

# INSTRUCTION MANUAL

## DC POWER SUPPLY

### 2000 Series



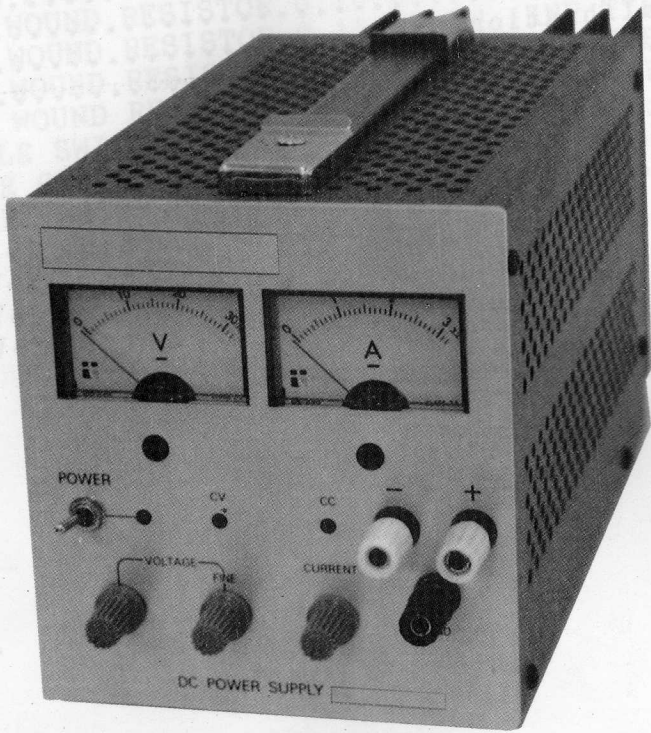
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- Circuit Diagrams
- Component Layout Diagrams
- Mechanical Assembly Drawings
- Specifications
- Parts list

TABLE of CONTENTS

Picture of Model 2000 .....	1
Introduction.....	2
Before We Begin.....	2
Front Panel of Model 2000 Series.....	3
Front Panel Description.....	4
Operating Instructions.....	5
Operating Cautions.....	5
Block Diagram.....	6
Maintenance & Calibration.....	7
Troubleshooting.....	8
Circuit Diagrams	
Component Layout Diagrams	
Mechanical Assembly Drawings	
Specifications	
Parts list	



## INTRODUCTION

The Model 2000 is a bench top single output power supply. The power supply has two meters for monitoring output voltage and current.

The 2000 will find wide application in schools, laboratories, and commercial engineering and testing departments, as well as with the advanced hobbieist.

