BENCHTOP INSTRUMENT

MYWAVE®

MSD-3606

Multi-output Dual-range Switching DC Power Supply

Operation Manual

Part No. SPOM-010010E

CE

Contents

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

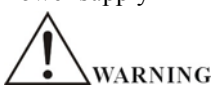
This chapter contains important safety instructions that you must follow when operating the instrument and when keeping it in storage. Read the following before any operation to insure your safety and to keep the best condition for the instrument.

Safety Symbols

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

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

General guideline 	● Do not place any heavy object on the instrument. ● Avoid severe impacts or rough handling that leads to damaging the instrument. ● Do not discharge static electricity to the instrument. ● Do not block or obstruct the cooling fan vent opening. ● Leave a space around the instrument, at least 3cm to the left and right. ● Do not disassemble the instrument unless you are qualified as service personnel. (Measurement categories) EN 61010-1: 2001 specifies the measurement categories and their requirements as follows. The instrument falls under category I. ● Measurement category IV is for the measurement performed at the source of low-voltage installation. ● Measurement category III is for the measurement performed in the building installation. ● Measurement category II is for the measurement performed on the circuits directly connected to the low voltage installation. ● Measurement category I is for the measurement performed on the circuits not directly connected to mains.
Power supply 	AC input voltage: 115V/230V±15%, 50/60Hz. Connect the protective grounding conductor of the AC power cord to an earth ground to avoid electrical shock.
Fuse 	● Fuse type: T10A/250V. ● Make sure the correct type of fuse is installed before power up. ● To ensure fire protection, replace the fuse only with the specified type and rating. ● Disconnect the power cord before fuse replacement. ● Make sure the cause of fuse blowout is fixed before fuse replacement.
Cleaning	● Disconnect the power cord before cleaning.

	● Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid. ● Do not use chemicals or cleaner containing harsh material such as benzene, toluene, xylene, and acetone.
Operation environment	● Location: indoor, no direc sunlight, dust free, almost non-conductive pollution. ● Relative humidity: <80% ● Altitude: <2000m ● Temperature: 0℃ ~ 40℃
Storage environment	● Location: indoor ● Relative humidity: <70% ● Temperature: 10℃ ~ 70℃

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 EATHED.

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 0.75mm^2 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 a engaged in live socket. Any re-wiring must be carrier 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.
For initial inspection, refer to the performance verification chapter.

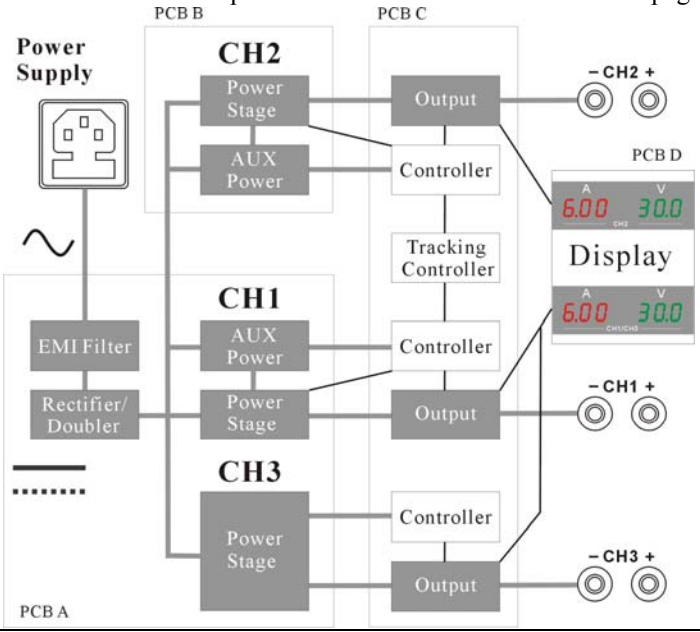
1.1 Main Features

Performance	➢ Low noise (≤50dB, cooling fan controlled by heatsink temperature) ➢ High efficiency power conversion, minimum 70% with full load ➢ Fast Output On/Off response (≤100ms) ➢ Low temperature coefficient (≤100ppm/℃+3mV, ≤150ppm/℃+3mA) ➢ Compact size, light weight
Operation	➢ Constant voltage operation ➢ Constant current operation ➢ Tracking series operation ➢ Tracking parallel operation ➢ Output On/Off control ➢ 3 outputs with full voltage control ➢ Output range selection for CH1 and CH2, 60V/3A or 30V/6A ➢ LED display
Protection	➢ Over load protection (OLP) ➢ Over temperature protection (OTP) ➢ Over voltage protection (OVP) ➢ Reverse polarity protection
Interface	➢ Remote control output On/Off terminal

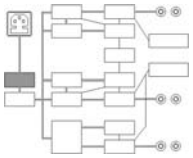
1.2 Principle of Operation

Block diagram

Power supply converts the AC mains into DC power source for internal units. Channel 1/2/3 control and produce the actual DC output. Display shows output and OVP level, receiving feedback from each channel. Internal components are placed on four printed circuit boards, A~D. Detailed description of each module starts on the next page.

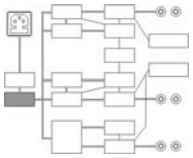


EMI Filter



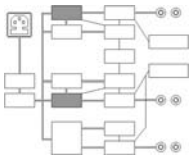
Other than deleting conduction EMI (electro- magnetic interference), the EMI unit contains protective circuits such as inrush current limit resistor and surge absorber. Internal units are protected under power-up sequence, normal operation, and AC mains fluctuation.

Rectifier/Doubler



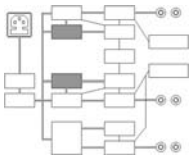
The rectifier unit converts AC mains into DC power source. For 115V±15% AC, double-wave rectification is used; for 230V±15% AC, full-wave rectification. An internal selector automatically switches the rectification circuit accordingly. The final DC Voltage reaches 240V ~ 370V.

CH1/2 AUX Power



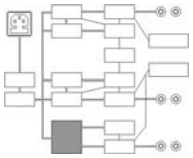
The power stage for Channel 1 and 2 produce the outputs using the combination of half-bridge converter and linear regulator. The half-bridge converter adopts PWM (pulse-width modulation) with high frequency switching. The linear regulator adjusts the output voltage down to 0V.

CH1/2 AUX Power



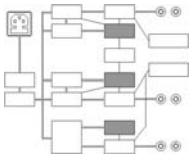
The AUX power for Channel 1 and 2 produces the power source for auxiliary devices, such as analog/digital controller, relay, LED display, and cooling fan. Altogether four pairs of power source are generated for different purpose: ±12V, +5V, and +12 V.

CH3 Power Stage



The power stage for Channel 3 produces both the channel output and the power source for auxiliary devices. It uses the combination of flyback converter and linear regulator, carrying lower efficiency compared to Channel 1 and 2. The flyback converter also produces ±12V for ICs and 4~8V settable voltage.

CH1/2/3 Controller



The controller for Channel 1, 2 and 3 takes care of the interface between the instrument and users. Several sub-units comprise the controller, including:

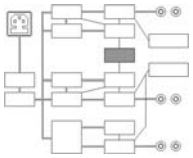
- Feedback control unit
- OVP setting unit
- Fan control unit

Detailed description of each unit follows.

