

**Multi-channel Programmable
DC Power Supply
Operation Manual**

Contents

SAFETY INSTRUCTION	II
1. OVERVIEW	- 1 -
1.1 Operation and Storage Environment.....	- 1 -
1.2 Introduction	- 1 -
1.3 Series Lineup/Main Features.....	- 2 -
1.4 Principle of Operation.....	- 3 -
1.5 Front Panel Overview.....	- 4 -
1.6 Rear Panel Overview	- 7 -
1.7 CV/CC Crossover Characteristics	- 8 -
2. SETUP	- 9 -
2.1 Power Up	- 9 -
2.2 Load Cable Connection	- 9 -
2.3 Output ON/OFF.....	- 10 -
2.4 Beep ON/OFF.....	- 10 -
2.5 Front Panel Lock	- 10 -
3. OPERATION	- 11 -
3.1 CH1/CH2 Independent Mode.....	- 11 -
3.2 CH3 Independent Mode	- 11 -
3.3 CH1/CH2 Tracking Series Mode.....	- 12 -
3.4 CH1/CH2 Tracking Parallel Mode	- 15 -
4. SAVE/RECALL SETUP	- 17 -
4.1 Save Setup	- 17 -
4.2 Recall Setup.....	- 17 -
5. REMOTE CONTROL (Only for models with USB interface).....	- 18 -
5.1 Remote Control Setup	- 18 -
5.2 Remote Connection Step	- 18 -
5.3 Command Syntax.....	- 19 -
5.4 Error Messages	- 19 -
5.5 Command List.....	- 19 -
5.6 Command Details.....	- 20 -
6. MAINTENANCE.....	- 23 -
6.1 Inspection	- 23 -
6.2 Fuse Replacement	- 23 -
6.3 Cleaning.....	- 23 -
7. FAQ.....	- 24 -
SPECIFICATIONS for 1mV, 1mA models.....	- 24 -
SPECIFICATIONS for 10mV, 10mA models.....	- 25 -
SPECIFICATIONS for 100mV, 10mA models.....	- 27 -

Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

Calibration notification

We notify that the instruments included in this manual are in compliance with the features and specifications as stated in this manual. Before shipment, the instrument has been calibrated in factory. The calibration procedures and standards are compliant to the national regulations and standards for electronic calibration.

Warranty

We guarantee that the instrument has been passed strict quality check. We warrant our instrument's mainframe and accessories in materials within the warranty period of one year. We guarantee the free spare parts for products which are approved defective in this period. To get repair service, please contact with your nearest sales and service office. We do not provide any other warranty items except the one being provided by this summary and the warranty statement. The warranty items include but not being subjected to the hinted guarantee items related to tradable characteristics and any particular purpose. We will not take any responsibility in cases regarding to indirect, particular and ensuing damage, such as modifications to the circuit and functions by the users, repairing or component replacement by the users, or damage during transportation.

For product improvement, the specifications are subject to change without prior notice.

SAFETY INSTRUCTION

This chapter contains important safety instructions that you must follow when operating the instrument and when keeping it in storage. Read the following before any operation to insure your safety and to keep the best condition for the instrument.

Safety Symbols

The following safety symbols may appear in this manual or on the instrument:



WARNING

WARNING

Identifies conditions or practices that could result in injury or loss of life.



CAUTION

CAUTION

Identifies conditions or practices that could result in damage to the instrument or to other properties.



DANGER

High voltage



ATTENTION

Refer to the manual



Protective conductor terminal



Earth (ground) terminal

Safety Guidelines



CAUTION

- Before plugging into local AC mains, check and make sure that the output voltage is compatible to the load. (It is suggested to disconnect a load before plugging into local AC mains.
- Do not use this instrument near water.
- Do not operate or touch this instrument with wet hands.
- Do not open the casing of the instrument when it is connected to AC mains.
- The max.output voltage of the instrument may be over 60VDC, avoid touch the metal contact part of the output terminals.
- Do not use the instrument in an atmosphere which contains sulfuric acid mist or other substances which cause corrosion to metal.
- Do not use the instrument in a dusty place or a highly humid place as such will cause instrument reliability degradation and instrument failures.
- Install the instrument in a place where is free from vibration.
- Install the instrument in a place where the ambient temperature is in range of -10~70°C. Note that the instrument operation may become unstable if it is operated in an ambient temperature exceeding the range of 0~40°C

Power supply



WARNING

AC Input voltage: 110V/220V $\pm 10\%$, 50/60Hz

Connect the protective grounding conductor of the AC power cord to an earth ground to avoid electrical shock.

Fuse



WARNING

- Fuse type: 110V: T6.3A /250V, 220V: T3.15A/250V.
- Make sure the correct type of fuse is installed before power up.
- Replace the AC fuse with the same type and rating as the original fuse.
- Disconnect the power cord before fuse replacement.
- Make sure the cause of fuse blowout is fixed before fuse replacement.

Power cord for the United Kingdom

When using the power supply series in the United Kingdom, make sure the power cord meets the following safety instructions.

NOTE: This lead/appliance must only be wired by competent persons.




WARNING: THIS APPLIANCE MUST BE EARTHED.

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

Green/Yellow:	Earth
Blue:	Neutral
Brown:	Live



As the colours of the wires in main leads may not correspond with the colours marking identified in your plug/appliance, proceed as follows:

- The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol  or coloured Green or Green & Yellow.
- The wire which is coloured Blue must be connected to the terminal marked with the letter N or coloured Blue or Black.
- The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse: refer to the rating information on the equipment and/or user instructions for details. As a guide, cable of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal/replacement must be destroyed by removal of any fuse & fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if engaged in live socket. Any re-wiring must be carried out in accordance with information detailed on this label.

1. OVERVIEW

This chapter describes the instrument in a nutshell, including its main features and front /rear panel introduction. After going through the overview, follow the SETUP chapter to properly power up and set operation environment.

1.1 Operation and Storage Environment

Operation Environment

Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution (note below)

Relative Humidity: < 80%

Altitude: < 2000m

Temperature: 0°C to 40°C

(Pollution Degree) EN 61010-1:2001 specifies the pollution degrees and their requirements as follows. The instrument falls under degree 2.

Pollution refers to “addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity”.

Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

Pollution degree 3: Conductive pollution occurs, or dry, nonconductive pollution occurs which becomes conductive due to condensation which is expected. In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

Storage Environment

Location: Indoor

Relative Humidity: < 70%

Temperature: -10°C to 70°C

1.2 Introduction

This series of regulated programmable DC power supply are light weight, adjustable, multifunctional work stations. They have three independent outputs: two with adjustable voltage level and one with fixed level selectable from 2.5V, 3.3V and 5V. The power supply can be used for logic circuits where various output voltage or current are needed, and for tracking mode definition systems where positive and negative voltages with good accuracy are required.

Independent /Tracking Series /Tracking Parallel

The three output modes of the power supply - independent, tracking series, and tracking parallel - can be selected by pressing the TRACKING key on the front panel. In the independent mode, the output voltage and current of each channel are controlled separately. The isolation degree, from output terminal to chassis or from output terminal to output terminal, is 300V. In the tracking modes, both the CH1 and CH2 outputs are automatically connected in series or parallel; no need to connect output leads. In the series mode, the output voltage is doubled; in the parallel mode, the output current is doubled.

Constant Voltage/Constant Current

Except for CH3, each output channel is completely transistorized and well-regulated, and works in constant voltage (CV) or constant current (CC) mode. Even at the maximum output current, a fully rated, continuously adjustable output voltage is provided. For a big load, the power supply can be used as a CV source; while for a small load, a CC source.

When in the CV mode (independent or tracking mode), output current (overload or short circuit) can be controlled via the front panel. When in the CC mode (independent mode only), the maximum (ceiling) output voltage can be controlled via the front panel. The power supply will automatically cross over from CV to CC operation when the output current reaches the target value. The power supply will automatically cross over from CC to CV when the output voltage reaches the target value. For more details about CV/CC mode operation, see page8.

Automatic Tracking Mode

The front panel display (CH1, CH2) shows the output voltage or current. When operating in the tracking mode, the power supply will automatically connect to the auto- tracking mode.

Dynamic Load

When used in audio production lines, the power supply will provide a continuous or dynamic load connector. When the connectors are connected to the position “ON”, a stable DC current power will be provided for audio power amplifiers.

