

# LPS Series

*Linear Power Supplies*

## OPERATION MANUAL



**METER INTERNATIONAL CORP.**

**茂迪股份有限公司**

6 Floor, No. 59, Tsao-Dih Woei,

Wan Shun Liao, Shen Keng Hsiang,

Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-662-5093 —5 . 886-2-662-5194 —6

Fax: 886-2-662-5097

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# 1. GENERAL INFORMATION

## 1.1 Introduction

This section contains a general description of your power supply as well as its performance specifications. Information about options and accessories are also provided.

## 1.2 Safety Considerations

### DO NOT EXCEED INPUT RATINGS

This instrument must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0mA peak.

### SAFETY SYMBOLS

#### WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met

#### CAUTION

The CAUTION sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met

## 1.3 Accessories

- Power cable
- Operation manual
- Fuse

## 1.4 Output Isolation

The output of the power supply is isolated from earth ground. Either output terminal may be grounded or the output may floated up to +/- 240 Vdc (including output voltage) from chassis ground

## 1.5 Specifications

Model	LPS301	LPS-302	LPS-303	LPS-304	
<b>MAX. OUTPUT POWER</b>	30W	60W	90W	70W	
<b>OUTPUTS</b>	Single	Single	Single	Triple	
<b>OUTPUT VOLTAGE</b>					
Output Voltage	30V/15V	30V/15V	30v	+/-30V	5V
Peak Output Voltage	32V/16V	32V/16V		+/-32V	
Setting Resolution	10mV	10mV	10mV	10mV	
<b>OUTPUT CURRENT</b>					
Output Current	<b>2A/1A</b>	<b>4A/2A</b>	2.5A	1A	2A
Peak Output Current	2.4A/1.2A	4.4A/2.2A	3A	1.2A	
Setting Resolution	1mA	1mA	1mA	1mA	
<b>CONSTANT VOLTAGE CHARACTERISTICS (at rated output)</b>					
Line Regulation ( 0% AC)	1mV	1mV	1mV	1mV	5mV
Load Regulation (100% load change)	2mV	2mV	2mV	2mV	10mV
Ripple/Noise rms (1 0Hz to 20MHz)	1mV rms	1mV rms	1mV rms	1mV rms	2mV rms
Ripple/Noise peak (1 0Hz to 20MHz)	10mV p-p	10mV p-p	10mV p-p	10mV p-p	10mV p-p
Transient Response	30ms				
Temperature Coefficient	100ppm/°c				
<b>CONSTANT CURRENT CHARACTERISTICS (at rated output)</b>					
Line Regulation ( 0% AC)	2mA	2mA	2mA	2mA	
Load Regulation (100% load change)	5mA	5mA	5mA	5mA	
Ripple/Noise rms (1 0Hz to 20MHz)	1mA rms	1mA rms	1mA rms	<b>1mA rms</b>	
Ripple/Noise peak (1 0Hz to 20MHz)	5mA P-P	5mA P-P	5mA p-p	5mA P-P	
Temperature Coefficient	200ppm/C				
<b>OTHER</b>					
Display	16 character x 2 line backlit LCD				
Voltage Accuracy *	±0.2%+2	±0.2%+2	±0.2%+2	±0.2%+2	±2%
Current Accuracy *	±0.5%+5	±0.5%+5	±0.5%+5	±0.5%+5	
Common Mode Voltage	40Vdc				
Temperature Range	Operating: 0°C to 40°C , less than 80% RH; Storage: -45°C to 75°C , less than 80% RH				
Dimensions (WxHxL)	8.7"x 3.4"x 11.8"	8.7"x 3.4"x 11.8"	8.7"x 3.4"x 11.8"	8.7"x 3.4"x 11.8"	
Weight	10 lbs	12 lbs	12 lbs	12 lbs	
Cooling	Forced Air				

\*For output less than 5% of rated output, add 5 digits to the accuracy specification

### RS232 Interface: (optional)

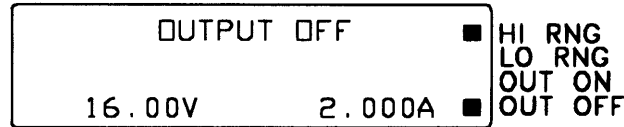
1. RS232C DCE interface: 9 pin D-SUB connector
2. Port configuration: asynchronous 2400 baud, 8 data bits, 1 stop bits, no parity

