is selected, press "On/Off" to operate the program. The program operation status is displayed：



PROG：Displays the program number of the current channel operation.

SEQ：Displays the sequence number of the operation.

Load: Displays the input status.

Mode: Displays the operation mode.

QC：Displays the test results compared with the standard inspection.

Sequence when the program operates is as in Figure 4- 2.

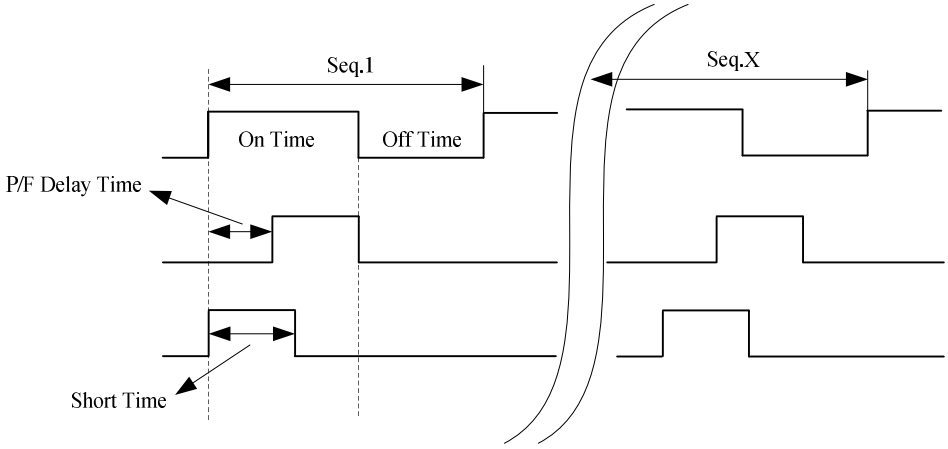
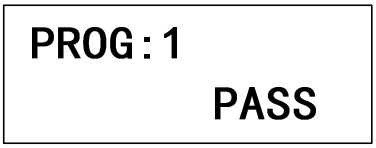


Figure 4- 2 Sequence when the program operates

When program test is finished, program running result will be displayed. If all is passed, “**PASS**” will be displayed.



If test fails，Failed sequence numbers of test will be shown in table form.

4.7 Specification Examination

Press "Shift" + "7" into the "**Specification Examination**. When “Examine Enable” is on, GO/NG at the display area of the module lights up, the load will compare the measured value with the specification limits. Examination contents include: voltage current and power.

The following will demonstrate the process of specification setting.

1. Examine ON/OFF

The "enable" option is set to open, which means opening the specification examination function. At this point the GO/NG enable port (NG/GO EN) of the host outputs high level (please refer to the manual section 4.11).

2. Setting Examination Content

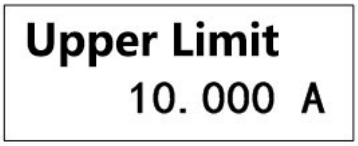
Press ▲ ▼ button or knob to select the "Examination Content" and confirm, and choose “Current” as examination content and confirm.

3. Setting Lower Limit

Press ▲ ▼ button or knob to select “**Lower Limit**”, enter 5 and confirm.

4. Setting Upper Limit

Press ▲ ▼ button or knob to select “**Upper Limit**”, enter 10 and confirm.



4.8 System Settings

Press "**Shift**" + "**6**" to enter the "**Settings**" menu. The electronic load provides many configuration characteristics such as load voltage, current limit, synchronous operation etc. To use these features, relative parameters need to be set in accordance with the requirements. The configuration parameters include: the main value and module configuration parameters. Channel configuration is stored separately, so must be set separately. The following will demonstrate the process of system setting.

1. Setting Synchronization

When the "**Sync Enable**" on, load switch is controlled by the "**On/Off**" button. When the "**Sync Enable**" off, "**On/Off**" are only valid for the current channel. Synchronous operation is set to be on by default.

2. Setting Remote Sampling

"**Remote Sampling**" on means load voltage remote sampling, "**Remote Sampling**" off means load voltage proximal sampling. Remote sampling eliminates the connection voltage drop on connection wire so as to obtain higher measurement accuracy. Default setting is on.

3. Setting CC Voltage Range

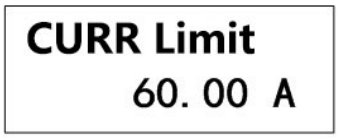
In CC mode, there are two kinds of read back voltage range. High range (High) is for use in high voltage, low range (Low) is for use in low voltage, so as to obtain a better voltage resolution. The voltage range of CC is high range (High) by default.

4. Setting Current Sampling Range

There are two "**Current Sampling Range**". High range is for (High) CCH, low range is for CCL. The default setting is high range (High).

5. Setting Current Limit

This function will limit the load current and the protection current in CV mode can not exceeds the limit value. The default value is the maximum permitted current.

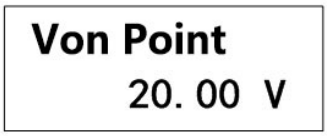


6. Setting Power Limit

This function will limit the maximum load power to be the power limit value. If the power exceeds the limit value, the load stops loading. The default value is the maximum permitted power.

7. Setting Load Voltage

When the load is ON and the output voltage of the unit to be measured reaches the load voltage, then the load sinks current.



8. Load Latch

Load control has two modes of operation: latched and unlatched mode. "Load latch" on means that when the load voltage is reached, the load sinks current; "Load latch" off means when lower than the load voltage, the load stops loading. The default setting is off. The following figure 4- 3 and 4- 4 shows the current waveform when the Von latch is on or off.

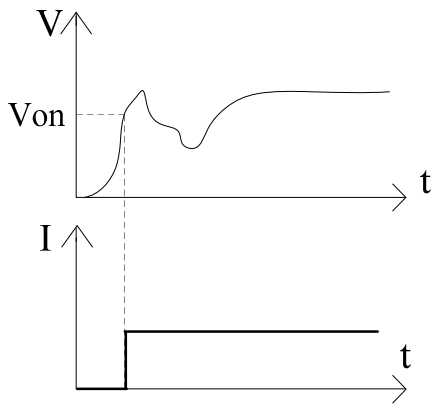


Figure 4- 3 Current waveform when Von Latch On

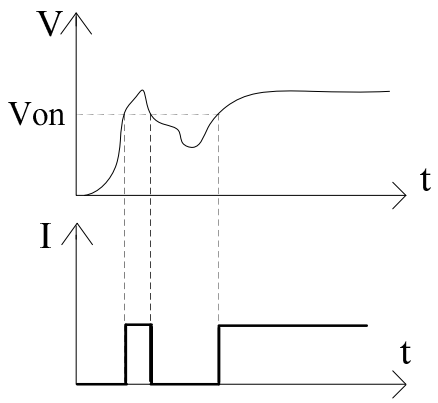


Figure 4- 4 Current waveform when Von Latch On

9. Setting Unload Enable

"**Load On**" on means the measured voltage of UUT is lower than the unload voltage, the load stops loading. "**Load On**" off means the unload voltage does not represent any function. The default value is off.

10. Setting Unload Voltage

"**Unload Enable**" is set to be on, "**Load Voltage**" and "**Load Latch**" must be set first. Load voltage must be greater than the unload voltage, and load latch must be opened so that the unloading voltage effects. When the voltage is lower than the unload voltage, load stop loading. Figure 4- 5 shows the waveform of the setting load and unloading voltage.

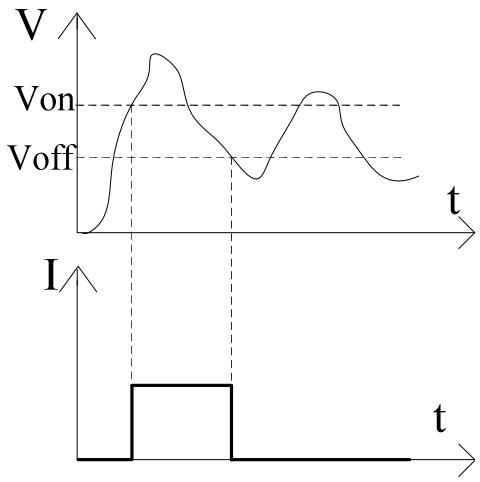


Figure 4- 4 Set load current waveform of Von and Voff

11. Setting Load On

When “**Load On**” is on, the module will operate in correspondence with the setting of “**Load On**” when the host is turned on. The default setting is off.

12. Setting Load On Mode

“**Load On Mode**” is set to be Mode, the module will operate in the latest setup mode when the host is turned on. If it is set to be PROG, the module will operate program 1.

13. Setting Load Time

For time setting of timing mode, the range is 0 to 99999 seconds (s). Where in 0s represents timing mode is not turned on. The default setting is 0s. When timing is over, the screen shows “Over”.

14. Setting Battery CV

“**Battery CV**” is set to be on. The load can be used for constant voltage charging. The default setting is off.

15. Setting Voltage Display Signs

When “**Voltage Display Sign**” is minus, voltage read back is “–“, and it accounts for a character width, if set to plus, no sign will be displayed.

16. Setting Keypad Sound

When “**Sound**” is on, key-touch tone is on; when it is off, key-touch tone is on.

17. Setting Short Key

Short ways include: **Hold** and **Toggle**. The default setting is **Toggle.**

18. Setting Digital IO

When "**Digi IO**" is on, loading of module can be controlled through external signal, at this point "**On/Off**" key is invalid. The default setting is off.

19. Setting Serial Baud Rate

The user needs to set the proper baud rate, and selectable baud rate: 600, 1200, 2400, 4800, 9600. The default setting is 9600.

20. Setting Serial Check

The RS232 has an optional check which includes: **None**, **Odd** and **Even**. The default setting is **None**.

21. Setting GPIB Address

"**GPIB Address**" can be any integer from 0～31. The default setting is 5.

22. Setting System Language

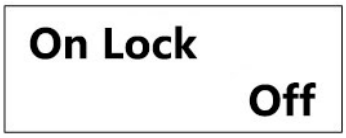
Setting language include: Simplified Chinese, Traditional Chinese and English. The default setting is English.

23. Setting Shortcut Recall

When “**Shortcut Recall**” is on, you can call the corresponding mode file by pressing the number keys on the keyboard. The default setting is off.

24. Setting On Lock

When “**Shortcut Recall**” is on, digital keyboard is locked after reboot. There is “**Shift**”+“**8**” on/off lock in addition. The default setting is off.



4.9 File Recall

Press "Shift" + "4" key to enter the "Recall" menu. FT66100 has 1 ~ 101 schema files and 1～10 OCP file for recall. No.101 file recall is to restore factory settings.

The following will demonstrate the process of file recall.

4.9.1 Recall Mode File

Press ▲ ▼ or knob to select “**Mode File**”, press **Enter** key to confirm. Input 10 to recall No. 10 file. Press “**Mode**” key for file content.

4.9.2 Recall OCP File

Press ▲ ▼ or knob to select “**OCP File**”, press **Enter** key to confirm. Enter 1 to recall No. 1 **OCP** file. Press “**Shift**” + “**3**” key for file content.

4.9.3 Fast Recall

In configuration menu, if “fast recall” is set to on, 1～10 mode files can be recalled by pressing numeric key “0”～“9” directly. Wherein key “0” corresponds to No.10 mode file.

Note：Fast recall function is only valid in mode page.

4.10 Save File

FT66100 has 1 ~ 10 schema files to save, and 1～10 program files and 1～10 OCP files to save. The following will demonstrate the process of file recall.

4.10.1 Save Mode File

In “**Mode**” menu, Press “**Shift**” + “**1**” key to enter “**Save**” menu. Press▲▼ or knob to select “**Mode File**”, and press **Enter** to confirm. Enter **10** and confirm.

4.10.2 Save Program File

In“**Program Edit**”menu, Press“**Shift**”+“**1**”key to enter “**Save**” menu. Press▲▼ or knob to select “**Program File**”, and press **Enter** to confirm. Choose “**Yes**” and confirm.

4.10.3 Save OCP File

In “**OCP File**” menu，Press “**Shift**” + “**1**” key to enter “**Save**” menu. Press▲▼ or knob to select “**OCP File**”, and press **Enter** to confirm. Enter **10** and confirm.

4.11 External Port

The rear panel of the main board of the loads has two rows of connection terminal: digital I/O AND NG/GO output.

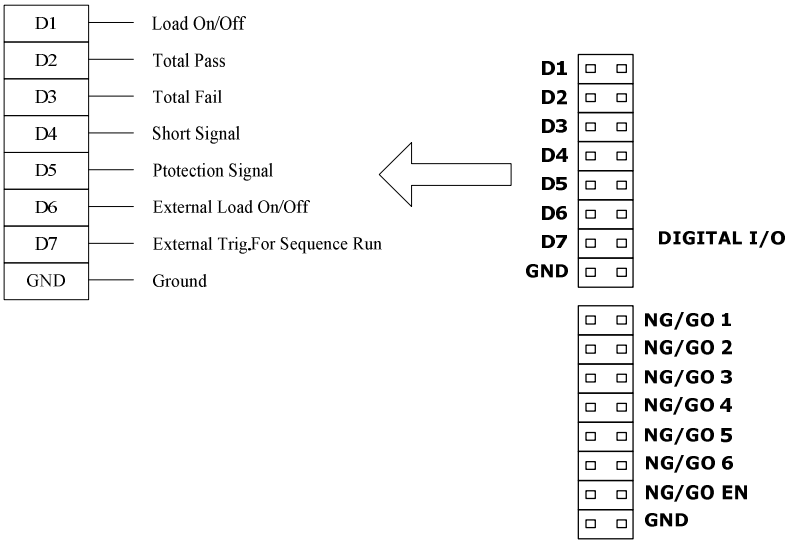


Figure 4- 5 Load control connection terminal

GO/NG Output Port

The use of TTL level indicates specification test results of each channel are Pass/ Fail. Functions of NG/GO terminal are as table 4- 5.

Figure 4- 5 NG/GO port function definition

Pin Name	Corresponding Channel	Description
NG/GO 1	1	High level：Pass Low level：Fail
NG/GO 2	2	High level：Pass Low level：Fail
NG/GO 3	3	High level：Pass Low level：Fail
NG/GO 4	4	High level：Pass Low level：Fail
NG/GO 5	5	High level：Pass Low level：Fail
NG/GO 6	6	High level：Pass Low level：Fail
NG/GO EN	Enable	Low level：Specification check off High level：Specification check on
GND	Ground	NG/GO public place

In steady state, if specification check is off (please refer to the manual section 4.7),

the NG/GO enable (NG/GO EN) port outputs low level, while the other channels output high level; if specification check is on, the NG/GO enable (NG/GO EN) port outputs high level and the output voltage level of the corresponding channel is up to check result. When the program runs, the output level of corresponding channel is determined by the result of step test.

DIGITAL I/O Port

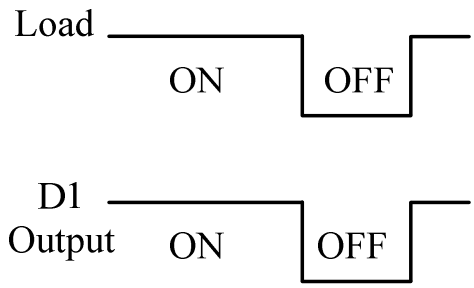
DIGITAL I/O port function definition is as Figure 4- 6.

Figure 4- 6 Function definition of DIGITAL I/O terminal

Port	Function	Remarks
D1	Load On/Off（O/P）	High level output at Load On, High level at Load Off.
D2	Total Pass（O/P）	High level pulse signal output if test items all channels are passed
D3	Total Fail（O/P）	High level pulse signal output if test items of one or more channels are failed.
D4	Short Signal（O/P）	High level output when channel is short circuited, otherwise low level output.
D5	Protection Signal（O/P）	Any protection happens at any channel, high level output, otherwise, low level output.
D6	External Load On/Off（I/P）	TTL input signal (high＞4.3V，low＜0.7V) is used to control module to execute synchronous loading (SYNC.Run is set to On).
D7	External Trig（I/P）	This signal is used for test program. Programs set to external trigger (SEQ Mode is set to External), when the program runs, the input down signal of the pin is to control the execution of the sequence.
GND	Ground	This pin is the public place of DIGITAL I/O

1. Load On/Off (O/P) (Level)

This signal is the actual loading On/Off signal. When the main board is On, output high level; when the main board is Off, output low level.



2. Total Pass (O/P) (Pulse)

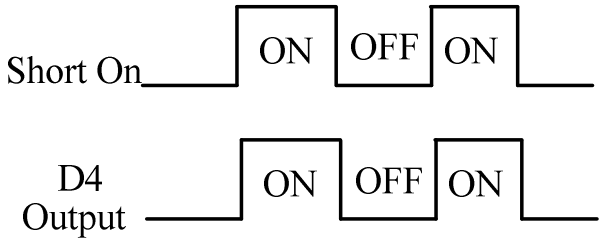
This signal is used only in program testing. If all tests are passed, output is high pulse signal. Signal pulse width is 50ms.

3. Total Fail (O/P) (Pulse)

This signal is used only in program testing. If one or more tests are failed, output is high pulse signal. Signal pulse width is 50ms.

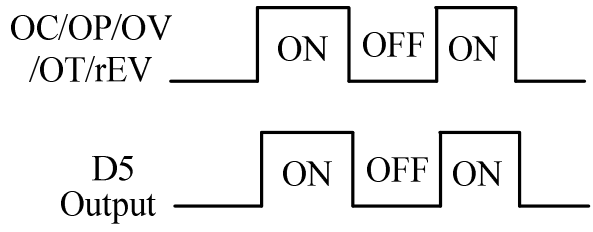
4. Short Signal (O/P) (Level)

When performing short circuit operation, Short ON will output the high level, while Short OFF will output low level.



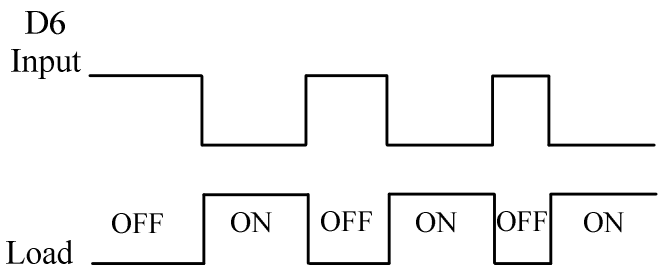
5. Protection Signal (O/P) (Level)

When protection happens on any module, Protection Signal will output high level. When protection disappears, signal will output low level.