1.3 Series Lineup/Main Features

Series Lineup

Model		Output	Voltmeter	Ammeter	USB Interface
1mV, 1mA model		0~30V×2, 0~3A×2 Fixed 2.5V/3.3V/5V, 3A	5 digits LED	4 digits LED	√
10mV, 10mA model	A	0~30V×2, 0~3A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	_____
	B	0~30V×2, 0~5A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	_____
100mV, 10mA model	C	0~30V×2, 0~3A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	√
	D	0~30V×2, 0~5A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	√
	E	0~30V×2, 0~3A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	_____
	F	0~30V×2, 0~5A×2 Fixed 2.5V/3.3V/5V, 3A	3 digits LED	3 digits LED	_____

Main Features

Performance	➤	Low ripple & noise, intelligent cooling fan
	➤	Compact design, light weight
Operation	➤	Constant voltage/constant current operation
	➤	Tracking series/tracking parallel operation
	➤	Output ON/OFF control
	➤	3 outputs: 30V/3A(5A)×2, 2.5V/3.3V/5V/3A×1
	➤	Digital panel control
	➤	Panel lock function

	<ul style="list-style-type: none"> ➤ 4 programming presets for voltage and current save/recall ➤ Coarse and fine control for voltage and current ➤ Software calibration ➤ Beeper output
Protection	<ul style="list-style-type: none"> ➤ Over load protection ➤ Reverse polarity protection
Interface	<ul style="list-style-type: none"> ➤ USB interface for remote PC control (only for models with USB interface)

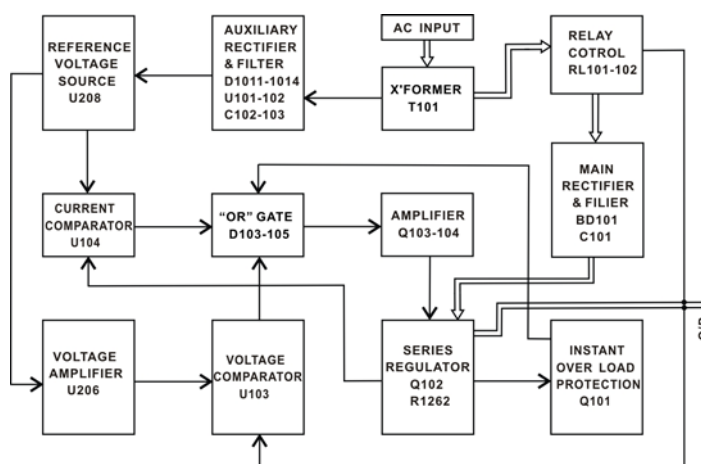
1.4 Principle of Operation

The power supply consists of the following:

- AC input circuit
- Transformer
- Bias power supply including rectifier, filter, pre-regulator and reference voltage source
- Main regulator circuit including the main rectifier and filter, series regulator, current comparator, voltage comparator, reference voltage amplifier, remote device and relay control circuit

The block diagram below shows the circuit arrangement. The single phase input power is connected to the transformer through the input circuit. Details of each part are described as below.

Overview



Rectifier	The auxiliary rectifiers D1011~D1014 provide bias voltage filtered by the capacitors C102 and C103, for the pre-regulators U101 and U102. They provide a regulated voltage for other modules.
Main rectifier	The main rectifier is a full wave bridge rectifier. It provides the power after the rectifier is filtered by the capacitor C101, and then regulated via a series-wound regulator, which is finally delivered to the output terminal.
Current limiter	U104 acts as a current limiter. When the current is over predetermined rating, U104 is activated and decreases the current. U208 provides a reference voltage. U206 is the inverter amplifier. U103 is a comparator amplifier which compares reference voltage and feedback voltage, and then delivers to Q103, Q104, which then calibrates the output voltage.

Overload When the unit is overload, Q107 activates to control the current magnitude of Q104, to limit the output current. The relay control circuit controls the power dissipation in the series-wound regulated circuit.

1.5 Front Panel Overview

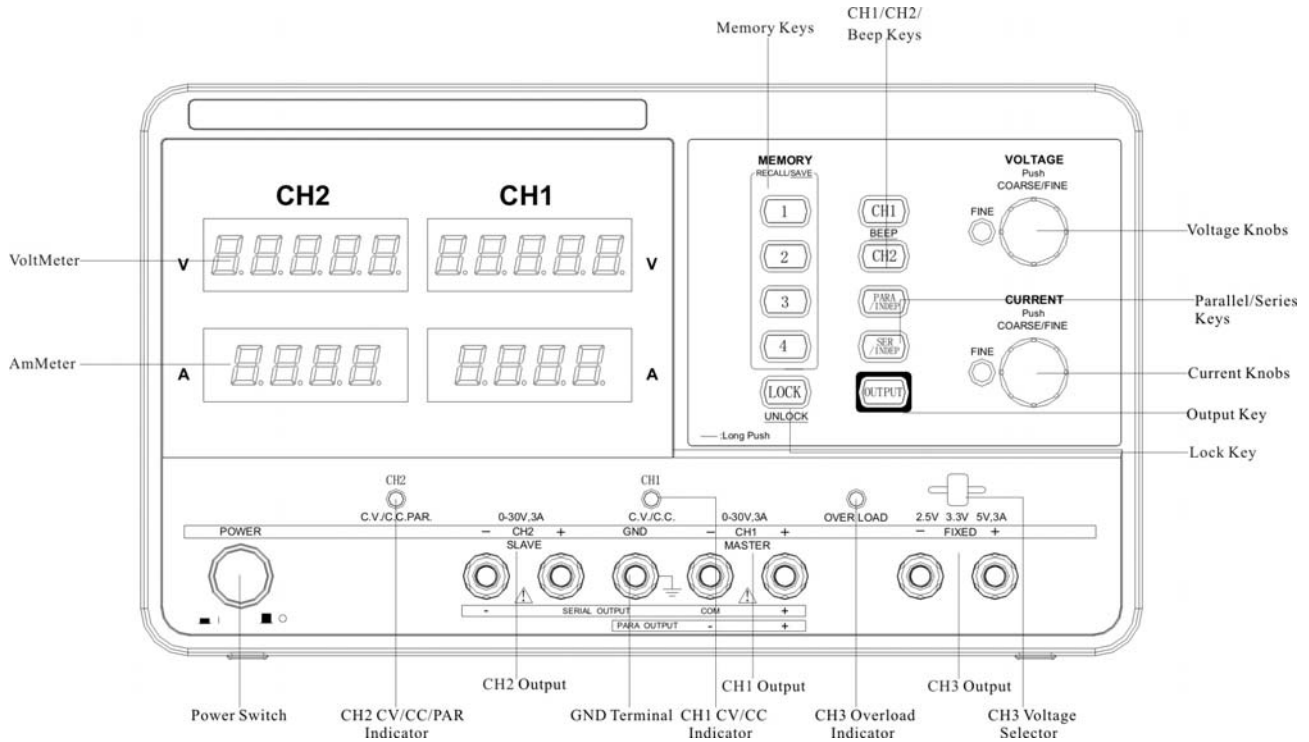


Fig.1.5-1 Front panel of 1mV, 1mA models

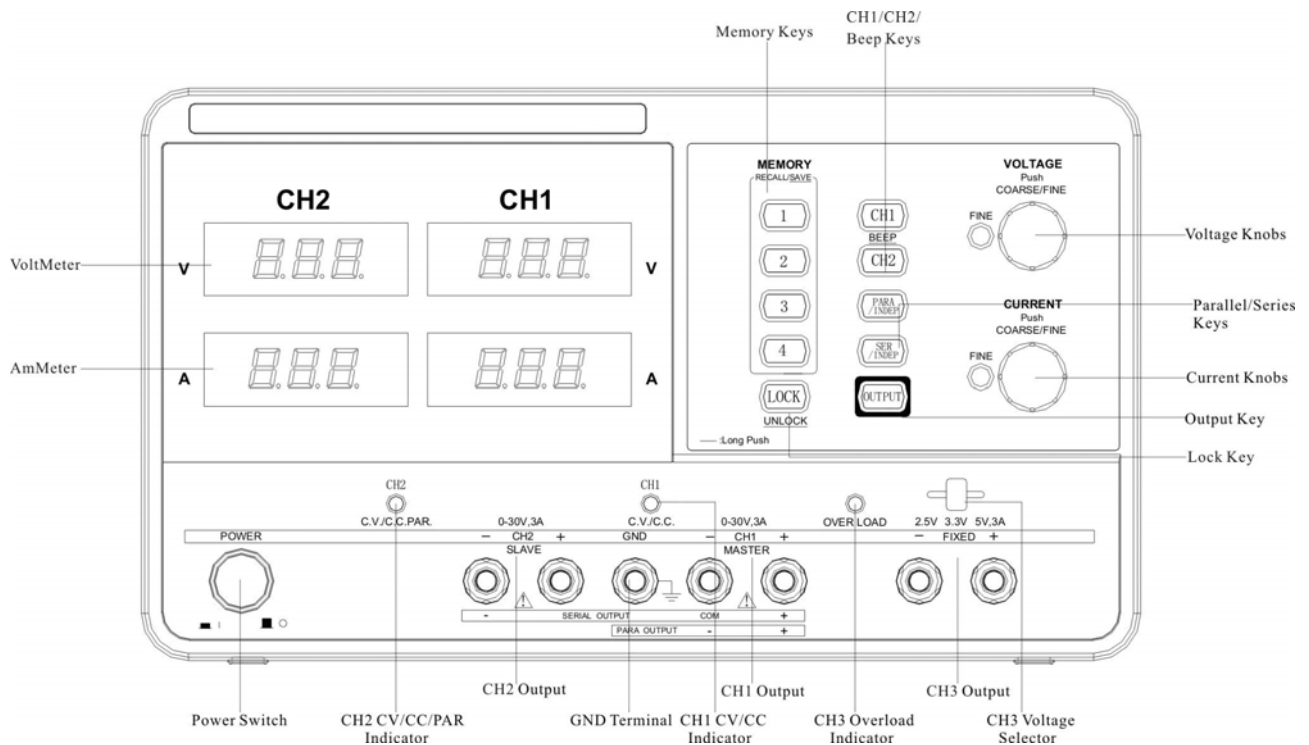
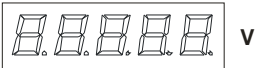
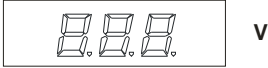