## 2. GETTING STARTED

### 2.1 Front Panel Controls and Output Terminals

#### A-1. The LCD Status Annunciators (LPS-301/302):

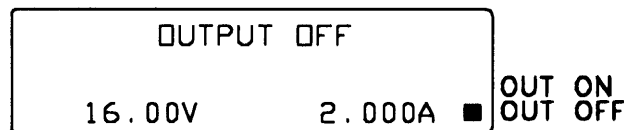
Display all functions and operating characteristics of the LPS-301/302



- (1). HI RNG :The power supply is operating in high range.
- (2). LO RNG :The power supply is operating in low range.
- (3). OUT ON :The power supply is in output mode.
- (4). OUT OFF :The power supply is in output-off mode.

#### A-2. The LCD Status Annunciators (LPS-303):

Display all functions and operating characteristics of the LPS-303



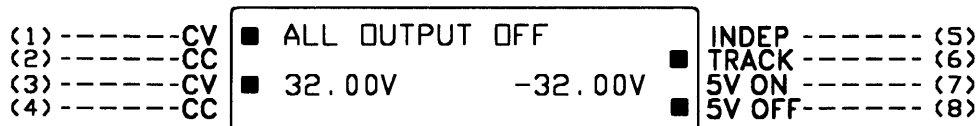
- (1). OUT ON :The power supply is in output mode.
- (2). OUT OFF :The power supply is in output-off mode.

#### NOTE:

When the power supply is turn on, it automatically enters the output-off mode. Also, all LPS models are equipped with power-off memory which will display the previous voltage setting and current setting when the power supply is turn on.

#### A-3. The LCD Status Annunciators (LPS-304):

Display all functions and operating characteristics of the LPS-304



- (1). CV :The positive channel is operating under constant voltage mode.
- (2). CC :The positive channel is operating under constant current mode.
- (3). CV :The negative channel is operating under constant voltage mode.
- (4). CC :The negative channel is operating under constant current mode.
- (5). INDEP :The output of negative channel is independent from the positive channel.
- (6). TRACK :The output of negative channel is in sync. with the positive channel.

- (7) 5V ON :The constant 5V output terminal is in output mode.
- (8) 5V OFF :The constant 5V output terminal is in stand-by mode.

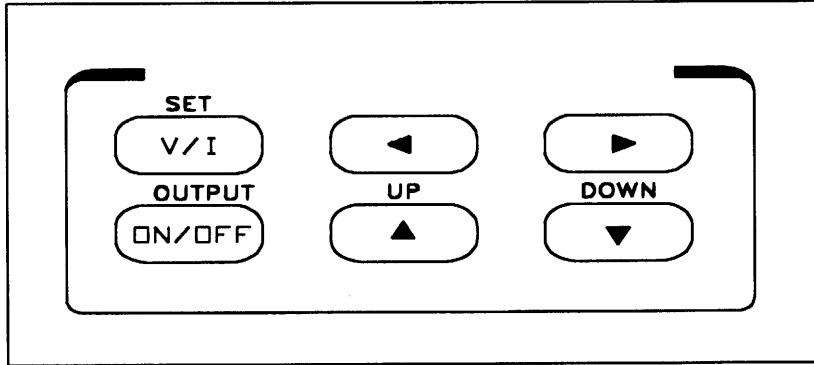
**NOTE:**



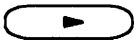
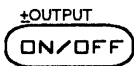


If the square dot annunciator indicating CV or CC mode is flashing, then the channel is in output setting mode. If the square dot annunciator is solid then the channel is not in the output setting mode.

(Press  key to select the channel.)