Feedback control unit	The feedback control unit receives the control signal for voltage/current output level and the level feedback signal from the actual output. The difference between the two signals are amplified and used as the control signal for the power stage to achieve stable output level.
OVP setting unit	The SVR (small variable resistor) sets the protection point so that the OVP setting unit shuts down the output when the output voltage level exceeds the configured level.
Fan control unit	Using NTC (negative temperature coefficient) resistor, the fan control

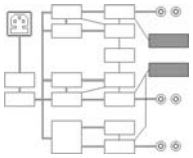
unit changes the control voltage for the cooling fan according to the temperature change, achieving low-noise and linear speed control.

Tracking Controller



The tracking controller controls the Channel 2 output level when in tracking series or parallel mode. In tracking series mode, Channel 2 output voltage is controlled by Channel 1 output voltage level. In tracking parallel mode, Channel 2 output current is controlled by Channel 1 output current level.

LED Display



The LED display shows Channel 1/2/3 output voltage/current level. The A/D converter changes the analog signal coming from each channel into digital format to be displayed.

1.3 Front Panel

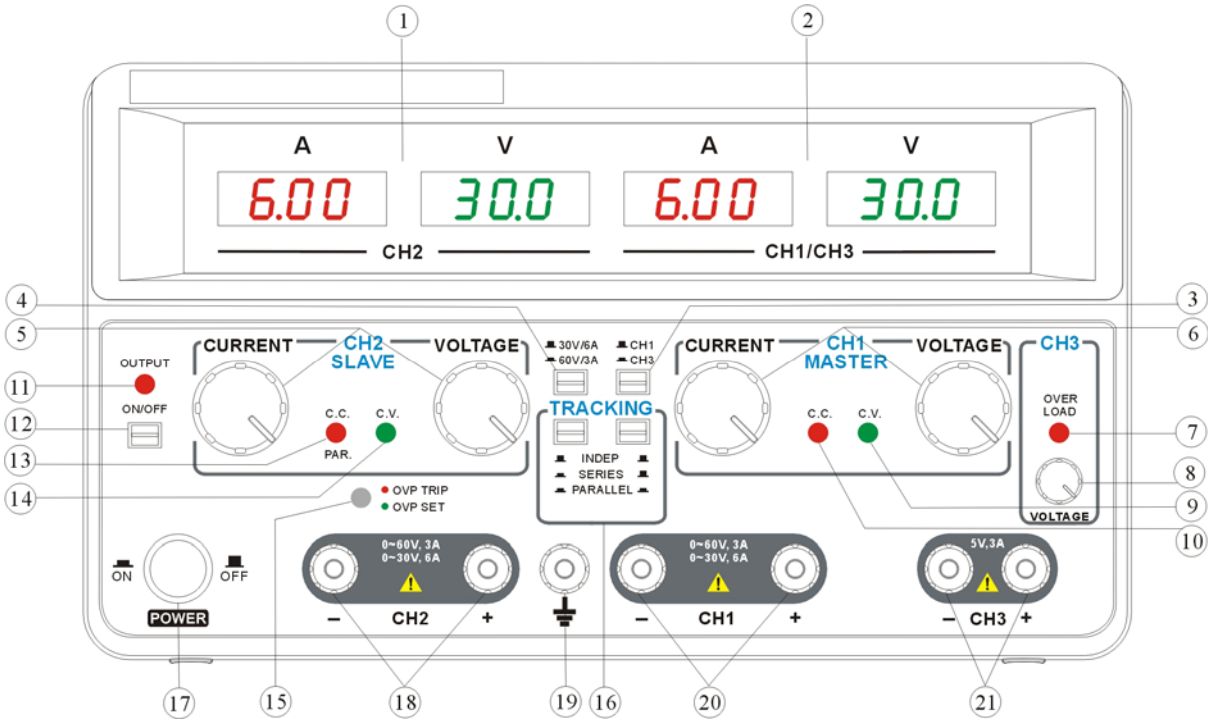


Fig.1.3-1 Front Panel

1. CH2 meter
2. CH1/3 meter
3. CH1/3 meter switch
4. Output range switch
5. CH2 output knob
6. CH1 output knob
7. CH3 over load indicator
8. CH3 voltage knob
9. CH1 C.V. indicator
10. CH1 C.C. indicator
11. OUTPUT indicator
12. OUTPUT ON/OFF key
13. CH2 C.C./PAR. indicator
14. CH2 C.V. indicator
15. OVP indicator
16. Auto tracking switch
17. Power switch
18. CH2 output terminal
19. Ground terminal
20. CH1 output terminal
21. CH3 output terminal

Power switch		Turns On or Off the main power. Refer to section 2.2 for power up sequence.
OVP indicator		Turns green during the OVP setup. Turns red (tripped) when the output voltage exceeds the setting. Refer to section 2.3 for OVP details.
OUTPUT ON/OFF key		Turn the output On (red) or Off (gray), all three channels at once.
Output range switch		Selects the output range, 60V/3A or 30V/6A.
CH2 meter		Displays Channel 2 current (A) and voltage (V).
Auto tracking switch		Activates and selects the tracking mode. Refer to section 3.3 (series) and section 3.4 (parallel) for tracking mode details.
CH1/3 meter + meter switch		Displays Channel 1 or Channel 3 current (A) and voltage (V). Select the Channel 1 or Channel 3 using the meter switch.
CH3 over load indicator		Turns red when Channel 3 output exceeds the current rating, 3A. Channel 3 switches from constant voltage (CV) to constant current (CC).
CH1/2/3 output terminal		Accepts the load cables. Refer to section 2.4 for cable connection details.

Independent

Series

Parallel

CH1 C.C./C.V. indicator		Turns green when operating in constant voltage (CV) mode, red in constant current (CC) mode. Refer to section 1.5 CV/CC characteristics.
CH2 C.C./PAR./C.V. indicator		Independent mode: Turns green when in constant voltage (CV) mode, red in constant current (CC) mode. Tracking parallel mode: When operating in tracking parallel mode, the Channel 2 indicator always stays red (PAR). Channel 1 indicator shows the CV/CC status.