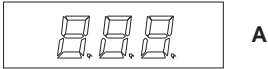














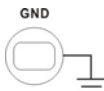









Fig.1.5-2 Front panel of 10mV, 10mA models and 100mV, 10mA models

Display		
Voltmeter	Displays CH1 or CH2 output voltage	
		
	For 1mV, 1mA models (5 digits)	For 10mV, 10mA /100mV, 10mA models (3 digits)
Ammeter	Display CH1 or CH2 output current	
		
	For 1mV, 1mA models (4 digits)	For 10mV, 10mA /100mV, 10mA models (3 digits)
Control Panel		
Memory keys		Saves or recalls panel settings. Max.4 sets for programming preset. Refer to page 17 for details.
CH1/CH2 beep keys	 	<p>Selects the output channel for level adjustment. Refer to page 11 for level setting details</p> <p>Pressing and holding CH2 key enables beep sound. Refer to page 10 for details.</p>
Parallel/Series keys	 	Activates Tracking Parallel operation or Tracking Series operation. Refer to page 12 for details.
Lock key		Locks or unlocks the front panel settings. Refer to page 10 for details.
Output key		Turns the output on or off.
VOLTAGE		
Voltage knobs	 	Adjusts the output voltage level for CH1 or CH2. Pressing the knob switches for coarse and fine level setting. When in fine adjustment, the FINE indicator lights on.
CURRENT		
Current knobs	 	Adjusts the output current level for CH1 or CH2. Pressing the knob switches coarse and fine level setting. When in fine adjustment, the FINE indicator lights on.

Terminals		
Power switch		Turns on  or off  the main power. Refer to page 9 for power up sequence.
GND terminal		Accepts a grounding wire.
CH1 output		Outputs CH1 voltage and current.
CH1 CV/CC indicator		Indicates CH1 constant voltage or constant current operation mode.
CH2 output		Outputs CH2 voltage and current.
CH2 CV/CC/ PAR indicator		Indicates CH2 constant voltage, constant current or tracking parallel operation mode.
CH3 output		Outputs CH3 voltage and current.
CH3 overload indicator		Indicates when CH3 output current is overloaded.
CH3 voltage selector		Selects CH3 output voltage from 2.5V, 3.3V, 5V.

1.6 Rear Panel Overview

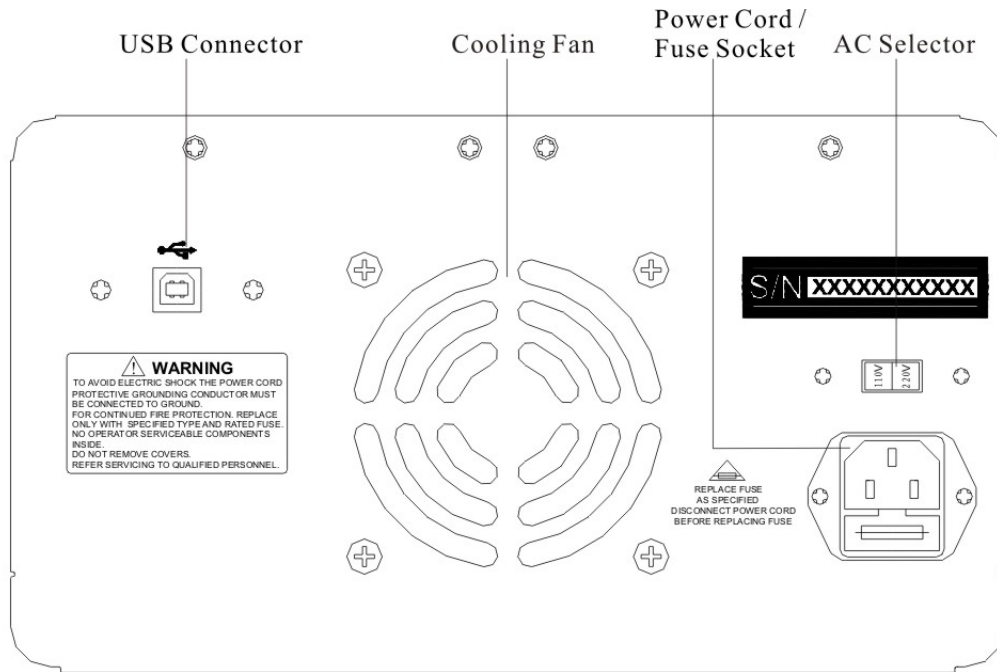


Fig.1.6-1 Rear panel of models with USB interface

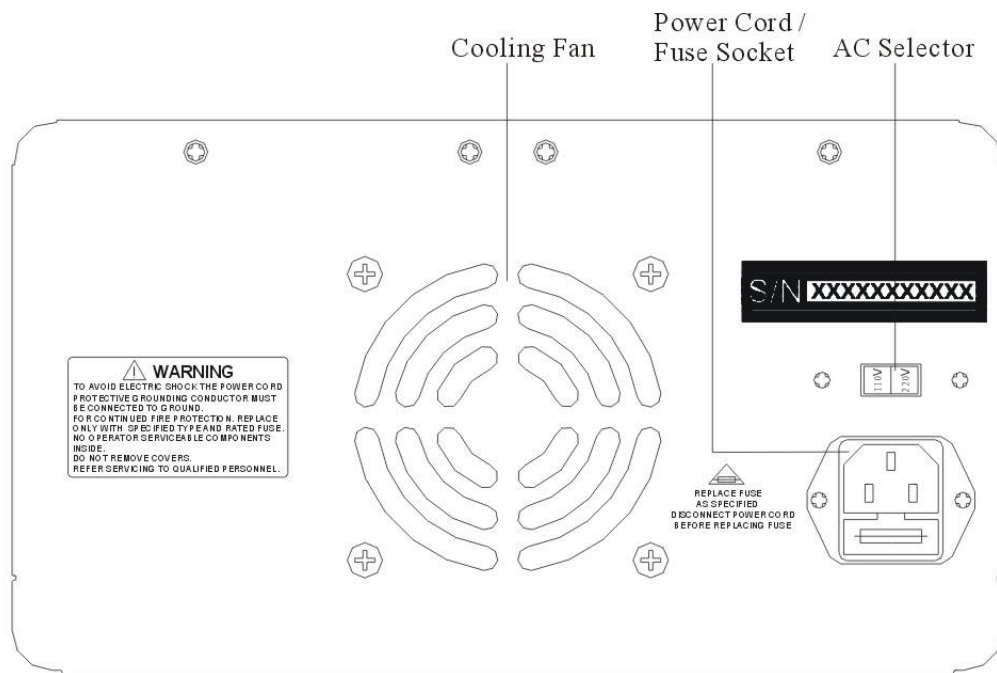





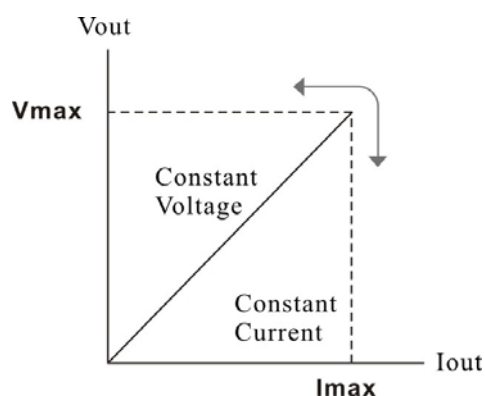
Fig.1.6-2 Rear panel of models without USB interface

USB connector		Accepts a USB slave connector for command-based remote control (page 18). For models with USB interface.
Power cord/fuse socket		The power cord socket accepts the AC mains. Refer to page 9 for power up details. The fuse holder contains the AC main fuse. Refer to page 23 for details of fuse replacement.
AC line voltage selector		Selects AC line voltage from 110V/220V.