## BEFORE WE BEGIN

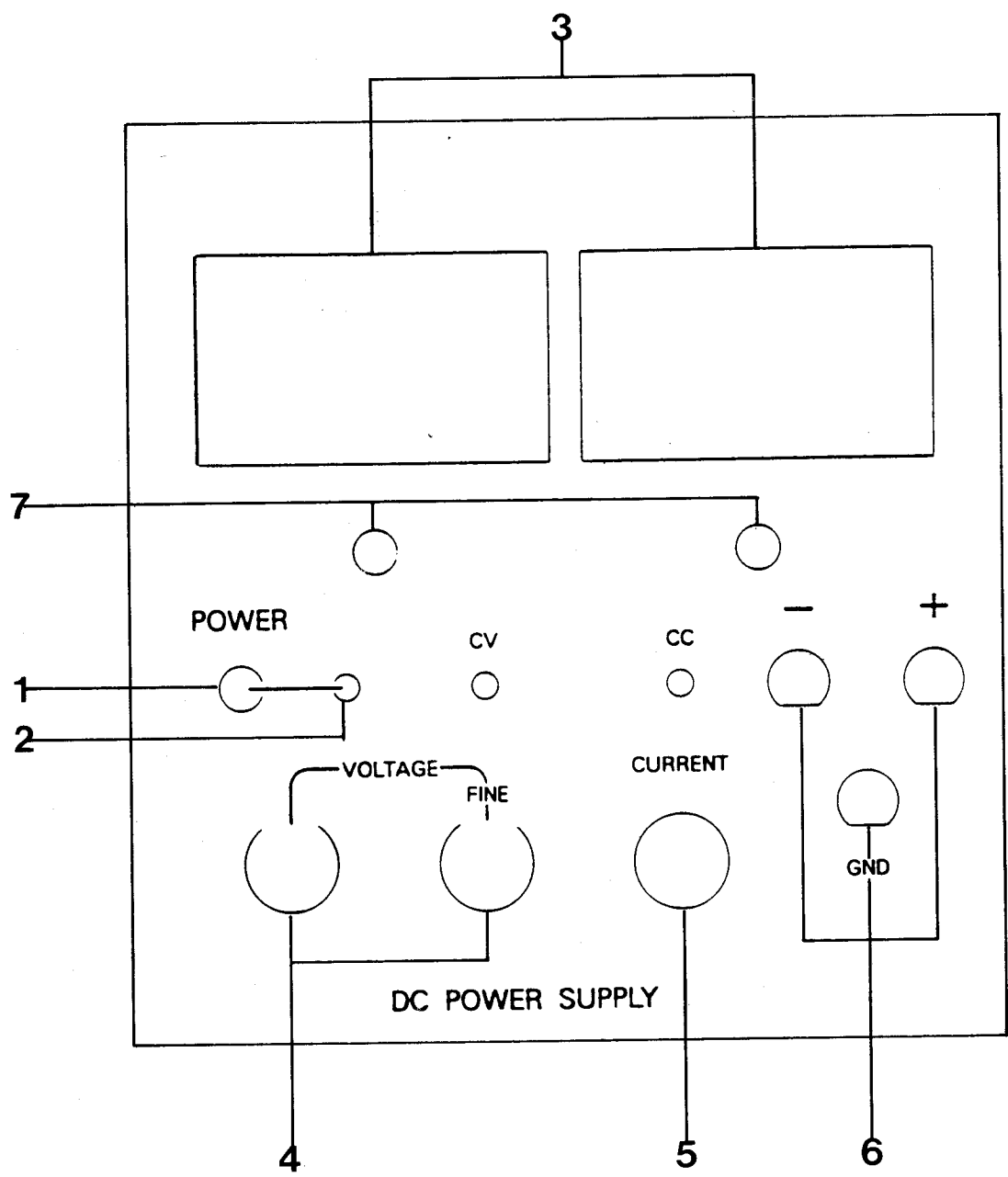
The Model 2000 is packed in styrofoam to protect it during shipment from the factory. You should keep this material, as well as the shipping box, in case your unit must be moved or shipped again.

The box should include the following items:

- Model 2000 Series power supply
- Removeable AC line cord
- Banana plug to Alligator clip cables
- Instruction manual

Please check to see that all of the above items are included.

Figure - 1



## FRONT PANEL DESCRIPTION

The following is the explanation of the function of each of the front panel controls and connectors. You should refer to Figure 1 for the location of each control/connector.

1. **POWER ON** - This is the main power switch.
2. **POWER ON LED** - This LED indicates that the power is on.
3. **VOLTAGE/CURRENT METERS** - These two meters indicate the output voltage and current as measured at the output terminals.
4. **VOLTAGE ADJUST** - These two controls (main & fine - Models 2203, 2302, 2303, 2601 only) adjust the output voltage of the supply.
5. **CURRENT ADJUST** - This control adjusts the output current that the supply will put out.
6. **OUTPUT TERMINALS** - There are three terminals. They represent positive, negative and ground.
7. **METER ZERO** - Each meter has a mechanical screw adjustment for setting the zero point.

## OPERATING INSTRUCTIONS

**WARNING** - Before applying power to your 2000 Series power supply, make sure that the AC input voltage setting SW03 and SW04 on rear panel is correctly set for your available power.

1. Connect the instrument to an AC power source using the line cord provided and turn the POWER ON switch (1) on. For maximum stability, allow the instrument to warm up for at least 20 minutes
2. Set the voltage and current adjustment knobs as you desire.