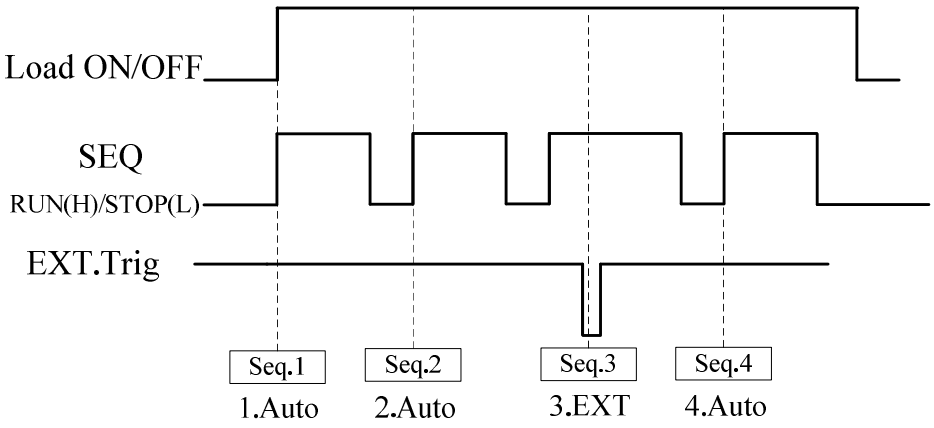
6. External Load On/Off (I/P) (Level)

TTL input signal (high＞4.3V，low＜0.7V) is used to control signal on main board so as to execute synchronous loading.



7. External Trig (I/P) (Pulse)

This signal is used only in program testing. It only works when "**DIGI IO**" is set to "ON". If the mode of any line of programs is set to "External", program running need pulse signal input externally.



5 Remote Control

ML1800 series programmable DC electronic load provides two kinds of remote communication interface for the user: RS232, GPIB (optional). Users can use a common microcomputer with the corresponding control lines to control the electronic load conveniently. Note, the above two kinds of communication interfaces can not be used at the same time, users can only choose one. The default selection is RS232 interface to be remote communication interface.

Figure 5- 1 Communication interface of electronic load

Remote Control Device	Communication Interface	Overview
microcomputer or other specialized equipment with relevant interface	GPIB	GPIB（universal interface bus）is used to connect computer and standard interfaces of peripheral units.
	RS232	Asynchronous serial communication interface, interface level is compatible with the RS232 specification.

5.1 GPIB interface

GPIB (universal instrument interface bus) is interface standard, which is used to connect the computer and peripheral equipments, and it supports the following international standards: IEEE488.1, IEC-625, IEEE488.2. The GPIB interface allows the external computer to control the electronic load through GPIB bus.

5.1.1 GPIB System Configuration

If GPIB bus interface is used to connect electronic load, you must first have a GPIB interface card. Electronic load provides optional accessories of GPIB interface card. If users use the GPIB interface card and related software provided by Intepro, GPIB remote control system can be built on personal computer easily. Figure 5- 1 is the structure diagram of GPIB remote control system using the GPIB interface card.

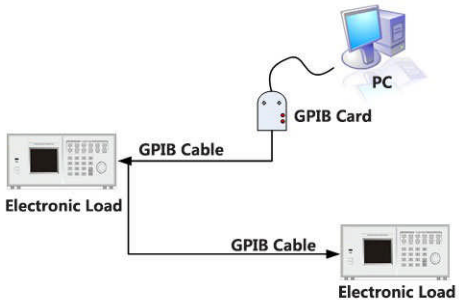


Figure 5- 1 GPIB system

A GPIB interface card can control 14 sets of equipment at most at the same time. Note the cable length between two interconnection equipment in system can not be more than 4 meters, system connecting cable length can not exceed the number of connected devices x 2 meters.

The GPIB interface card and IEEE488.2 GPIB connection cable for optional accessories, please contact the Intepro for the accessories.

5.1.2 GPIB Address

Before using the GPIB interface to connect to the load, you must set the address for the GPIB interface, address can be any value between 0 and 30. The default value of the GPIB address in the factory is "5". The GPIB address can only be changed by the panel operation mode, and unable to be set by remote control. Press "Shift" + "6" key to enter the "System Settings" menu, select the communication mode to be GPIB, than set the GPIB address.

Note：

1. Once the electronic load receives programming commands through the GPIB interface, it will automatically enter a remote control mode.

2. The GPIB address is stored in the non-volatile memory, it will not be changed after shutdown or calling the preset.

5.2 RS232 Serial Port

RS232 serial port is asynchronous serial communication interface, which conforms to RS232 level specification. The baud-rate, parity and other parameters need to be

configured first before using this interface. The serial correlation parameters can only be set through the front panel in the local control mode. Command string must end with ASCII characters "LF" (decimal 10) when edit commands are sent by using serial interface.

5.2.1 Set Baud rate

The default baud rate in the factory is 9600bp. The user can set the appropriate baud rate, selectable baud rates: 600, 1200, 2400, 4800 or 9600bps.

In the "Settings" menu option, you can set “**Serial Baud rate**” option to change the baud rate of RS232.

5.2.2 Set Parity Check System

Serial check properties of the factory default settings is "none parity". Users will also be able to set odd or even parity for serial port. In the "system settings" menu, you can set the "Serial Check" option.

5.3 Remote Control Mode

In remote control mode, the keyboard is locked, the electronic load can only be controlled through programming commands. When remote connection, load voltage, current and power parameters will be updated in real time.

Remote connection. After receiving the programming commands of the remote interface, the electronic load automatically enters the remote connection mode. In remote connection, the electronic load only can be controlled by programming command. If you want to return to local control mode, press "Shift" + "9" or send commands "CONFigure:REMote OFF ".

6 Programming Commands Overview

6.1 Introduction to Programming Commands

Command of electronic load includes two types: IEEE488.2 public command and SCPI command equipment related.

IEEE 488.2 public commands defines some control and query commands which are universal to instruments. Public commands allow the basic operation of the electronic load, such as reset, state query. All the IEEE 488.2 public commands consist of " * " and three letter mnemonics, such as: *RST, *IDN?, *ESE?.IEEE 488.2

The SCPI command realizes the function of the electronic load such as most of the tests, setting, calibration and measurement etc. This type of command is in command tree form. Each command can contain multiple mnemonics, each node of command tree is separated with the characters " : " separation, as shown in figure 6- 1 shown. Top of command tree "ROOT" is called "root". The whole route from the "root" to the nodes is one complete programming command.

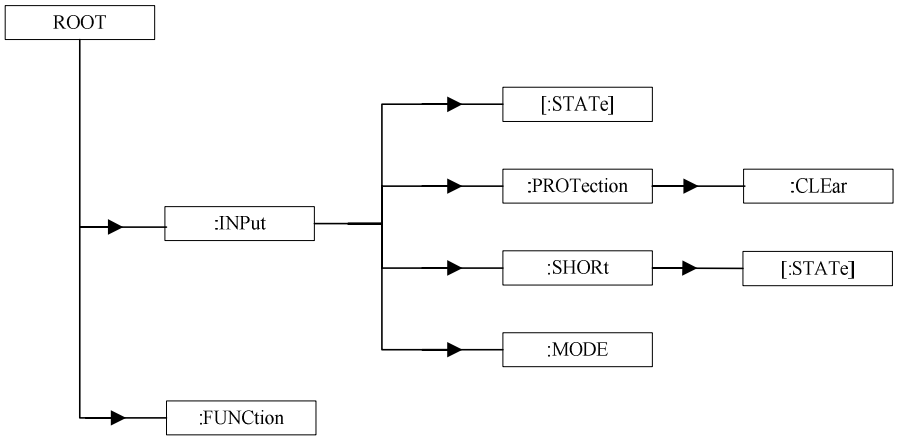


Figure 6- 1 Command tree example

6.2 Command Definition

The GPIB statement includes the instrument control and the query commands. Command statement transfer commands to the electronic load, and the query commands request information from the electronic load.

Simple Command

Simple commands include one command or keyword, which is normally followed by parameter or data:
LOAD ON

Complex command

When two or more than two keywords are connected with the colon (:), it consists of a complex command. The last keyword is normally followed by a parameter or data：
CURRent: STATic:L1 3
or
CONFigure: VOLTage:RANGe H

Query Command

A simple query command includes a keyword and then followed by a question mark：
MEASure: VOLTage?
MEASure: CURRent?
or
CHAN?

Keyword Form

Each keyword has two forms：

- Long form
  Complete spelling of the word to confirm its function, such as CURRENT，VOLTAGE and MEASURE.

- Short form
  Word group includes only the first three or four words of the long form, such as CURR, VOLT and MEAS.

In the definition and chart of the keyword, in short form of each keyword, uppercase letters are emphasized to help you remember. However, However, Volt, volt, voltage, VOLTAGE, volTAGE and so on, regardless of the form, electronic load can receive. If the keyword is incomplete, for example, "VOL" or "curr", the electronic load will not be able to identify.

6.3 Data Format

Main data formats include：digital data format and character data format.

6.3.1 Digital Data Format

Digital data format ML1800 electronic load receive is as shown in Table 6- 1. Digital data can be added to the suffix to distinguish data. Doubler may be put before the suffix. The unit of data forms can be adopted in ML1800 is as shown in table 6-2, the doubler are listed in table 6- 3.

Table 6- 1 Digital Data Format

Symbol	Description	Example
NR1	Digits without decimal point. Assumed decimal point in the right of the least significant digit to the right.	123, 0123
NR2	Digits with decimal point.	123., 12.3, 0.123, .123
NR3	Digits with decimal point and index.	1.23E+3, 1.23E-3
NRf	Elastic decimal format, include NR1 or NR2 or NR3.	123, 12.3, 1.23E+3
NRf+	Expanded decimal format, include NRf, MIN, MAX. MIN and MAX are the minimum and maximum value of the parameters.	123, 12.3, 1.23E+3, MIN, MAX

Table 6- 2 Unit Form

Mode	Type	First Suffix	Secondary Suffix	Reference Unit
CC	Current	A		Ampere
CR	Resistance	OHM		Ohm
CV	Voltage	V		Volt
All	Time	s		Second
			ms	Millisecond
All	Slew Rate	A/μs		Amperes/micro Second

Table 6- 3 Suffix Doubler

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

6.3.2 Character Data Format

On the instruction statement, <NRf+> data format allows character input. On enquiry statement, string may return in one of the two formats shown in the following.

Symbol	Character Format
crd	Character response data. Characters allowed to up to 12.
aard	Any ASCII response data, it allows the contingent 7 digits ASCII to return. This data format is hidden message Terminator (reference to "Separator and Terminator.").

6.4 Separator and Terminator

Except keywords and parameters, GPIB program statement need：

- Data separation
  Data must be separated with the command keywords before by a space. Using spaces to delimit is shown in example (such as: CURR 3), and the circle inside is separated with the letter SP on the chart.

- Keywords separation
  Keywords (or header) are separated with a colon (:), a semicolon (;) or both. For example:
  LOAD:SHOR ON
  MEAS:CURR?;VOLT?
  CURR:STAT:L1 3;:VOLT:L1 5
- Program line separators
  Terminator notify GPIB has reached the end of the program, normally it is transmitted by GPIB programming statement automatically. Other terminator code will also end, such as EOI. In this manual, terminator is at the end of each example. If you need to specify the words, to show in symbol <nl>, which means "new line" and said the byte of ASCII code is 0x0A hexadecimal (or 10 decimal places).
- Branch instructions:
  - Colon “:” separated between keywords means the change of the main value of the branch to the next lower layer. For example:
    CONF:VOLT:ON 5
    CONF is the root order instruction, VOLT is the first branch, while ON is the second branch. Each ":" moves instructions down to the next branch.
  - Semicolon“;”, makes you connect instruction statement for a column, return

instructions to a colon before.

For example: Join the following two instruction statements：

RES:RISE 100 <nl> and

RES:L1 400 <nl>

makes synthetic instruction listed below：

RES:RISE 100;L1 400 <nl>

- Return to the root order format, you can

1. Enter a new line character, with "<nl>" as the representative. And "LF" for wrapping or / and "EOI" for the end of the line. Or
2. Follow colon ":", then enter semicolon.

Please refer to the following：

1. (root order):VOLT:L1：30<nl>

Start a new line to return to the root order

2. (root order):SPEC:VOLT:H 30;

:L 5;：

(root order):RES:L1 400;

:RISE 1000;：

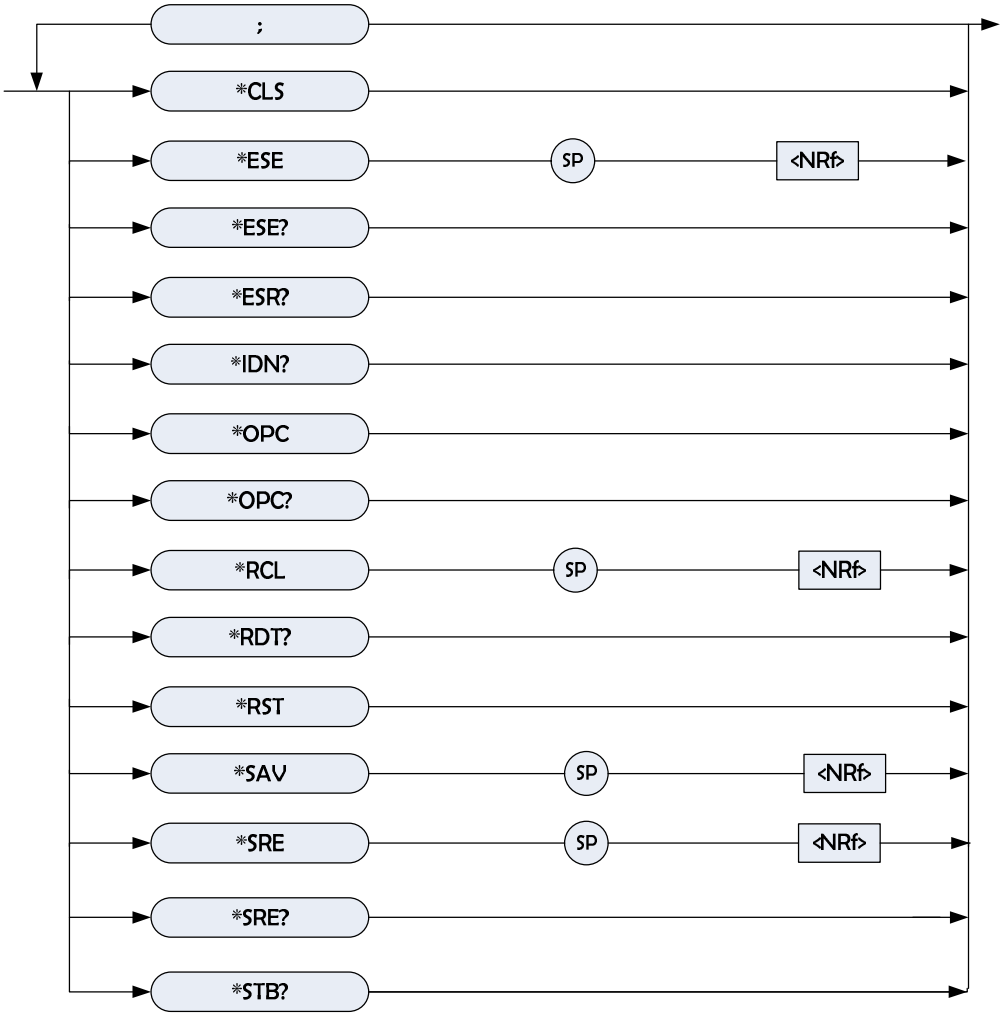
6.5 Command Terminator

The command terminator has newline characters (ASCII characters LF, the value is 10) and EOI (only applicable to GPIB interface) two formats. At the end of the function of the terminator is to end the current command string and will reset the command path to the root path.

7 Command Details

7.1 Public Commands

Public commands are a general command IEEE 488.2 specification requires the instrument to support, for general function control of instruments, such as reset, status query, its syntax and semantics follow the IEEE 488.2 protocol specification. IEEE 488.2 public commands are without hierarchy, each command has a first symbol "*".



*CLS

***CLS** **Clear Status Command**

Type: Device status

Description: The function of commands execution:

1. Clear the following registers:
   <1> All channels use Channel Status Event registers
   <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 the “Clear Status Command” follows immediately the program message termination program (<nl>), the "output queue" and MAV will also be removed.

Syntax: *CLS

Parameter: None

*ESE

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

Type: Unit Status

Description: The instruction sets Standard Event Status Enable register, decide which one of the events of Standard Event Status Event register (see *ESR?) can be allowed to set the ESB (event summary bit) of Status Byte register. “1”in the bit site, starts the corresponding event. Initiating event of all Standard Event Status register is the logical 「Or」function makes the status byte ESB (5) to be set up. Description of all three registers, please see Chapter eighth "Status System".

Syntax: *ESE <NR1>

Parameter: 0 to 255

Example: *ESE 48

This command starts the CME and EXE events of Standard Event Status register.

Query syntax: *ESE?

Return Parameter: <NR1>

Query example: *ESE?

The current of return to “Standard Event Status Enable” is set.

*ESR?

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

Type: Device status

Description: This query reads Standard Event Status register. Cleared after reading register. The detailed description of this register, please see Chapter eighth "Status System".

Standard Event Status register

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

Query syntax: *ESR?

Return Parameter: <NR1>

Query example: *ESR?

Return the status reading value of Standard Event Status register.

Return example: 48

*IDN?

***IDN? Recognition Query**

Type: System interface

Description: This query requests self identification of the host of electronic load host

Query Syntax: *IDN?
Return Parameter: <aard>
Query example: *IDN?
Return string description:
Intepro (manufacturer), ML1800 (model), 0 (always returns zero), 01.00 (rev level)
Return example: Intepro, ML1800,0,01.01

*OPC

***OPC** **Operating Commands**
Type: Device status
Description: When the electronic load host 66100 completes all pending operation, this instruction becomes the reason of interface setting of OPC bit (bit 0) of Standard Event Status register.
Syntax: *OPC
Parameter: None

*OPC?

***OPC?** **Operating Completing Query**
Type: Device status
Description: When all the pending operations are finished, this query returns ASCII “1”.
Query Syntax: *OPC?
Return Parameter: <NR1>
Query example: 1

*RCL

***RCL** **Recall Instrument Status Command**
Type： Device status
Description： This command resets the status with *SAV command of the electronic load stored in the memory before to specified site (see*SAV).
Syntax： *RCL <NR1>
Parameter： 1 to 100
Example： *RCL 50

*RDT?

***RDT?** **Resource Transmission Query**
Type: system interface
Description: This command returns the 66100 module type of the electronic load, if no channel exists, it returns 0.
If channel exists，it returns type such as FT66103A,FT66105A,FT66106A...
Query Syntax: RDT?
Return Parameter: <aard>

Query Example: FT66103A,FT 66103A,FT66105A,FT66105A,0, 0

*RST

***RST** **Reset Command**

Type: Device status

Description: This command imposes ABORt, *CLS, LOAD:PROT:CLE instructions.

Syntax: *RST

Parameter: None

*SAV

***SAV** **Store Command**

Type: Device status

Description: This command stores the current status of single electronic load and status of all the channels of multiple modules to specified particular locations.

Syntax: *SAV <NR1>

Parameter: 1 to 100

Example: *SAV 50

*SRE

***SRE** **Service Request On Command/Query**

Type: Device status

Description: This commands set service request start register, decide which one of the events of Status Byte register is allowed to set MSS(main status summary) bit. In bit sites “1” bit is logical「Or」function, which makes bit 6(main status summary bit) of Status Byte register to be set up. Detailed corresponding Status Byte register, please refer to “Status System.