1.4 Rear Panel

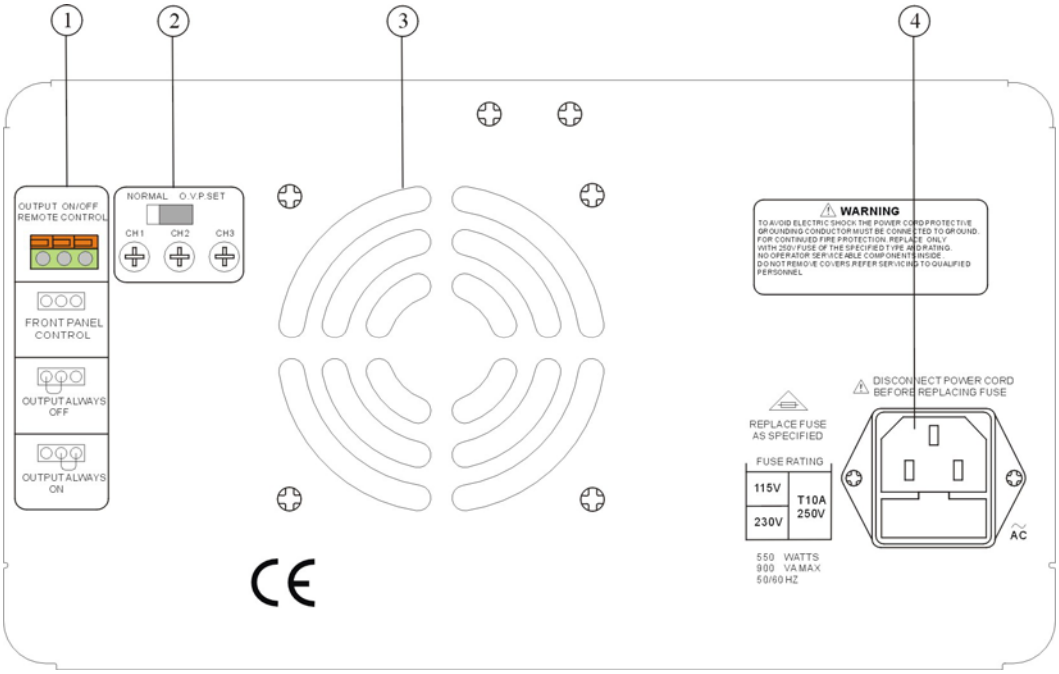
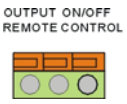
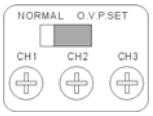
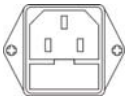
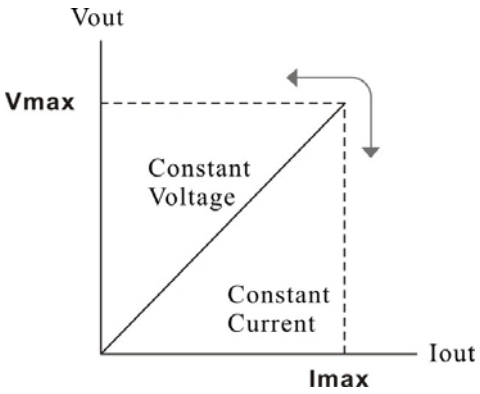


Fig.1.4-1 Rear Panel

1．Remote control terminal　　2．OVP setting point　　3．Cooling fan　　4．Power cord / fuse socket

Remote control terminal		Accepts remote output On/Off control connection. Refer to chapter 4 for details.
OVP setting point		Activates over voltage protection (OVP) and sets the protection threshold for Channel 1/2/3. Refer to section 2.3 for OVP setup details.
Power cord / fuse socket		The power cord socket accepts the AC mains: 115V/230V, 50/60Hz. Refer to section 2.2 for power up details. The fuse holder contains the AC main fuse. Refer to section 6.2 for fuse replacement details.

1.5 CV/CC Crossover Characteristics

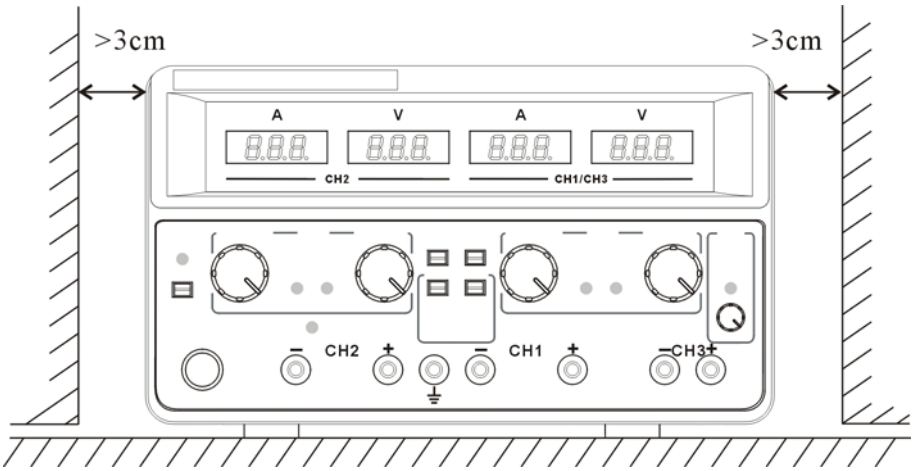
Description	The instrument automatically switches between constant voltage mode (CV) and constant current mode (CC), according to load condition.
C.V. 	When the current level is smaller than the output setting, the instrument operates in constant voltage mode. The indicator on the front panel turns green (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.
C.C. 	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 before the operation. For checking the functionality, refer to the performance verification chapter.

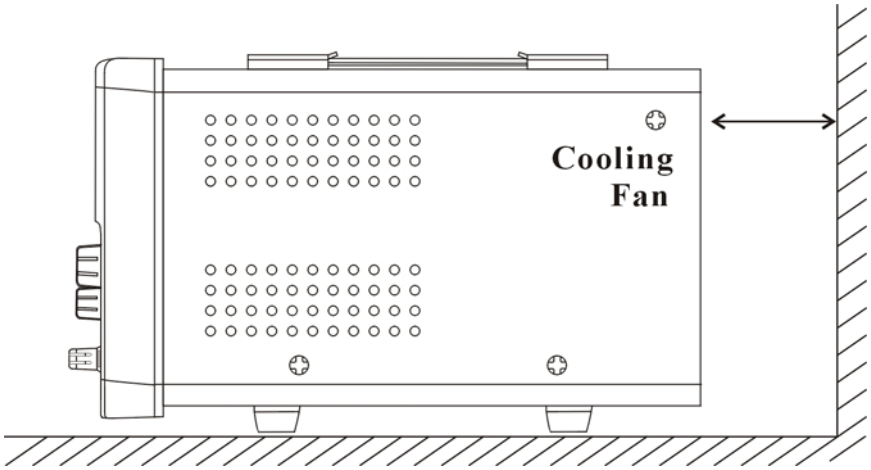
2.1 Installation Location

Ventilation space Leave at least 3cm around the instrument, to the left and right.



Cooling fan opening

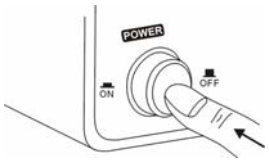
The cooling fan is located on the rear panel. Allocate extra space on the back of the instrument so that the cooling fan opening would not become blocked.

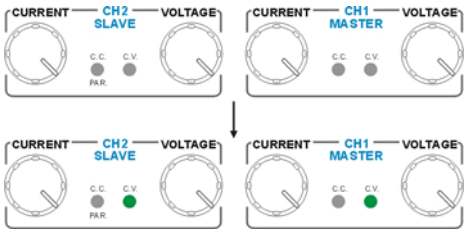


2.2 Power Up

Power on

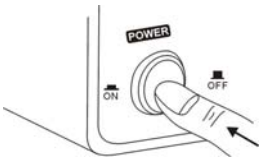
Press the power switch to turn on the power.
The CH1/CH2 indicators and meters turn on.





Power off

Press the power switch again to turn off the power.
After two seconds, the meters and indicators turn off.



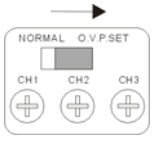
2.3 Over Voltage Protection Setup

Description

Over voltage protection protects the power supply and DUT from excessive output voltage. The user sets the maximum output voltage limit before operation. When the output voltage exceeds this limit, the indicator shows the over voltage status and the output is shut off immediately.

OVP setup

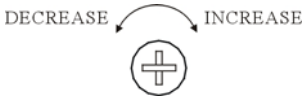
1. Slide the rear panel switch to the "O.V.P. SET" position.



2. The OVP indicator on the front panel turns green, indicating OVP setup.

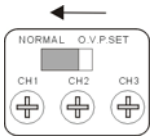
3. The voltage meters show the OVP setting level instead of the output level.
   The current meters show zero (0.00).

