

**In order to better use the power supply, please read the user manual carefully before using and keeping it properly.**

**Warning:** Do not connect any load to the power supply before it's turned on. Likewise, make sure to disconnect the load before shutting down the power supply. Damages to the power supply can happen if you do not follow this. Such damages are not under warranty.

**Warning:** If you are running inductive load like magnetic coils, DC motors, stepper motors, etc., make sure to change the voltage/current slowly, and NEVER turn the power supply on or off with a inductive load connected!

## **1. Summary:**

This serial multiplex output is high-precision power supply composed of two way regulated output power supply and one-way fixed output power supply. It uses four groups of three LED to display output voltage and current values of the two way power supply respectively. In addition, two-way regulated output power supply possesses automatic transfer function to regulate voltage and current. And its circuit is composed of compensating pipe power exhaustion steering circuit, operational amplifier and reference voltage regulator with temperature compensation. Therefore, the circuit is stable and reliable. The output power voltage of the power supply may randomly be regulated from 0 to nominal voltage value. When it is in the state of current regulation, the current regulation output current can continuously be regulated from 0 to nominal current value. The two-way regulated power supply can be randomly in series or in parallel in terms of the power supply. When it is in series or in parallel, one circuit may track its voltage or current (in parallel).The maximum output voltage can reach the total amount of the two-way voltage rating when it is in series, while the maximum output current can reach the total amount of the two-way current rating when it is in parallel. The other regularly outputs 5V power supply, and the controlling part is composed of single scale integrated regulator. The three groups of power

supply all have over-loading protection function, and over-loading or short circuit in output will not damage power supply. This series of power supplies are characterized by small volume, good performance and new style, and are first choices for scientific and research institutions, colleges, factories and electrical appliance maintenance units.

## 2. The specifications for parameters

### 2.1 Technical parameters

(1) Input voltage: 220V/110V $\pm$ 10% 50Hz/60Hz $\pm$ 2Hz (the output current is less than 5A)

(2) Two-way regulated power supply:

Nominal output voltage: see table (can be regulated continuously)

Nominal output current: see table (can be regulated continuously)

Model	voltage	current	Fixed output
TPR-3002-2D	2 $\times$ 0-30V	2 $\times$ 0-2A	5V/3A
TPR-3003-2D	2 $\times$ 0-30V	2 $\times$ 0-3A	5V/3A
TPR-3005-2D	2 $\times$ 0-30V	2 $\times$ 0-5A	5V/3A
TPR-6405-2D	2 $\times$ 0-64V	2 $\times$ 0-5A	---

(3) Current effect:  $CV \leq 1 \times 10^{-4} + 0.5mV$

$$CC \leq 2 \times 10^{-3} + 6mA$$

(4) Load effect:  $CV \leq 1 \times 10^{-4} + 2mV$  (output current $\leq$ 3A)

$$\leq 1 \times 10^{-4} + 5mV$$
 (output current $>$ 3A)

$$CC \leq 2 \times 10^{-3} + 6mA$$

(5) Ripples and noises:  $CV \leq 0.5mVr.m.s.$  (Output current $\leq$ 3A)

$$\leq 1.0mVr.m.s.$$
 (Output current $>$ 3A)0

$$CC \leq 3mAr.m.s.$$

(6) Protection: Protection of current limitation

(7) Instruction:

Digital voltmeter and ammeter, three LED digital displays.

Precision: voltmeter  $\pm 1\%+2$  figures    Ammeter  $\pm 2\%+2$  figures

(8) Other: two-way power supply can be in series and in parallel, one-way main power supply may regulate output voltage when it is in series and in parallel, at the moment the output voltage from the power supply strictly tracks the output magnitude of voltage of the main power supply. When regulating the parallel current, the main power supply may regulate current regulation of the output current, at this moment the current output from power supply strictly tracks the output current value from the main power supply.