Syntax: *SRE <NR1>

Parameter: 0 to 255

Example: *SRE 20 starts CSUM and MAV bits service request to be on.

Query Syntax: *SRE?

Return Parameter: <NR1>

Query example: *SRE? returns “Service Request Enable”.

*STB?

***STB?** **Read the Status Byte Query**

Type: Device status

Description: This query reads Status Byte register. Please note in MSS(main status summary)but not RQS bit， return in bit 6, this bit shows if the electronic load has at least one reason to request service. *STB? will not remove Status Byte register until only when the later actions has cleared all

setting bits. More information on registers, please refer to chapter eighth “Status System”.

Status Byte Register

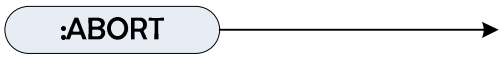
Bit Site	7	6	5	4	3	2	1	0
Status	0	MSS	ESB	MAV	QUES	CSUM	0	0
Site	128	64	32	16	8	4	2	1

Query Syntax: *STB?
Return Parameter: <NR1>
Query Example: *STB? returns the content of “status byte”.
Return Example: 20

7.2 Specified Instructions

FT66100 series products have the following specified SCPI commands.

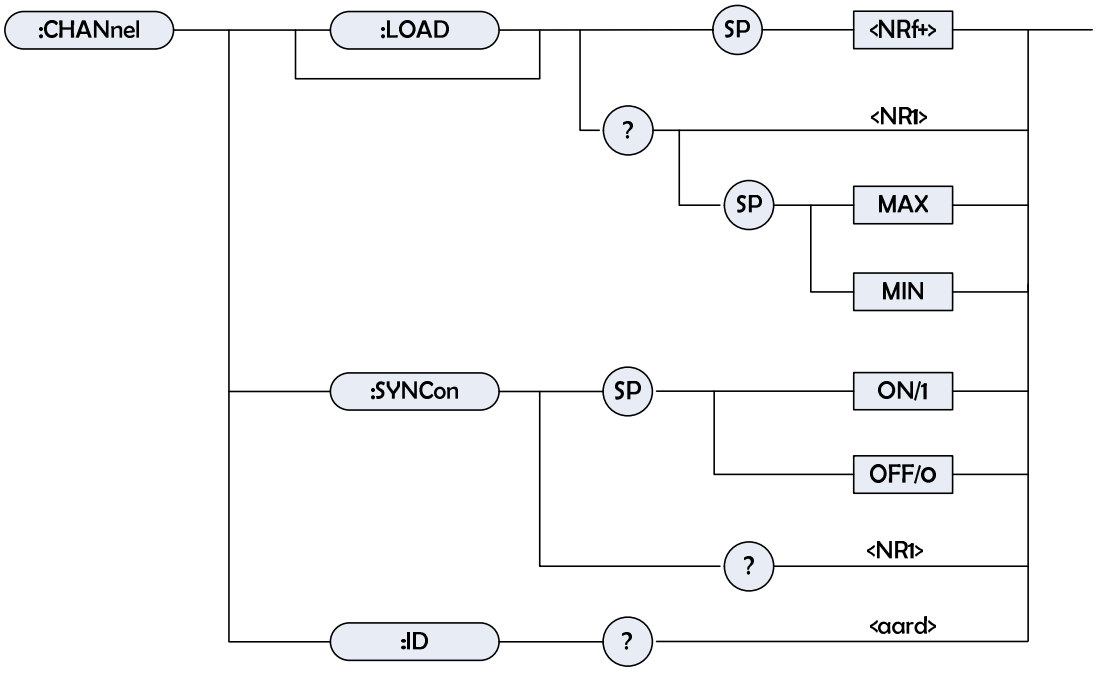
ABORT Subsystem



ABORt

Type: All channels
Description: Set all electronic loads to be “OFF”
Syntax: ABORt

CHANNEL Subsystem



CHANnel[:LOAD]

Type: Specified channel

Description: Select channel by the later channel specific instruction, will receive and execute specified instructions.

Syntax: CHANnel <NRf+>

Parameter: 1 ~ 6

Example: CHAN 1 Set specified channel to be “1”

CHAN MAX Set specified channel to be “6”

CHAN MIN Set specified channel to be “1”

Query Syntax: CHAN?

CHAN? MAX

CHAN? MIN

Return Parameter: <NR1>

Query Example: CHAN? Return to the current specified channel

Return Example： 1

CHANnel:SYNCon

Type: Specified channel

Description: Set if the load receives synchronous instruction action of RUN ABORT.

Syntax: CHANnel:SYNCon ON

CHANnel:SYNCon OFF

Parameter: ON/1, OFF/0

Example: CHAN:SYNC ON Set the load to receive the synchronous instruction action of RUN ABORT.

CHAN:SYNC OFF Set the load to receive the synchronous instruction

action of RUN ABORT.

Query Syntax:	CHAN:SYNC?
Return Parameter:	<NR1>
Query Example:	CHAN:SYNC? Return to load module and receive synchronous instruction status.
Query Example:	0 Load module can not receive synchronous instruction status. 1 Load module receives synchronous instruction status.

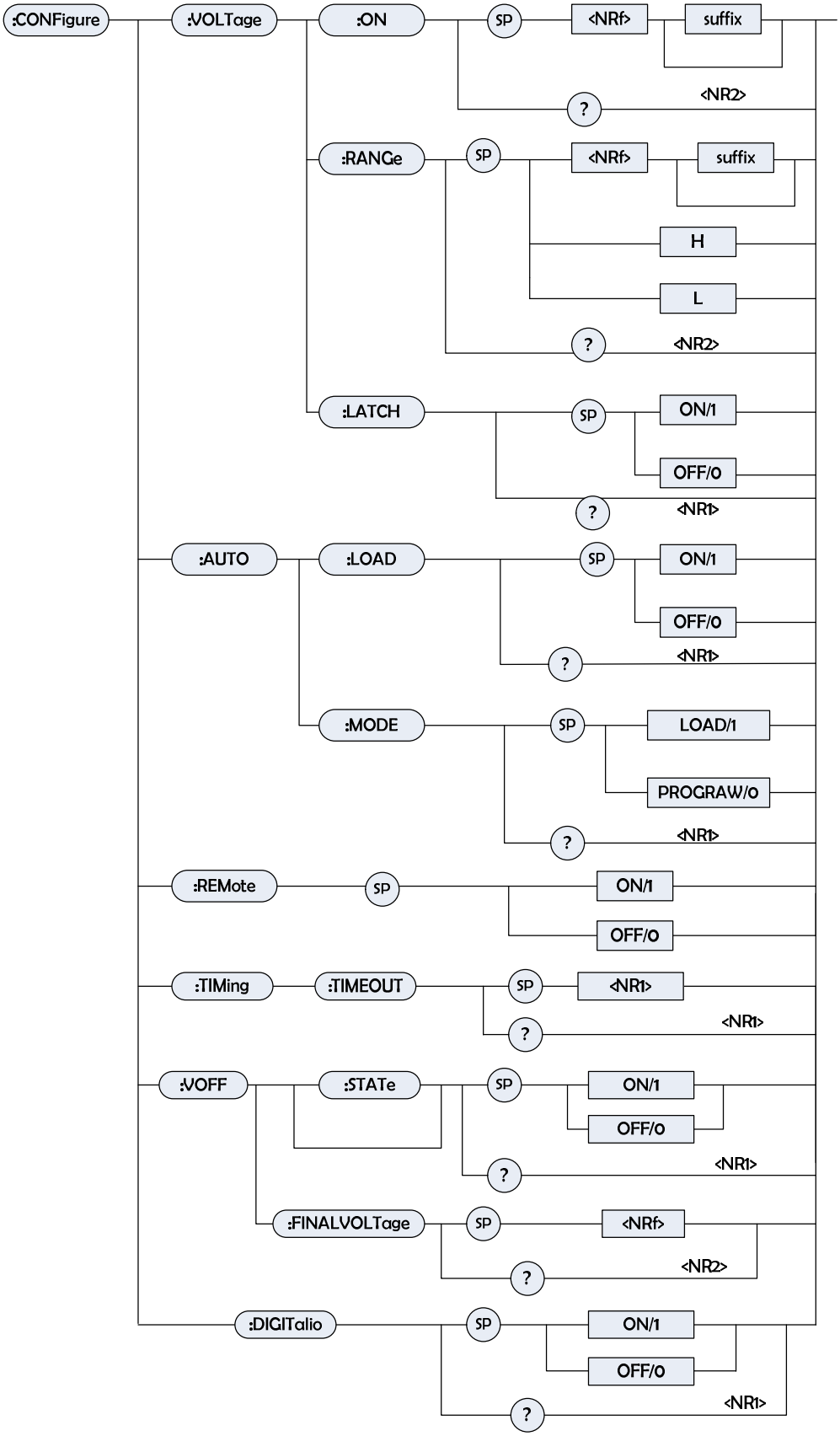
CHANnel:ID?

Type:	Specified channel
Description:	This query requests module self identification.
Query Syntax:	ID?
Return Parameter:	<aard>
Query Example:	CHAN:ID?

String	Description
Intepro	Manufacturer
FT6610xA	Model
0	Always return zero
xx.xx	The main revision
2011.11.23	Revision date

Return Example: Intepro,FT66103A,0,01.00,2011.11.23

CONFIGURE Subsystem


:CONFigure
:VOLTage
:ON
SP
<NRf>
suffix
?
<NR2>
:RANGe
SP
<NRf>
suffix
H
L
?
<NR2>
:LATCH
SP
ON/1
OFF/0
?
<NR1>
:AUTO
:LOAD
SP
ON/1
OFF/0
?
<NR1>
:MODE
SP
LOAD/1
PROGRAW/0
?
<NR1>
:REMote
SP
ON/1
OFF/0
:TIMing
:TIMEOUT
SP
<NR1>
?
<NR1>
:VOFF
:STATe
SP
ON/1
OFF/0
?
<NR1>
:FINALVOLTage
SP
<NRf>
?
<NR2>
:DIGITalio
SP
ON/1
OFF/0
?
<NR1>

CONFigure:VOLTage:ON

Type:	Specified channel	
Description:	Set start voltage	
Syntax:	CONFigure:VOLTage:ON <NRf+> [suffix]	
Parameter:	Numerical value range is set according to module specifications.	
Example:	CONF:VOLT:ON 1	Set Von=1V
	CONF:VOLT:ON 300mV	Set Von=300mV
Query Syntax:	CONFigure:VOLTage:ON?	
Return Parameter:	<NR2>, [Unit=Volt]	
Query Example:	CONF:VOLT:ON?	Return setup Von value
Return Example:	3.5	

CONFigure:VOLTage:RANGe

Type:	Specified channel	
Description:	Set voltage measurement range in constant current mode.	
Syntax:	CONFigure:VOLTage:RANGe <NRf>[suffix]	
Parameter:	Numerical value range is set according to module specifications.	
Example:	CONF:VOLT:RANG 16	Set voltage level to be low level.
	CONF:VOLT:RANG 80	Set voltage level to be high level.
	CONF:VOLT:RANG H	Set voltage level to be high level.
	CONF:VOLT:RANG L	Set voltage level to be low level.
Query Syntax:	CONFigure:VOLTage:RANGe?	
Return Parameter:	<NR2>	
Query Example:	CONF:VOLT:RANG?	Return to voltage rank
Return Example:	16	

CONFigure:VOLTage:LATCh

Type:	Specified channel	
Description:	Set functions and classification of Von.	
Syntax:	CONFigure:VOLTage:LATCh ON	
	CONFigure:VOLTage:LATCh OFF	
Parameter:	ON/1, OFF/0	
Example:	CONF:VOLT:LATC ON	Set functions and classification of Von to be latch.
	CONF:VOLT:LATC OFF	Set functions and classification of Von to be non-latch. (detailed functions，please refer to user manual)
Query Syntax:	CONFigure:VOLTage:LATCh?	

Return Parameter: <NR1>
Query Example: CONF: VOLT:LATC?
Return Example: 0 (non-latch)， 1 (latch) Return functions and classification of Von Von.

CONFigure:AUTO:LOAD

Type: All channels
Description: Set whether the load module will perform automatic load conduction during boot.
Syntax: CONFigure:AUTO:LOAD ON
CONFigure:AUTO:LOAD OFF
Parameter: ON/1, OFF/0
Example: CONF:AUTO:LOAD ON During boot, turn on the automatic load conduction. CONF:AUTO:LOAD OFF During boot, turn off the automatic load conduction.
Query Syntax: CONFigure:AUTO:LOAD?
Return Parameter: <NR1>
Query Example: CONF:AUTO:LOAD?
Return Example: 0 or 1 Return status of the automatic load conduction.

CONFigure:AUTO:MODE

Type: All channels
Description: Set the automatic load conduction to be LOAD ON or PROGRAM RUN.
Syntax: CONFigure:AUTO:MODE LOAD
CONFigure:AUTO:MODE PROGRAM
Parameter: LOAD/1, PROGRAM/0
Example: CONF:AUTO:MODE LOAD Set the automatic load conduction to be normally LOAD ON.
CONF:AUTO:MODE PROGR Set the automatic load conduction to be PROGRAM RUN.
Query Syntax: CONFigure:AUTO:MODE?
Return Parameter: <NR1>
Query Example: CONF:AUTO:MODE?
Return Example: 0 or 1 Return the execution type of automatic load conduction.

CONFigure:REMote

Type: All channels
Description: Set status of remote control
Syntax: CONFigure:REMote ON
CONFigure:REMote OFF
Parameter: ON/1, OFF/0
Example: CONF:REM ON Set to be remote control

CONFigure:TIMing:TIMEOUT

Type:	Specified channel
Description:	Set the stop time of timing mode [0s-99999s]
Syntax:	CONFigure:TIMing:TIMEOUT <NRf>
Parameter:	0~99999
Example:	CONFigure:TIMing:TIMEOUT 1000 Set stop time to be 1000ms
Query Syntax:	CONFigure:TIMing:TIMEOUT?
Return Parameter:	<NR1>,[unit=MS]
Query Example:	CONFigure:TIMing:TIMEOUT?
Return Example:	00:16:40.000s

CONFigure:VOFF[:STATe]

Type:	Specified channel
Description:	Set VOFF mode to be on/off
Syntax:	CONFigure:VOFF[:STATe] <NR1>
Parameter:	ON/1,OFF/0
Example:	CONFigure:VOFF ON Set VOFF mode to be on
Query Syntax:	CONFigure:VOFF?
Return Parameter:	<NR1>
Query Example:	CONFigure:VOFF? Return VOFF mode to be on or off
Return Example:	1

CONFigure:VOFF:FINALVOLTage

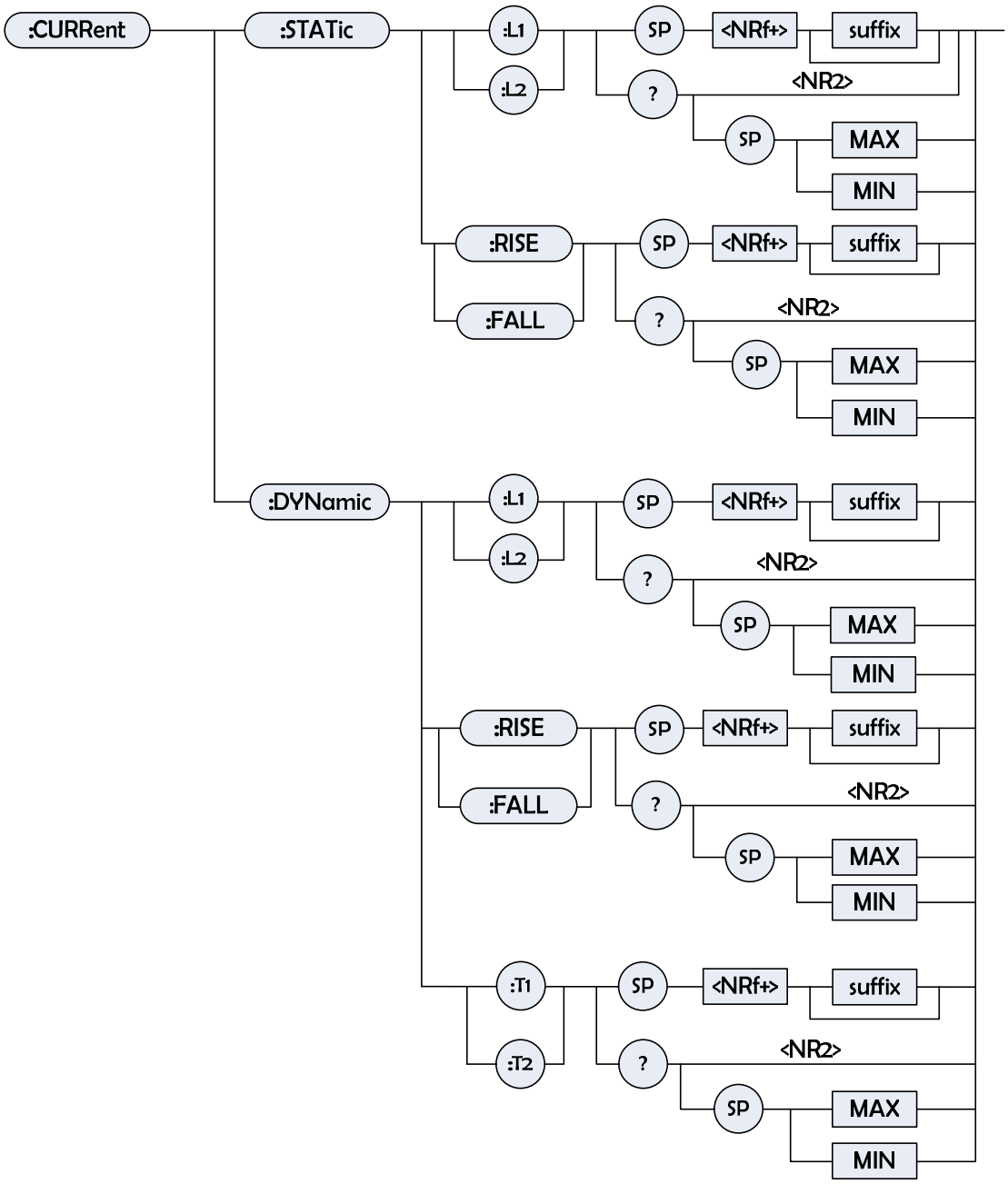
Type:	Specified channel
Description:	Setting the end voltage in VOFF mode
Syntax:	CONFigure:VOFF:FINALVOLTage <NRf>
Parameter:	Value returned according to load module. Detailed number range, please refer to specification.
Example:	CONFigure:VOFF:FINALVOLTage 1.8 Setting the end voltage to be 1.8V.
Query Syntax:	CONFigure:VOFF:FINALVOLTage?
Return Parameter:	<NRf>,[unit=Volt]
Query Example:	CONFigure:VOFF:FINALVOLTage? Return setting value of the end voltag
Return Example:	1.8

CONFigure:DIGITalio

Type:	Specified channel
Description:	Setting On or Off of the DIGITal I/O function
Syntax:	CONFigure:DIGITalio <NR1>

Parameter:	ON/1,OFF/0
Example:	CONFigure:DIGITalio ON Setting up DIGITal I/O function to be on
Query Syntax:	CONFigure:DIGITalio?
Return Parameter:	<NR1>
Query Example:	CONFigure:DIGITalio? Return DIGITal I/O function to be on or off
Return Example:	1
Return Example:	1 Respond to what kind of parameter setting

CURRENT Subsystem



CURRent:STATic:L1/L2

Type:	Specified channel
Description:	Setting the current of static load in CC mode.
Syntax:	CURRent:STATic:L1 <NRf+> [suffix] CURRent:STATic:L2 <NRf+> [suffix]
Parameter:	Effective number range, refer to module specification (default unit is A).
Example:	CURR:STAT:L1 20 Setting up CC current= 20A to be used by static load L1 CURR:STAT:L2 10mA Setting up CC current = 10mA to be used

by static loadL2

CURR:STAT:L1 MAX Setting up CC current = maximum value to be used by static load L1

CURR:STAT:L2 MIN Setting up CC current = minimum value to be used by static load L2

Query Syntax: CURRent:STATic:L1?