4. Adjust the OVP level using the rear panel terminal. The setting on the front panel meter changes accordingly.

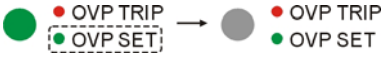


Setting range	Channel 1	1.0V ~ 67.0V
	Channel 2	1.0V ~ 67.0V
	Channel 3	0.1V ~ 6.0V

When setting the OVP for Channel 3, select CH3 meter using the CH1/CH3 meter switch.

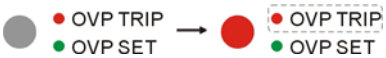


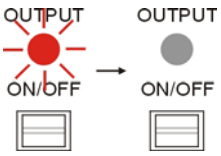
5. When finished, slide the rear panel switch to the "Normal" position. The OVP indicator on the front panel turns off.



When OVP is activated…

The OVP activates when one of Channel 1/2/3 output voltage exceeds the OVP setting. The indicator turns on red (tripped), and the output is shut off immediately.

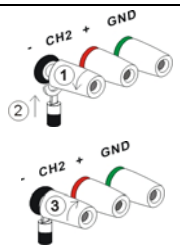




2.4 Load Cable Connection

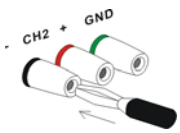
Standard accessory

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/cm^2.

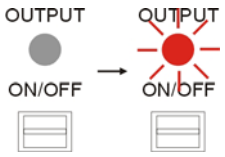
Wire size (AWG)	Maximum current (A)
20	2.5
18	4

16	6
14	10
12	16

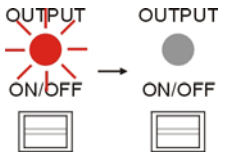
2.5 Output ON/OFF

Panel operation

Pressing the Output key once turns on the output, all Channels 1/2/3.



Pressing again turns off the output.



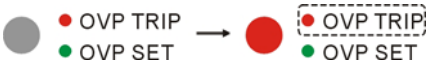
Automatic output Off

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

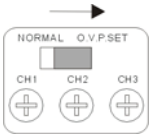
- Change the range

- Change the auto tracking switch between independent / series / parallel

- OVP tripped



- OVP set mode



- Remote control: When in remote control mode, front panel output control is disabled.

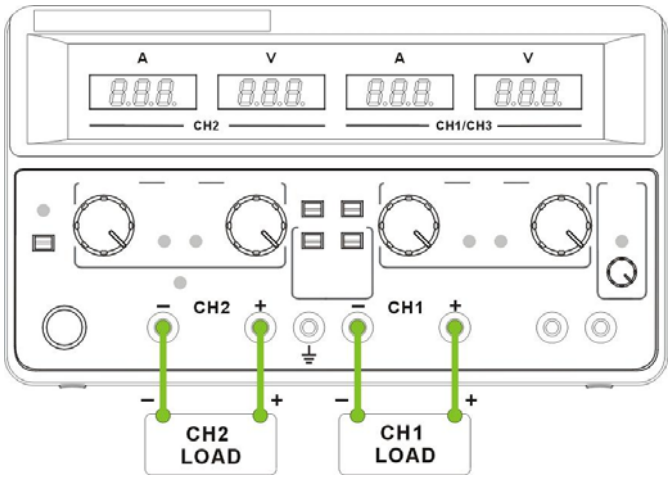
- Red CC indicator when output Off indicates internal error. Contact the service center.

3. OPERATION

3.1 CH1/CH2 Independent Mode

Description /Connection

Channel 1 and Channel 2 outputs work independent of each other and are separately controlled.

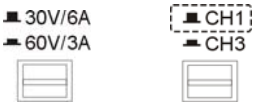


Output rating

0~30V/0~6A or 0~60V/0~3A for each channel

Setting step

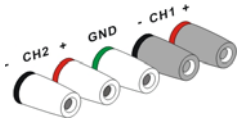
1. Select the output range, 60V/3A or 30V/6A. Set the CH1/CH3 meter switch to the CH1 position.



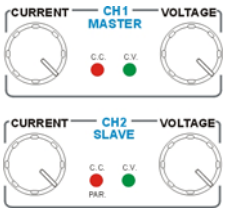
2. Set the auto tracking switch position to INDEP, ■+■.

3. Set the OVP if necessary. Refer to section 2.3 for details.

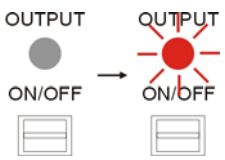
4. Connect the load to the front panel terminals, Channel 1 +/-, Channel 2 +/-.



5. Set the output voltage and current using the control knobs for each channel.

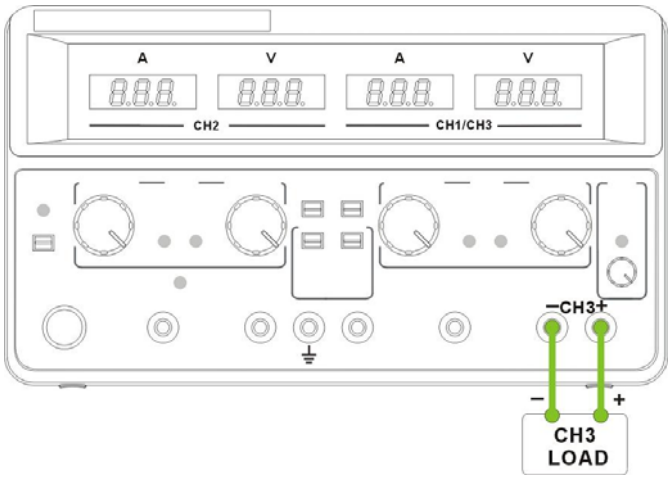


6. Press the output key. The output indicator turns red.



3.2 CH3 Independent Mode

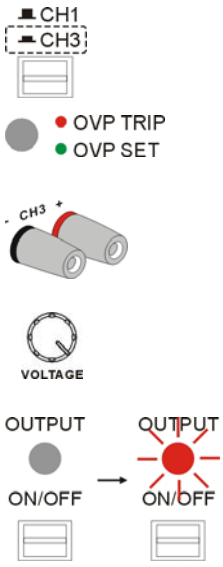
Description /Connection	Channel 3 rating is 0.1~5V, maximum 3A. It works independently from Channel 1 and Channel 2, regardless of their modes.



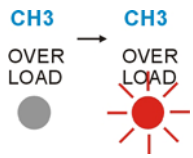
Output rating	0.1 ~ 5V, 3A maximum
No tracking Series/Parallel mode	Channel 3 does not have tracking series/parallel mode. Also, Channel 3 output is not affected by Channel 1 and 2 modes: independent/series/parallel.

Setting step

1. Set the CH1/CH3 meter switch to the CH3 position.
2. Set the OVP if necessary. Refer to section 2.3 for details.
3. Connect the load to the front panel Channel 3 +/- terminal
4. Set the output voltage using the Channel 3 voltage control knob.
5. Press the output key. The output indicator turns red.



CV → CC	When the output current level exceeds 3A, the overload indicator turns red and Channel 3 operation mode switches from constant voltage to constant current. Note: “overload” in this case does not mean an abnormal operation.