1.7 CV/CC Crossover Characteristics

Background	The instrument automatically switches between constant voltage mode (CV) and constant current mode (CC), according to load condition.
CV mode	When the current level is smaller than the output setting, the instrument operates in Constant Voltage mode. The indicator on the front panel turns green (C.V.) The Voltage level is kept at the setting and the Current level fluctuates according to the load condition until it reaches the output current setting.
CC mode	When the current level reaches the output setting, the instrument starts operating in Constant Current mode. The indicator on the front panel turns red (C.C.) The Current level is kept at the setting but the Voltage level becomes lower than the setting, in order to suppress the output power level from overload. When the current level becomes lower than the setting, the instrument goes back to the Constant Voltage mode.

Diagram

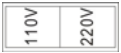


2. SETUP

This chapter describes how to properly power up and configure the power supply series before operation.

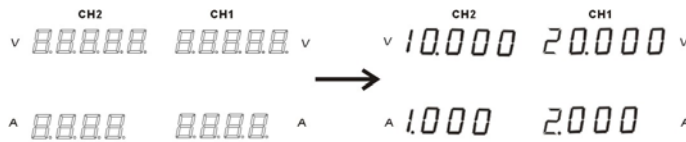
2.1 Power Up

Select AC line Before powering up the power supply, select the AC input voltage from the rear panel. voltage



Connect AC power cord Connect the AC power cord to the rear panel socket.

Power on Press the power switch to turn on the power. The display shows the initialization screen, followed by the last recalled settings.

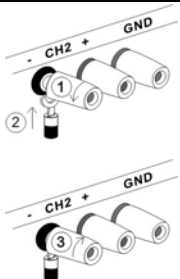


Power off Press the power switch again to turn off the power.

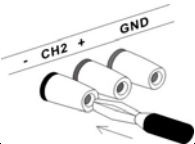


2.2 Load Cable Connection

Standard accessory 1. Turn the terminal counterclockwise and loosen the screw.
2. Insert the cable terminal.
3. Turn the terminal clockwise and tighten the screw.



Banana plug Insert the plug into the socket.



Wire type When using load cables other than the attached, make sure they have enough current capacity for minimizing cable loss and load line impedance. Voltage drop across a wire should not exceed 0.5V. The following list is the wire current rating at 450A/cm².

Wire size (AWG)	Max. current (A)
20	2.5
18	4
16	6
14	10
12	16

2.3 Output ON/OFF

Panel operation

Pressing the Output key turns on all CH 1/2/3 outputs.



The key LED also turns on. Pressing the Output key again turns off the output and the key LED.

Automatic output off

Any of the following actions during output on automatically turns it off. They might involve sudden and harmful change in the output level.

- Change the operation mode between independent / tracking series / tracking parallel
- Recalling other setups from the memory
- Storing the setup into the memory

2.4 Beep ON/OFF

Panel operation

By default, the beeper sound is enabled. To turn off the beep, press the beep key for 2 seconds.



A beep sound comes out and the beeper setting will be turned off. To enable the beeper, press the beep key again for 2 seconds.

List of beeper

The following operations go with a beep sound when the beeper setting is on.

Power on

Output on/off

INDEP – SER – PAR mode switching

Panel lock/unlock

Setup save/recall

CH1/CH2 output level knob

Voltage/current knob, fine/coarse knob

Voltage/current level reaching minimum (zero) level

2.5 Front Panel Lock

Panel operation

Press the LOCK key to lock the front panel key operation. The key LED turns on. To unlock, press the LOCK key for 2 seconds. The key LED also turns off.



Note

The OUTPUT key is not affected by the lock operation.

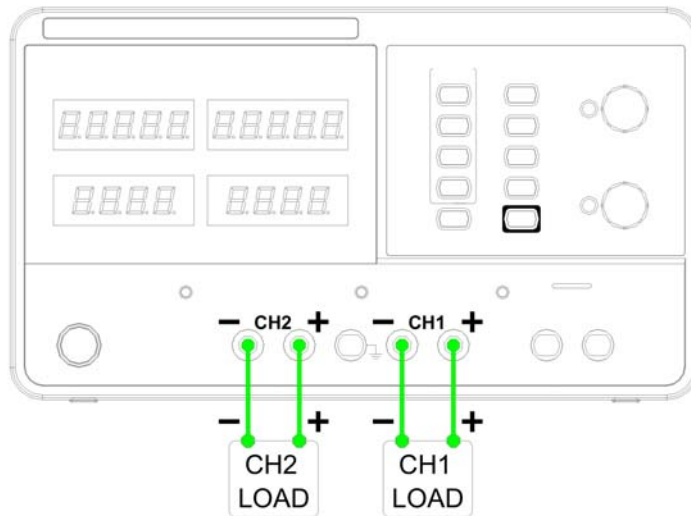


3. OPERATION

3.1 CH1/CH2 Independent Mode

Background/ CH1 and CH2 outputs work independent of each other and are separately controlled.

Connection



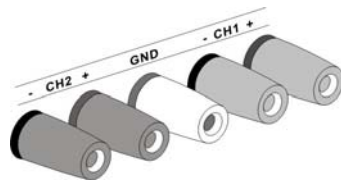
Output rating 0~30V/0~3A for each channel ($I \leq 3A$)

0~30V/0~5A for each channel ($I > 3A$)

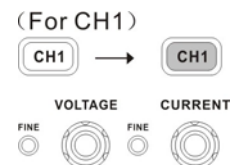
Panel operation 1. Make sure the PARA INDEP and SERIES INDEP keys are turned off (the key LEDs are off)



2. Connect the load to the front panel terminals, CH1 +/-, CH2 +/-.



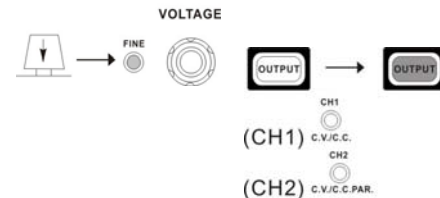
3. Set the CH1 output voltage and current. Press the CH1 switch (LED turns on) and use the Voltage and Current knob. By default, the Voltage and Current knob work in the coarse mode. To activate the fine mode, press the knob and turn on the FINE LED.



(Fine control)

Coarse: 0.1V or 0.1A @ rotation click.

Fine: the smallest digit @ rotation click.



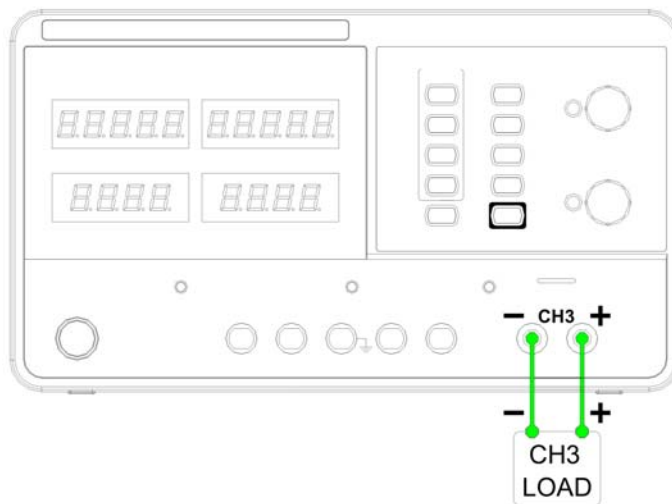
4. Repeat the above settings for CH2 channel.

5. To turn on the output, press the output key. The key LED turns on and the CH1 /CH2 indicator shows the output mode, CV or CC.

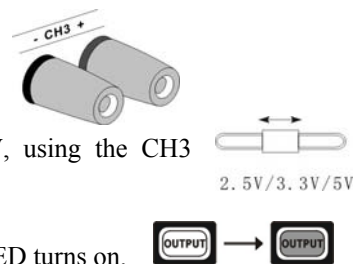
3.2 CH3 Independent Mode

Background/ The CH3 rating is 2.5V/3.3V/5V, maximum 3A. It works independently from CH1 and CH2, regardless of their modes.