(9) Regular output power supply

① Nominal output voltage:  $5V\pm 3\%$

② Nominal output current: 3A

③ Current effect:  $\leq 1\times 10^{-4}+1\text{mV}$

④ Load effect:  $\leq 1\times 10^{-3}$

⑤ Ripples and noises:  $\leq 0.5\text{mVr.m.s}$

⑥ Protection: Current limitation and protection for short circuit

(10) Environmental conditions:  $0-40^{\circ}\text{C}$  relative humidity  $< 90\%$

(11) Overall dimensions:  $360\text{mm}\times 265\text{mm}\times 165\text{mm}$  (Output current  $\leq 10\text{A}$ )

(The length is different in accordance with model)

(12) Working hours: constantly working more than 8 hours

## 2.2 Working principles

The regulated power supply is composed of rectifier filter circuit; auxiliary power supply circuit; reference voltage circuit and voltage and current regulation amplified circuit; regulated circuit and voltage and current regulation sampling circuit etc.

The pane drawings are shown as Figure1.

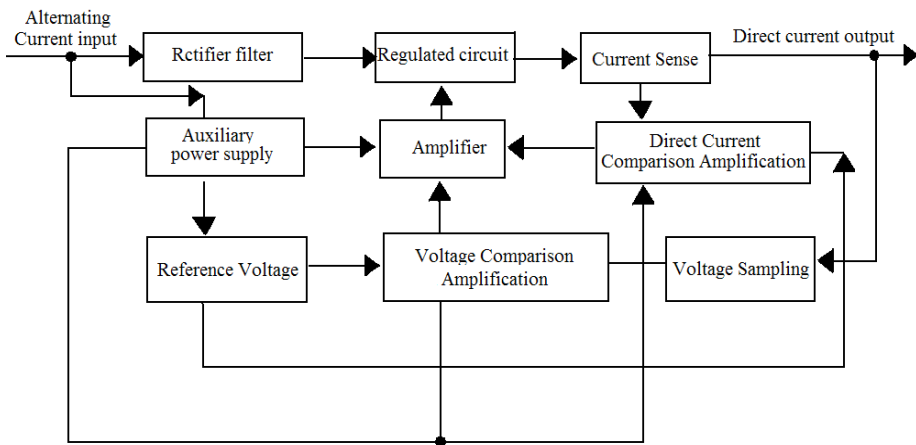


Figure 1

When the output voltage is changed due to the change of power supply voltage or load current, then the changed signals were compared by voltage regulation sampling circuit and reference voltage, and the error signals were amplified by comparison amplifier and the output voltage was regulated as the set value by amplifying circuit controlling and regulating tube. Since the comparison amplifier is composed of integrated operational amplifier, therefore the power gain is very high, and the output terminal has minor variation in voltage, which can also be regulated so as to achieve the goal of highly stable output.

Current regulation is basically the same with voltage regulation, therefore both are highly stable.

The function of every element in circuit is as the following:

After the voltage being reduced, the input 220V 50Hz or 110V 60Hz alternating currents supply the main circuit rectifier and the auxiliary power supply rectifier respectively. The main circuit rectifier selects circuit through transformer winding (i.e. regulation tube power loss controlling circuit) and connects to the transformer winding corresponding with output voltage. The rectified filter circuit is composed of  $V_7 \sim V_{10}$ ,  $C_6$ , and adopts bridge

rectification and high volume capacitor filter, so the alternating component of the output direct voltage is very small in quantity.

The auxiliary power supply composes auxiliary power circuit with  $N_3$ ,  $V_1 \sim V_4$ ,  $V_6$ ,  $C_1 \sim C_3$  and relevant resistance. It is mainly used as the positive and negative of the integrated operational amplifier and  $V_5$  integrated reference voltage of regulator.

The selective circuit of transformer winding is composed of  $N_4$  (LM324 four operational amplifiers),  $V_{23} \sim V_{28}$  and  $R_{20} \sim R_{34}$ ,  $K_1 \sim K_2$ . After the voltage being parted by resistance, the input voltage of the regulation power supply is added to the same reversal phase end of the two operational amplifiers, the opposite reversal phase ends of the two operational amplifiers connect to two voltages respectively. When the output voltage changes among  $0 \sim 7.5V$ ,  $7.5V \sim 15V$ ,  $15V \sim 22.5V$ ,  $22.5V \sim 30V$ , the output of the two operational amplifiers have four combinations, namely,  $K_1$ ,  $K_2$ , relays have four different make-and-break combinations, that is, the alternative voltage attached to circuit of the main rectifier filter has four different values, and they correspond with the output voltage of the regulated power supply. When the output voltage is high, the alternative voltage is also high, and when the output voltage is low, consequently, the alternative voltage is low, thus ensures the power consumption of high-power regulation tube not too high.