CURRent:STATic:L2?

CURRent:STATic:L1? MAX

CURRent:STATic:L2? MIN

Return Parameter: <NR2>,[unit=Amp]

Query Example: CURR:STAT:L1? Return the setup current value of static load

Return Example: 3.12

CURRent:STATic:RISE/FALL

Type: Specified channel

Description: Setting the slew rate in constant current static mode.

Syntax: CURRent:STATic:RISE <NRf+> [suffix]

CURRent:STATic:FALL <NRf+> [suffix]

Parameter: Effective number range, refer to module specification (default unit is A/μs).

Example: CURR:STAT:RISE 2.5 Setting up the rise slew rate of static load to be 2.5A/μs

CURR:STAT:FALL 1A/μs Setting up the fall slew rate of static load to be 1A/μs

Query Syntax: CURRent:STATic:RISE?

CURRent:STATic:FALL?

CURRent:STATic:RISE? MAX

CURRent:STATic:FALL? MIN

Return Parameter: <NR2>,[unit=A/μs]

Query Example: CURR:STAT:RISE? Return the rise slew rate of static load

Return Example: 2.5

CURRent:DYNamic:L1/L2

Type: Specified channel

Description: Setting up current of dynamic load in CC mode.

Syntax: CURRent:DYNamic:L1 <NRf+> [suffix]

CURRent:DYNamic:L2 <NRf+> [suffix]

Parameter: Effective number range, refer to module specification（default unit is A）.

Example: CURR:DYN:L1 20 Setting up parameter of dynamic load L1 = 20A

CURR:DYN:L2 10mA Setting up parameter of dynamic load L2 = 10mA

CURR:DYN:L1 MAX Setting up parameter of dynamic load L1 =

maximum value

CURR:DYN:L2 MIN Setting up parameter of dynamic load L2 = minimum value

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

Return Parameter: <NR2>,[unit=Amp]

Query Example: CURR:DYN:L1? Return the setup value in dynamic load L1

Return Example: 35.6

CURRent:DYNamic:RISE/FALL

Type: Specified channel

Description: Setting up the current slew rate in CC dynamic mode

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

Parameter: Effective number range, refer to module specification (default unit is A/μs).

Example: CURR:DYN:RISE 2.5 Setting up the rise slew rate to be 2.5A/μs
CURR:DYN:FALL 1A/μs Setting up the fall slew rate to be 1A/μs
CURR:DYN:RISE MAX Setting up the rise slew rate to be the maximum value of dynamic load
CURR:DYN:FALL MIN Setting up the fall slew rate to be the minimum value of dynamic load

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

Return Parameter: <NR2>,[unit=A/μs]

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

Return Example: 2.500

CURRent:DYNamic:T1/T2

Type: Specified channel

Description: Setting up the parameter at T1 or T2 duration of dynamic load.

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

Parameter: Effective number range 0.025ms～50000ms (default unit is s).

Example: CURR:DYN:T1 10ms Setting up dynamic time period T1 = 10ms
CURR:DYN:T1 10 Setting up dynamic time T1 = 10s
CURR:DYN:T2 2s Setting up dynamic time period T2 = 2s

CURR:DYN:T1 MAX Setting up dynamic time period T1 to be the maximum value
CURR:DYN:T2 MIN Setting up dynamic time period T2 to be the minimum value

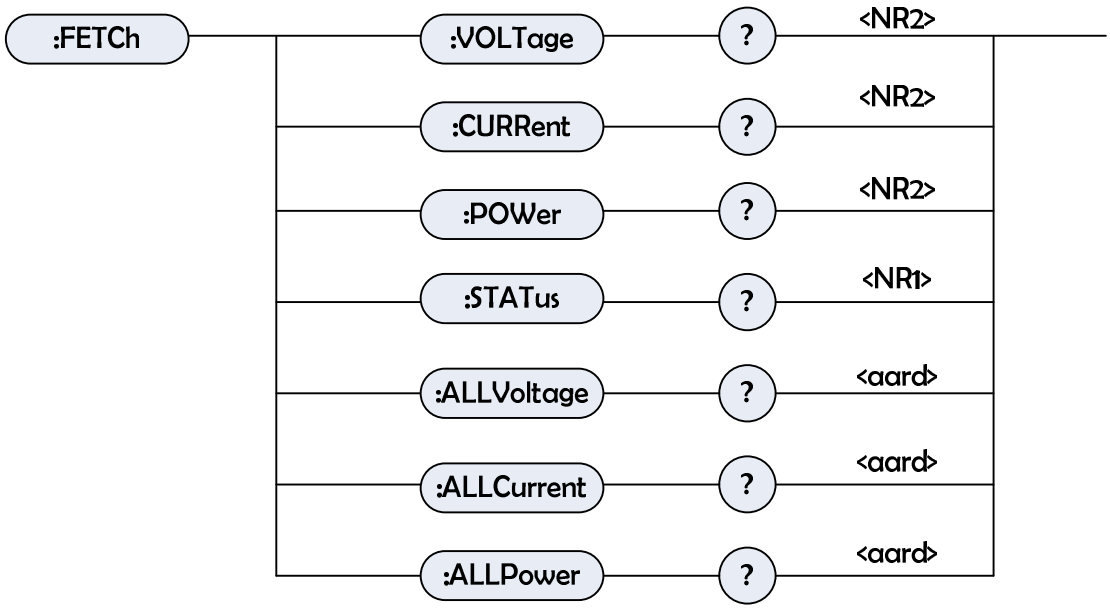
Query Syntax: CURRent:DYNamic:T1?
CURRent:DYNamic:T2?
CURRent:DYNamic:T1? MAX
CURRent:DYNamic:T2? MIN

Return Parameter: <NR2>,[unit=s]

Query Example: CURR:DYN:T1? Return the parameter of dynamic time period T1

Return Example: 0.15

FETCH Subsystem



FETCh:VOLTage?

Type: Specified channel

Description: The measurement at the input of the load module, return real time voltage.

Query Syntax: FETCh:VOLTage?

Return Parameter: <NR2> ,[unit=Volt]

Query Example: FETC:VOLT?

Return Example: 8.12

FETCh:CURRent?

Type: Specified channel
Description: The measurement at the input of the load module, return real time current.
Query Syntax: FETCh:CURRent?
Return Parameter: <NR2>, [unit=Amp]
Query Example: FETC:CURR?
Return Example: 3.15

FETCh:POWer?

Type: Specified channel
Description: The measurement at the input of the load module, return real time power.
Query Syntax: FETCh:POWer?
Return Parameter: <NR2>, [unit=Watt]
Query Example: FETC:POW?
Return Example: 5.28

FETCh:STATus?

Type: Specified channel
Description: Return real time status of the load module
Query Syntax: FETCh:STATus?
Return Parameter: <NR1>

Site	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status												OT	RV	OP	OV	OC
Bit value												16	8	4	2	1

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

FETCh:ALLVoltage?

Type: Independent channel
Description: The measurement at the input of all load modules, return real time voltage.
Query Syntax: FETCh:ALLVoltage?
Return Parameter: <aard> ,[unit=Volt]
Query Example: FETC:ALLV?
Return Example: 1.2, 2, 0, 0, 10.2, 0

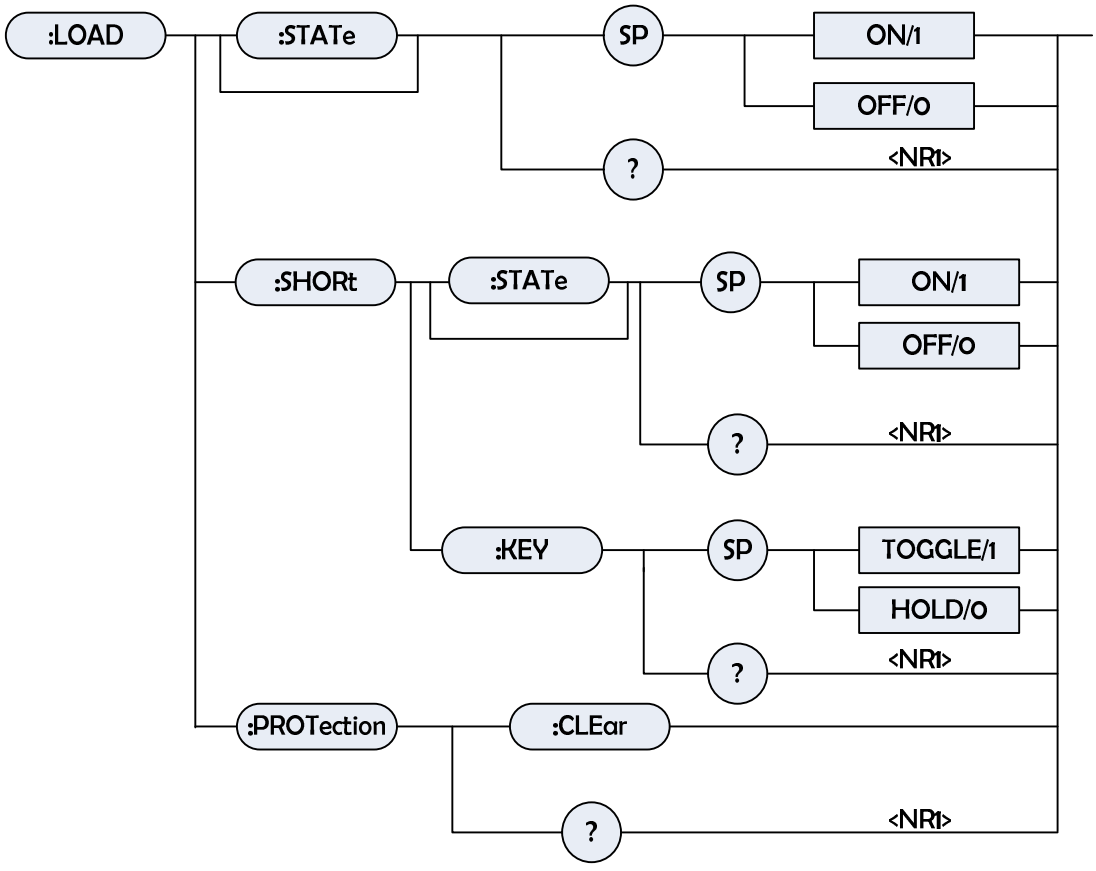
FETCh:ALLCurrent?

Type:	Independent channel
Description:	The measurement at the input of all load modules, return real time current.
Query Syntax:	FETCh:ALLCurrent?
Return Parameter:	<aard>, [unit=Amp]
Query Example:	FETC:ALLC?
Return Example:	0, 0, 0, 0, 5.12, 0

FETCh:ALLPower?

Type:	Independent channel
Description:	The measurement at the input of all load modules, return real time power.
Query Syntax:	FETCh:ALLPower?
Return Parameter:	<aard>, [unit=Watt]
Query Example:	FETC:ALLP?
Return Example:	5.28,2,0,0,10.2,0

LOAD Subsystem



LOAD:[STATe]

Type:	Specified channel	
Description:	LOAD command to make the electronic load effective/On or ineffective/Off	
Syntax:	LOAD:[STATe] ON	
	LOAD:[STATe] OFF	
Parameter:	ON/1, OFF/0	
Example:	LOAD ON	Make the load effective
	LOAD OFF	Make the load ineffective
Query Syntax:	LOAD:[STATe]?	
Return Parameter:	<NR1>	
Query Example:	LOAD?	Return if the electronic load is effective Return
Example:	1	

LOAD:SHORt[:STATe]

Type:	Specified channel	
Description:	Make the short circuit simulation effective or ineffective	
Syntax:	LOAD:SHORt[:STATe]	
Example:	LOAD:SHOR ON	Make the short circuit simulation effective
	LOAD:SHOR OFF	Make the short circuit simulation ineffective
Parameter:	ON/1, OFF/0	
Query Syntax:	LOAD:SHORt [:STATe]?	
Return Parameter:	<NR1>	
Query Example:	LOAD:SHOR?	Return the status of short circuit simulation
Return Example:	1	

LOAD:SHORt:KEY

Type:	All channels	
Description:	Setting up the mode of short circuit key in the electronic load.	
Syntax:	LOAD:SHORt:KEY TOGGLE	
Parameter:	TOGGLE/1, HOLD/0	
Example:	LOAD:SHOR:KEY TOGGLE	Setting up the mode of short circuit key to be Toggle
	LOAD:SHOR:KEY HOLD	Setting up the mode of short circuit key to be Hold
Query Syntax:	LOAD:SHORt:KEY?	
Return Parameter:	<NR1>	
Query Example:	LOAD:SHOR:KEY?	Return the mode of short circuit key in the electronic load.

Return Example: 1

LOAD:PROTection?

Type: Specified channel

Description: This command is to query the protection status of the electronic load.

Syntax: LOAD:PROTection?

Example: LOAD:PROT?

Return Parameter: <NR1>

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

Query Example: LOAD:PROT? Return the status of the electronic load

Return Example: 0

LOAD:PROTection:CLEar

Type: Specified channel

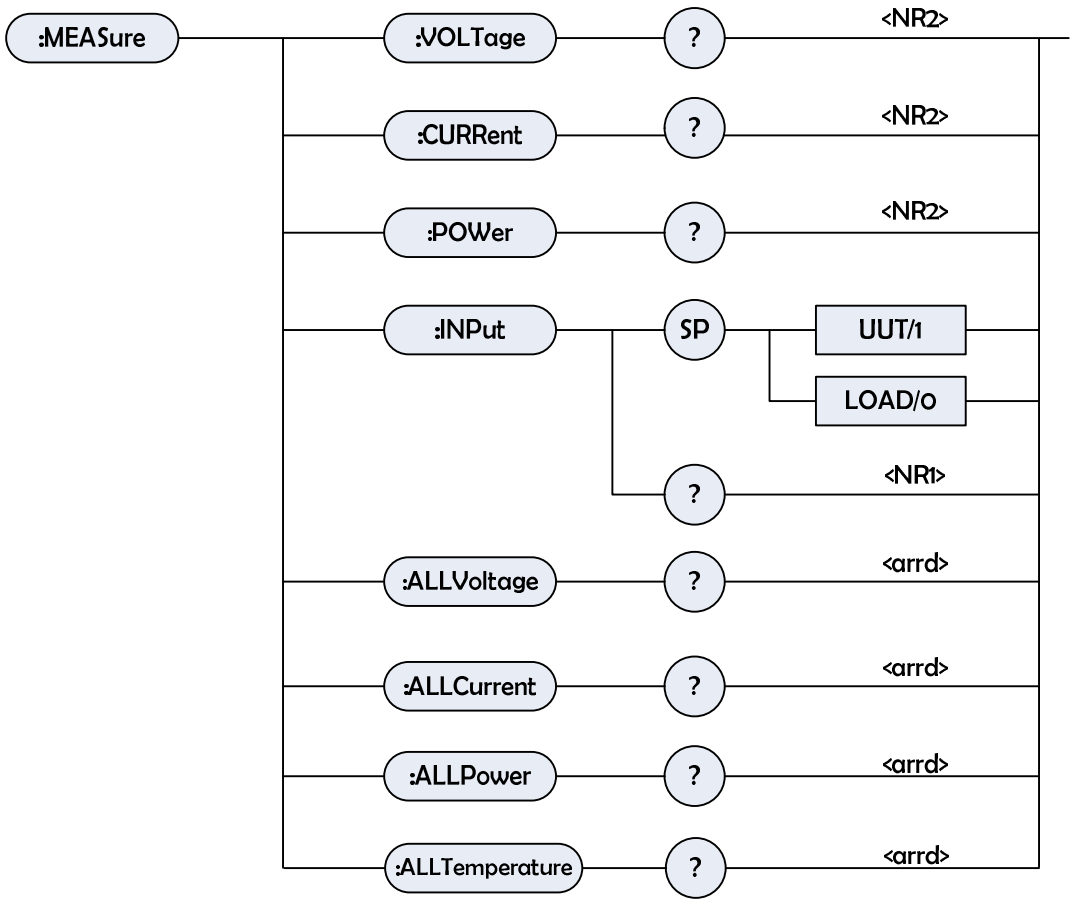
Description: This command resets the protection status of the electronic load.

Syntax: LOAD:PROTection:CLEar

Parameter: Effective number range, refer to individual specification.

Example: LOAD:PROT:CLE

MEASURE Subsystem



MEASure:VOLTage?

Type:	Specified channel
Description:	Return the measured voltage at the input of the electronic load.
Query Syntax:	MEASure:VOLTage?
Return Parameter:	<NR2> ,[unit=Volt]
Query Example:	MEAS:VOLT?
Return Example:	8.12

MEASure:CURRent?

Type:	Specified channel
Description:	Return the measured current at the input of the electronic load.
Query Syntax:	MEASure:CURRent?
Return Parameter:	<NR2>, [unit=Amp]
Query Example:	MEAS:CURR?
Return Example:	3.15

MEASure:POWer?

Type:	Specified channel

Description:	Return the measured power at the input of the electronic load.
Query Syntax:	MEASure:POWer?
Return Parameter:	<NR2>,[unit=Watt]
Query Example:	MEAS:POW?
Return Example:	3.15

MEASure:INPut

Type:	Specified channel
Description:	Select the input interface of electronic load (distal or proximal) to measure the voltage
Syntax:	MEASure:INPut?
Parameter:	UUT/1, LOAD/0
Example:	MEAS:INP UUT MEAS:INP LOAD
Query Syntax:	MEASure:INPut? Return the input interface has been set up
Return Parameter:	<NR1>
Query Example:	MEAS:INP?
Return Example:	0

MEASure:ALLVoltage?

Type:	Independent channel
Description:	Return all the measured voltage of all the load modules at the input.
Query Syntax:	MEASure:ALLVoltage?
Return Parameter:	<aard>, [unit=Volt]
Query Example:	MEAS:ALLV?
Return Example:	1.2, 2, 10.2,0, 0, 0

MEASure:ALLCurrent?