**B-1. Key Pad Controls (LPS-301/302/303):**

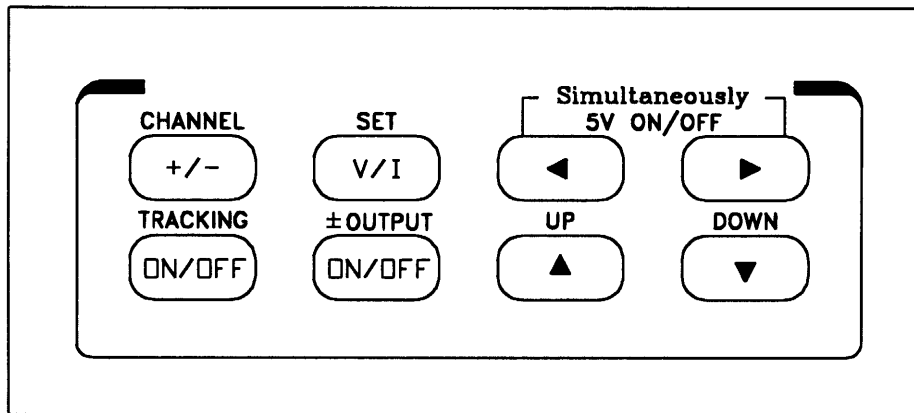
For data input and mode selection

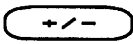



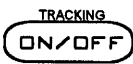
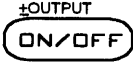




1.  Press this key to toggle between the voltage setting mode and the current setting mode.
2.  Press this key in the output setting mode to move the cursor one digit left until it comes to the desired digit to be varied.
3.  Press this key in the output setting mode to move the cursor one digit right until it comes to the desired digit to be varied. When the cursor is at the rightmost digit, press this key again will lock the new output value into the memory.
4.  Press this key to enable or diable the power supply output.
5.  Press this key to increase the value of the digit to be varied when the power supply is in the output setting mode.
6.  Press this key to decrease the value of the digit to be varied when the power supply is in the output setting mode.

## B-2. Key Pad Controls (LPS-304):

For data input and mode selection.



-  Press this key to toggle between the positive and the negative channel.
-  Press this key to toggle between the voltage setting mode and the current setting mode.
-  Press this key in the output setting mode to move the cursor one digit left until it comes to the desired digit to be varied.
-  Press this key in the output setting mode to move the cursor one digit right until it comes to the desired digit to be varied. When the cursor is at the rightmost digit, press this key again will lock the new output value into the memory.
-  Press this key to toggle the tracking mode on and off. When the tracking mode is on, the output of the negative channel is in sync. with the positive channel.
-  Press this key to enable or diable the channel output.
-  Press this key to increase the value of the digit to be varied when the channel is in the output setting mode.
-  Press this key to decrease the value of the digit to be varied when the channel is in the output setting mode.

### NOTE:

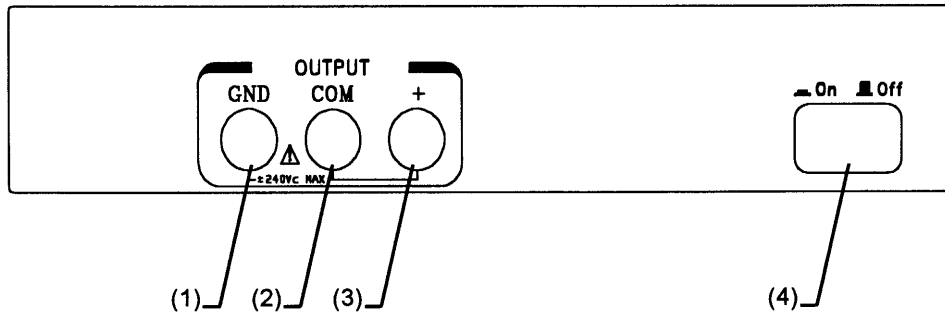
Simultaneously pressing



these two keys will enable or disable the constant 5V

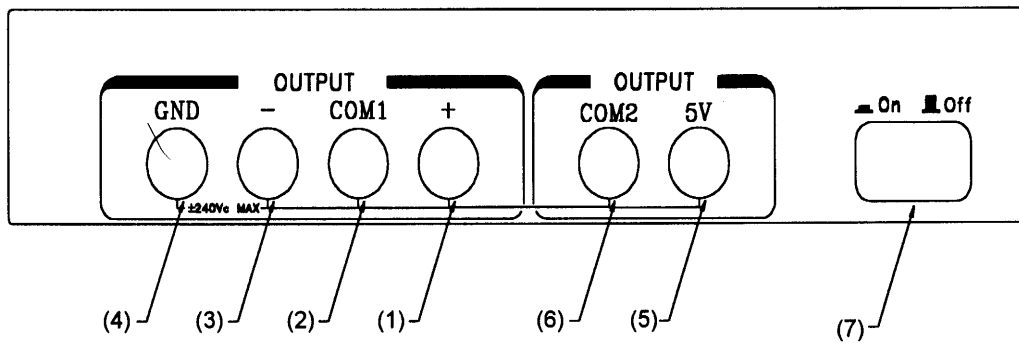
output terminal.