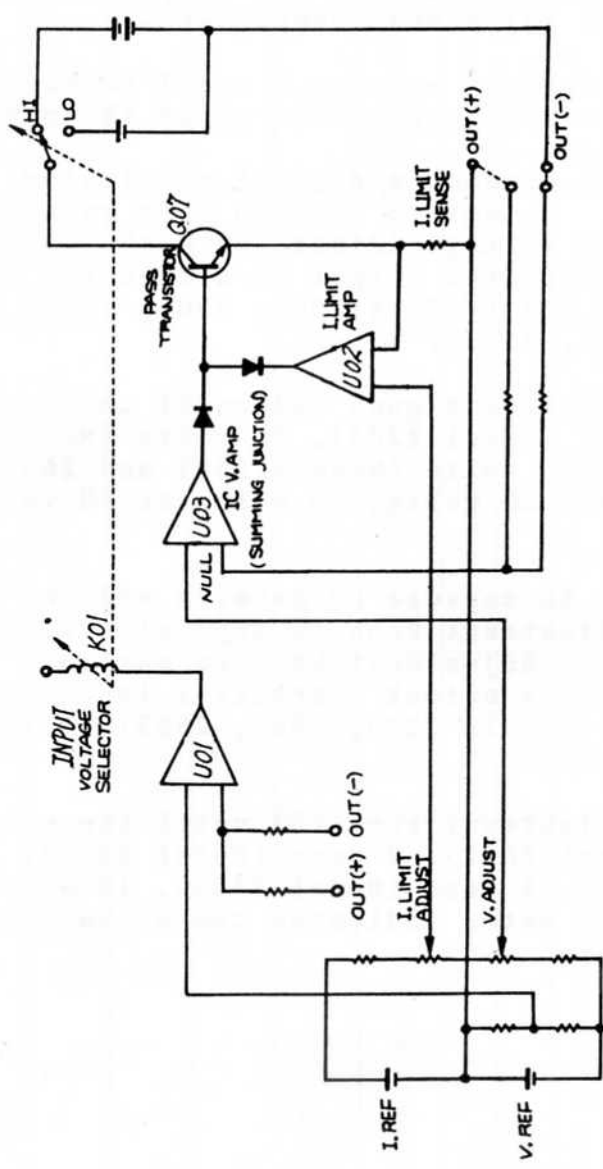
## OPERATING CAUTIONS

Please follow the following cautions when using your Model 2000 Series power supply to prevent damage to the unit.

1. Verify that the AC voltage setting is the same as your available power BEFORE you apply power the instrument.
2. Do not connect a voltage that is greater than the current output voltage to the terminals of the instrument.
3. Do not parallel the output of 2000 series.



REVISION	DATE



DO NOT SCALE THIS DRAWING	TOLERANCE UNLESS SPECIFIED ARE	2000 SERIES BLOCK DIAGRAM
	ANGLES ±	
	DECIMALS ±	DRAWING NO:
	DRAFTER <i>B. L. Hwang</i>	DESIGNER <i>Simon Wang</i>
		APPROVED <i>Simon Wang</i>

1 2 3 4

A B C D E

1 2 3 4

A B C D E

To keep your 2000 Series power supply in top working condition, you should periodically calibrate it. As you follow the adjustment procedure below, refer to the component layout diagrams for the location of the adjustment components.

1. Mechanical zero adjustment - Using a small screwdriver, turn off the power and adjust the four screws under the meters to read zero.
2. Turn on the unit and connect a digital multimeter set to the 200 volt range to the output terminals. Turn the Voltage Adjustment knob (4) fully clockwise. Adjust R33 until the output is within the range 21V -23V (Model 2203), 31V - 33V (Models 2302, 2303, 2306, 23010) or 62V-65V (Models 2601, 2603).
3. Turn the Voltage Adjustment knob (4) until the output voltage is exactly 20 volts (Model 2203), 30 volts (Models 2302, 2303, 2306 and 23010) or 60 volts (Models 2601 and 2603). Adjust R34 until the meter reads 20 volts, 30 volts or 60 volts depending on the model.
4. Set the multimeter to measure DC amperes and the range to 20A. Turn the Voltage Adjustment knob to approximately 25% of full scale and the Current Adjustment knob to maximum. Adjust R32 in order to have a minimum output current: 1.1A (Model 2601), 2.1A (Model 2302), 3.1A (Models 2203, 2303, 2603), 6.1A (Model 2306) or 10.1A (Model 23010).
5. Turn the Current adjustment knob (5) until the output current is exactly 1 amps (Model 2601), 2 amps (Model 2302), 3 amps (Models 2203, 2303, or 2603), 6 amps (Model 2306), 10 amps (Model 23010). Adjust R35 until the meter indicates the above values.

1. Control Section for Power Supply and Correct Reference Voltage

- A. Check to be sure that voltage select switch on bottom rear panel is switched to correct line voltage.
- B. With power on, check CC, CV, and power LED. If there is indication of functional error, turn off power. Then check transformer and fuse on rear panel.
- C. Turn on power again and consult circuit diagram. There are two diode bridge circuits. The upper one from D01 to D04 is for the main power source. The lower one from D05 to D08 is for the control circuit and the reference voltage generator.
- D. Check to be sure that the Q05 emitter is set at a positive reading of  $9.6V \pm 10\%$  and that the Q06 emitter is set at a negative reading of  $11.5V \pm 10\%$ . The DMM GND (negative) clip must be clipped to the main output (positive) terminal.
- E. Check CR03 to be sure that CR03 shows a positive reading of  $3.3V \pm 10\%$  and that CR04 shows a negative reading of  $8.2V \pm 10\%$

2. Voltage Control Circuit

- A. Turn the voltage verniers (main and fine) to minimum and the current vernier to maximum. Check to be certain that the U03 pin 6 shows a reading of from  $-5V$  to  $-12V$ .
- B. Then turn the voltage vernier to maximum and check to see that U03 pin 6 shows a reading of  $+2V \pm 20\%$ .
- C. Please note that the positive voltage control current passes through Q01, Q02, and Q07.
- D. The voltage meter is controlled by the voltage verniers.