Type:	Independent channel
Description:	Return all the measured current of all the load modules at the input.
Query Syntax:	MEASure:ALLCurrent?
Return Parameter:	<aard> ,[unit=Amp]
Query Example:	MEAS:ALLC?
Return Example:	5.12, 0, 0, 0, 0, 0

MEASure:ALLPower?

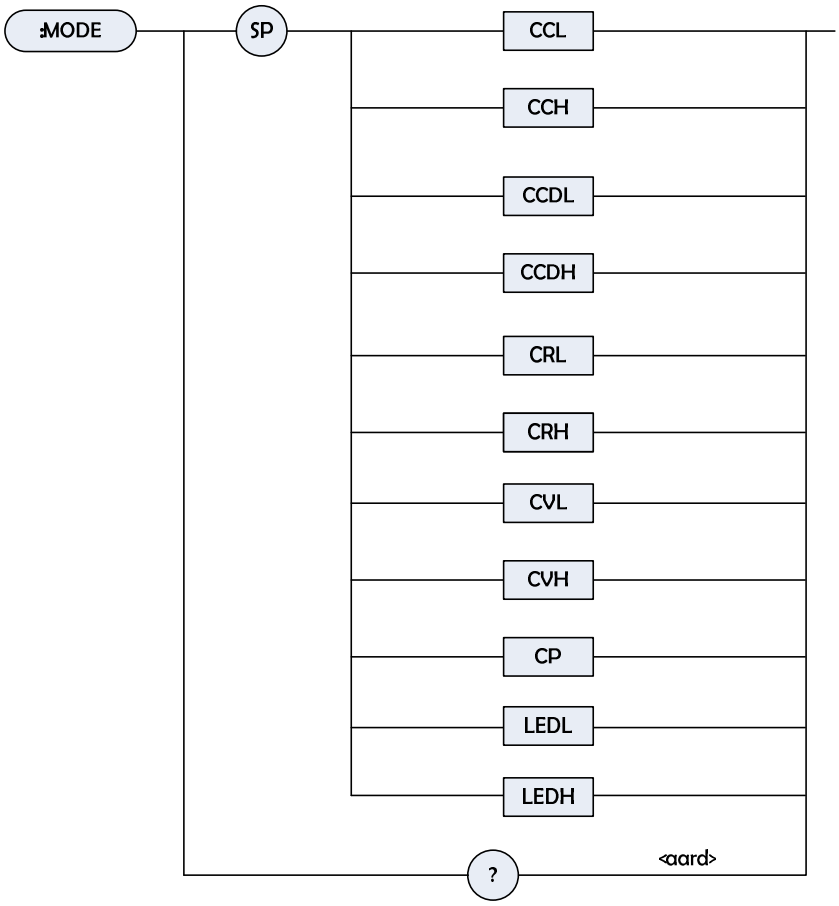
Type:	Independent channel
Description:	Returns all the measured power of all the load modules at the input.
Query Syntax:	MEASure:ALLPower?

Return Parameter: <aard>, [unit=watt]
Query Example: MEAS:ALLP?
Return Example: 5.12,0, 0, 0, 0, 0

MEASure:ALLTemperature?

Type: Specified channel
Description: Return the temperature of the electronic load.
Query Syntax: MEASure:ALLTemperature?
Return Parameter: <NR1>,[unit=centigrade]
Query Example: MEAS:ALLT?
Return Example: 30,30, 30, 30, 30, 50

MODE Subsystem



MODE

Type: Specified channel
Description: This command sets up the operation mode of the electronic load.
Syntax: MODE CCL Setting up the CC mode in low range.

MODE CCH	Setting up the CC mode in high range.
MODE CCDL	Setting up the CC dynamic mode in low range.
MODE CCDH	Setting up the CC dynamic mode in high range.
MODE CRL	Setting up the CR mode in low range.
MODE CRH	Setting up the CR mode in high range.
MODE CVH	Setting up CVH mode.
MODE CVL	Setting up CVL mode
MODE CP	Setting up the CP mode in high range.
MODE LEDL	Setting up the LEDL mode in low range.
MODE LEDH	Setting up the LEDL mode in high range.

Parameter: CCL, CCH, CCDL, CCDH, CRL, CRH, CVH, CVL, CP, LEDL,LEDH

Example: MODE CCL

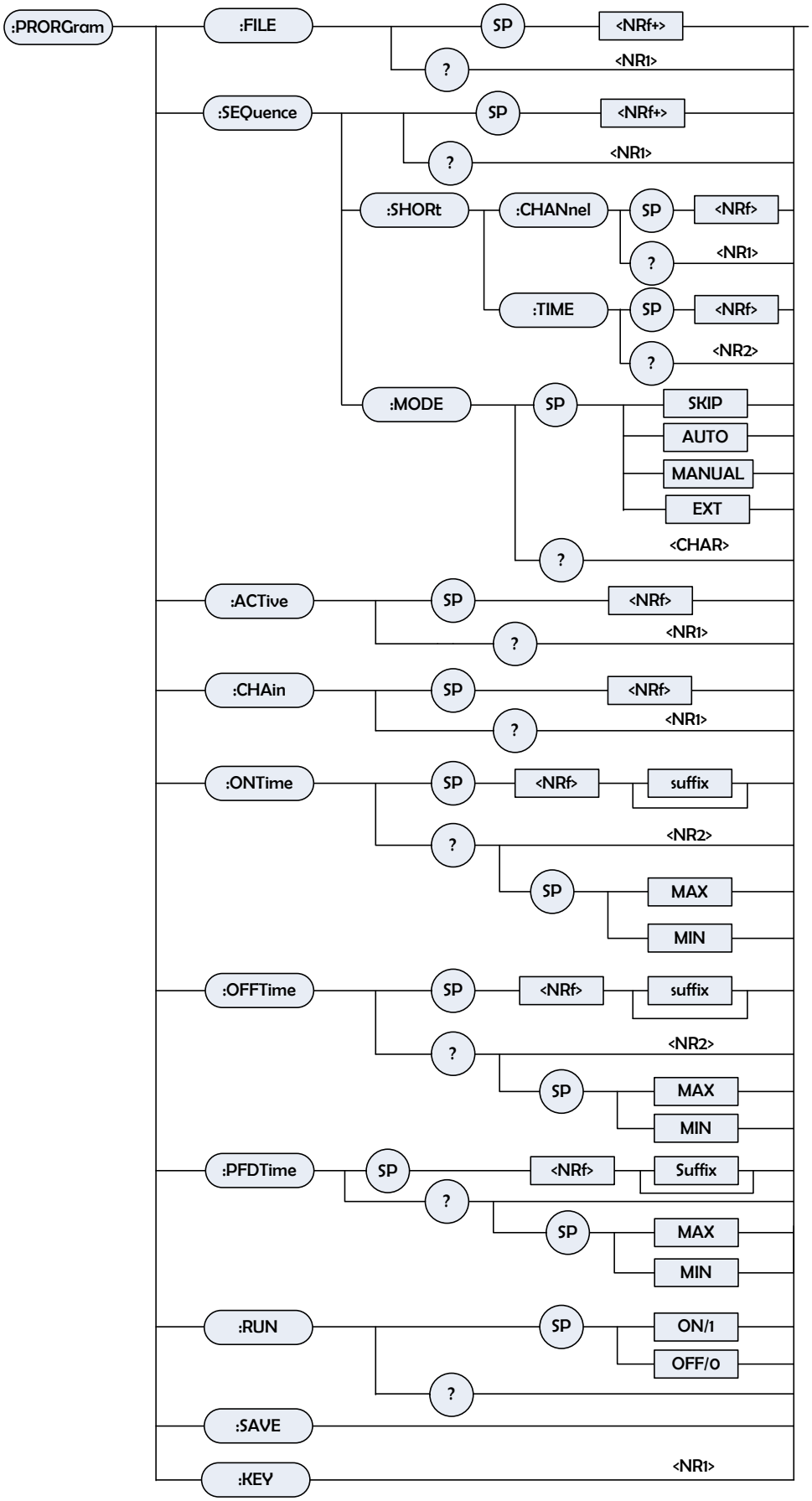
Query Syntax: MODE? Return the operation mode of the electronic load.

Return Parameter: <aard>

Query Example: MODE?

Return Example: CCL

PROGRAM Subsystem


:PRORGram
:FILE
SP
<NRf+>
?
<NR1>
:SEQuence
SP
<NRf+>
?
<NR1>
:SHORt
:CHANnel
SP
<NRf>
?
<NR1>
:TIME
SP
<NRf>
?
<NR2>
:MODE
SP
SKIP
AUTO
MANUAL
EXT
?
<CHAR>
:ACTive
SP
<NRf>
?
<NR1>
:CHAin
SP
<NRf>
?
<NR1>
:ONTime
SP
<NRf>
suffix
?
<NR2>
SP
MAX
MIN
:OFFTime
SP
<NRf>
suffix
?
<NR2>
SP
MAX
MIN
:PFDTime
SP
<NRf>
Suffix
?
SP
MAX
MIN
:RUN
SP
ON/1
OFF/0
?
:SAVE
:KEY
<NR1>

PROGram:FILE

Type:	Depends on program file
Description:	Setting up program number
Syntax:	PROGram:FILE <NRf+>
Parameter :	1 to 10
Example:	PROG:FILE 10
Query Syntax:	PROGram:FILE? Return the program number used
Return Parameter:	<NR1>
Query Example:	PROG:FILE?
Return Example:	10

PROGram:SEQuence

Type:	Depends on program file
Description:	Setting up program sequence
Syntax:	PROGram:SEQuence <NRf+>
Parameter:	1 to 10
Example:	PROG:SEQ 3
Query Syntax:	PROGram:SEQuence?
Return Parameter:	<NR1>
Query Example:	PROG:SEQ?
Return Example:	3

PROGram:SEQuence:MODE

Type:	Depends on program file
Description:	Setting up sequence type
Syntax:	PROGram:SEQuence:MODE SKIP
	PROGram:SEQuence:MODE AUTO
	PROGram:SEQuence:MODE MANUAL
	PROGram:SEQuence:MODE EXT
Parameter:	SKIP, AUTO, MANUAL,EXT
Example:	PROG:SEQ:MODE SKIP
	PROG:SEQ:MODE AUTO
	PROG:SEQ:MODE MANUAL
	PROG:SEQ:MODE EXT
Query Syntax:	PROGram:SEQ:MODE?
Return Parameter:	SKIP, AUTO, MANUAL,EXT
Query Example:	PROG:SEQ:MODE?
Return Example:	AUTO

PROGram:SEQuence:SHORt:CHANnel

Type: Depends on program file
Description: Setting up the short channel of SEQuence in PROGRAM file
Syntax: PROGram:SEQuence:SHORt:CHANnel <NRf+>
Parameter: 0～255

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

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

PROGram:SEQuence:SHORt:TIME

Type: Depends on program file
Description: Setting up short time of SEQuence in PROGRAM file (default unit is s)
Syntax: PROGram:SEQuence:SHORt:TIME < NRf+>
Parameter: 0～60.0
Example: PROG:SEQ:SHOR:TIME 10
Query Syntax: PROGram:SEQuence:SHORt:TIME?
Return Parameter: <NR2>,[unit=s]
Query Example: PROG:SEQ:SHOR:TIME?
Return Example: 10.000

PROGram:ACTive

Type: Depends on program file
Description: Select load module used
Syntax: PROGram:ACTive <NRf>
Parameter: 0～255

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

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

PROGram:CHAin

Type: Depends on program file
Description: Setting up the type of program file with continuous execution.
Syntax: PROGram:CHAin <NRf>
Parameter: 0～10 (0 is dis continuous)
Example: PROG:CHA 7
Query Syntax: PROGram:CHAin?
Return Parameter: <NR1>
Query Example: PROG:CHA?
Return Example: 7

PROGram:ONTime

Type： Depends on program file
Description： Setting up the load on time of program file（default unit is s）
Syntax： PROGram:ONTime <NRf+>
Parameter： Effective number range, refer to individual specification.
Example： PROG:ONT 10
PROG:ONT 100ms
Query Syntax： PROGram:ONTime?
Return Parameter： <NR2>, [unit=s]
Query Example：PROG:ONT?
Return Example： 10.5

PROGram:OFFTime

Type: Depends on program file
Description: Setting up the load off time of program file（default unit is s）
Syntax: PROGram:OFFTime <NRf+>
Parameter: Effective number range, refer to individual specification.
Example: PROG:OFFT 20
PROG:OFFT 200ms
Query Syntax: PROGram:OFFTime?
Return Parameter: <NR2> ,[unit=s]
Query Example: PROG:OFFT?
Return Example: 0.2

PROGram:PFDTime

Type: Depends on program file
Description: Setting up the delay time of good/bad products in program file.
Syntax: PROGram:PFDTime <NRf+>
Parameter: Effective number range, refer to individual specification.
Example: PROG:PFDT 1

PROG:	PFDT 200ms
Query Syntax:	PROGram:PFDTime?
Return Parameter:	<NR2> [unit=s]
Query Example:	PROG:PFDT?
Return Example:	0.2

PROGram:SAVE

Type:	Depends on program file
Description:	Setting up stored program
Syntax:	PROGram:SAVE
Parameter:	None
Example:	PROG:SAVE

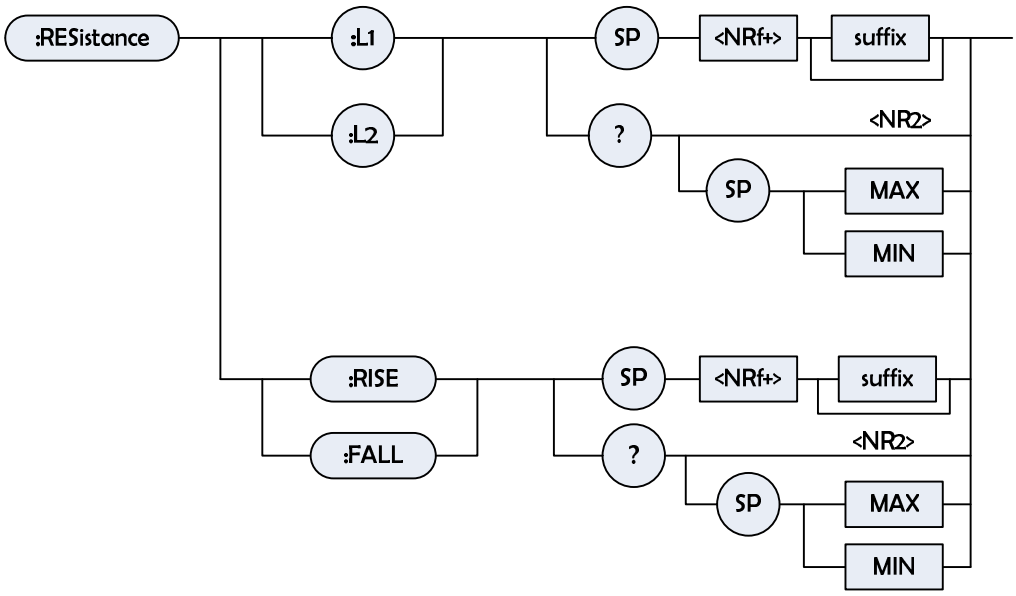
PROGram:RUN

Type:	Depends on program file
Description:	Execute program
Syntax:	PROGram:RUN ON PROGram:RUN OFF
Parameter:	ON/1, OFF/0
Example:	PROG:RUN ON
Query Syntax:	PROGram:RUN?
Return Parameter:	<NR1>
Query Syntax:	PROGram:RUN?
Return Parameter:	1

PROGram:KEY

Type:	Depends on program file
Description:	Respond to key codes in the manual (Keys are those on the panel of the mainframe)
Syntax:	PROGram:KEY <NR1> PROGram:RUN OFF
Parameter:	0～9→ K0～K9 10→Kup 11→Kdown
Example:	PROG:KEY 11

RESISTANCE Subsystem



RESistance:L1/L2

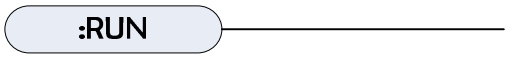
Type:	Specified channel
Description:	Setting up the main value of static resistance in CR mode
Syntax:	RESistance:L1 <NRf+> [suffix] RESistance:L2 <NRf+> [suffix]
Parameter:	Effective number range, refer to individual specification.
Example:	RES:L1 20 OHM Setting up CR = 20 ohm to be used by load L1 RES:L2 10 OHM Setting up CR = 10 ohm to be used by load L2 RES:L1 MAX Setting up CR = maximum value of L1 to be used by load L1 RES:L2 MIN Setting up CR = minimum value of L2 to be used by load L2
Query Syntax:	RESistance:L1? RESistance:L2? RESistance:L1? MAX RESistance:L2? MIN
Return Parameter:	<NR2>,[unit=OHM]
Query Example:	RES:L1? Return the setup resistance of load L1 value
Return Example:	10

RESistance:RISE/FALL

Type:	Specified channel
Description:	Setting up the impedance slew rate in CR mode
Syntax:	RESistance:RISE <NRf+> [suffix] RESistance:FALL <NRf+> [suffix]

Parameter:	Effective number range, refer to individual specification.
Example:	RES:RISE 2.5 Setting up CR rise slew rate to be 2.5A/μs
	RES:FALL 1A/μs Setting up CR fall slew rate to be 1A/μs
	RES:RISE MAX Setting up CR rise slew rate to be maximum programmable value
	RES:FALL MIN Setting up CR fall slew rate to be minimum programmable value
Query Syntax:	RESistance:RISE?
	RESistance:FALL?
	RESistance:RISE? MAX
	RESistance:FALL? MIN
Return Parameter:	<NR2>,[unit=A/μs]
Query Example:	RES:RISE? Return CR rise slew rate
Return Example:	2.5

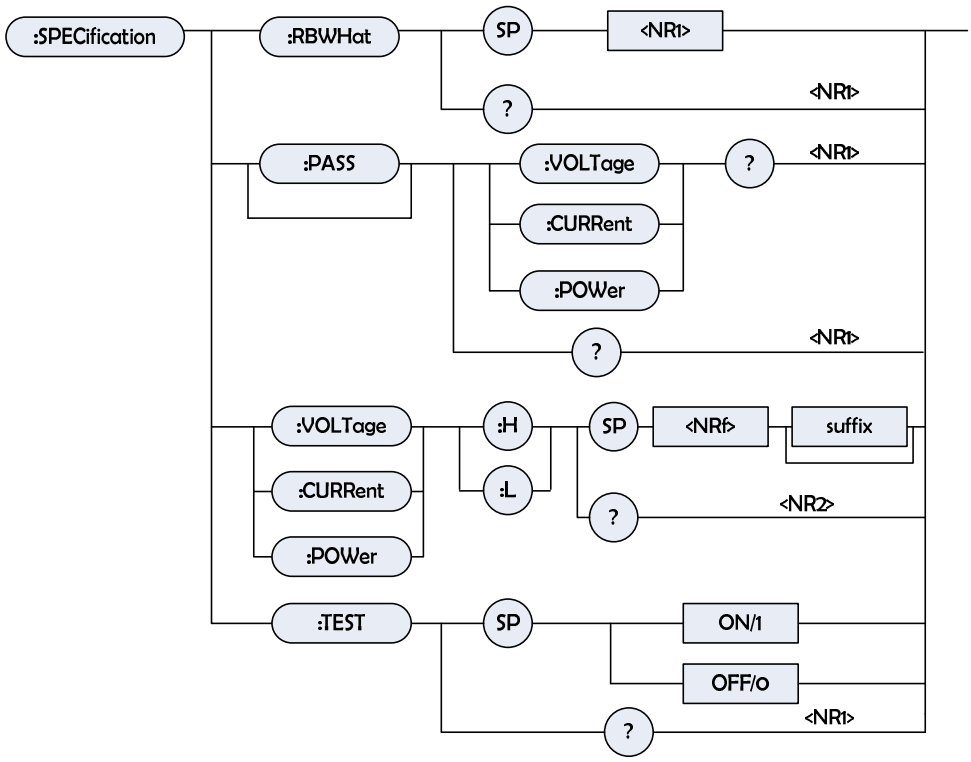
RUN Subsystem



RUN

Type:	All channels
Description:	Set all electronic loads to be “ON”
Syntax:	RUN

SPECIFICATION Subsystem



SPECification:RBWHat

Type:	Specified channel
Description:	Setting up examination content of specification
Syntax:	SPECification:RBWHat
Parameter:	Effective number range, refer to individual specification.
Example:	SPEC:RBWH <NR1>
Query Syntax:	SPECification:RBWHat?
Query Example:	SPEC:RBWH?
Return Parameter:	<NR1>
Return Example:	0 (0: current; 1: voltage; 2: power)

SPECification[:PASS]:VOLTage?