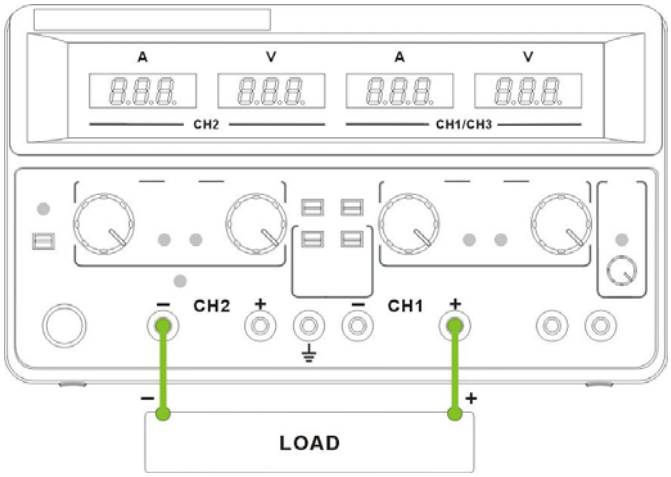


3.3 CH1/CH2 Tracking Series Mode

Description	Tracking series operation doubles the voltage capacity of the power supply by internally connecting Channel 1 (Master) and Channel 2 (Slave) in series and combining the output to a single channel. Channel 1 (Master) controls the combined voltage output level. The following describes two types of configurations depending on the common ground usage.

Tracking series without common terminal

Connection



Output rating 0~120V/0~3A or 0~60V/0~6A

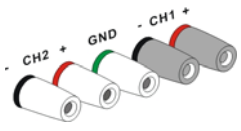
Setting step

1. Select the output range, 60V(120V)/3A or 30V(60V)/6A. Set the CH1/CH3 meter switch to the CH1 position.

2. Set the auto tracking switch position to Series, ▟+▙.

3. Set the OVP if necessary. In tracking series mode, set the Channel 2 (Slave) OVP to the maximum level, so that the OVP trips if the Channel 1 (Master) setting is violated. Refer to section 2.3 for OVP setup details.

4. Connect the load to the front panel terminals, Channel 1 + & Channel 2 – (single supply).



5. Turn up the Channel 2 current knob to maximum.

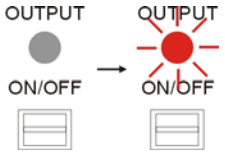
6. Set the output voltage and current using the Channel 1(Master) knob.

7. Refer to the Channel 1 (Master) meter and indicator for the output setting level and CV/CC status.

Current level: Channel 1 meter reading shows the output current. (Channel 2 current control must be in the maximum position).

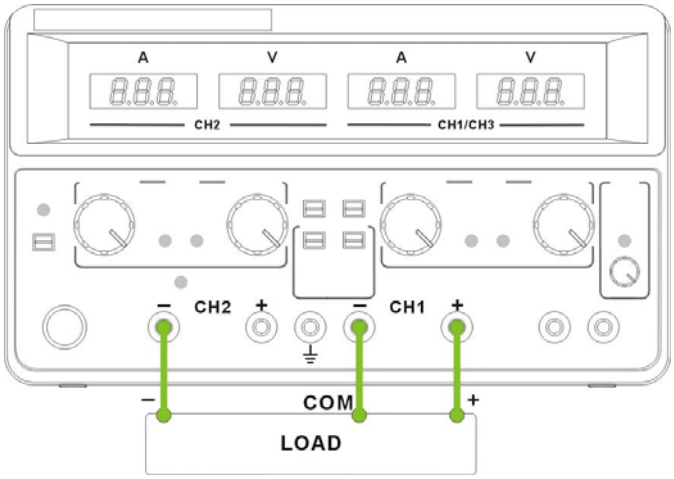
Voltage level: Double the reading on the Channel 1 voltage meter. (In the above case, the actual output is 23.6×2 = 47.2V).

8. Press the output key. The output indicator turns red.



Tracking series with common terminal

Connection



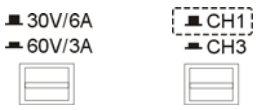
Output rating

0~60V/0~3A or 0~30V/0~6A for CH1~COM

0~-60V/0~3A or 0~-30V/0~6A for CH2~COM

Setting step

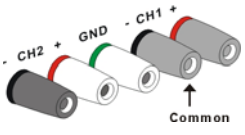
1. Select the output range, 60V(120V)/3A or 30V(60V)/6A. Set the CH1/CH3 meter switch to the CH1 position.



2. Set the auto tracking switch position to Series, ▬+▬.

3. Set the OVP if necessary. In tracking series mode, set the Channel 2 (Slave) OVP to the maximum level, so that the OVP trips if the Channel 1 (Master) setting is violated. Refer to section 2.3 for OVP setup details.

4. Connect the load to the front panel terminals, Channel 1 + & Channel 2 -. Use Channel 1 (-)

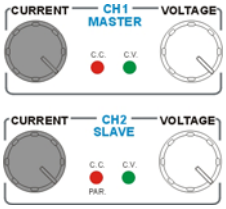


terminal as the common line connection.

5. Set the output voltage using the Channel 1 (Master) voltage knob. Refer to the Channel 1 (Master) meter for the output setting level.

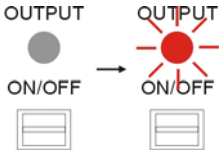
CH1(+)~COM Voltage = 23.6V in the above case
CH2(-)~COM Voltage = -23.6V in the above case

6. Set the output current separately, using both the Channel 1 (Master) and Channel 2 (Slave) current knob.



CH1(+)~COM Current = 1.84A in the above case
CH2(-)~COM Current = -2.18A in the above case

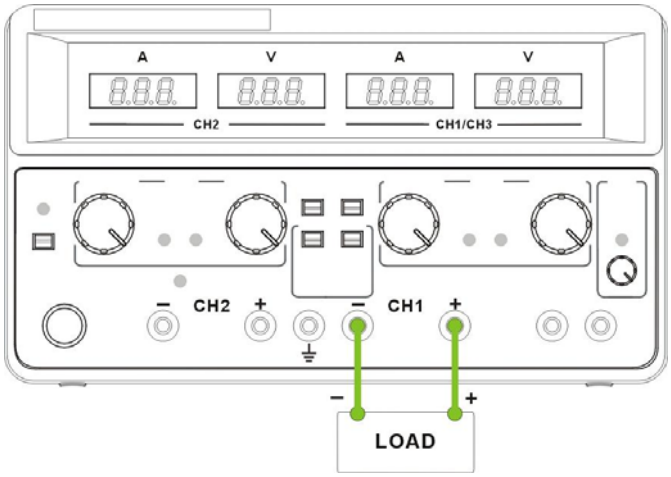
7. Press the output key. The output indicator turns red.



8. Refer to Channel 1 (Master) indicator for CH1(+)~COM CV/CC status, and the Channel 2 (Slave) for CH2(-)~COM CV/CC status.

3.4 CH1/CH2 Tracking Parallel Mode

Description /Connection	Tracking parallel operation doubles the current capacity of the power supply by internally connecting Channel 1 (Master) and Channel 2 (Slave) in parallel and combining the output to a single channel. Channel 1 (Master) controls the combined output.



Output rating	0~30V/0~12A or 0~60V/0~6A

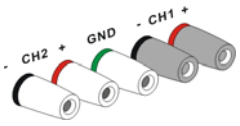
Setting step

1. Select the output range, 60V/3A(6A) or 30V/6A(12A). Set the CH1/CH3 meter switch to the CH1 position.

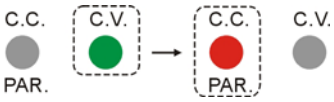
2. Set the auto tracking switch position to Parallel, ▪+▪.

3. Set the OVP if necessary. In tracking parallel mode, set the Channel 2 (Slave) OVP to the maximum level, so that the OVP trips if the Channel 1 (Master) setting is violated. Refer to section 2.3 for OVP setup details.