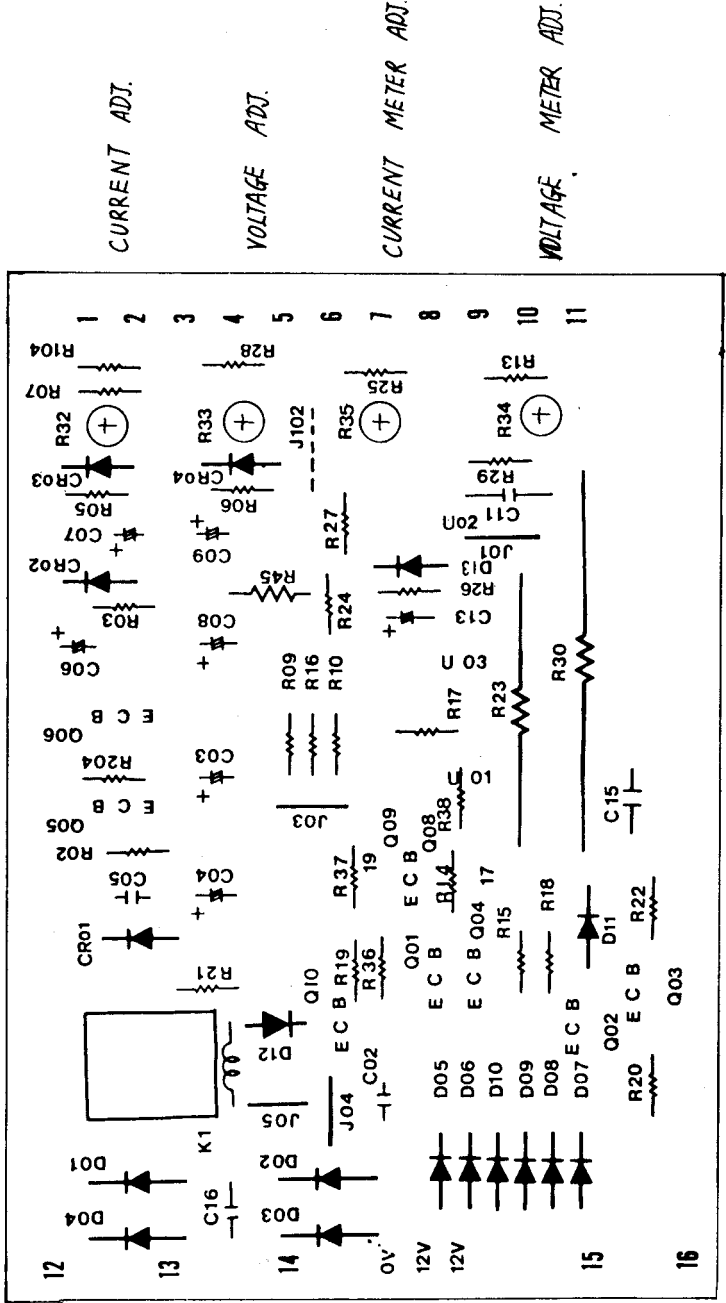
### 3. Current Control Circuit

- A. Turn the current vernier to minimum. Check to be sure that the U02 output shows a reading of from -5V to -9V.
- B. Turn both voltage verniers to maximum.
- C. Connect the positive output terminal and the negative output terminal with a 5 Ohm 50W resistor or similar component.
- D. The current meter is controlled by the current vernier.

### 4. Relay Circuit and the CC and CV LED

- A. The U01 relay control IC is controlled by the output voltage. At approximately half of maximum output the relay will change state. Please note that with specially ordered power supplies there may be a four state relay change.
- B. The CC LED is controlled by the constant current mode. Otherwise it will be controlled by the constant voltage mode.

REVISION	DATE



CURRENT ADJ.

VOLTAGE ADJ.

CURRENT METER ADJ.