**C-1. Output Terminals (LPS-301/302/303):**



- 1. + (RED) :Positive output terminal.
- 2. COM (BLACK) :Common output terminal.
- 3. GND (GREEN) :Ground (earth) output terminal connected to the main chasis.
- 4. ON OFF :Powers on/off the unit.

**C-2. Output Terminals (LPS-304):**

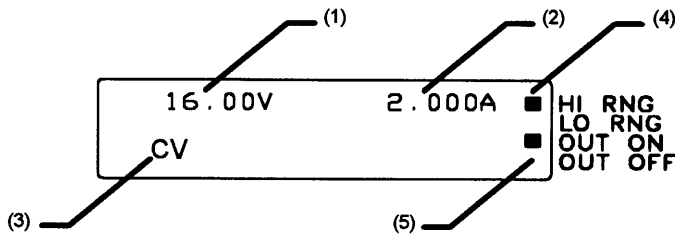


- 1. + (RED) :Positive channel output terminal.
- 2. COM1 (BLACK) :Common terminal for both positive and negative channels.
- 3. --- (WHITE) :Negative channel output terminal.
- 4. GND (GREEN) :Ground (earth) terminal connected to the main chasis.
- 5. 5V (RED) :Constant 5V output terminal with respect to COM2 terminal.
- 6. COM2 (BLUE) :Common terminal for the constant 5V output terminal.
- 7. ON OFF :Powers on/off the unit.



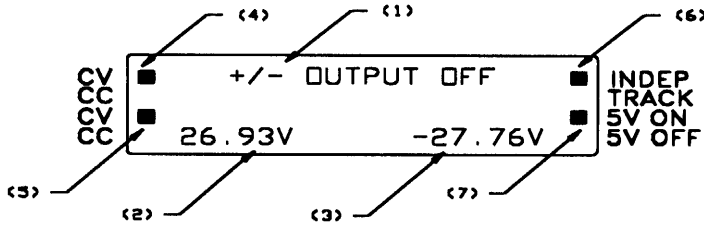
## 2.2 LCD Display

### A-1. When the power supply is in output mode (LPS-301/302):



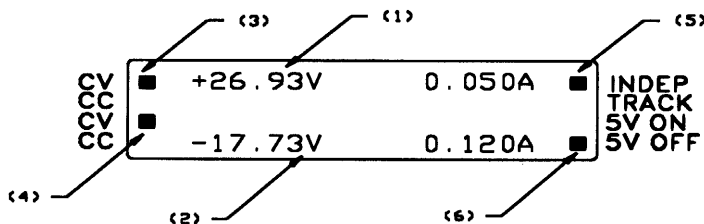
1. Indicates the power supply is outputting 16.00 V.
2. Indicates the power supply is outputting 2.000A.
3. Indicates the power supply is in constant voltage mode.
4. Indicates the power supply is in high range operating mode. .
5. Indicates the power supply is in output mode.

### B-1. When the positive and the negative channels are in stand by mode (LPS-304):



1. Indicates both the positive and the negative channels are in stand by mode, no output.
2. Indicates the positive channel output voltage is set at 26.93V DC.
3. Indicates the negative channel output voltage is set at -27.76V DC.
4. Indicates the positive channel is in constant voltage mode. When the square dot annunciator flashes, the channel is in the output setting mode.
5. Indicates the negative channel is in constant voltage mode.
6. Indicates the negative channel is independent from positive channel.
7. Indicates the constant 5V channel is in output mode.