Reference voltage circuit is composed of  $V_5$  and  $R_1$ ,  $C_4$ , and is produced on the integrated regulator which passed through current-limiting resistance  $R_1$ , with temperature compensation by  $+12V$  of the auxiliary power supply, therefore the reference voltage is very stable.

The output voltage sampling and voltage comparison amplified circuit are composed of  $N_1$  voltage comparator and relevant resistance capacitance. The sampling voltage is directly taken from output wire connecting terminal  $X_2$ , and connects to the reversal phase of  $N_1$  voltage comparator amplifier. Reference voltage connects to the same phase of  $N_1$  voltage comparator after the voltage of the resistance  $R_{16}$ , regulation resistance  $RP_2$ ,  $RP_5$  being parted. Because of the secondary voltage regulation with temperature compensation,

the reference voltage has good stability.  $RP_6$  regulation resistance is placed on the panel; the reference value of the same phase input terminal of the comparison amplifier can only be changed by regulating the resistance values of regulation resistance  $RP_6$  so as to regulate the output magnitude of voltage.

Current regulation sampling and comparison amplifying circuit are composed of  $N_2$  and resistance  $R_9 \sim R_{12}$  and regulation resistance  $RP_1, RP_4$  ect. The voltage on the reversal terminal of the input operational amplifier  $N_2$  is reduced by the electricity produced by the circuit transmitting  $R_{10}, R_{12}$ , so the voltage on the reversal terminal of the  $N_2$  operational amplifier reflects the amount of output current. The input voltage of the same terminal is produced by the reduced voltage reference. When the voltage on the same terminal is higher than that on the reversal, the operational amplifier inputs higher level, and the current regulation circuit doesn't work and the power supply is in a stable voltage position. When the voltage on the same terminal is lower than that on the reversal, the operational amplifier is lower than level and the current regulation circuit work and the circuit is in a current stable position. For example: when the load resistance becomes smaller, and the output current is going to increase and the voltage drop on the both terminals of  $R_{10}, R_{12}$  resistance will be increased, that is when the input voltage on the reversal terminal of the operational amplifier  $N_2$  is increasing, for the reference voltage on the same terminal remains unchanged, therefore the output voltage of the operational amplifier will be dropped, which makes the output voltage decrease, thus ensures the invariableness of the output current. For this reason, changing the resistance value of  $RP_4$  and  $RP_5$  changes the reference voltage, and the constant output current value is also changed.

$V_{17}$  and  $V_{18}$  are two regulating tubes in parallel, which maintain certain amount of output current and guarantee sufficient power, selected high-power dynatron with the same parameters to be in parallel, and connected equalizing resistance ( $R_{10}, R_{12}$ ) in emitter to avoid damaging regulating tubes because of uneven distribution of current.