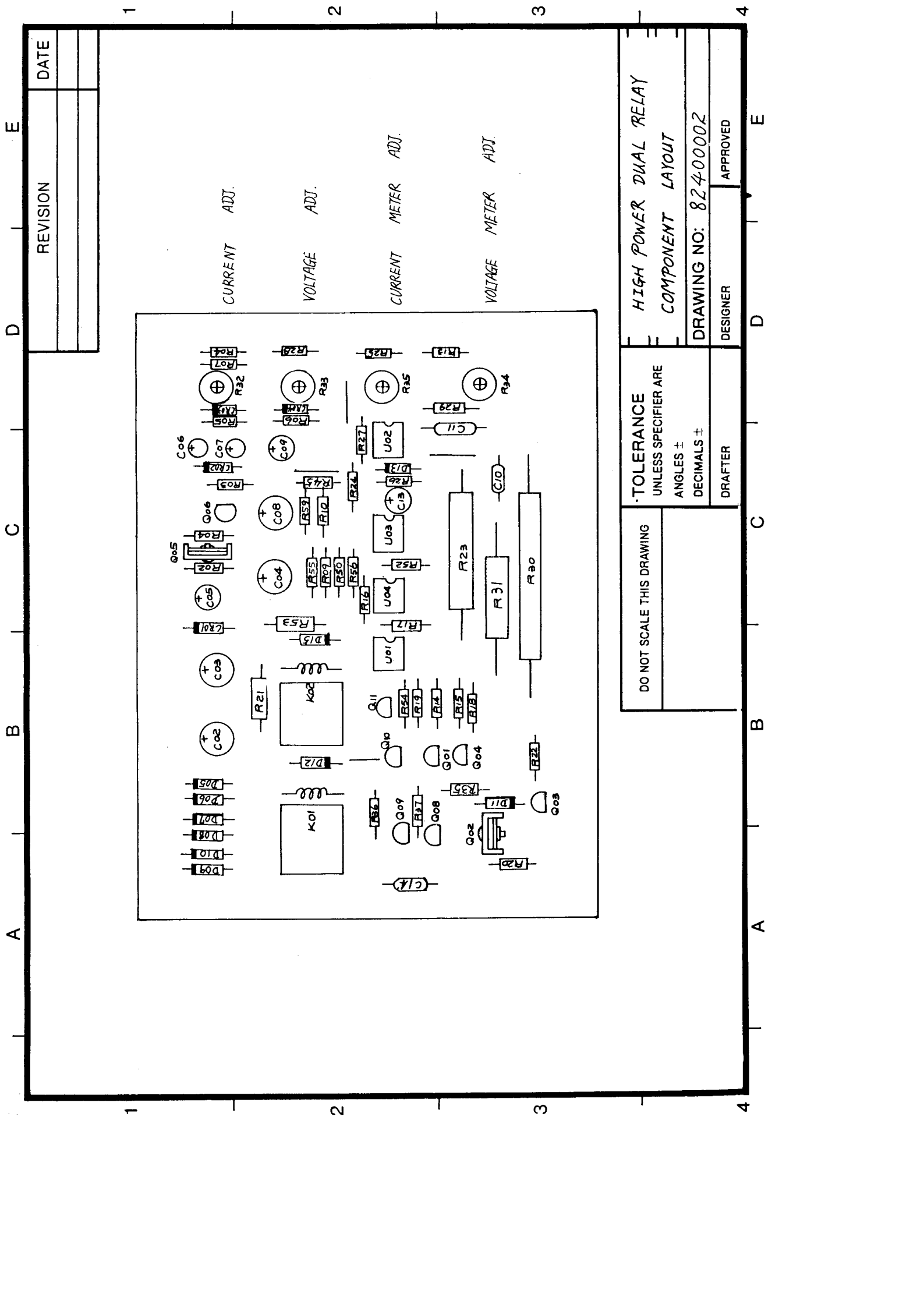
VOLTAGE METER ADJ.

DO NOT SCALE THIS DRAWING	TOLERANCE UNLESS SPECIFIER ARE
	ANGLES ±
	DECIMALS ±
	DRAFTER
	DESIGNER
	APPROVED

POWER SUPPLY LOW POWER SERIES

COMPONENT LAYOUT

DRAWING NO: 824-00001



REVISION	DATE

HIGH POWER DUAL RELAY	
COMPONENT LAYOUT	
DRAWING NO: 82400002	
DESIGNER	APPROVED

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 DRAFTER

CURRENT METER ADJ.

VOLTAGE METER ADJ.

CURRENT METER ADJ.

VOLTAGE METER ADJ.