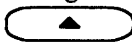


### B-2. When the positive and the negative channels are in output mode (LPS-304):




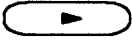


1. Indicates the positive channel is outputting 26.93 V 0.050A.
2. Indicates the negative channel is outputting -17.73V 0.120A.
3. Indicates the positive channel is in constant voltage mode.
4. Indicates the negative channel is in constant voltage mode.
5. Indicates the negative channel is independent from positive channel.
6. Indicates the constant 5V channel is in stand by mode.


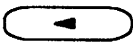

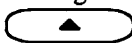
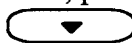

## 2.3 How To Set Voltage/Current

### A. When the power supply is in stand by mode.

1. Press  key to toggle between voltage setting and current setting mode. Next, press  or  key to select the digit to be varied, then press  or  key to choose the desired value. At last, press  till the cursor disappeared to lock in the selected value.

### B. When the power supply is in output mode.

1. If in CV mode, use cursor arrow keys  or  and then up/down keys  or  to directly set the voltage value. If in CC mode, use the cursor arrow keys and the up down keys to directly set the current value.

2. Or .Press  key to toggle between voltage setting and current setting mode. Next, press  or  key to select the digit to be varied, then press  or  key to choose the desired value. At last, press  till the cursor disappeared to lock in the selected value.

## 3. OPERATING CHARACTERISTICS AND CONFIGUATIONS

### 3.1 INTRODUCTION

These sections contain summary information on operating characteristics and how to configure the LPS series. The topics included are operating ranges, load consideration, parallel/series operation and tracking operation

### 3.2 OPERATING RANGES

All power supplies operate in either constant voltage (CV) or constant current (CC), over the rated output . Their respective voltage and current operating locus (figure 4.2) are found in operating quadrants for all models. The power supply acts as a constant voltage source for comparatively large values of load resistance and as a current source for comparatively small values of load resistance. The automatic crossover or transition between these two modes of operations occurs at a critical stage or "crossover" value of load resistance;  $R_C = E_S / I_S$ , where  $E_S$  is front panel voltage setting and  $I_S$  front panel current setting.

The following are the operating quadrants (current -vs- voltage) of the power supplies.

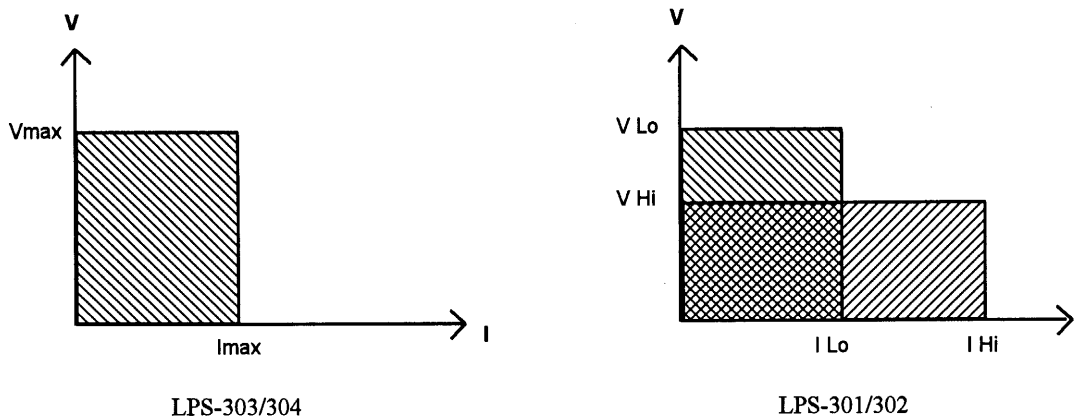


Figure 3.2. Operating Quadrants

### 3.3 LOAD CONSIDERATION AND CONNECTING MULTIPLE LOADS

When the power supply is being connected with multiple loads to the output, connect each load to the output terminal using separate load leads. This minimizes mutual coupling effects and takes full advantages of the supply's low output resistance. Each pair of wires should be as short as possible and twisted or bundled to reduce lead inductance and noise pickup.

If cabling considerations require the use of distribution terminals that are located remotely from the supply, connect the power supply output terminals to the remote distribution terminals by a pair of twisted or bundled wires. Connect each load to the distribution terminals separately.

**OUTPUT ISOLATION:** The output of the power supply is isolated from earth ground. Either output terminal may be grounded, or an external source of voltage may be connected between either output and ground. However, both output terminals must be kept within +/-240Vdc of ground. An earth ground terminal is provided on the front panel terminal block.