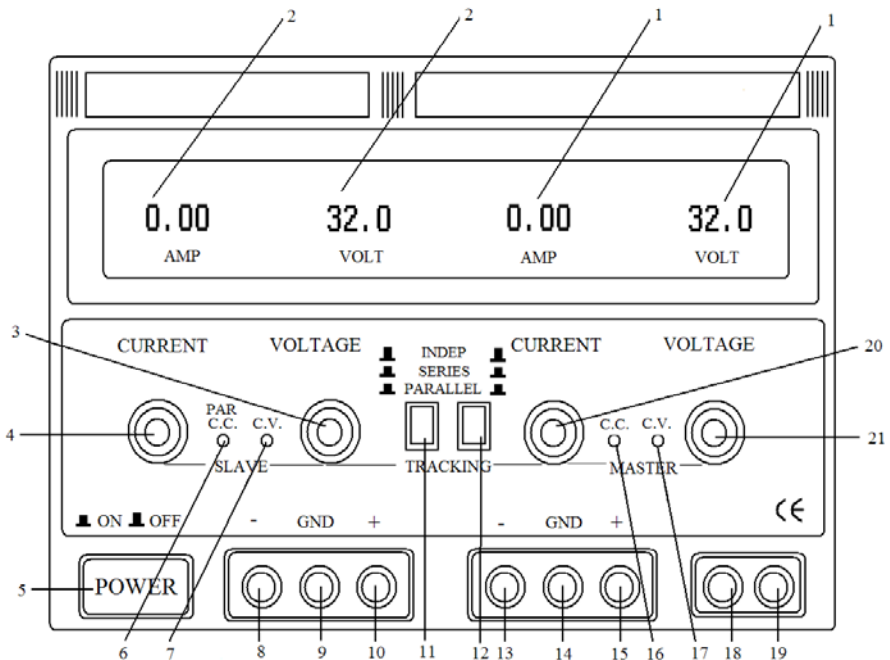
This power supply uses two three binary voltmeters and ammeters to display the output voltage and current at due time. Therefore, the output voltage value and current value of every loop can be surveyed in a timely manner.

### 3. The control and instruction of the panel

#### 3.1 The function of every element on the panel

- (1) Numeration table: indicating the major output voltage value and current value.
- (2) Numeration table: indicating the subordinate output voltage value and current value.
- (3) The subordinate voltage regulation output voltage regulation knob: regulating subordinate output voltage value.

The map for the panel:



**Figure2**


- (4) The subordinate current regulation output current regulation knob: regulating subordinate output current value. (i.e. current limitation protection regulation)
- (5) Power switch when the power switch is placed “ON” (that is when the power switch is lowered down), the machine is “on”, at this moment the voltage regulation indicator light is on or current regulation light is on. Conversely, the machine is off (that is when the switch is up).
- (6) The subordinate current regulation or the two-way power supply parallel indicator light: when the subordinate power supply is under the condition of current regulation or when the two-way power supply is in parallel, the indicator light is on.
- (7) The subordinate voltage regulation indicator light: when the subordinate power supply is in the position of voltage regulation, the indicator light is on.
- (8) The subordinate direct current output negative terminal: the negative electrode of output voltage connects to the negative terminal of the load.
- (9) Cabinet ground terminal: the cabinet connects to the ground.
- (10) The subordinate direct current output positive terminal: the anode of the output voltage connects to positive terminal of the load.
- (11) The control switch of two-way power supply is in independence, series and parallel. (**Which output voltage is more than 30V or current is higher than 10A will has not series and parallel function**)
- (12) The control switch of two-way power supply is in independence, series and parallel. (**Which output voltage is more than 30V or current is higher than 10A will has not series and parallel function**)
- (13) Main direct current output negative terminal: the negative electrode of output voltage connects to the negative terminal of the load.
- (14) Cabinet ground terminal: the cabinet connects to the ground.
- (15) Main direct current output positive terminal: the anode of the output voltage connects to positive terminal of the load.
- (16) Main current regulation indicator light: when the main power supply is under the condition of current regulation, the indicator light is on.



- (17) Main voltage regulation indicator light: when the main power supply is under the condition of voltage regulation, the indicator light is on.
- (18) Regulator 5V direct power supply output negative terminal: the negative electrode of the output voltage connects to the negative terminal of the load.
- (19) Regulator 5V direct power supply output positive terminal: the anode of the output voltage connects to the positive terminal of the load.
- (20) Main current regulation output current adjusting knob: regulate the main output current value (that is the regulation of current limit protection)
- (21) Main voltage regulation output voltage adjusting knob: regulate the main output voltage value.