Connection



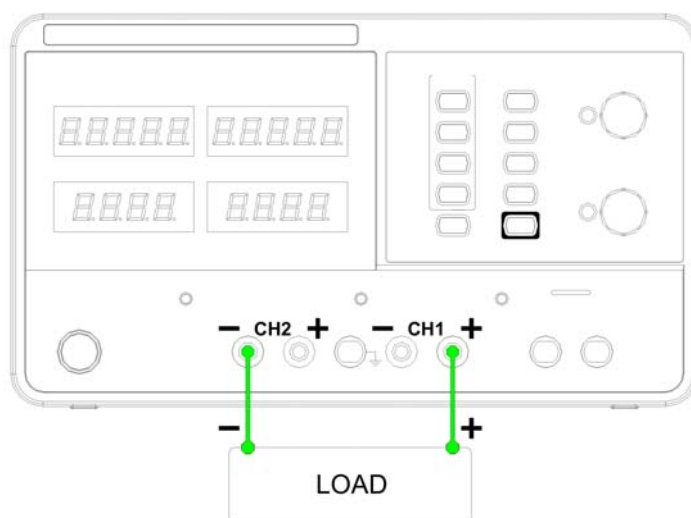
Output rating	Fixed 2.5V/3.3V/5V, 3A
No tracking Series/Parallel mode	CH3 does not have tracking series/parallel mode. Also, CH3 output is not affected by CH1 and 2 modes.
Panel operation	<ol style="list-style-type: none"> 1. Connect the load to the front panel CH3 +/- terminal. 2. Select the output voltage from 2.5V, 3.3V and 5V, using the CH3 voltage selector switch. 3. To turn on the output, press the output key. The key LED turns on.
CV to CC	<p>When the output Current level exceeds 3A, the overload indicator turns red and CH3 operation mode switches from Constant Voltage to Constant Current.</p> <p>Note: “overload” in this case does not mean an abnormal operation.</p>



3.3 CH1/CH2 Tracking Series Mode	
Background	<p>Tracking series operation doubles the Voltage capacity of the power supply series by internally connecting CH1 (Master) and CH2 (Slave) in series and combining the output to a single channel. CH1 (Master) controls the combined Voltage output level.</p> <p>The following describes two types of configurations depending on the common ground usage.</p>

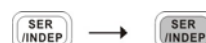
Tracking series without common terminal

Connection



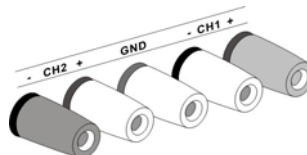
Output rating 0~60V/0~3A ($I \leq 3A$)
 0~60V/0~5A ($I > 3A$)

Panel operation 1. Press the SER/INDEP key to activate the tracking series mode.

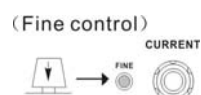


The key LED turns on.

2. Connect the load to the front panel terminals, CH1+ & CH2-. (Single supply).



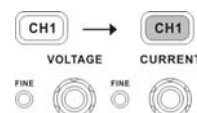
3. Press the CH2 switch (LED turns on) and use the Current knob to set the CH2 output current to the maximum level. By default, the Voltage and Current knob work in the coarse mode. To activate the fine mode, press the knob and turn on the FINE LED.



Coarse: 0.1V or 0.1A @ rotation click.

Fine: the smallest digit @ rotation click.

4. Press the CH1 switch (LED turns on) and use the Voltage and Current knob to set the output voltage and current level.



5. To turn on the output, press the output key. The key LED turns on.



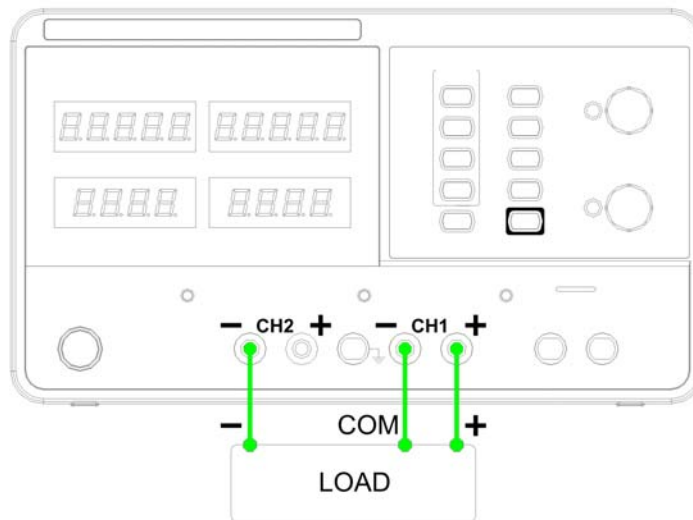
6. Refer to the CH1 (Master) meter and indicator for the output setting level and CV/CC status.



Voltage level	Double the reading on the CH1 Voltage meter. In the above case, the actual output is $20.0 \times 2 = 40.0V$.
Current level	CH1 meter reading shows the output Current. In the above case, 2.000A. (CH2 Current control must be in the Maximum position= $3.0A(I \leq 3A)$ or $5.0A(I > 3A)$).

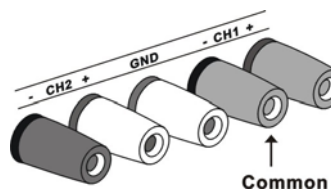
Tracking series with common terminal

Connection



Output rating	0~30V/0~3A for CH1~COM ($I \leq 3A$)	0~30V/0~5A for CH1~COM ($I > 3A$)
	0~30V/0~3A for CH2~COM ($I \leq 3A$)	0~30V/0~5A for CH2~COM ($I > 3A$)

- Panel operation
- Press the SER/INDEP key to activate the tracking series mode. The key LED turns on.
 - Connect the load to the front panel terminals, CH1+ & CH2-. Use the CH1 (-) terminal as the common line connection.



- Press the CH1 switch (LED turns on) and use the Voltage knob to set the master & slave output voltage (the same level for both channels). By default, the Voltage and Current knob work in the coarse mode. To activate the fine mode, press the knob and turn on the FINE LED.

Coarse: 0.1V or 0.1A @ rotation click.

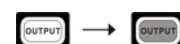
Fine: the smallest digit @ rotation click.



- Use the current knob to set the master output current.



- To turn on the output, press the output key. The key LED turns on.



6. For the master (CH1) output level and CV/CC status, refer to the CH1 meter and indicator.



Master (CH1) voltage level: CH1 meter reading shows the output voltage. In the above case, 20.0V.

Master (CH1) current level: CH1 meter reading shows the output current. In the above case, 2.000A.

7. Press the CH2 switch (LED turns on) and use the Current knob to set the slave output current.



8. For the slave (CH2) output level and CV/CC status, refer to the CH1/2 meter and CH2 indicator.

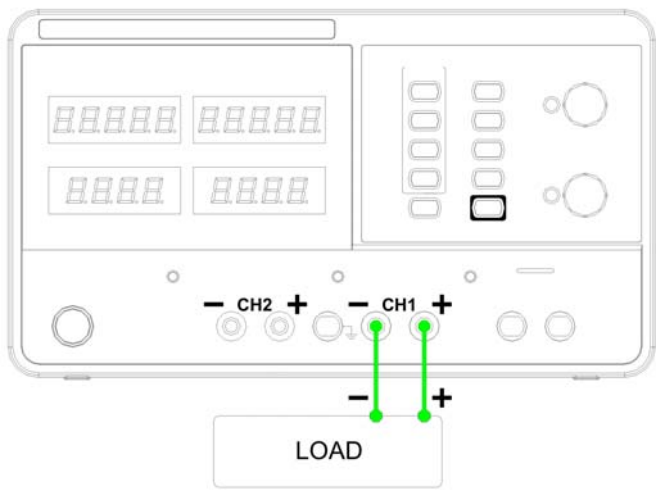


Slave (CH2) voltage level: CH1 meter reading shows the output voltage. In the above case, 20.0V.

Slave (CH2) current level: CH2 meter reading shows the output current. In the above case, 3.000A.

3.4 CH1/CH2 Tracking Parallel Mode

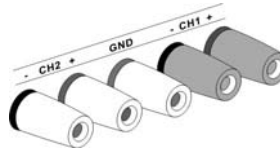
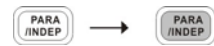
Background/ connection Tracking parallel operation doubles the current capacity of the power supply series by internally connecting CH1 and CH2 in parallel and combining the output to a single channel. CH1 controls the combined output.