SPECIFICATIONS

Mode	2203	2303	2302	2306	2603	2601	23010
Output DC Voltage DC Current	0-20V 0-3A	0-30V 0-3A	0-30V 0-2A	0-30V 0-6A	0-60V 0-3A	0-60V 0-1A	0-30V 0-10A
Loading Effect (Load Regulation)	0.02% + 5mV 0.02% + 5mA						
Source Effect (line Regulation)	0.02% + 2mV 0.02% + 0.25mA						
PAR (Ripple & Noise) At Any Line Voltage	0.5mV(rms), 4mV(p-p) 0.5mA(rms), 4mA(p-p)						
Input 110V/120V/220V/240V + 10%	1A 115W 60Hz	1.5A 120W 60Hz	1.1A 120W 60Hz	2.2A 260W 60Hz	3.1A 340W 60Hz	1.2A 135W 60Hz	5.1A 560W 60Hz
Dimensions: (Width, Height, Depth in mm)	125*140*303 125*140*303 125*140*303 250*140*363 250*140*363 125*140*303 250*140*363						
Weight : (in Kg)	4.9 5 4.5 9.2 8.6 4.5 13.2						
Accessory : ACS-002 (Banana-Clip)	1 1 1 1 1 1 1						
Operating Temperature Range	0 C to 40 C in Operation -20 C to 55 C in Storage						

Notes: CV=Constant Voltage, CC=Constant Current  
Input voltage can be factory-modified to meet different country.

## PARTS LIST -- LOW POWER SERIES

Most parts of 2203,2302,2303,2601 are the same, except those marked with '#'. The following table specifies the difference between these models.

PART	MODEL			
	2203	2302	2303	2601
C001	3300U/75V	2200U/75V	3300U/75V	2200U/75V
C013	2.2U/50V	2.2U/50V	2.2U/50V	2.2U/100V
C016	0.47U/100V	0.47U/100V	0.47U/100V	0.47U/250V
D001-004	TIE 620	1N5402	TIE 620	1N5402
Q007	2N3772	2N3772	2N3772	2SD873
R006	390	390	390	150
R007	2.7K	5.1K	2.7K	13K
R013	18K	27K	27K	60.4K
R016	270K	270K	270K	150K
R017	120K	300K	300K	470K
R025	330	270	330	47
R028	6.8K	4.7K	4.7K	4.7K
R029	15K	15K	15K	33K
R030	3K/5W	3K/5W	3K/5W	5.6K/3W
R032	3.3KB	2.2KB	2.2KB	10KB



Location	Description
C 001	ELECTROLYTIC CAPACITOR 3300UF 75V +80%~-20%
C 002	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 003	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 004	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 005	ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 006	ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 007	ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 008	ELECTROLYTIC CAPACITOR 1000UF 16V +80%~-20%
C 009	ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 011	MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 012	ELECTROLYTIC CAPACITOR 220UF 50V +80%~-20%
C 013	ELECTROLYTIC CAPACITOR 2.2UF 50V +80-20%
C 015	MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 016	MYLAR CAPACITOR 0.47UF 100V 10%
CRO01	ZENER DIODE 10V 5% 0.5W
CRO02	ZENER DIODE 12V 5% 0.5W
CRO03	ZENER DIODE 3.3V 5% 0.5W
CRO04	ZENER DIODE 8.2V 5% 0.5W
D 001	DIODE D-620 6A 200V
D 002	DIODE D-620 6A 200V
D 003	DIODE D-620 6A 200V
D 004	DIODE D-620 6A 200V
D 005	DIODE 1N4002 100V 1A
D 006	DIODE 1N4002 100V 1A
D 007	DIODE 1N4002 100V 1A
D 008	DIODE 1N4002 100V 1A
D 009	DIODE 1N4002 100V 1A
D 010	DIODE 1N4002 100V 1A
D 011	DIODE 1N4148 75V 100mA
D 012	DIODE 1N4002 100V 1A
D 013	DIODE 1N4002 100V 1A
D 014	DIODE 1N4002 100V 1A
DS001	LED CS-0311-4 (RED) 5mm ROUND
DS002	LED CS-0311-4 (RED) 5mm ROUND
DS003	LED CS-0311-4 (RED) 5mm ROUND
F 001	FUSE 2A L=30mm D=6.5mm
K 001	RELAY 12V 5A 2POLES EMI 6 PIN 250VAC
Q 001	TRANSISTOR 2SC1815 GR
Q 002	TRANSISTOR 2SC2270B OR 2SC2270C
Q 003	TRANSISTOR 2SC1815 GR
Q 004	TRANSISTOR 2SA1015 GR
Q 005	TRANSISTOR 2SC2270B OR 2SC2270C
Q 006	TRANSISTOR 2SA1015 GR
Q 007	TRANSISTOR 2N3772 TO-3 type
Q 008	TRANSISTOR 2SA1015 GR
Q 009	TRANSISTOR 2SA1015 GR
Q 010	TRANSISTOR 2SA1015 GR