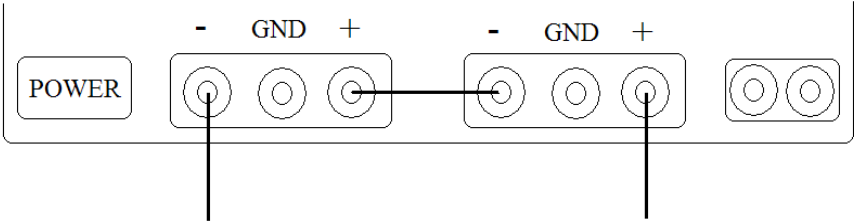
### **3.2 The method for use**

#### **(1) The independent use of two-way regulated power supply**

- ① Put the switch of (11) and (12) on the rising position (that is )
- ② When the regulated power supply is used as the voltage regulated power supply, first of all, the current regulation knobs (4) and (20) should be clockwise regulated to the maximum, then turn on the power supply switch (5), and regulate voltage regulation knobs (3) and (21) to regulate voltages of the main and subordinate output direct currents to the necessary voltage values, at this moment the voltage regulation indicator lights (7) and (17) will shine.
- ③ When the regulated power supply is used as the current regulated power supply, and after turning on the power supply switch (5), first, the voltage regulation knobs (3) and (21) should be clockwise regulated to the maximum, at the same time the current regulation indicators (4) and (20) should be counterclockwise regulated to the minimum, then connect the necessary load, and clockwise regulate current regulation knobs (4) and (20) to make the output current to the necessary regulated current value. At the moment, voltage regulation indicator lights (7) and (17) are off; the current regulation indicator lights (6) and (16) will shine.
- ④ When used as voltage regulation power supply, the current regulation knobs (4) and (20) should be regulated to the maximum, however, the power

supply can randomly set current limitation protection. The method for the setting: turn on the power supply, and counterclockwise regulate the current regulation indicators (4) and (20) to the minimum, then short connect regulation knobs (4) and (20) to make output current equal to the necessary current value of the current limitation protection, at this moment the current the current limitation protection is set.

**(2) Two-way regulation power supply used in series**



**Figure3**

① When the power supply is used in series, please connect the output terminal as Figure3 shows. Depress switch (11) (i.e. position) switch (12) ejects(i.e. position) at this moment regulate the voltage regulation knob(21) of the main power supply, and the subordinate output voltage of strictly track the main output voltage, thus make the output voltage reaches the total amount of the rated values of the two way currents (i.e. voltages between terminal (8) and terminal(15)).

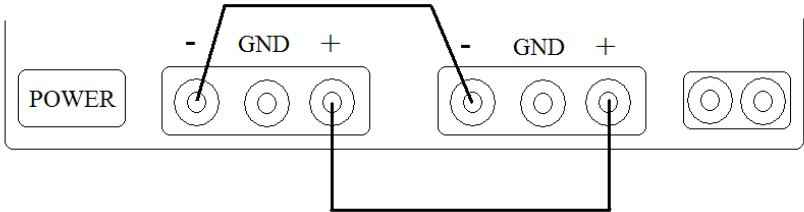
② Check the main and subordinate before the two power supplies are in series whether the negative terminal has end connector to connect ground terminal, if it has, the end connector should be cut off, otherwise it would cause short circuit of the power supply when the two power supplies are in series.

③ When the two power supplies are in parallel, the two output voltage are controlled by main power supply, but still the current regulation of the two way are independent. Therefore, when the two ways are in series, attention should be paid to the position of (4) current regulation knob. If knob (4) is at



the end of counterclockwise position or the subordinate output current exceeds the current limitation protection, at this moment, the output voltage of the subordinate will no longer track the main output voltage. So knob (4) should be clockwise turn to the maximum when the two ways are in series.

④ when the two ways are in series, and if there is power output, the corresponding lead of the application power and output power will reliably connects the negative terminal of the main way and positive terminal of the subordinate way. Since the internal part of the machine is short connected through a switch, and when there is power output, the short connected switch will pass the output current. But for a long time, it will do nothing to improve the reliability of the whole machine.

**(3) The two ways of regulation power supply used in parallel**



**Figure4**

① When the power supply is used in parallel, please connect the output terminal as Figure4 shows. Depress switch (11) (i.e.  position) switch (12) also pressed(i.e.  position) at this moment, the two ways of power supply are in parallel, regulation the voltage regulation knob(21) of the main power supply, then the two output voltages are the same. Concurrently, the subordinate current regulation indicator light (6) is on.