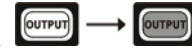
Output rating 0~30V/0~6A (I≤3A)
 0~30V/0~10A (I>3A)

Panel operation

1. Press the PAR/INDEP key to activate the tracking parallel mode.
The key LED turns on.
2. Connect the load to the CH1 +/- terminals.



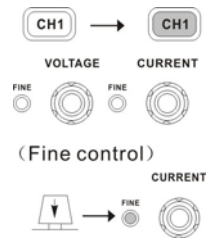
3. To turn on the output, press the output key. The key LED turns on.



4. The CH2 indicator turns red, indicating tracking parallel (PAR) mode.



5. Press the CH1 switch (LED turns on) and use the Voltage and Current knob to set the output voltage and current. The CH2 output control is disabled. By default, the Voltage and Current knob work in the coarse mode. To activate the fine mode, press the knob and turn on the FINE LED.



6. For the output level and CV/CC status, refer to the CH1 meter and indicator.



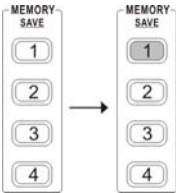
Voltage level: The CH1 meter reading shows the output voltage. In the above case, 20.0V.

Current level: Double the amount of CH1 current meter reading. In the above case,

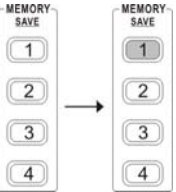
$$2.0A \times 2 = 4.0A.$$

4. SAVE/RECALL SETUP

4.1 Save Setup

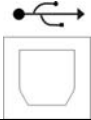
Background	The front panel settings can be stored into one of the four internal memories.
Programming contents	<p>The following list shows the programming setting contents:</p> <ul style="list-style-type: none">➤ Independent / tracking series / tracking parallel mode➤ CH1/CH2 knob selection➤ Fine/coarse knob editing mode➤ Beep on/off➤ Output voltage/current level <p>The following settings are always saved as “off”:</p> <ul style="list-style-type: none">➤ Output on/off➤ Front panel lock on/off
Panel operation	<p>Press one of the 1~4 Memory keys for 2 seconds, for example memory 1. The panel settings will be saved in memory 1 by long push to this key and the key LED turns on. When the panel settings are modified, the LED turns off.</p> 
Note	When the setting is stored, the output automatically turns off.

4.2 Recall Setup


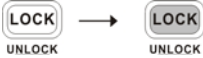


Background	The front panel settings can be recalled from one of the four internal memories.
Programming contents	<p>The following list shows the programming setting contents:</p> <ul style="list-style-type: none">➤ Independent / tracking series / tracking parallel mode➤ CH1/CH2 knob selection➤ Fine/coarse knob editing mode➤ Beep on/off➤ Output voltage/current level <p>The following settings are always recalled as “off”:</p> <ul style="list-style-type: none">➤ Output on/off➤ Front panel lock on/off
Panel operation	<p>Press one of the 1~4 Memory keys, for example memory 1. The panel settings saved in memory 1 will be recalled by pressing this key. The key LED turns on. When the panel settings are modified, the LED turns off.</p> 
Note	When a setting is recalled, the output automatically turns off.

5. REMOTE CONTROL (Only for models with USB interface)

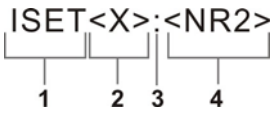
5.1 Remote Control Setup

Background	The power supply is capable of being remotely controlled via the USB connection.	
Interface		USB slave port, rear panel
COM setting	Set up the COM port inside the PC according to the following list: Baud rate: 9600 Parity bit: None Data bit: 8 Stop bit: 1 Data flow control: None	
Functionality check	Run this query command via the terminal application such as MTTTY (Multi-threaded TTY). *IDN? This should return the identification information: series number, firmware version.	

5.2 Remote Connection Step

Enter the remote control mode	<ol style="list-style-type: none">1. Connect the USB cable to the slave port.2. The connection will be automatically established, and the front panel shows “USB...YES” message. 3. The power supply also automatically enters the lock state (the Lock key will be activated). 	
Exit the remote control mode	<ol style="list-style-type: none">1. Disconnect the USB cable from the rear.2. The display shows “USB...NO” message. 3. Unlock the power supply by pressing the Lock key until it turns off backlight. 4. The power supply goes back to local operation mode.	

5.3 Command Syntax

Command format		1: command header 2: output channel 3: separator 4: parameter	
Parameter	Type	Description	Example
	<Boolean>	Boolean logic	0 (off), 1 (on)
	<NR1>	Integers	0, 1, 2, 3
	<NR2>	Decimal numbers	0.1, 3.14, 8.5
Output channel	1 (CH1) or 2 (CH2)		
Note	Commands must be capital letters		

5.4 Error Messages

The following error messages might appear when the power supply cannot accept the command.

Message contents	Descriptions
a Program mnemonic too long	The command length must be 15 characters or less.
b Invalid character	Invalid characters, such as symbols, are entered. Example: VOUT#
c Missing parameter	The parameter is missing from the command. Example: VSET: (should have a number)
d Data out of range	The entered value exceeds the specification. Example: VSET:33 (should be ≤32V)
e Command not allowed	The entered command is not allowed in the circumstance. Example: trying to set CH2 output while in the tracking mode.
f Undefined header	The entered command does not exist, or the syntax is wrong.

5.5 Command List

Detailed descriptions of each command starts from the next page.

The “HELP” command shows all the following commands and their meanings, except for the HELP command itself.

Command	Meanings
ISET<X>:<NR2>	Sets the output current
ISET<X>?	Returns the output current setting
VSET<X>:<NR2>	Sets the output voltage
VSET<X>?	Returns the output voltage setting
IOUT<X>?	Returns the actual output current
VOUT<X>?	Returns the actual output voltage
TRACK<NR1>	Selects the operation mode
BEEP<BOOLEAN>	Turn on or off the beep
OUT<BOOLEAN>	Turn on or off the output
STATUS?	Returns the MODEL status

*IDN?	Returns the MODEL identification
RCL<NR1>	Recalls a panel setting
SAVE<NR1>	Saves the panel setting
HELP?	Shows the command list
ERR?	Returns the instrument error messages

5.6 Command Details

Command	ISET<X>:<NR2>
Description	Sets the output current.
Panel operation	Refer to page 11
Response time	Min.70ms
Example	ISET1:2.234 Sets the CH1 output current to 2.234A. (for 1mV 1mA models) ISET1:2.23 Sets the CH1 output current to 2.23A. (for 100mV 10mA models C, D)

Command	ISET<X>?
Description	Returns the output current setting
Response time	Min.70ms
Example	ISET1? Returns CH1 output current setting.

Command	VSET<X>:<NR2>
Description	Sets the output voltage.
Panel operation	Refer to page 11
Response time	Min.70ms
Example	VSET1:20.345 Sets the CH1 voltage to 20.345V.(for 1mV 1mA models) VSET1:20.3 Sets the CH1 voltage to 20.3V.(for 100mV 10mA models C, D)

Command	VSET<X>?
Description	Returns the output voltage setting.
Response time	Min.70ms
Example	VSET1? Returns the CH1 voltage setting.

Command	IOUT<X>?
Description	Returns the actual output current.
Response time	Min.70ms
Example	IOUT1? Returns the CH1 output current.

Command	VOUT<X>?
Description	Returns the actual output voltage.
Response time	Min.70ms
Example	VOUT1? Returns the CH1 output voltage.

Command	TRACK<NR1>
Description	Selects the operation mode: INDEP, tracking SER, tracking PAR
Panel operation	Refer to page 12
NR1	0: Independent 1: Tracking series 2: Tracking parallel
Response time	Min.70ms
Example	TRACK0 Selects the independent mode.

Command	BEEP<Boolean>
Description	Turns on or off the beeper.
Panel operation	Refer to page 10
Response time	Min.70ms
Example	BEEP1 Turns on the beeper.

Command	OUT<Boolean>
Description	Turns on or off the output.
Panel operation	Refer to page 10
Response time	Min.70ms
Example	OUT1 Turns on the output.

Command	STATUS?
Description	Returns the MODEL status.
Response time	Min.400ms
Contents	8 bits in the following format. (Refer to table on the right.)