4. Connect the load to the front panel terminals, Channel 1 + / -.



5. The Channel 2 (Slave) indicator turns red, indicating tracking parallel (PAR). The CV/CC status of tracking parallel mode is displayed in the Channel 1 (Master) indicator.



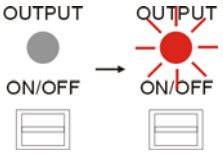
6. Set the output voltage and current using the Channel 1 (Master) control knobs. Channel 2 control knobs are disabled.

7. Refer to Channel 1 meter for the output setting level.

Current level: Double the reading on the Channel 1 meter. In the above case, the actual output is 1.84×2 = 3.68A.

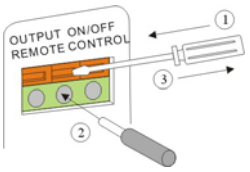
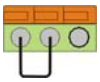
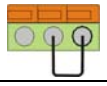
Voltage level: Channel 1 meter reading shows the actual output voltage.

8. Press the output key. The output indicator turns red.



9. Refer to Channel 1 (Master) meter for the CV/CC status.

4. REMOTE OUTPUT CONTROL

Description	The remote control terminal on the rear panel can turn the output On/Off, just like the output key on the front panel. This feature is useful for automated measurement and testing using externally connected control device, such as in production line or incoming quality inspection.	
Wire connection	Connect the terminals using bare wires. Use a minus driver to push the orange part, insert the wire, then release the orange part.	
Remote control Off (front panel control)	When there is no connection, output On/Off is entirely controlled from the front panel.	
Output always Off	when the left two terminals are connected, the output is always Off. The front panel output key is disabled.	
Output always On	when the right two terminals are connected, the output is always On. The front panel output key is disabled.	

5. PERFORMANCE VERIFICATION

Overview

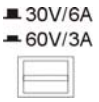
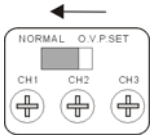
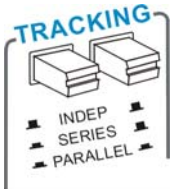
Description	Performance verification checks functionality of the power supply before the operation or at the incoming inspection. Recording tables are attached at the end of this chapter.
Verification item	● Output voltage ● Tracking series voltage ● Output current ● OVP

Equipment

Digital multimeter	● DCV accuracy < 0.1% ● DCA accuracy < 0.5% ● DCA range ≥ 12A ● Resolution ≥4 $\frac{1}{2}$ digit
Digital multimeter—cable	● Voltage rating > 70V ● Current rating > 12A
Screw driver	● < 3mm (for OVP adjustment)

5.1 Default Setting

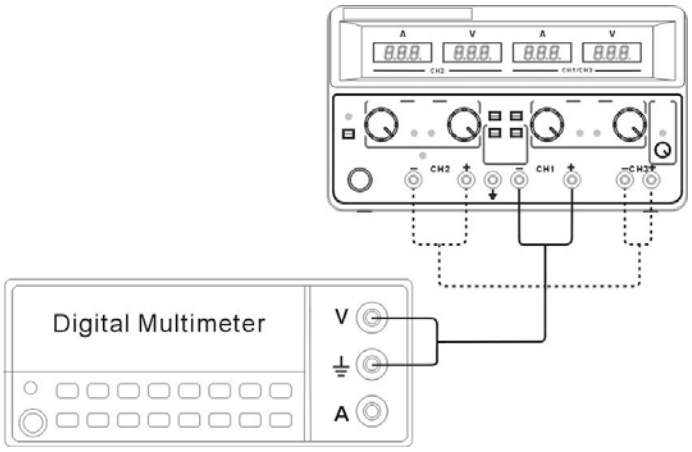
The following is the required front and rear panel setting before running each verification.

Range	60V/3A; 30V/6A	
	● Output voltage ● Tracking series ● OVP	● Output current ● Tracking parallel
OVP setting switch	Normal position	
CH1/3 meter switch	CH1 position	
Auto tracking switch	Independent position, ▟+▟	
CH1/2/3 voltage knob	Minimum position	
CH1/2 current knob	Minimum position	

5.2 Output Voltage Verification

Check item	● Minimum output voltage accuracy ● Maximum output voltage accuracy ● Voltage meter accuracy (output On) ● Voltage meter accuracy (output Off)

Connection



Verification step

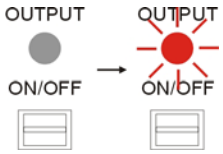
1. Set the power supply panel according to the default setting list. Refer to section 5.1 for details.

2. Connect the Channel 1 and digital multimeter voltage terminal.

3. Power up the power supply and digital multimeter.

4. Turn up the current knob to the maximum.

5. Turn on the output.



Minimum output voltage

6. Record the digital multimeter reading as the minimum output voltage.
   Here is the acceptance range.

Channel 1/2	< 0V
Channel 3	< 100mV

7. Turn up the voltage knob to the maximum.
   Switch the digital multimeter voltage terminal if necessary.

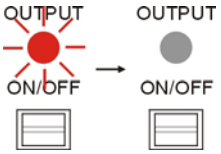
Maximum output voltage

8. Record the digital multimeter reading as the maximum output voltage.
   Here is the acceptance range.

Channel 1/2	61.5V ~ 62.5V
Channel 3	5.20V ~ 5.30V

Voltage meter accuracy

9. Compare and record the difference between the power supply voltage meter and the digital multimeter reading as the voltage meter accuracy (Out On).
   Then turn the output Off, and check the power supply reading again (Out Off).



   Here is the acceptance range and example.

Channel 1/2/3	Difference < ±(0.5% of reading +2 digits) of digital multimeter

Example:
Digital multimeter (Out On) =30.00V
Tolerance = ±(0.005×30+0.2) ≈ ±0.4V
Accepted reading of power supply (Out On) =29.6V~30.4V
Accepted reading of power supply (Out Off) =29.6V~30.4V

Channel 2

10. Connect the digital multimeter to Channel 2 and repeat step 4 to 9.

Channel 3

11. Switch the CH1/CH3 meter switch to CH3 position. Connect the digital multimeter to Channel 3 and repeat step 5 to 9.

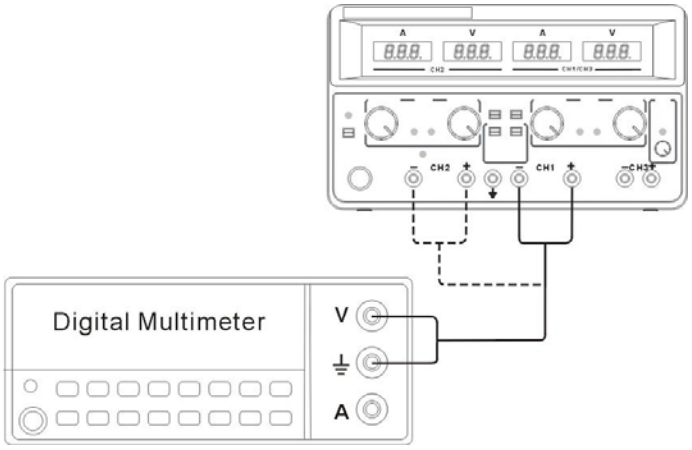
Note: Skip step 4 since Channel 3 does not have current knob.