Type:	Specified channel
Description:	Request GO-NG result, please refer to voltage specification.
Query Syntax:	SPECification:VOLTage?
Query Example:	SPEC:VOLT? Return voltage GO-NG result to CC and CR mode
Return Parameter:	<NR1>
Return Example:	0 (NG), 1 (GO)

SPECification[:PASS]:CURRent?

Type:	Specified channel
Description:	Request GO-NG result, please refer to current specification.

Query Syntax:	SPECification:CURRent?
Query Example:	SPEC:CURR? Return current GO-NGresult to CV mode
Return Parameter:	<NR1>
Return Example:	0 (NG), 1 (GO)

SPECification[:PASS]:POWer?

Type:	Specified channel
Description:	Request GO-NG result, please refer to power specification.
Query Syntax:	SPECification:POWer?
Query Example:	SPEC:POW? Return power GO-NG result to CP mode
Return Parameter:	<NR1>
Return Example:	0 (NG), 1 (GO)

SPECification?

Type:	All channels
Description:	Request GO-NG result, please refer to specifications of all channels.
Query Syntax:	SPECification?
Query Example:	SPEC? Return GO-NG results of all channels.
Return Parameter:	<NR1>
Return Example:	0 (NG), 1 (GO)

SPECification:VOLTage

Type:	Specified channel
Description:	Setting up voltage specifications
Syntax:	SPECification:VOLTage:H SPECification:VOLTage:L
Parameter:	Effective number range, refer to individual specification.
Example:	SPEC:VOLT:H <NRf+> [suffix] SPEC:VOLT:L <NRf+> [suffix]
Query Syntax:	SPECification:VOLTage:H? SPECification:VOLTage:L?
Query Example:	SPEC:VOLT:H?
Return Parameter:	<NR2>,[unit=Volt]
Return Example:	4.75

SPECification:CURRent

Type:	Specified channel
Description:	Setting up current specifications
Syntax:	SPECification:CURRent:H SPECification:CURRent:L
Parameter:	Effective number range, refer to individual specification.

Example:	SPEC:CURR:H <NRf+> [suffix]
	SPEC:CURR:L <NRf+> [suffix]
Query Syntax:	SPECification:CURR:H?
	SPECification:CURR:L?
Query Example:	SPEC:CURR:H?
Return Parameter:	<NR2>,[unit=Amp]
Return Example:	4.75

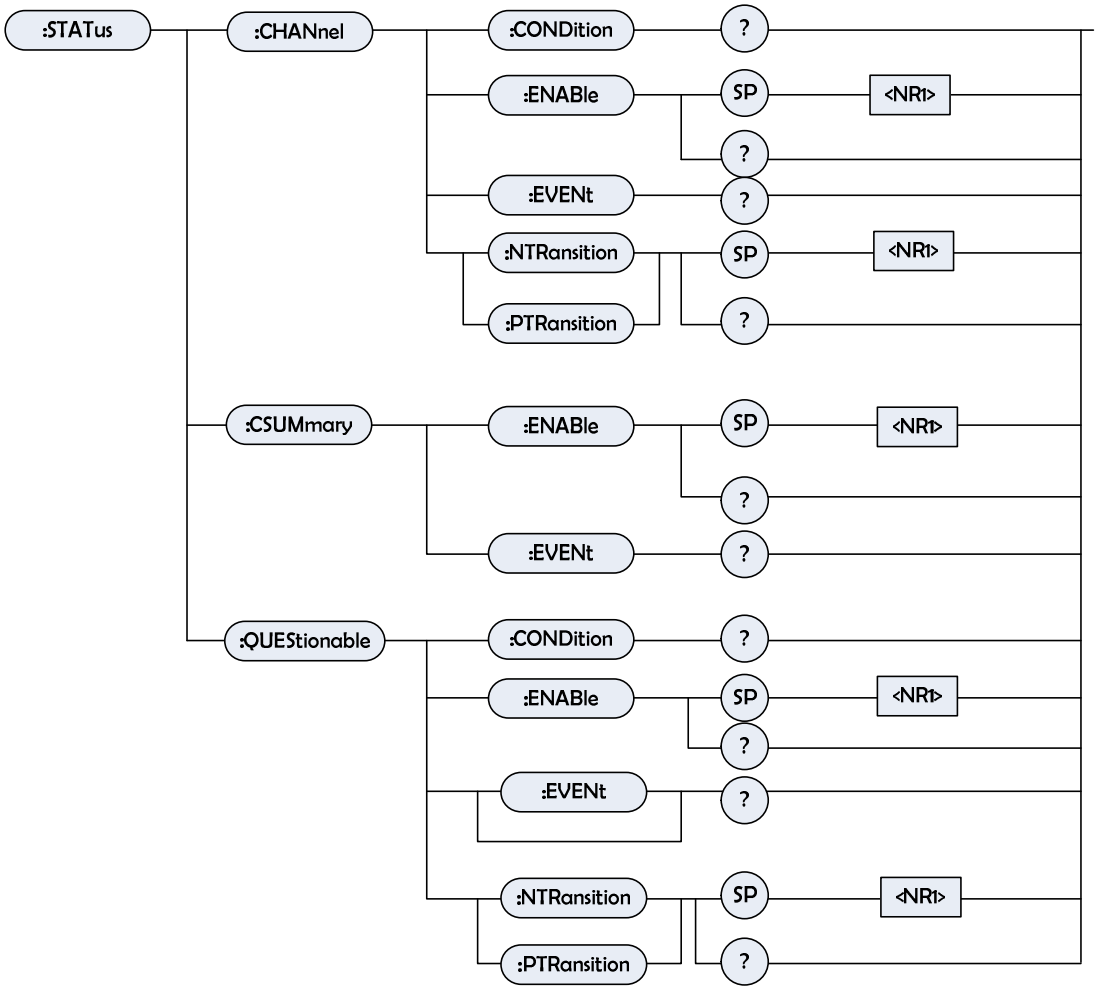
SPECification:POWer

Type:	Specified channel
Description:	Setting up power specifications
Syntax:	SPECification:POWer:H
	SPECification: POWer:L
Parameter:	Effective number range, refer to individual specification.
Example:	SPEC:POW:H <NRf+> [suffix]
	SPEC:POW:L <NRf+> [suffix]
Query Syntax:	SPECification: POW:H?
	SPECification: POW:L?
Query Example:	SPEC: POW:H?
Return Parameter:	<NR2>,[unit=Volt]
Return Example:	4.75

SPECification:TEST

Type:	Specified channel
Description:	On or Off specification test
Syntax:	SPECification:TEST ON
	SPECification:TEST OFF
Parameter:	ON/1, OFF/0
Example:	SPEC:TEST ON
	SPEC:TEST OFF
Query Syntax:	SPECification:TEST?
Query Example:	SPEC:TEST?
Return Parameter:	<NR1>
Return Example:	1

STATUS Subsystem



STATus:CHANnel:CONDition

Type: Specified channel
Description: Return status of real time channel
Query Syntax: STATus:CHANnel:CONDition?
Return Parameter: <NR1>

Bit Site of Channel Status Register

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

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

STATus:CHANnel:ENABle

Type:	Specified channel
Description:	The shielding part of the site in Event register can be alternative, and allowed to be summarized into corresponding channel site of Channel Summary Event register.
Syntax:	STATus:CHANnel:ENABle
Parameter:	0 ~ 65535
Example:	STAT:CHAN:ENABle 24
Query Syntax:	STATus:CHANnel:ENABle
Return Parameter:	<NR1>
Query Example:	STAT:CHAN:ENAB? Return the content of Status Channel Enable register
Return Example:	24

STATus:CHANnel:EVENt?

Type:	Specified channel
Description:	After reading the regiter last time, record all the channel event and reset Channel Event register.
Query Syntax:	STATus:CHANnel:EVENt?
Return Parameter:	<NR1>
Query Example:	STAT:CHAN:EVEN? Read and reset Channel Event register
Return Example:	24

STATus:CHANnel:PTRansition/NTRansition

Type:	Specified channel
Description:	Programmable filter can decide the conversion type in Condition register (0 to1 or 1to 0)，and will set up the Event register's corresponding bits.
Syntax:	STATus:CHANnel:PTRansition/NTRansition <NR1>
Parameter:	0 ~ 65535
Example:	STAT:CHAN:PTR 4 Setting up over power(over power site 2)to be 0 to 1 STAT:CHAN:NTR 4 Setting up over power(over power site 2)to be from 1 to 0 PTR and NTR are both 4 presents from 0 to 1and 1 to 0 are set.
Query Syntax:	STATus:CHANnel:PTRansition? STATus:CHANnel:NTRansition?
Return Parameter:	<NR1>
Query Example:	STAT:CHAN:PTR? Query the setup of PTRansition channel
Return Example:	4

STATus:CSUMmary:ENABle

Type: All channels

Description: The shielding part of the site in Event register can be alternative, and allowed to be summarized into CSUM site of Status Byte register.

Syntax: STATus:CSUMmary:ENABle

Parameter:

Site Configuration of Channel Summary register

Bit Site	5	4	3	2	1	0
Channel	6	5	4	3	2	1
Site	32	16	8	4	2	1

Example: STAT:CSUM:ENAB 3

Query Syntax: STATus:CSUMmary:ENABle?

Return Parameter: <NR1>

Query Example: STAT:CSUM:ENAB? Return the setup of Channel Summary Enable register

Return Example: 3

STATus:CSUMmary:EVENt?

Type: All channels

Description: After reading the registers last time, point out all channels in the startup STAT:CHAN event.

Parameter:

Site Configuration of Channel Summary register

Bit Site	5	4	3	2	1	0
Channel	6	5	4	3	2	1
Site	32	16	8	4	2	1

Query Syntax: STATus:CSUMmary:EVENt?

Return Parameter: <NR1>

Query Example: STAT:CSUM:EVEN? Return the value of Channel Summary register

Return Parameter: 3

STATus:QUEStionable:CONDition

Type: All channels

Description: Real time (“live”) record Questionable data

Query Syntax: STATus:QUEStionable:CONDition?

Return Parameter: <NR1>
Query Example: STAT:QUES:COND? Return channel status
Return Example: 6

STATus:QUEStionable:ENABle

Type: All channels
Description: The shielding part of the site in Event register can be alternative, and allowed to be summarized into QUES site of Status Byte register.
Syntax: STATus:QUEStionable:ENABle
Parameter:

Bit Site of Questionable Status Register

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

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

STATus:QUEStionable:EVENt?

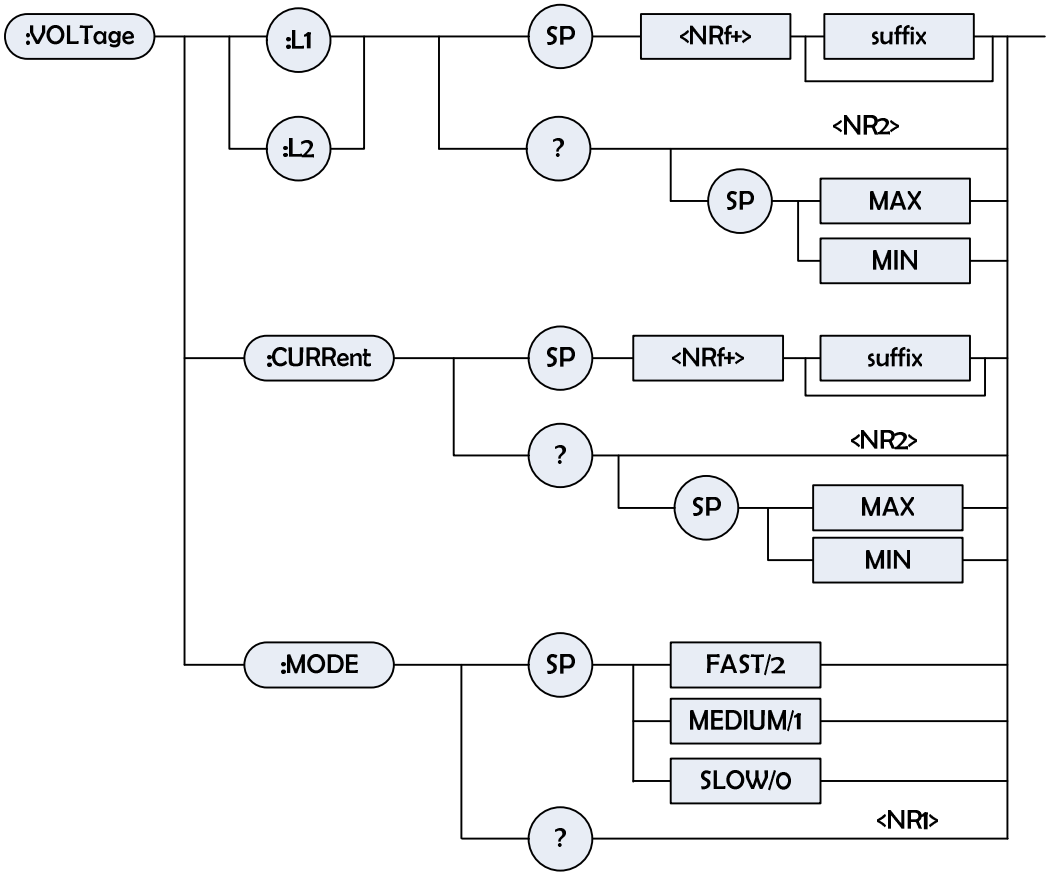
Type: All channels
Description: After reading the registers last time, record all the Questionable
status.
Query Syntax: STATus:QUEStionable:EVENt?
Return Parameter: <NR1>
Query Example: STAT:QUES:EVEN? Return the content of Questionable Event register
Return Example: 24

STATus:QUEStionable:PTRansition/NTRansition

Type: All channels
Description: Programmable filter can decide the conversion type in Condition register (0 to1 or 1to 0)，and set up the Event register’s corresponding bits.
Syntax: STATus:QUEStionable:PTRansition/NTRansition <NR1>
Parameter: 0 ~ 65535

Example: STAT:QUES:PTR 4 Setting up over power(over power bit 2) to be from 0 to 1
STAT:QUES:NTR 4 Setting up over power (over power bit 2) to be from 1 to 0
Query Syntax: STATus:QUEStionable:PTRansition?
STATus:QUEStionable:NTRansition?
Return Parameter: <NR1>
Query Example: STAT:QUES:PTR? Return the setup on QUEStionable Ptransition/ Ntransition
Return Example: 4

VOLTAGE Subsystem



VOLTage:L1/L2

Type: Specified channel
Description: During CV mode, setting up the voltage of the static load.
Syntax: VOLTage:L1

VOLTage:L2

Parameter: Effective number range, refer to individual specification.

Example: VOLT:L1 8V Setting up voltage of load L1 to be 8V
VOLT:L2 24V Setting up voltage of load L2 to be 24V
VOLT:L1 MAX Setting up voltage of load L1 to be the maximum value
VOLT:L2 MIN Setting up voltage of load L2 to be the minimum value

Query Syntax: VOLTage:L1?
VOLTage:L2?
VOLTage:L1? MAX
VOLT:L2? MIN

Return Parameter: <NR2>,[unit=Volt]

Query Example: VOLT:L1? Return the setup voltage value of Load L1

Return Example: 0

VOLTage:CURRent

Type: Specified channel

Description: Setting up the current limit in CV mode.

Syntax: VOLTage:CURRent

Parameter: Effective number range, refer to individual specification.

Example: VOLT:CURR 3 During CV mode, setting up load current limit to be 3A
VOLT:CURR MAX During CV mode, setting up load current limit to be maximum value.
VOLT:CURR MIN During CV mode, setting up load current limit to be minimum value.

Query Syntax: VOLTage:CURRent?

Return Parameter: <NR2>,[unit=Amp]

Query Example: VOLT:CURR?

Return Example: 3

VOLTage:MODE

Type: Specified channel

Description: Setting up the response rate in CV mode.

Syntax: VOLTage:MODE FAST
VOLTage:MODE MEDIUM
VOLTage:MODE SLOW

Parameter: FAST/2,MEDIUM/1,SLOW/0

Example: VOLT:MODE FAST
VOLT:MODE SLOW

Query Syntax: VOLTage:MODE?