Each of the power supplies will operate accordingly to the various types of loads connected to the output.

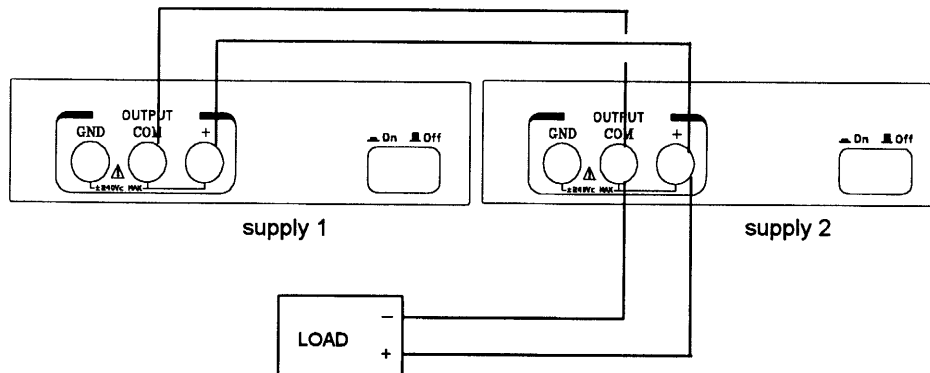
**CAPACITANCE LOADING:** In normal conditions, the supply will be stable for almost any size load capacitance. However, large load capacitance may cause ringing in the supply's transient response. It is even possible that certain combinations of capacitance and ESR (equivalent series resistance) will result in instability. If this is the case, the solution is to increase or decrease total load capacitance.

### 3.4 PARALLEL CONNECTION OPERATION

**NOTE:** Power supplies equipped with SCR crowbars should not be used in series or parallel with each other unless a master-slave interconnection is employed and their crowbars interlock.

Greater current capability can be achieved by connecting outputs in parallel. However, only power supplies which have equivalent voltage and current output ratings may be connected in parallel. Otherwise, damage to the unit may result.

A typical connection is shown in figure 4.4 through the front of two LPS-301. All leads are kept as short as possible and are bundled together. The CV and CC operations have identical setup.



**Figure 3.4 Parallel Configuration**

### 3.4.1 CV OPERATION

Although both outputs operate independently of each other in CV operation, one of the outputs must dominate (control) over the other. Additionally, the dominant output must operate in CV mode, while the other output may operate in CC mode.

As an example of this operation, let's assume in figure 4.4 that supply 2 operates in CC mode and supply 1 operates in CV mode. Perform the following steps:

1. Set supply 2 to the maximum output voltage of desired range.
2. Set supply 1 to the desired operating voltage.

The voltage of supply 1 controls the voltage across the load. The output currents are algebraic sums of the individual outputs.

### 3.4.2 CC OPERATION

The CC operation is similar in many ways to the CV operation, except that the output current must also be set. To obtain CC operation, perform the following steps:

1. Program output voltage of the two supplies to the desired operating voltage.
2. Program supply 1 to one-half the desired operating current.
3. Program supply 2 to one-half the desired operating current.

Both outputs operate in CC mode.

### 3.5 SERIES CONNECTION OPERATION

NOTE: Power supplies equipped with SCR crowbars should not be used in series or parallel with each other unless a master-slave interconnection is employed and their crowbars interlock.

Greater output voltage capability can be obtained by connecting outputs in series. A note of caution, since current is the same in each element of a series circuit, both outputs need identical rated currents. If this is not followed, excessive current may be forced into one of the outputs and cause a failure.