Location	Description
R 002	CARBON FILM RESISTOR 470 1/4W 5%
R 003	CARBON FILM RESISTOR 470 1/4W 5%
R 004	CARBON FILM RESISTOR 470 1/4W 5%
R 005	CARBON FILM RESISTOR 300 1/4W 5%
R 006	CARBON FILM RESISTOR 390 1/4W 5%
R 007	CARBON FILM RESISTOR 2.7K 1/4W 5%
R 008	VR 1KB D=24mm B-type WIRING-type NO TEETH SHAFTER=20R
R 009	CARBON FILM RESISTOR 680K 1/4W 5%
R 010	CARBON FILM RESISTOR 100K 1/4W 5%
R 012	VR 10KB D=24mm B-type WIRING-type NO TEETH SHAFTER=20R
R 013	CARBON FILM RESISTOR 27K 1/4W 5%
R 014	CARBON FILM RESISTOR 470 1/4W 5%
R 015	CARBON FILM RESISTOR 470 1/4W 5%
R 016	CARBON FILM RESISTOR 270K 1/4W 5%
R 017	CARBON FILM RESISTOR 300K 1/4W 5%
R 018	CARBON FILM RESISTOR 100 1/4W 5%
R 019	CARBON FILM RESISTOR 2.7K 1/4W 5%
R 020	CARBON FILM RESISTOR 100 1/2W 5%
R 021	CARBON FILM RESISTOR 100 1W 5%
R 022	CARBON FILM RESISTOR 100 1/4W 5%
R 023	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 024	CARBON FILM RESISTOR 10K 1/4W 5%
R 025	CARBON FILM RESISTOR 270 1/4W 5%
R 026	CARBON FILM RESISTOR 100 1/4W 5%
R 027	CARBON FILM RESISTOR 10K 1/4W 5%
R 028	CARBON FILM RESISTOR 4.7K 1/4W 5%
R 029	CARBON FILM RESISTOR 15K 1/4W 5%
R 030	METAL OXIDE FILM RESISTOR 3K 10% 5W
R 032	SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)
R 033	SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)
R 034	SVR 10KB CARBON FILM D=10mm (RIVER 10-C)
R 035	SVR 220B CARBON FILM (RIVER 10-C)
R 036	CARBON FILM RESISTOR 470 1/4W 5%
R 037	CARBON FILM RESISTOR 470 1/4W 5%
R 038	CARBON FILM RESISTOR 2K 1/4W 5%
R 039	VR 1KB D=24mm B-type WIRING-type NO TEETH SHAFTER=20R
S 001	TOGGLE SWITCH 3PIN 5A 125V (C&K 7101)
S 003	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10)
S 004	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10)
U 001	IC 741 OP-AMP
U 002	IC 741 OP-AMP
U 003	IC 741 OP-AMP

## PARTS LIST -- HIGH POWER DUAL RELAY SERIES

Most parts of 2306,2603,23010 are the same, except those marked with '#'. The following table specifies the difference between these models.

PART	MODEL		
	2306	2603	23010
C01	8200U/75V	4700U/100V	6800U/75V
D16	NONE	NONE	1N4002
D17	NONE	NONE	1N4002
K03	NONE	NONE	RELAY
K04	NONE	NONE	RELAY
Q13	NONE	NONE	2SD873
Q14	NONE	NONE	2SD873
R07	2.2K	2.7K	2.2K
R09	10K	68K	10K
R13	27K	56K	27K
R16	22K	27K	22K
R17	27K	38.3K	27K
R21	100	100	33
R25	470	330	330
R29	15K	33K	15K
R30	3K/5W	5.6K/3W	3K/5W
R31	0.15/5W	NONE	0.15/5W