Return Parameter: <NR1>

Query Example: VOLT:MODE?
Return Example: 0

System Commands

M

Type: All channels
Description: Setting up the load mode to be one mainframe with 6 channels. If channel does not exist, then the mainframe will ignore the setup.
Syntax: M “n,n,n,n,n,n”
Parameter: 0：no change；1:CCL；2:CCH；3:CCDL；4:CCDH；5:CRL；6:CRH；7:CVH；8:CVL；9:CPH；10:LEDL；11:LEDH
Example: M 1,1,2,2,2,2
M 2,2,2,2,2,2

AC

Type: All channels
Description: Setting up the main value 1(L1) of the current in CC mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: AC n,n,n,n,n,n
Parameter: <NR2>, [unit =Amp]
Example: AC 1.0,1,2.5,5.0,10.5,4.5

AR

Type: All channels
Description: Setting up the main value 1(L1) of the resistance in CR mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: AR n,n,n,n,n,n
Parameter: <NR2>, [unit =OHM]
Example: AR 1.0,0.1,0.2,0.5,0.15,0.4

AV

Type: All channels
Description: Setting up the main value1(L1) of the voltage in CV mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: AV n,n,n,n,n,n
Parameter: <NR2>, [unit =Volt]

Example: AV 5.0,5.5,3.3,5.1,12.0,-5.5

CCR

Type: All channels
Description: Setting up the rise slew rate in CC mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CCR n,n,n,n,n,n
Parameter: <NR2> ,[unit =A/us]
Example: CCR 1.0,2.5,2.5,1,2.0,1

CCF

Type: All channels
Description: Setting up the fall slew rate in CC mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CCF n,n,n,n,n,n
Parameter: <NR2>, [unit=A/us]
Example: CCF 1.0,2.5,2.5,10,2.0,5.0

CRR

Type: All channels
Description: Setting up the rise slew rate in CR mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CRR n,n,n,n,n,n
Parameter: <NR2>, [unit=A/us]
Example: CRR 1.0,2.5,2.5,10,2.0,5.0

CRF

Type: All channels
Description: Setting up the fall slew rate in CR mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CRF n,n,n,n,n,n
Parameter: <NR2>,[unit=A/us]
Example: CRF 1.0,2.5,2.5,10,2.0,5.0

LAT

Type: All channels
Description: Setting up the action type of Von in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: LAT n,n,n,n,n,n
Parameter: 0：OFF, 1：ON
Example: LAT 0,1,1,1,0, 1

GO

Type: All channels
Description: This command start/stop the current sinking of the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: GO n,n,n,n,n, n
Parameter: 0：OFF, 1：ON, other value：no action
Example: GO 0,1,1,1,0,1

VRB

Parameter: 0：LOW range, 1：HIGH range, other value：no action
Example: VRB 0,1,1,1,0,1,0,1

VR

Type: All channels
Description: Setting up the voltage range in CC mode in the 6 channel host. If the channel does not exist, the host chassis will ignore the setup. The unit of the setup value is Volt. Please refer to the specification table in measurement section.
Syntax: VR n,n,n,n,n,,n
Parameter: <NR2>,[unit =Volt]
Example: VR 1,1,2,16,80,10

VON

Type: All channels
Description: Setting up the Von voltage in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: VON n,,n,n,n,n,n
Parameter: <NR2>,[unit =Volt]
Example: VON 1.23,1.23,0,0,5, 12

CCSR

Type: All channels
Description: Setting the rise and fall slew rate of CC mode the host sets in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CCSR n,n,n,n,n,n
Parameter: <NR2>,[unit=A/us]
Example: CCSR 1.0,2.5,2.5,10,2.0,5.0

CRSR

Type: All channels
Description: Setting up the rise and fall slew rate of CR mode the host sets in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CRSR n,n,n,n,n, n
Parameter: <NR2>,[unit=A/us]
Example: CRSR 1.0,2.5,2.5,10,2.0,5.0

CDL1

Type: All channels
Description: Setting up the current main value 1(L1)of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CDL1 n,n,n,n,n,n
Parameter: <NR2>,[unit =Amp]
Example: CDL1 1.0,1,2.5,5.0,10.5,4.5

CDL2

Type: All channels
Description: Setting up the of current main value 2(L2) of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup
Syntax: CDL2 n,n,n,n,n,n
Parameter: <NR2>,[unit =Amp]
Example: CDL2 1.0,1,2.5,5.0,10.5,4.5

CDT1

Type: All channels
Description: Setting up the enable time T1 of current main value 1(L1) of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup
Syntax: CDT1 n,n,n,n,n,n
Parameter: <NR2>,[unit =s]
Example: CDT1 1.0,1,2.5,5.0,10.5,4.5

CDT2

Type: All channels
Description: Setting the enable time T2 of current main value 2(L2)of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.

Syntax: CDT2 n,n,n,n,n,n
Parameter: <NR2>,[unit =s]
Example: CDT2 1.0,1,2.5,5.0,10.5,4.5

CDR

Type: All channels
Description: Setting rise slew rate of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CDR n,n,n,n,n, n
Parameter: <NR2>,[unit =A/us]
Example: CDR 1.0,2.5,2.5,10,2.0,5.0

CDF

Type: All channels
Description: Setting fall slew rate of CCDL/CCDH mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: CDF n,n,n,n,n, n
Parameter: <NR2>,[unit =A/us]
Example: CDF 1.0,2.5,2.5,10,2.0,5.0

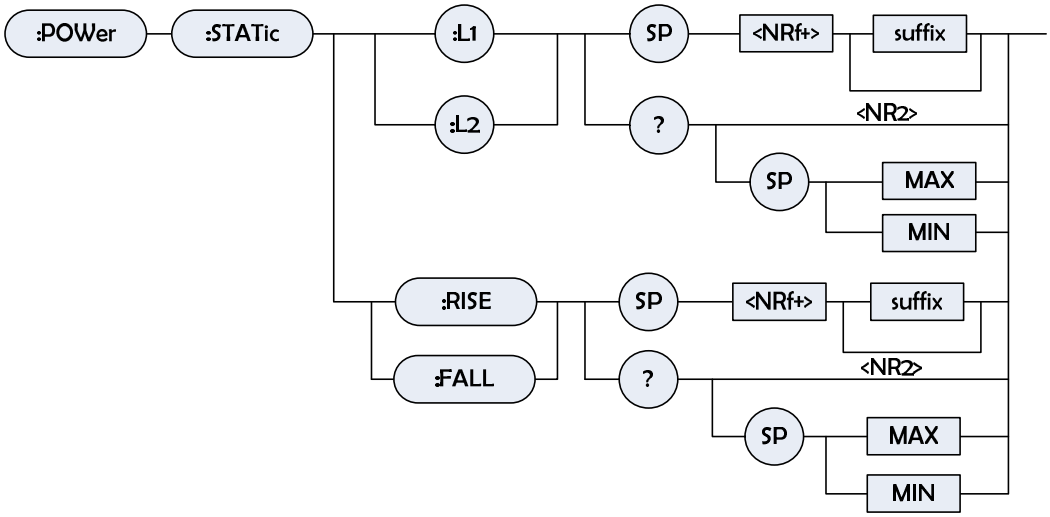
L

Type: All channels
Description: Setting load principal value according to the mode in the 6 channel mainframe. If the channel does not exist, the mainframe will ignore the setup.
Syntax: L n,n,n,n,n,n
Parameter: <NR2> ,[unit =Amp(CCL/CCH)]
[unit=OHM(CRL/CRH)]
[unit =Volt(CV)]
Example: L 1.0,2.5,2.5,10,2.0,5.0

ERR?

Type: All channels
Description: For querying errors of electronic load generates in the process of using
Syntax: ERR?
Parameter: <crd>
Example: ERR?

POWER Subsystem



POWer:STATic:L1/L2

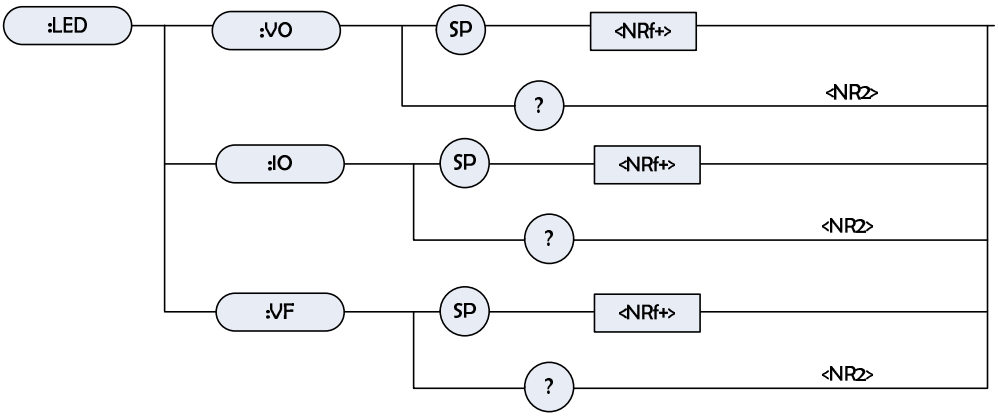
Type:	Specified channel
Description:	Setting up the power of static load in CP mode
Syntax:	POWer:STATic:L1 <NR2> [suffix] POWer:STATic:L2 < NR2> [suffix]
Parameter:	Effective number range, refer to individual specification.
Example:	POWer:STAT:L1 20 Setting up CC power = 20W to be used by static load L1. POWer:STAT:L2 10 Setting up CC power = 10W to be used by static load L2 . POWer:STAT:L1 MAX Setting up CC power = maximum value to be used by static load L1. POWer:STAT:L2 MIN Setting up CC power = minimum value to be used by static load L2 .
Query Syntax:	POWer:STATic:L1? POWer:STATic:L2? POWer:STATic:L1? MAX POWer:STATic:L2? MIN
Return Parameter:	<NR2> [unit=Watt]
Query Example:	POW:STAT:L1? Return the setup power value of the static load L1.
Return Example:	20

POWer:STATic:RISE/FALL

Type:	Specified channel
Description:	Setting up the power slew rate in CC static mode
Syntax:	POWer:STATic:RISE <NRf+> [suffix] POWer:STATic:FALL <NRf+> [suffix]

Parameter:	Effective number range, refer to individual specification.
Example: POWer:	STAT:RISE 2.500 Setting up the rise slew rate of the static load to be 2.5W/μs
	POWer:STAT:FALL 1W/μs Setting up the fall slew rate of the static load to be 1W/μs
Query Syntax:	POWer:STATic:RISE?
	POWer:STATic:FALL?
	POWer:STATic:RISE? MAX
	POWer:STATic:FALL? MIN
Return Parameter:	<NR2>,[unit=A/μs]
Query Example:	POW:STAT:RISE? Return the rise slew rate of the static load
Return Example:	2.5

LED Subsystem



LED:VO

Type:	Specified channel
Description:	Setting up the output voltage of LED driver.
Syntax:	LED:VO <NRf+>
Parameter:	Effective number range, refer to individual specification.
Example:	LED:VO 8 Setting up Vo=8V
	LED:VO 24 Setting up Vo=24V
Query Syntax:	LED:VO?
Return Parameter:	<NR2>
Query Example:	LED:VO? Respond to the setup Vo value.
Return Example:	24

LED:IO

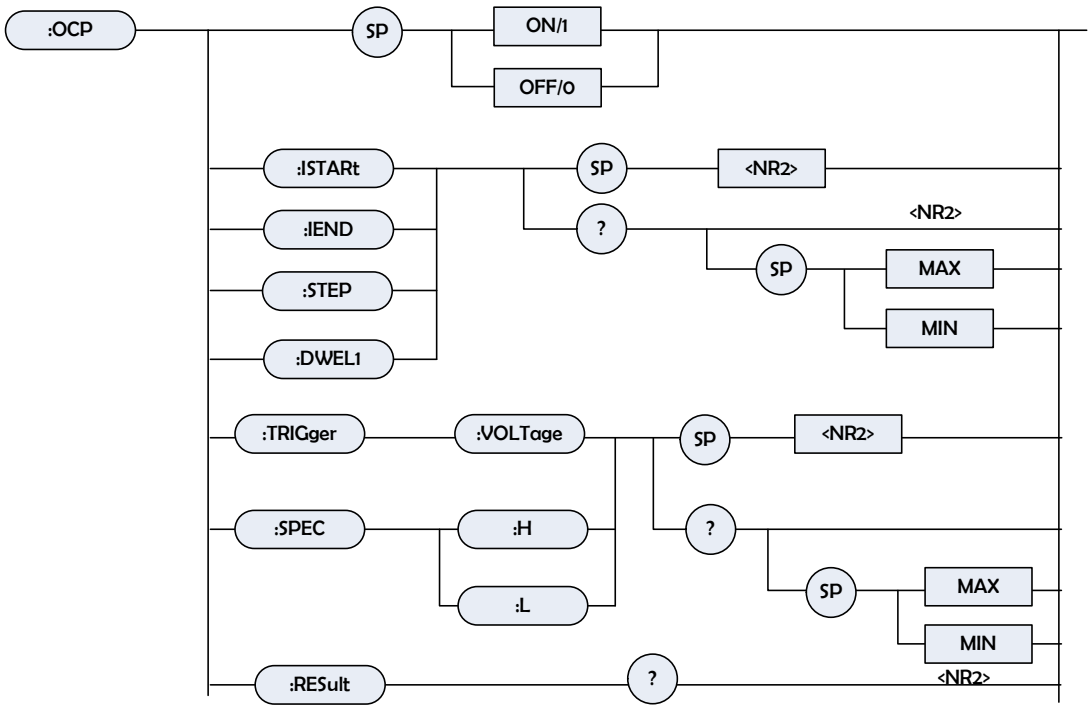
Type:	Specified channel

Description:	Setting up the output current of LED driver	
Syntax:	LED:IO <NRf+>	
Parameter:	Effective number range, refer to individual specification.	
Example:	LED:IO 0.1	Setting up Io=0.1A
	LED:IO 2	Setting up Io=2A
Query Syntax:	LED:IO?	
Return Parameter:	<NR2>	
Query Example:	LED:IO?	Respond to the setup Io value.
Return Example:	2	

LED:VF

Type:	Specified channel	
Description:	Setting up the forward bias of LED	
Syntax:	LED:VF <NRf+>	
Parameter:	Effective number range, refer to individual specification.	
Example:	LED:VF 8	Setting up Vf=8V
	LED:VF 24	Setting up Vf=24V
Query Syntax:	LED:VF?	
Return Parameter:	<NR2>	
Query Example:	LED:VF?	Respond to the setup Vf value.
Return Example:	24	

OCP Subsystem



OCP

Type: Specified channel
Description: Execute or cancel OCP test
Syntax: OCP <NR1>
Parameter: ON/1,OFF/0
Example: OCP ON Execute OCP test

OCP:ISTArt

Type: Specified channel
Description: Setting the start current in OCP mode.
Syntax: OCP:ISTArt <NRf+>
Parameter: Effective number range, refer to individual specification.

Example: OCP:ISTA 0.5 Setting up the start current to be 0.5A.
OCP:ISTA MAX Setting up the start current to be the maximum value.
OCP:ISTA MIN Setting up the start current to be the minimum value.
Query Syntax: OCP:ISTArt?[<MAX | MIN>]
Return Parameter: <NR2>,[unit=Amp]
Query Example: OCP:ISTA?
OCP:ISTA? MAX
OCP:ISTA? MIN
Return Example: 0.5

OCP:IEND

Type:	Specified channel
Description:	Setting up the end current in OCP mode.
Syntax:	OCP:IEND <NRf+>
Parameter:	Effective number range, refer to individual specification.
Example:	OCP:IEND 3 Setting up the end current to be 3A.
	OCP:IEND MAX Setting up the end current to be the maximum value.
	OCP:IEND MIN Setting up the end current to be the minimum value
Query Syntax:	OCP:IEND?[<MAX | MIN>]
Return Parameter:	<NR2>, [unit=Amp]
Query Example:	OCP:IEND?
	OCP:IEND? MAX
	OCP:IEND? MIN
Return Example:	3

OCP:STEP

Type:	Specified channel
Description:	Setting up the step number in OCP mode.
Syntax:	OCP:STEP <NR1>
Parameter:	1~100
Example:	OCP:STEP 100 Setting up the step number to be 100.
	OCP:STEP MAX Setting up the step number to be maximum value.
	OCP:STEP MIN Setting up the step number to be minimum value.
Query Syntax:	OCP:STEP?[<MAX | MIN>]
Return Parameter:	<NR1>
Query Example:	OCP:STEP?
	OCP:STEP? MAX
	OCP:STEP? MIN
Return Example:	100

OCP:DWELl

Type:	Specified channel
Description:	Setting up the interval time in OCP mode.
Syntax:	OCP:DWELl <NRf+>
Parameter:	500~1000
Example:	OCP:DWEL 500 Setting up the interval time to be 100 ms.
	OCP:DWEL MAX Setting up the interval time to be

maximum value.
OCP:DWEL MIN Setting up the interval time to be minimum value.

Query Syntax: OCP:DWEL?[<MAX | MIN>]
Return Parameter: <NR1>,[unit = ms]
Query Example: OCP:DWEL?
OCP:DWEL? MAX
OCP:DWEL? MIN
Return Example: 500

OCP:TRIGger:VOLTage

Type: Specified channel
Description: Setting up the trigger voltage in OCP mode.
Syntax: OCP:TRIGger:VOLTage <NRf+>
Parameter: Effective number range, refer to individual specification.
Example: OCP:TRIGger:VOLTage 4.5 Setting up the trigger voltage to be 4.5V.
OCP:TRIGger:VOLTage MAX Setting up the trigger voltage to be the maximum value.
OCP:TRIGger:VOLTage MIN Setting up the trigger voltage to be the minimum value.
Query Syntax: OCP：TRIGger:VOLTage?[<MAX | MIN>]
Return Parameter: <NR2>, [unit=Volt]
Query Example: OCP:TRIGger:VOLTage?
OCP:TRIGger:VOLTage? MAX
OCP:TRIGger:VOLTage? MIN
Return Example: 4.5

OCP:SPECification:L

Type: Specified channel
Description: Setting up the lower limit of test specification in OCP mode.
Syntax: OCP:SPECification:L <NR2>
Parameter: Effective number range, refer to individual specification.
Example: OCP:SPECification:L 1.5 Setting up the lower limit of specification to be 1.5A
OCP:SPECification:L MAX Setting up the lower limit of specification to be the maximum value.
OCP:SPECification:L MIN Setting up the lower limit of specification to be the minimum value.
Query Syntax: OCP:SPECification:L?[<MAX | MIN>]
Return Parameter: <NR2>, [unit=Amp]
Query Example: OCP:SPECification:L?
OCP:SPECification:L? MAX

OCP:SPECification:L? MIN

Return Example: 1.5

OCP:SPECification:H

Type: Specified channel

Description: Setting up the upper limit of test specification in OCP mode

Syntax: OCP:SPECification:H <NR2>

Parameter: Effective number range, refer to individual specification.

Example: OCP:SPECification:H 2.8 Setting up the upper limit to be 2.8A.

OCP:SPECification:H MAX Setting up the upper limit to be the maximum value.

OCP:SPECification:H MIN Setting up the upper limit to be the minimum value.

Query Syntax: OCP:SPECification:H?[<MAX | MIN>]

Return Parameter: <NR2>, [unit=Amp]

Query Example: OCP:SPECification:H?

OCP:SPECification:H? MAX

OCP:SPECification:H? MIN

Return Example: 2.8

OCP:RESult?

Type: Specified channel

Description: Return test result in OCP mode.

Syntax: None

Parameter: None

Example: None

Query Syntax: OCP:RESult?

Return Parameter: When -1 is returned, it represents OCP test stops.

-2 represents OCP test is ready to execute, wait for Von or other conditions.

-3 represents OCP test is executed.

<arg1>,<arg2>

<arg1>：Pass/Fail. <NR1>, 0：PASS；1：FAIL [unit = none]

<arg2>：OCP current. <NR2>, [unit = Amp]

Query Example: OCP:RES?

8 Status System

8.1 Introduction

This chapter describes the status data structure of Intepro ML1800 series electronic load, as Figure 8- 1 shows. Standard register such as Event Status register, the output queue, status byte and service request start register to implement the standard GPIB function and define programmable instrumentation with IEEE-488.2 standard digital interface. Other status register groups use specific status system requirements of electronic load. Multiple channels of electronic load use channel status and Channel Summary register group to save the status information into the status register of each channel.