Figure 3.5 illustrates the Series configuration on a LPS-304

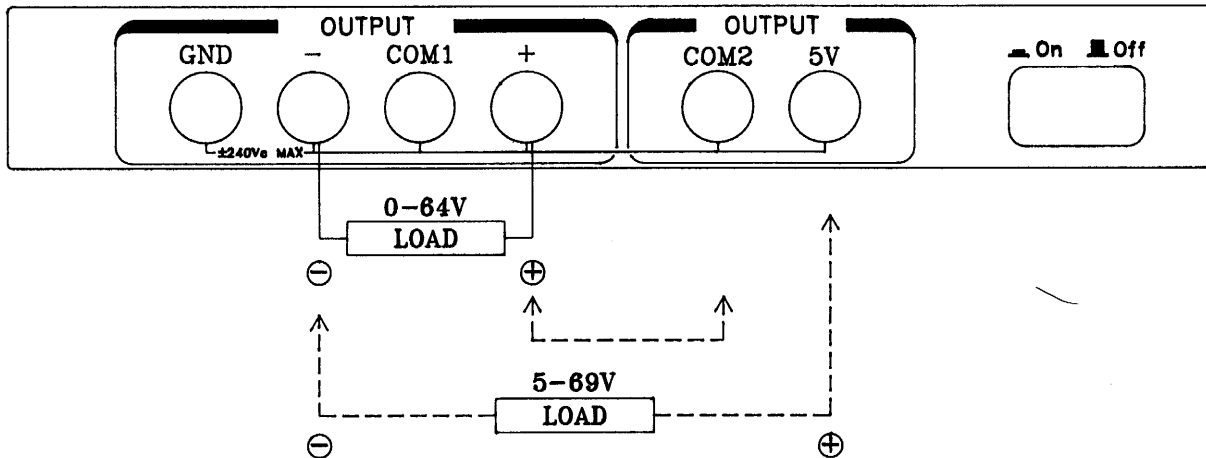


Figure 3.5 Series Configuration

#### 3.5.1 CV OPERATION

In CV operation, first program the current of both outputs to the desired value. Secondly, program the desired operating voltage to equal the sum of the output voltages.

#### 3.5.2 CC OPERATION

In CC operation, one output will operate in CV mode, the other in CC mode. To obtain this operation, perform the following:

1. Program the output current of the two channels to the desired operating current.
2. Program output positive channel to one-half the desired operating voltage.
3. Program output negative channel to one-half the desired operating voltage.

At load levels less than one half the total voltage limit, the output that was originally in CC mode, stays in CC mode.

At load voltages greater than one-half the total voltage limit, the output that was originally in CC mode, changes to CV mode. The secondary output will regulate the current in CC mode and provide the necessary voltage.

### 3.6 TRACKING OPERATION (LPS-304)

LPS-304 has extra capability of tracking since it has two output channels. When the tracking mode is enabled, voltage and current output of negative channel is in sync. with positive channel and is controlled by the positive channel. For instance, an one volt step up in positive channel would also cause a one volt step up in negative channel.

If a positive and negative supply is desired (e.g. op-amp application) use the output connector pair connected as in circuit common. Positive channel provides +V, negative channel provides -V and COM1 connects to ground.

**WARNING:** Under certain circumstances, potentials as low as 24 volts can cause severe injury or even death from electrocution. Please observe proper safety precautions when using such output voltages.

### 3.7 RANGE OPERATION (LPS-301/302)

The models LPS-301 and LPS-302 have two (HI/LO) operating ranges. These ranges are switched automatically by the power supplies. When low range is active the square dot annunciator in the LCD will point to LO RNG. When high range is active the square dot annunciator will point to HI RNG.

## 4. USER MAINTENANCE/SERVICE

### 4.1 Fuse Replacement

If the fuse is suspected of being defective, it should be inspected and, if necessary, replaced. To inspect or replace the fuse, please perform the following steps:

- (1) Disconnect the AC line cord from the unit to reduce electrical shock hazard.
- (2) Remove the fuse by sliding out the fuse holder. The fuseholder is beneath the AC Receptacle. Test the fuse for electrical continuity with any ohmmeter.
- (3) If the fuse is found to be defective, replace it with a replacement fuse as specified in the label on the rear panel.
- (4) Replace the fuse in the fuseholder and re-install.
- (5) Reconnect the AC power cord.

**NOTE: USE OF ANY FUSE OTHER THAN THE ONE SPECIFIED MAY CAUSE DAMAGE TO THE UNIT, POSE A SEVERE FIRE HAZARD, AND WILL VOID THE WARRANTY.**

### 4.2 In Case Of Difficulties

This power supply has been designed to be accurate, reliable, and easy-to-use. However, it is possible that you may experience difficulties during operation. If there appears to be any kind of problem during use of the unit, please perform the following steps to help determine the cause:

- (1) Re-read the operating instructions. It is very easy to inadvertently make mistakes in operating procedure.
- (2) Remove and test the fuse. The power supply will not function with an open fuse.