② When the two ways of power supply are in parallel, the current regulation knob (4) of the subordinate power supply will not work. When the power supply is used as current regulation power supply, only the main current regulation knob (20) needs to be regulated, at this moment, the output current

of the main and subordinate leads will be controlled and they are the same. The maximum output current can reach the total amount of currents of the two leads.

③ When the two ways of power supply are in parallel, if there is power output, the corresponding lead of the application power and output power will reliably connects the positive terminals of the main and subordinate ways and the negative terminals of the main and subordinate ways so as to make load reliably connects the output terminals of the ways. Otherwise, if the load is only connected to output terminal of one way power supply, it will probably cause the imbalance of the output current in the two ways of power supply, at the same time, and it may cause damage to the switches of series circuit and parallel circuit.

The output indicator of this power supply is three binary, if more precise values need to be obtained, more precise measuring instrument should be used to adjust in the outer circuit.

#### **4. Matter need attention**

4.1 The power supply has prefect protective functions, and 5V power supply has reliable current limitation and short circuit protective functions. The two-way regulated power supply has current limitation protective function. Since compensating tube power loss controlling circuit has been set in the circuit, so when there are short circuits in output, the power loss of the high-power compensating tube is not so high, it will not cause any damage to the power supply. However, when there are short circuits, this power supply still has power loss, and in order to reduce unnecessary wearing of the machine and loss of energy, the power should be switched off and fault should be eliminated.

4.2 After using, it should be placed in dry and ventilated area and be kept clean, if it is not used for a long time, the plug should plugged off.

4.3 When maintaining the regular power supply, the input power supply should be cut off.

4.4 Power failures may be caused by improperly using power supply or environment abnormal as well as the ineffectiveness of electron component inside the machine. When there are power failures, the output voltage may exceed the maximum voltage of the rated power, please pay attention when use! Beware of unnecessary load damage.

4.5 The protective ground terminal of the three-core power cord should be reliably connected with the ground to ensure safety in use.

## **5. Attachment**

User manual	1
Power cord	1

## **6. Operating procedure**

6.1 Place the power switch in “OFF” position.

6.2 Determine the correct input voltage as there is an 220V/110V switch selection in the back panel.

6.3 Plug in power

6.4 Place the power switch in “ON” position

6.5 Regulate “VOLTAGE” and “CURRENT” knobs to necessary out voltage and current values.

6.6 Connect external loading to “+” “-“outlet terminal.

6.7 When used in places with high demand, the output post head“-”must reliably connects with post head “GND” so as to reduce output ripple voltage.

## **7. Maintenance**

### **7.1 Replacement of protective tube**

If the protective tube burned out, the power supply will stop working, the crisper should not be opened unless something goes wrong.

## 7.2 Regulation

The power supply is precisely regulated before it goes out; if there are errors in precision in repairing, please follow the following procedures to reregulate.

### (1) Voltage regulation

- ① on the output terminal of the power supply, a multimeter with the precision of  $\pm 0.1\%$  will be connected to measure the direct voltage.
- ② coarsely and fine regulated the voltage to the minimum value
- ③ Regulate “MINVOLTS” vernier regulation, the reading of multimeter is 0
- ④ coarsely and fine regulate the voltage to the maximum value (clockwise)
- ⑤ Fine regulate “MAXVOLTS” to make the reading on the multimeter voltage rating  $\times 1.05$
- ⑥ coarsely regulate to make the reading of the multimeter to voltage rating.
- ⑦ Regulate the regulation resistance of the voltage meter to make the reading of the voltage rating.

### (2) Current regulation

- ① Turn the current to the minimum (counterclockwise)
- ② Connect a multimeter to the output terminal of the power supply to measure current.
- ③ Regulate “CURRENT” knob to make the reading of multimeter 0A
- ④ coarsely and finely regulate the voltage to make it in the middle.
- ⑤. Regulate the current knob to make the reading of the multimeter the maximum rating current value.
- ⑥ Regulate fine regulation on the front panel regulation resistance “PCB” to make the indication on the ammeter correspond with that of the multimeter.