8.2 Channel Register Group

- Status Register
  Status Register represents the present status of electronic load signal. Reading status register does not change its bit status.
  PTR/NTR filter, EVEN event register
  Event register depends on the corresponding status change of status bit in the status register, or specific status in the electronic load. When the corresponding status makes the definition of the electronic load change, the event becomes true.
  - Positive conversion (0 to 1)
  - Negative conversion (1 to 0)
  - Positive or Negative conversion (0 to 1 or 1 to 0)
- PTR/NTR filter decides setting which kind of status conversion bit in the event of register. Channel status and Questionable status allow programming conversion. Other register groups, such as Channel Summary, standard event status register group use implied rising (0 to 1) status transformation to set the bits in the event register. Reading event register clears the value of the register (all bits set to zero).
- Enable register
  Enable register can make the bits corresponding to Event register to be logical 「or」 function, and programmed into Channel Summary bit .

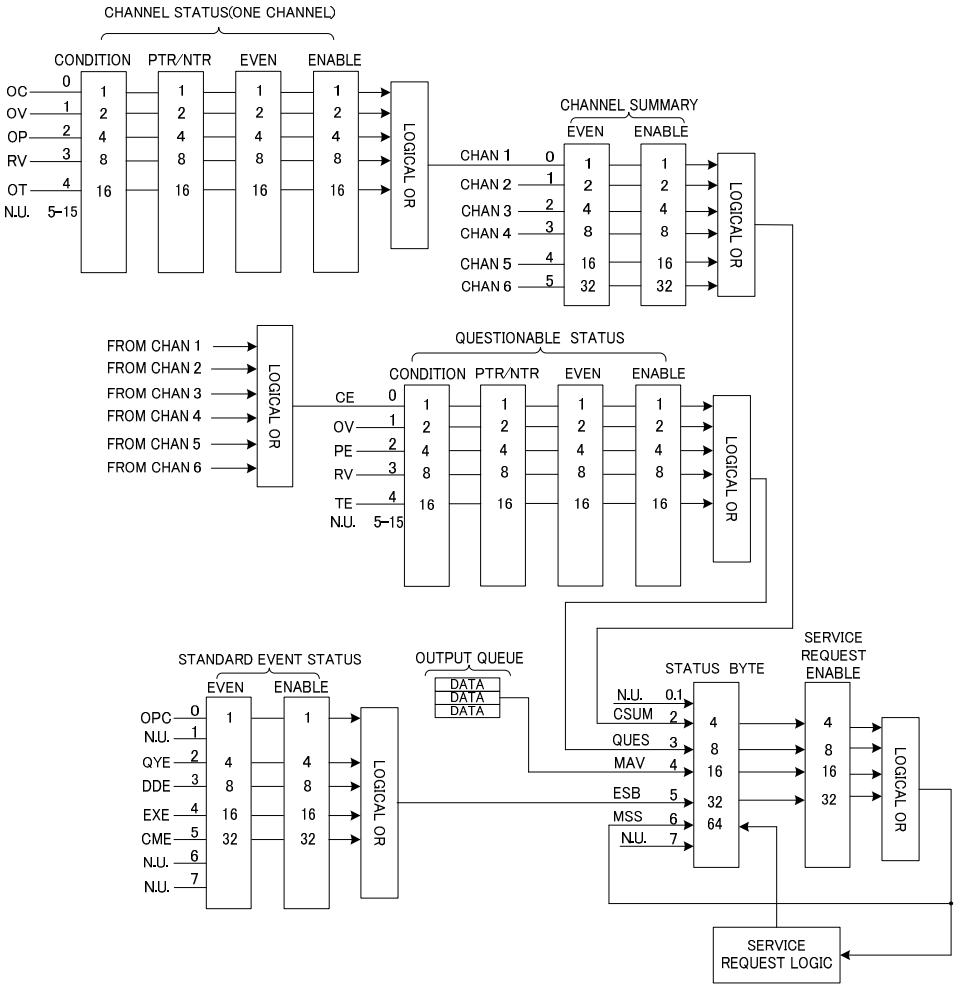


Figure 8- 1 Status register of electronic load

8.2.1 Channel Status

Figure 8- 1 Channel Status register of electronic load

Mnemonic symbol	Bit	Value	Meaning
OC	0	1	Over current. When over current occurs in the channel, set up bit 0 and save the setting until over current is removed and programming LOAD:PROT:CLE .
OV	1	2	Over voltage. When over voltage occurs in the channel, set up bit 1 and save the setting until over voltage is removed and programming LOAD:PROT:CLE .
OP	2	4	Over power. When over power occurs in the channel, set up bit 2 and save the setting until over power is removed and programming LOAD:PROT:CLE .
RV	3	8	Reverse voltage input. When reverse voltage is applied in the

			channel, set up bit 3. Save the setting until reverse voltage is removed and programming LOAD:PROT:CLE.
OT	4	16	Over temperature. When over temperature occurs in the channel, set up bit 4 and turn off the channel. Save the setting until complete cooling, lower than over temperature dividing point and programming LOAD:PROT:CLE.

- Channel Status register provide you one or more channel status condition, pointing out some fault or error in specific channel. Figure 8- 1 describes the channel status condition applied to electronic load.
- When setting up bits of Channel Status Condition register, corresponding conditions are true.
- Programming PTR/NTR filters to select which kind of conversion way of bit condition in Channel Status Condition register, and will set up the corresponding bit in Event register. The reading of Channel Status Event register will be reset to be 0.
- Channel Status Enable register is programmable and demonstrate which bit in channel status event is logical「or」function, which will change into the corresponding bit in Channel Summary Event register.

8.2.2 Channel Summary

- Channel Summary register summarizes channel condition status, and up to 6 channels.
- When setting up one of the bits in Channel Status Event register is set, will also make the corresponding channel bits to be set in Channel Summary Event register.
- Reading the value of Event register will make the position to be 0.
- Channel Summary Enable register is programmable and demonstrate which channel summary event bit changes from the current channel logically-O Red into the bit 2 (CSUM)in Status Byte register.

8.2.3 Questionable Status

- Questionable Status register provides one or more abnormal status condition bits. Table 8- 2 lists abnormal conditions of electronic load, which are same as channel status conditions. Complete description, please refer to Table 8-1.
- Where abnormal status occurs, corresponding condition register is set.
- Programming PTR/NTR to select which conversion way of bit condition in Status Condition register, will set up the corresponding bits in Event register.
- Read the value of Questionable Status Event register, the data will be reset.
- Questionable Status Enable register is used to control the electronic load to enable

which questionable events. Only when the corresponding bit is enabled, Channel Questionable Event register will record corresponding questionable event.

Table 8- 2 Bit description of questionable status

Mnemonic symbol	Bit	Value	Meaning
CE/OC	0	1	Current error
OV	1	2	Over voltage
PE/OP	2	4	Power error voltage
RV	3	8	Input reverse
TE/OT	4	16	Temperature error

8.3 Output Queue

- Output queue store output message until reading from electronic load.
- Output queue store output message in FIFO sequence.
- When there is data in the queue bit 4 (MAV bit)is set in status byte register.

8.4 Standard Event Status

- All programming errors will set one or more error bits in the standard event status register. Table 8- 3describes standard events applied in electronic load.
- Read the value of standard event status register, the data will be reset.
- Standard Event Enable is used to control standard events electronic load records.

Table 8- 3 Bit description of standard event status

Mnemonic symbol	Bit	Value	Meaning
OPC	0	1	Finish operation. Generation of this event bit is to respond to *OPC command. Point out that the device has completed all the selected pending operation.
QYE	2	4	Query error. When no data or the data in the queue is lost, reading the output queue.
DDE	3	8	Subject to device error memory lost or self test error.
EXE	4	16	Execution error. Command parameter is not within the statutory range or consistent with the operation of the electronic load, or

			command can not be executed because of some operation condition.
CME	5	32	Command error. Occurrence of syntactic or semantic error, or electronic load received <GET> from program information.

8.5 Status Byte Register

- Status byte register summarize all the standard status events in all Status register. Table Table 8-4describes status events applied to electronic load.
- Status byte register can be read with serial polling or *STB? query.
- RQS is the only bit which can be removed automatically after serial polling
- When Status byte register is read by *STB? query, bit 6 in Status byte register will include MSS bit. MSS bit indicates the load has at least one requested service. *STB? will not influence status byte.
- Status byte register is removed by *CLS command.

Table 8- 4 Bit description of status byte

Mnemonic symbol	Bit	Value	Meaning
CSUM	2	4	Channel summary. Indicates whether to enable channel events. Affected by channel condition, channel event and channel summary event register.
QUES	3	8	Questionable. Indicates whether to occur.
MAV	4	16	Message can be used. Indicates whether the output queue includes data.
ESB	5	32	Event status bit. Indicates whether the standard event occurs.
RQS/MSS	6	64	Request service/main summary status. During serial polling period, returns and remove RQS. Query with *STB?, return but do not remove MSS.

8.6 Service Request Enable Register

Service Request Enable register is programmable to specify which one bit in the status byte register will generate service request.

9 Practical Example

◎Note：

Some programming commands in this section are followed by comment statements started with “//”, which is not within the range that the electronic load can identify, but only for the convenience of understanding the corresponding programming commands, so in the actual operation of electronic load, comment statement including “//” can not be entered.

This section provides a basic paradigm for the control of electronic load. Here the GPIB is NI (National Instruments) product. For more detailed information, please refer to the examples folder under installation CD-ROM directory.

paradigm:

```
#include "stdafx.h"
#include <windows.h>
#include "ni488.h"
#define    BUFFERSIZE          1024              // define character buffer size
#define    GPIB_BoardID    0                     // Board handle
#define    GPIB_ADDRESS 5                   // device address
#define    GPIB_NO_SECONDARY_ADDR   0    //second-level address
#define    TIMEOUT          T10s                 // timeout 10s
#define    EOTMODE           1                   // Enable the END message
#define    EOSMODE         0                 // Disable the EOS mode
int        iDev;
int        txLength;
char       txBuffer[BUFFERSIZE + 1];            // Send buffer
char       rxBuffer[BUFFERSIZE + 1];            // Receive buffer

int main(int argc, _TCHAR* argv[])
{
   // Traditional NI-488.2 Calls ( ibwrt/ ibrd) traditional function communication
   iDev          =          ibdev(GPIB_BoardID,          GPIB_ADDRESS,
GPIB_NO_SECONDARY_ADDR,
TIMEOUT, EOTMODE, EOSMODE);
   strcpy(txBuffer,"*IDN?\n");
   txLength=strlen(txBuffer);
```

```
printf("ibwrt -> %s\n", txBuffer);
ibwrt(iDev, txBuffer, 10L);
ibrd(iDev,rxBuffer, BUFFERSIZE);
rxBuffer[ibcntl] = '\0';
printf("ibrd <- %s\n", rxBuffer);
ibonl (GPIB_BoardID, 0);
// Multi-Device NI-488.2 Calls (Send/ Receive) Multiple devices function communication
//Send the following ending way are used respectively NULLend / NLend / DABend
   SendIFC(GPIB_BoardID);
   DevClear(GPIB_BoardID, GPIB_ADDRESS);
strcpy(txBuffer,"*IDN?");
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
   Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
   Receive(GPIB_BoardID, GPIB_ADDRESS, rxBuffer, BUFFERSIZE, STOPend);
   rxBuffer[ibcntl] = '\0';
   printf("Receive <- %s\n", rxBuffer);
strcpy(txBuffer,":CHANnel 1");              // set up channel 1
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
strcpy(txBuffer,":MODE CCL");               //set up mode to be CCL
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
strcpy(txBuffer,":CURRent:STATic:L1 2.5");  //set up L1 current in CCL to be 2.5A
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
strcpy(txBuffer,":LOAD ON");                //start loading
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
Sleep(500);
strcpy(txBuffer,":MEASure:VOLTage?");       // measured voltage value
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, DABend);
Receive(GPIB_BoardID, GPIB_ADDRESS, rxBuffer, BUFFERSIZE, STOPend);
rxBuffer[ibcntl] = '\0';
```

```
printf("Receive <- %s\n", rxBuffer);
strcpy(txBuffer,":MEASure:CURRent?\n");      //measured current value
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NULLend);
Receive(GPIB_BoardID, GPIB_ADDRESS, rxBuffer, BUFFERSIZE, STOPend);
rxBuffer[ibcntl] = '\0';
printf("Receive <- %s\n", rxBuffer);
strcpy(txBuffer,":LOAD OFF");                    //unload
txLength=strlen(txBuffer);
printf("Send -> %s\n", txBuffer);
Send(GPIB_BoardID, GPIB_ADDRESS, txBuffer, txLength, NLend);
   ibonl (GPIB_BoardID, 0);
getchar();
return 0;
```

Error Message

9.1 Introduction

Any errors that occur in the working process of the load, are recorded in the error queue until the queue is full. Error message can be read through the panel menu or programming commands.

Error is retrieved with FIFO sequence, the first returned error is the earliest error occurred. One of the error message will be deleted from the error queue after each reading If there is currently no error, which means error queue is empty, then when sending the query command, the load returns information with "+0 No error ".

9.2 Error Message Check

In the remote control mode, one error message in the queue can be read out and removed by executing the following commands:

ERR?

The message this command returns is string, such as:

“+101 Invalid character”

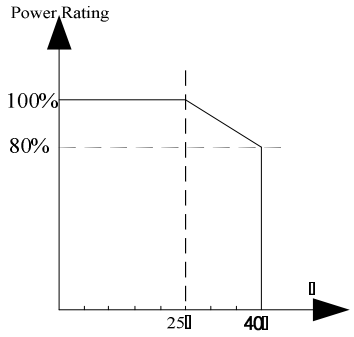
The error message shows that invalid characters exist in the command string electronic load received. If all the error message has been read or no error occurs when reading error information, executing "ERR?" command will return information: “+0 No error”

This message shows no error or all error message has been removed.

Specification

Supplementary Characteristic

AC power input：220V ±10%，50Hz
Cooling Mode：Air cooling
Storage Environmental Temperature：0 to 60 °C
Operation Temperature：0 to 40 °C. Relationship between load power and operating temperature as shown in Figure：



Relationship between load power and operating temperature

Main Technical Parameter

Note：

Measurement accuracy is specified for one year, load operation temperature should be 22℃～28℃（71～82℉），and relative humidity is up to 80%. In addition，please preheat the load for half an hour before measuring accuracy.

Model No.	66103A		66105A		66106A		66108A	
Power	300W		300W		600W		600W	
Current	60A		10A		120A		20A	
Voltage*1	80V		500V		80V		500V	
Minimum Voltage at Full Current	1V@60A		4.5V@10A		1.5V@120A		5V@20A	
CC								
Range	0～6A	0～60A	0～1A	0～10A	0～12A	0～120A	0～2A	0～20A
Resolution	0.1mA	1mA	0.02mA	0.2mA	0.2mA	2mA	0.04mA	0.4mA
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.	0.1%+0.1%F.S	0.1%+0.2%F.S.	0.1%+0.1%F.S.	0.1%+0.2%F.S.
CV								
Range	0～16V	0～80V	0～50V	0～500V	0～16V	0～80V	0～50V	0～500V
Resolution	0.3mV	2mV	1mV	10mV	0.3mV	2mV	1mV	10mV
Accuracy	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.	0.05%+0.1%F.S.
CP*2								
Range	0～300W		0～300W		0～600W		0～600W	
Resolution	5mW		5mW		10mW		10mW	
Accuracy	0.5%+1%F.S.		0.5%+1%F.S.		0.5%+1%F.S.		0.5%+1%F.S.	
CR*2*3								
Range	0.025Ω～100Ω(16V) 0.625Ω～2500Ω(80V)		0.5Ω～1875Ω(50V) 25Ω～93600Ω(500V)		12.5mΩ～50Ω(16V) 0.3125～1250Ω(80V)		0.25～937.5Ω(50V) 12.5～46.8KΩ(500V)	
Resolution	16bit		16bit		16bit		16bit	
Accuracy	3%+0.4%(100Ω) 3%+0.2% (2500Ω)		3%+0.4%(1875Ω) 3%+0.2% (93600Ω)		3%+0.4%(50Ω) 3%+0.2% (2500Ω)		3%+0.4%(937.5Ω) 3%+0.2% (46800Ω)	
Transient								
T1 & T2	0.025～50ms/Res:5μs 0.1～500ms/Res:25μs 10～50s/Res:2.5ms		0.025～50ms/Res:5μs 0.1～500ms/Res:25μs 10～50s/Res:2.5ms		0.025～50ms/Res:5μs 0.1～500ms/Res:25μs 10～50s/Res:2.5ms		0.025～50ms/Res:5μs 0.1～500ms/Res:25μs 10～50s/Res:2.5ms	
Accuracy	1us/1ms+100ppm		1us/1ms+100ppm		1us/1ms+100ppm		1us/1ms+100ppm	
Slew Rate								

Current Range	0～6A	0～60A	0～1A	0～10A	0～12A	0～120A	0～2A	0～20A
Slew Rate	1～25mA/μs	0.01～2.5A/μs	0.16～40mA/μs	1.6～400mA/μs	2～50mA/μs	0.02～5A/μs	0.32～80mA/μs	3.2～800mA/μs
	0.001A/μs	0.01A/μs	0.16mA/μs	1.6mA/μs	0.002A/μs	0.02A/μs	0.32mA/μs	3.2mA/μs
Accuracy	(1±35%)×setting value							
Measurement								
Voltage Measurement								
Range	0～16V	0～80V	0～50V	0～500V	0～16V	0～80V	0～50V	0～500V
Resolution	0.3mV	2mV	1mV	10mV	0.3mV	2mV	1mV	10mV
Accuracy	0.05%+0.1%F.S.		0.05%+0.1%F.S.		0.05%+0.1%F.S.		0.05%+0.1%F.S.	
Current Measurement								
Range	0～6A	0～60A	0～1A	0～10A	0～12A	0～120A	0～2A	0～20A
Resolution	0.1mA	1mA	0.02mA	0. 2mA	0.2mA	2mA	0.04mA	0. 4mA
Accuracy	0.05%+0.1%F.S.		0.05%+0.1%F.S.		0.05%+0.1%F.S.		0.05%+0.1%F.S.	
Power Measurement								
Range	0～300W		0～300W		0～600W		0～600W	
Resolution	5mW		5mW		10mW		10mW	
Accuracy	1%+0.5%F.S.		1%+0.5%F.S.		1%+0.5%F.S.		1%+0.5%F.S.	
Short Circuit Feature								
Current(CC)	≒6A	≒60A	≒1A	≒10A	≒12A	≒120A	≒2A	≒20A
Voltage(CV)	0V		0V		0V		0V	
Other Features								
Temperature Drift	100ppm/℃(typical value)		100ppm/℃(typical value)		100ppm/℃(typical value)		100ppm/℃(typical value)	
Weight	2.7Kg		2.7Kg		5.5Kg		5.5Kg	

NOTE *1：If the operation voltage is 1.1 times of the full range, the load will be damaged .

NOTE *2： Vin >6V is required for nominal accuracy.

NOTE *3：When CR mode，if I < 0.5%F.S., accuracy will not be specified.