Bit	Item	Description
0	CH1	0=CC mode, 1=CV mode
1	CH2	0=CC mode, 1=CV mode
2, 3	Tracking	01=Independent, 11=Tracking series, 10=Tracking parallel
4	Beep	0=Off, 1=On
5	N/A	N/A
6	Output	0=Off, 1=On
7	N/A	N/A

Command	SAV<NR1>
Description	Saves the panel setting.
Panel operation	Refer to page 17
NR1	1~4: Memory 1 to 4
Responses time	Min.70ms
Example	SAV1 Stores the panel setting into memory 1.

Command	RCL<NR1>
Description	Recalls a panel setting.
Panel operation	Refer to page 17
NR1	1~4: Memory 1 to 4
Responses time	Min.70ms
Example	RCL1 Recalls the panel setting stored in memory 1.

Command	*IDN?
Description	Returns the MODEL identification
Responses time	Min.300ms
Contents	Series number, firmware version

Command	HELP?
Description	Shows the command list.
Responses time	Min.1000ms
Contents	Refer to the following table.

Command	ERR?
Description	Checks the error status of the instrument and returns the nearest error message
Responses time	Min.70ms
Contents	See page 19 for list of error messages.

Contents for Command HELP	
ISet<x>:<NR2>	Sets the value of current.
VSET<x>:<NR2>	Sets the value of voltage. X: 1=CH1, 2=CH2.
ISet<x>?	Return the value of current.
VSET<x>?	Return the value of voltage.
IOUt<x>?	Returns actual output current.
VOUt<x>?	Returns actual output voltage.
TRACK<NR1>	Sets the output of the power supply working on independent or tracking mode. NR1: 0=INDE, 1=SER, 2=PARA.
BEEP<Boolean>	Sets the BEEP state on or off.
OUT<Boolean>	Sets the output state on or off
STATUS?	Returns the power supply state.
bit0:(CH1)0=CC,1=CV	
bit1:(CH2)0=CC,1=CV	
bit23:(TRACK)01=INDEP, 11=SER,10=PAR	
bit4:(BEEP)0=OFF,1=ON	
bit6:(OUT)0=OFF,1=ON	
*IDN?	Returns instrument identification.
RCL<NR0>	Recall the setting data from the memory which previous saved.
SAV<NR0>	Saves the setting data to memory.
NR0: 1=Memory1, 2=Memory2, 3=Memory3, 4=Memory4;	
ERR? Returns instrument error messages.	

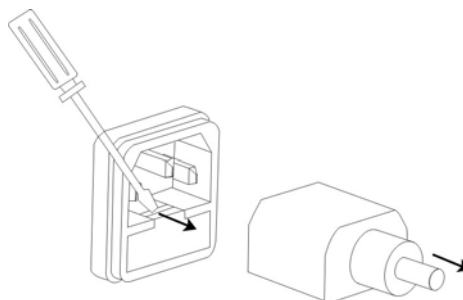
6. MAINTENANCE

6.1 Inspection

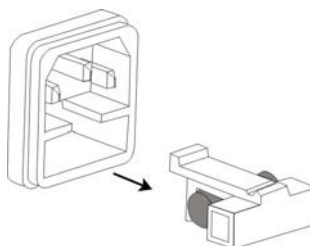
- Inspect the instrument at regular intervals so that it maintains its initial performance for a long time.
- Check the input power cord for damage of the vinyl cover and overheating of the plug and cord stopper. Check the terminal screws and binding posts for loosening.
- Remove dust from the inside of the casing and ventilation holes of the cover by using a compressed air or the exhaust air of a vacuum cleaner.

6.2 Fuse Replacement

Steps 1. Take off the power cord and remove the fuse socket using a minus driver.



2. Replace the fuse in the holder.



Fuse rating 110V: T6.3A/250V
220V: T3.15A/250V

6.3 Cleaning

- Before cleaning, disconnect the AC mains.
- To clean the power supply, use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the instrument, since it may leak into the cabinet and cause damage.
- Do not use chemicals containing benzene, toluene, xylene, acetone, or similar solvents.
- Do not use abrasive cleaners on any portion of the instrument.

7. FAQ

Q1: I pressed the panel lock key but the output still turns on/off.

A1: The output key is not affected by the panel lock key operation, for ensuring safety.

Q2: The CH3 overload indicator turned on - is this an error?

A2: No, it simply means that the CH3 output current reached the maximum 3.0A and the operation mode turned from CV (constant voltage) to CC (constant current). You can continue using the power supply, although reducing the output load is recommended.

Q3: The specifications do not match the real accuracies.

A3: Make sure that the instrument is powered on for at least 30 minutes, within ambient temperature of +20°C ~ +30°C

Q4: The internal memory is not recording the panel setting correctly - the output should be on.

A4: The output is always stored or recalled as "off" to ensure safety.

SPECIFICATIONS for 1mV, 1mA models

Output ratings

CH1/CH2 independent: 0~30V, 0~3A

CH1/CH2 series: 0~60V, 0~3A

CH1/CH2 parallel: 0~30V, 0~6A

CH3: 2.5V/3.3V/5V, 3A

Constant voltage operation

Line regulation: $\leq 0.01\% + 3\text{mV}$

Load regulation: $\leq 0.01\% + 3\text{mV}$ ($I \leq 3\text{A}$) / $\leq 0.02\% + 5\text{mV}$ ($I > 3\text{A}$)

Recovery time: $\leq 100\mu\text{s}$ (50% load change, minimum load 0.5A)

Ripple & Noise: $\leq 1\text{mV rms}$ ($I \leq 3\text{A}$) (5Hz~1MHz) / $\leq 2\text{mV rms}$ ($I > 3\text{A}$) (5Hz~1MHz)

Temp.co-efficient: $\leq 300\text{ppm}/^\circ\text{C}$

Constant current operation

Line regulation: $\leq 0.2\% + 3\text{mA}$

Load regulation: $\leq 0.2\% + 3\text{mA}$ ($I \leq 3\text{A}$) / $\leq 0.2\% + 5\text{mA}$ ($I > 3\text{A}$)

Ripple & Noise: $\leq 3\text{mA rms}$ ($I \leq 3\text{A}$) / $\leq 6\text{mA rms}$ ($I > 3\text{A}$)

Tracking parallel operation

Line regulation: $\leq 0.01\% + 3\text{mV}$

Load regulation: $\leq 0.01\% + 5\text{mV}$ ($I \leq 3\text{A}$) / $\leq 0.02\% + 10\text{mV}$ ($I > 3\text{A}$)

Tracking series operation

Line regulation: $\leq 0.01\% + 5\text{mV}$

Load regulation: $\leq 300\text{mV}$

Tracking error: $\leq 0.5\% + 10\text{mV}$ of the master (No load. With load, add load regulation $\leq 300\text{mV}$)

CH3 output

Line regulation: $\leq 25\text{mV}$

Load regulation: $\leq 25\text{mV}$

Ripple & Noise: $\leq 2\text{mV rms}$

Output voltage: 2.5V, 3.3V, 5V, $\pm 8\%$

Output current: 3A

Display

Ammeter: 3.200A full scale, 4 digits 0.4" LED display

Voltmeter: 32.000V full scale, 5 digits 0.4" LED display

Voltmeter resolution: 1mV

Ammeter resolution: 1mA

Programming accuracy: $\pm(0.03\% \text{ of reading} + 10\text{mV})$ (0~30V)
($25\pm 5^\circ\text{C}$) $\pm(0.3\% \text{ of reading} + 10\text{mA})$ ($I \leq 3\text{A}$)

Readback accuracy: $\pm(0.03\% \text{ of reading} + 10\text{mV})$ (0~30V)
($25\pm 5^\circ\text{C}$) $\pm(0.3\% \text{ of reading} + 10\text{mA})$ ($I \leq 3\text{A}$)

Protection: Over load and reverse polarity protections

Insulation: Between base and output terminal $\geq 20\text{M}\Omega/500\text{VDC}$

Between base and power cord $\geq 30\text{M}\Omega/500\text{VDC}$

Operation environment: Indoor use

Altitude: $\leq 2000\text{m}$

Ambient temperature: $0\sim 40^\circ\text{C}$

Relative humidity: $\leq 80\%$

Installation category: II

Pollution degree: 2

Storage environment: Ambient temperature: $-10\sim 70^\circ\text{C}$

Relative humidity: $\leq 70\%$

Power source: AC 110V/220V $\pm 10\%$, 50/60Hz

Accessories: User manual $\times 1$, power cord $\times 1$, USB cable, USB interface software CD

Dimensions: 310(D)*250(W)*150(H)mm

Weight: 7.5kg

SPECIFICATIONS for 10mV, 10mA models

Output ratings

CH1/CH2 independent: 0~30V, 0~3A ($I \leq 3\text{A}$) / 0~30V, 0~5A ($I > 3\text{A}$)