5.3 Tracking Series Voltage Verification

Check item

- Minimum output voltage accuracy
- Maximum output voltage accuracy

Connection



Verification step

1. Set the power supply panel according to the default setting list, except for the auto tracking switch. Refer to section 5.1 for details.

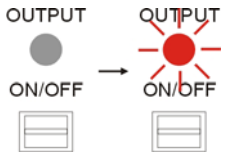
2. Set the auto tracking switch position to Series, ▄+▄.

3. Connect the Channel 1 and digital multimeter voltage terminal.

4. Power up the power supply and digital multimeter.

5. Turn up the current knob, both Channel 1 and Channel 2, to the maximum.

6. Turn on the output.



7. Turn up the Channel 1 voltage knob until the digital multimeter reading shows 1.000V.

Minimum tracking series output voltage

8. Connect the digital multimeter to Channel 2 and record the reading. Here is the acceptance range.

Channel 2	0.985V ~ 1.015V

9. Connect the digital multimeter back to Channel 1.

10. Turn up the Channel 1 voltage knob until the digital multimeter reading shows 60.00V.

Maximum tracking series output voltage

11. Connect the digital multimeter to Channel 2 and record the reading. Here is the acceptance rang.

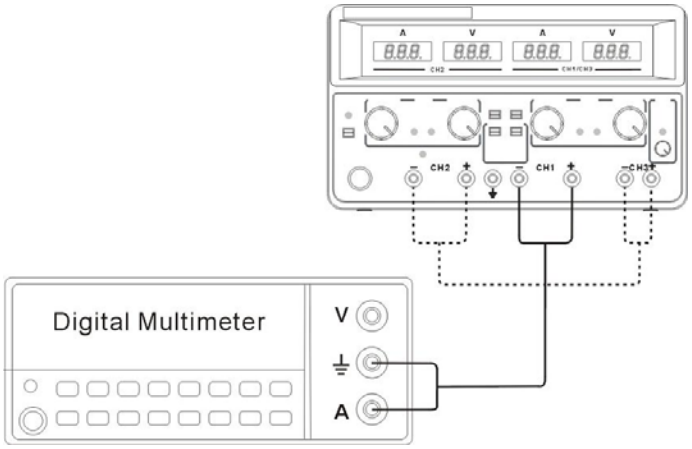
Channel 2	59.69V ~ 60.31V

5.4 Output Current Verification

Check item

- Minimum output current accuracy
- Maximum output current accuracy
- Current meter accuracy (output On)
- Current meter accuracy (output Off)

Connection



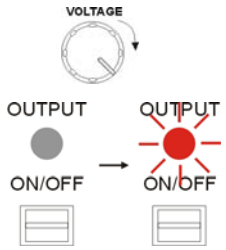
Verification step

1. Set the power supply panel according to the default setting list. Refer to section 5.1 for details.

2. Connect the Channel 1 and digital multimeter current terminal.

3. Power up the power supply and digital multimeter.

4. Turn up the voltage knob to the maximum.



5. Turn on the output.

Minimum output current

6. Record the digital multimeter reading as the minimum output current.
Here is the acceptance range.

Channel 1/2	< 0A

7. Turn up the current knob to the maximum. Switch the digital multimeter current terminal to high current range.

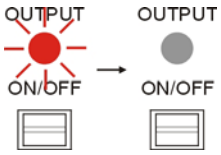
Maximum output current

8. Record the digital multimeter reading as the maximum output current.
Here is the acceptance range.

Channel 1/2	6.15A ~ 6.25A
Channel 3	3.05A ~ 3.15A

Current meter accuracy

9. Compare and record the difference between the power supply current meter and the digital multimeter reading as the current meter accuracy (Out On). Then turn the output Off, and check the power supply reading again (Out Off).



Here is the acceptance range and example.

Channel 1/2/3	Difference < ±(0.5% of reading +2 digits) of digital multimeter

Example:
Digital multimeter (Out On) =3.000A
Tolerance = ±(0.005×3+0.02) ≈ ±0.04A
Accepted reading of power supply (Out On) =2.96A~3.04A
Accepted reading of power supply (Out Off) =2.96A~3.04A

Channel 2

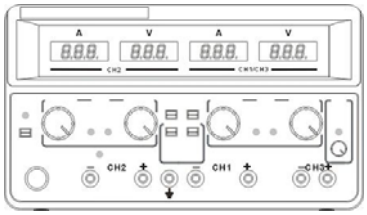
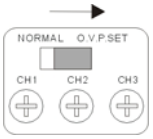
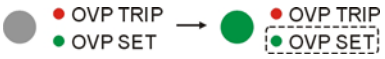
10. Connect the digital multimeter to Channel 2 and repeat step 4 to 9.

Channel 3

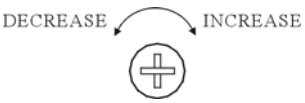
11. Switch the CH1/CH3 meter switch to CH3 position. Connect the digital multimeter to Channel 3 and repeat step 4, 5, 8, 9.

Note: Skip step 6 and 7 since Channel 3 does not have minimum current verification and current knob.

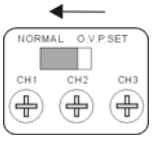
5.5 OVP Verification

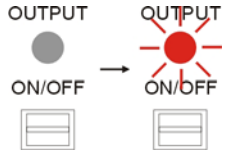
Check item	● OVP setting accuracy (minimum) ● OVP functionality (minimum) ● OVP setting accuracy (maximum) ● OVP functionality (maximum)
Connection	 (No connection)
Verification step	1. Set the power supply panel according to the default setting list. Refer to section 5.1 for details. 2. Power up the power supply. 3. Set the OVP setting switch to the "O.V.P. SET" position.  4. The OVP indicator on the front panel turns green.  5. Turn down the OVP setting terminal to minimum. 
Minimum OVP setting	6. Record the power supply voltage meter reading as the minimum OVP setting accuracy. Here is the acceptance rang.

Channel 1/2	≤ 1.0V
Channel 3	≤ 0.50V

7. Adjust the OVP setting terminal until the power supply meter shows the exact following value. 

Channel 1/2	1.0V
Channel 3	0.50V

8. Set the OVP setting switch to the "Normal" position. The OVP indicator on the front panel turns off. 

9. Turn on the output. 

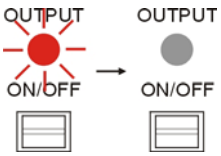
10. Slowly turn up the voltage knob until the OVP indicator turns red (tripped).

Minimum OVP functionality

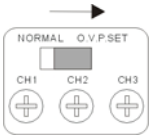
11. Record the power supply voltage meter reading as the minimum range OVP functionality. Here is the acceptance range.

Channel 1/2	0.5V ~ 1.5V
Channel 3	0.00V ~ 1.00V

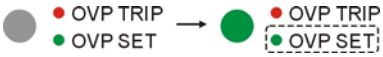
12. Turn off the output.



13. Set the OVP setting switch to the “O.V.P. SET” position.



14. The OVP indicator turns green.



15. Turn up the OVP setting terminal to maximum.

Maximum OVP setting

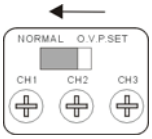
16. Record the power supply voltage meter reading as the maximum OVP setting accuracy. Here is the acceptance rang.

Channel 1/2	65.0V ~ 68.0V
Channel 3	6.00V ~ 7.00V

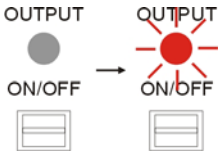
17. Adjust the OVP setting terminal until the power supply meter shows the exact following value.