If the preceding two steps fail to resolve the problem, please call your local distributors.

**NOTE: ATTEMPTED REPAIR, MODIFICATIONS, OR TAMPERING BY UNAUTHORIZED PERSONNEL WILL VOID THE WARRANTY.**

## 5. USING THE RS-232-C SERIAL INTERFACE

This section describes how to set up the RS-232-C interface for remote control.

The Interface of LPS-300 Series are designed in accordance with EIA (Electronic Industries Association) standard RS-232-C. Through its interface the LPS-300 Series can be remotely controlled and transmit its internal data to a host computer.

Command	Description	Example
VSET	Voltage setup	VSET1 12.345
VOUT	Voltage readback	VOUT2
ISET	Current setup	ISET2 1.23
IOUT	Current readback	IOUT1
OUT	0=+/- output off 1=+/- output on	OUT0 OUT1
TRACK	0=independent 1=tracking from ch1 2=tracking from ch2	TRACK0 TRACK1 TRACK2
STATUS	Working status (see note7)	STATUS
CALI	0=end calibration 1=begin calibration 2=input calibration parameter	CALI0 CALI1 CALI2 9.574
MODEL	Display model no.	MODEL
VERSION	Display version no.	VERSION
HELP	Display command list	HELP
BEEP	0=beeper function disable 1=beeper function enable 2=force beeper alarm 3=beeper alarm off	BEEP0 BEEP1 BEEP2 BEEP3
VDD	0=digital output off 3=digital output 3.3V 5=digital output 5V	VDD0 VDD3 VDD5
LOWA	0=CC output compensated off 1=CC output compensated on	LOWA0 LOWA1

**NOTE:**

1. All RS232 command are case-nonsensitivity ASCII codes.
2. Use async framing 8 data bits, no parity bit ,1 stop bit.
3. Bit rate=2400bps
4. Every command string is terminated by CR or LF or BOTH (carriage return)
5. There is one command allowable in a command string
6. A command string enter before "OK" prompt will be reject & no function
7. STATUS opratin explanation:  
After a LPS accept A "STAUS" command, it will display a decimal number in ASCII  
Convert this decimal number to binary form. each bit indicate a action/status:

bit 0: channel 1 o=c v l=CC

bit 1: channel 2 o=c v l=CC

bit 3,2: 00: independent  
10: tracking to channel 1  
11 :tracking to channel 2

bit 4: 0 : digital output off  
1: digital output on

bit 5: 0: digital output 5V  
1:digital output 3.3V

bit 6: 0: output off  
1: output on

bit 7: 0=nothing  
1 =digital output overload

bit 8: 0=fanoff 1=~~fan~~ on

bit 9: 0=beeper function disbale  
1=beeper function enable

bit 10: 0=CC output compensated off  
1=CC output compensated on



Calibration For LPS 301-304

Equipment needed for calibration: DMM, such as Fluke model 46 or HP 3479A

Step 1: Simultaneously press  $\boxed{V / I}$  and  $\boxed{\blacktriangledown}$  keys to enter calibration mode.

Step 2: Measure the DC voltage from the positive channel output terminals (+ and COM1) with DMM, and then use the arrow keys to enter the measured value as the +V Lo,

Step 3: Repeat step 2. Enter the measured value as +V Hi.

Step 4: Measure the DC current from positive channel output terminals with the DMM and enter the measured current value as +I Lo.

Step 5: Repeat step 4. Enter the measured value as +I Hi.

(For LPS-304 Only)

Step 6: Measure the DC voltage from negative channel output terminals (- a; COM1) with the DMM, and enter the measured value as -V Lo.

Step 7: Repeat step 6. Enter the measured value- as -V Hi.

Step 8: Measure the DC current from negative channel output terminals with the DMM and enter the measured current value as -I Lo.

Step 9: Repeat step. 8. Enter the measured value as -I Hi. Calibration is completed.'

NOTE: If Error #0002 appear on the LCD after inputting calibration parameter please make sure all the calibration parameters are correct-and the re-enter them again.