CH1/CH2 series: 0~60V, 0~3A ($I \leq 3\text{A}$) / 0~60V, 0~5A ($I > 3\text{A}$)

CH1/CH2 parallel: 0~30V, 0~6A ($I \leq 3\text{A}$) / 0~30V, 0~10A ($I > 3\text{A}$)

CH3: 2.5V/3.3V/5V, 3A

Constant voltage operation

Line regulation: $\leq 0.01\% + 3\text{mV}$

Load regulation: $\leq 0.01\% + 3\text{mV}$ ($I \leq 3\text{A}$) / $\leq 0.02\% + 5\text{mV}$ ($I > 3\text{A}$)

Recovery time: $\leq 100\mu\text{s}$ (50% load change, minimum load 0.5A)

Ripple & Noise: $\leq 1\text{mV rms}$ ($I \leq 3\text{A}$) (5Hz~1MHz) / $\leq 2\text{mV rms}$ ($I > 3\text{A}$) (5Hz~1MHz)

Temp.co-efficient: $\leq 300\text{ppm}/^\circ\text{C}$

Constant current operation

Line regulation: $\leq 0.2\% + 3\text{mA}$

Load regulation: $\leq 0.2\% + 3\text{mA}$ ($I \leq 3\text{A}$) / $\leq 0.2\% + 5\text{mA}$ ($I > 3\text{A}$)

Ripple & Noise: $\leq 3\text{mA rms}$ ($I \leq 3\text{A}$) / $\leq 6\text{mA rms}$ ($I > 3\text{A}$)

Tracking parallel operation

Line regulation: $\leq 0.01\% + 3\text{mV}$

Load regulation: $\leq 0.01\% + 5\text{mV}$ ($I \leq 3\text{A}$) / $\leq 0.02\% + 10\text{mV}$ ($I > 3\text{A}$)

Tracking series operation

Line regulation: $\leq 0.01\% + 5\text{mV}$

Load regulation: $\leq 300\text{mV}$

Tracking error: $\leq 0.5\% + 50\text{mV}$ of the master (No load. With load, add load regulation $\leq 300\text{mV}$)

CH3 output

Line regulation: $\leq 25\text{mV}$

Load regulation: $\leq 25\text{mV}$

Ripple & Noise: $\leq 2\text{mV rms}$

Output voltage: 2.5V, 3.3V, 5V, $\pm 8\%$

Output current: 3A

Display

Ammeter: 3.20A full scale, 3 digits 0.5" LED display ($I \leq 3\text{A}$)

5.10A full scale, 3 digits 0.5" LED display ($I > 3\text{A}$)

Voltmeter: 32.0V full scale, 3 digits 0.5" LED display

Voltmeter resolution: 10mV(0~9.99V), 100mV(10~30V)

Ammeter resolution: 10mA

Programming accuracy: $\pm(0.2\%$ of reading + 3digits) (0~9.99V)

($25 \pm 5^\circ\text{C}$) $\pm(0.5\%$ of reading + 2digits) (10~30V)

$\pm(0.5\%$ of reading + 2digits) ($I \leq 3\text{A}$)

$\pm(0.5\%$ of reading + 5digits) ($I > 3\text{A}$)

Readback accuracy: $\pm(0.2\%$ of reading + 3digits) (0~9.99V)

($25 \pm 5^\circ\text{C}$) $\pm(0.5\%$ of reading + 2digits) (10~30V)

$\pm(0.5\%$ of reading + 3digits) ($I \leq 3\text{A}$)

$\pm(0.5\%$ of reading + 5digits) ($I > 3\text{A}$)

Protection: Over load and reverse polarity protections

Insulation: Between base and output terminal $\geq 20\text{M}\Omega/500\text{VDC}$

Between base and power cord $\geq 30\text{M}\Omega/500\text{VDC}$

Operation environment: Indoor use

Altitude: $\leq 2000\text{m}$

Ambient temperature: 0~40 $^\circ\text{C}$

Relative humidity: $\leq 80\%$

Installation category: II

Pollution degree: 2

Storage environment: Ambient temperature: -10~70°C

Relative humidity: $\leq 70\%$

Power source: AC 110V/220V $\pm 10\%$, 50/60Hz

Accessories: User manual $\times 1$, power cord $\times 1$

Dimensions: 310(D)*250(W)*150(H)mm

Weight: 7.5kg ($I \leq 3A$) / 10kg ($I > 3A$)

SPECIFICATIONS for 100mV, 10mA models

Output ratings

CH1/CH2 independent: 0~30V, 0~3A ($I \leq 3A$) / 0~30V, 0~5A ($I > 3A$)

CH1/CH2 series: 0~60V, 0~3A ($I \leq 3A$) / 0~60V, 0~5A ($I > 3A$)

CH1/CH2 parallel: 0~30V, 0~6A ($I \leq 3A$) / 0~30V, 0~10A ($I > 3A$)

CH3: 2.5V/3.3V/5V, 3A

Constant voltage operation

Line regulation: $\leq 0.01\% + 3mV$

Load regulation: $\leq 0.01\% + 3mV$ ($I \leq 3A$) / $\leq 0.02\% + 5mV$ ($I > 3A$)

Recovery time: $\leq 100\mu s$ (50% load change, minimum load 0.5A)

Ripple & Noise: $\leq 1mV$ rms ($I \leq 3A$) (5Hz~1MHz) / $\leq 2mV$ rms ($I > 3A$) (5Hz~1MHz)

Temp.co-efficient: $\leq 300ppm/^{\circ}C$

Constant current operation

Line regulation: $\leq 0.2\% + 3mA$

Load regulation: $\leq 0.2\% + 3mA$ ($I \leq 3A$) / $\leq 0.2\% + 5mA$ ($I > 3A$)

Ripple & Noise: $\leq 3mA$ rms ($I \leq 3A$) / $\leq 6mA$ rms ($I > 3A$)

Tracking parallel operation

Line regulation: $\leq 0.01\% + 3mV$

Load regulation: $\leq 0.01\% + 5mV$ ($I \leq 3A$) / $\leq 0.02\% + 10mV$ ($I > 3A$)

Tracking series operation

Line regulation: $\leq 0.01\% + 5mV$

Load regulation: $\leq 300mV$

Tracking error: $\leq 0.5\% + 50mV$ of the master (No load. With load, add load regulation $\leq 300mV$)(for model C, D)
 $\leq 0.5\% + 100mV$ of the master (No load. With load, add load regulation $\leq 300mV$)(for model E, F)

CH3 output

Line regulation: $\leq 25mV$

Load regulation: $\leq 25mV$

Ripple & Noise: $\leq 2mV$ rms

Output voltage: 2.5V, 3.3V, 5V, $\pm 8\%$

Output current: 3A

Display

Ammeter: 3.20A full scale, 3 digits 0.5" LED display ($I \leq 3A$)

5.10A full scale, 3 digits 0.5" LED display ($I > 3A$)

Voltmeter: 32.0V full scale, 3 digits 0.5" LED display

Voltmeter resolution: 100mV

Ammeter resolution: 10mA

Programming accuracy: $\pm(0.5\% \text{ of reading} + 2\text{digits})(0 \sim 30V)$,
($25 \pm 5^\circ C$) $\pm(0.5\% \text{ of reading} + 2\text{digits}) (I \leq 3A)$

$\pm(0.5\% \text{ of reading} + 5\text{digits}) (I > 3A)$

Readback accuracy: $\pm(0.5\% \text{ of reading} + 2\text{digits})(0 \sim 30V)$,

($25 \pm 5^\circ C$) $\pm(0.5\% \text{ of reading} + 3\text{digits}) (I \leq 3A)$

$\pm(0.5\% \text{ of reading} + 5\text{digits}) (I > 3A)$

Protection: Over load and reverse polarity protections

Insulation: Between base and output terminal $\geq 20M\Omega/500VDC$

Between base and power cord $\geq 30M\Omega/500VDC$

Operation environment: Indoor use

Altitude: $\leq 2000m$

Ambient temperature: $0 \sim 40^\circ C$

Relative humidity: $\leq 80\%$

Installation category: II

Pollution degree: 2

Storage environment: Ambient temperature: $-10 \sim 70^\circ C$

Relative humidity: $\leq 70\%$

Power source: AC 110V/220V $\pm 10\%$, 50/60Hz

Accessories: User manual $\times 1$, power cord $\times 1$, USB cable, USB interface software CD (only for models with USB interface)

Dimensions: 310(D)*250(W)*150(H)mm

Weight: 7.5kg ($I \leq 3A$) / 10kg ($I > 3A$)