Channel 1/2	60.0V
Channel 3	5.0V

18. Set the OVP setting switch to the “Normal” position. The OVP indicator on the front panel turns off.



19. Turn on the output.



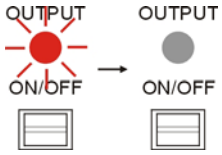
20. Slowly turn up the voltage knob until the OVP indicator turns red (tripped).

Maximum OVP functionality

21. Record the power supply voltage meter reading as the maximum range OVP functionality. Here is the acceptance rang.

Channel 1/2	59.2V ~ 60.8V
Channel 3	4.47V ~ 5.05V

22. Turn off the output.



23. Repeat the step 3 to 22 for Channel 2.
24. Repeat the step 3 to 22 for Channel 3.

5.6 Recording Tables

Output voltage verification (minimum / maximum)

Item	Channel	Min. limit	Result	Max. limit
Minimum output voltage	CH1	-30mV		0mV
	CH2	-30mV		0mV
	CH3	0mV		100mV
Maximum output voltage	CH1	61.5V		62.5V
	CH2	61.5V		62.5V
	CH3	5.2V		5.3V

Output voltage verification (meter accuracy)

Tolerance = ±(0.5%×digital multimeter+0.2)V

Channel	Digital multimeter	Tolerance	Power supply (On)	Power supply (Off)
Channel 1		~		
Channel 2		~		
Channel 3		~		

Tracking series voltage virification

Item	Channel	Min. limit	Result	Max. limit
Tracking series (minimum)	CH2	0.985V		1.015V
Tracking series (maximum)	CH2	56.69V		60.31V

Output current verification (minimum / maximum)

Item	Channel	Min. limit	Result	Max. limit
Minimum output current	CH1	-1mA		0mA
	CH2	-1mA		0mA
Maximum output current	CH1	6.15A		6.25A
	CH2	6.15A		6.25A
	CH3	3.05A		3.15A

Output current verification (meter accuracy)

Tolerance = ±(0.5%×digital multimeter+0.02)A

Channel	Digital multimeter	Tolerance	Power supply (On)	Power supply (Off)
Channel 1		~		
Channel 2		~		
Channel 3		~		

OVP verification

Item	Channel	Min. limit	Result	Max. limit
Minimum OVP setting	CH1	0.0V		1.0V
	CH2	0.0V		1.0V
	CH3	0.0V		0.1V
Minimum OVP functionality	CH1	0.5V		1.5V
	CH2	0.5V		1.5V
	CH3	0.00V		1.00V
Maximum OVP setting	CH1	65.0V		68.0V
	CH2	65.0V		68.0V
	CH3	6.0V		7.0V
Maximum OVP functionality	CH1	59.2V		60.8V
	CH2	59.2V		60.8V
	CH3	4.47V		5.53V

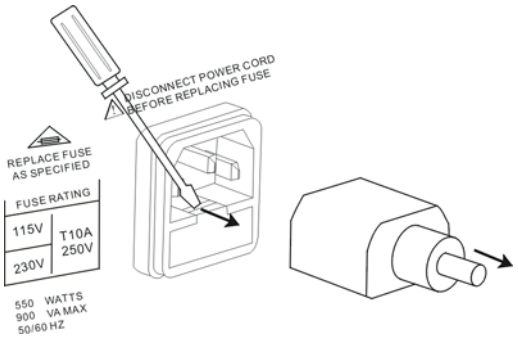
6. MAINTENANCE

6.1 Inspection

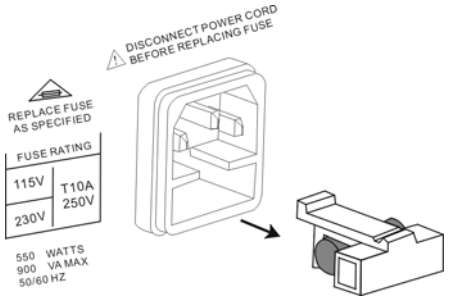
- Inspect the instrument at regular intervals so that it maintains its initial performance for a long time.
- Check the input power cord for damage of the vinyl cover and overheating of the plug and cord stopper. Check the terminal screws and binding posts for loosening.

6.2 Fuse Replacement

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



2. Replace the fuse in the holder.



Rating T10A/250V

7. FAQ

Q1: I cannot turn on the output (the output key does not respond).

A1: The following scenarios are possible.

- The rear panel remote control terminal is in the Off position. In this case, set it to the On position or deactivate remote control. Refer to chapter 4 for details.
- The OVP setting switch on the rear panel is on the SET side. In this case, set the switch to the Normal side.
- The OVP indicator is red. In this case, change the OVP setting to higher value or remove the over voltage condition.

Note that in several conditions, the output key automatically turns off to avoid harmful condition. Refer to section 2.5 for details.

Q2: The CC indicator is red (constant current) while the output is Off.

A2: This indicates there is an internal error. Contact the service center.

Q3: The meter does not match the real value.

A3: The following scenarios are possible.

- Make sure the rear panel OVP setting is in the “Normal” position. If the OVP switch is in the “SET” position, the meter might show the OVP setting, not the output value. Refer to section 2.3 for OVP details.
- If you are using Channel 1 or Channel 3, make sure the meter switch is in the correct position. Channel 1 and Channel 3 share the same meter.

8. SPECIFICATION

Output ratings

CH1/CH2 independent: 0~30V/0~6A; 0~60V/0~3A

CH1/CH2 series: 0~60V/0~6A; 0~120V/0~3A

CH1/CH2 parallel: 0~30V/0~12A; 0~60V/0~6A

CH3：0.1~5V/3A

Voltage

Line regulation: ≤0.01%+3mV

Load regulation: ≤0.01%+5mV (rating current≤6A); ≤0.01%+8mV (rating current≤12A)

Ripple & Noise: ≤5mV rms (5Hz~1MHz); ≤50mVpp (20Hz~20MHz)

Recovery time: ≤100us (50% load change, minimum load 0.5A)

Current

Line regulation: ≤0.2%+3mA

Load regulation: ≤0.2%+3mA

Ripple & Noise: ≤3mA rms

Tracking operation

Tracking error: ≤0.5%+10mV of the master

Series regulation: ≤300mV

Ripple & Noise: ≤10mV rms (5Hz~1MHz); ≤100mVpp (20Hz~20MHz)

Output On/Off response time

Voltage up (10%~90%): ≤100ms (≤95% rating load)

Voltage down (90%~10%): 100ms (≥10% rating load)

OVP

Accuracy: ±(0.5% of reading +0.5V)

Meter

Type: 3 $\frac{1}{2}$ digits 0.39" LED display

Accuracy: ±(0.5% of reading +2 digits)

Resolution: 100mV/10mA

Protection: Over load, over temperature, over voltage and reverse polarity protections

Remote control: Output On/Off

Fan noise: ≤50dB

Temperature coefficient: Voltage: ≤1000ppm/℃+3mV

Current: ≤150ppm/℃+3mA

Insulation: Between chassis and output terminal: ≥100MΩ/1000VDC

Between chassis and AC cord: ≥100MΩ/1000VDC

Operation environment: Ambient temperature: 0~40℃

Relative humidity: ≤80%

Storage environment: Ambient temperature: 10℃~70℃

Relative humidity: ≤70%

Power source: AC 115V/230V±15%, 50/60Hz

Accessories: User manual×1， power cord×1

Dimensions: 310(D)×250(W)×150(H)mm

Weight: 5.5kg