Location Description

#	Location	Description
C 001		ELECTROLYTIC CAPACITOR 6800UF 75V 80%~-20%
C 002		ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 003		ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 004		ELECTROLYTIC CAPACITOR 1000UF 25V +80%~-20%
C 005		ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 006		ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 007		ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 008		ELECTROLYTIC CAPACITOR 1000UF 16V +80%~-20%
C 009		ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 010		MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 011		MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 012		ELECTROLYTIC CAPACITOR 100UF 100V +80%~-20%
C 013		ELECTROLYTIC CAPACITOR 2.2UF 100V +80% ~ -20%
C 014		MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 016		MYLAR CAPACITOR .47UF 250V 10% (MD TYPE)
C 017		MYLAR CAPACITOR 0.0022UF 250V 10%
CR001		ZENER DIODE 10V 5% 0.5W
CR002		ZENER DIODE 12V 5% 0.5W
CR003		ZENER DIODE 3.3V 5% 0.5W
CR004		ZENER DIODE 8.2V 5% 0.5W
D 005		DIODE 1N4002 100V 1A
D 006		DIODE 1N4002 100V 1A
D 007		DIODE 1N4002 100V 1A
D 008		DIODE 1N4002 100V 1A
D 009		DIODE 1N4002 100V 1A
D 010		DIODE 1N4002 100V 1A
D 011		DIODE 1N4148 75V 100mA
D 012		DIODE 1N4002 100V 1A
D 013		DIODE 1N4002 100V 1A
D 014		DIODE 1N4002 100V 1A
D 015		DIODE 1N4002 100V 1A
D 016		DIODE 1N4002 100V 1A
D 017		DIODE 1N4002 100V 1A
DB001		DIODE BRIDGE 35A 200V
DS001		LED CS-0311-4 (RED) 5mm ROUND
DS002		LED CS-0311-4 (RED) 5mm ROUND
DS003		LED CS-0311-4 (RED) 5mm ROUND
F 001		FUSE 6A L=30mm D=6.5mm
K 001		RELAY 12V 160OHM 2POLES SRET 10A (SRET-202 DP5)
K 002		RELAY 12V 160OHM 2POLES SRET 10A (SRET-202 DP5)
K 003		RELAY 12V 160OHM 2POLES SRET 10A (SRET-202 DP5)
K 004		RELAY 12V 160OHM 2POLES SRET 10A (SRET-202 DP5)
Q 001		TRANSISTOR 2SC1815 GR
Q 002		TRANSISTOR 2SC2270B OR 2SC2270C
Q 003		TRANSISTOR 2SC1815 GR
Q 004		TRANSISTOR 2SA1015 GR
Q 005		TRANSISTOR 2SC1096

Location Description

# R 053	CARBON FILM RESISTOR 33 5% 1W
R 054	CARBON FILM RESISTOR 2.7K 1/4W 5%
R 055	CARBON FILM RESISTOR 68K 1/4W 5%
R 056	CARBON FILM RESISTOR 10K 1/4W 5%
R 057	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 058	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
# R 059	METAL FILM RESISTOR 6.04K 1/4W 1%
R 065	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 066	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 067	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 068	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
S 001	TOGGLE SWITCH 3PIN 5A 125V (C&K 7101)
S 003	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10)
S 004	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10)
U 001	IC 741 OP-AMP
U 002	IC 741 OP-AMP
U 003	IC 741 OP-AMP
U 004	IC 741 OP-AMP

Location Description

Q 006 TRANSISTOR 2SA1015 GR  
Q 007 TRANSISTOR 2SD873  
Q 008 TRANSISTOR 2SA1015 GR  
Q 009 TRANSISTOR 2SA1015 GR  
Q 010 TRANSISTOR 2SA1015 GR  
Q 011 TRANSISTOR 2SA1015 GR  
Q 012 TRANSISTOR 2SD873  
Q 013 TRANSISTOR 2SD873  
Q 014 TRANSISTOR 2SD873  
R 002 CARBON FILM RESISTOR 470 1/4W 5%  
R 003 CARBON FILM RESISTOR 470 1/4W 5%  
R 004 CARBON FILM RESISTOR 470 1/4W 5%  
R 005 CARBON FILM RESISTOR 2K 1/4W 5%  
R 006 CARBON FILM RESISTOR 390 1/4W 5%  
#R 007 CARBON FILM RESISTOR 2.2K 1/4W 5%  
R 008 VR 1KB D=24mm B-type WIRING-type NO TEETH SHAFTER=20R  
#R 009 CARBON FILM RESISTOR 10K 1/4W 5%  
R 010 CARBON FILM RESISTOR 15K 1/4W 5%  
R 012 VR 10KB D=24mm B-type WIRING-type NO TEETH SHAFTER=20R  
#R 013 CARBON FILM RESISTOR 27K 1/4W 5%  
R 014 CARBON FILM RESISTOR 470 1/4W 5%  
R 015 CARBON FILM RESISTOR 470 1/4W 5%  
#R 016 CARBON FILM RESISTOR 22K 1/4W 5%  
#R 017 CARBON FILM RESISTOR 27K 1/4W 5%  
R 018 CARBON FILM RESISTOR 100 1/4W 5%  
R 019 CARBON FILM RESISTOR 2.7K 1/4W 5%  
R 020 CARBON FILM RESISTOR 100 1/2W 5%  
#R 021 CARBON FILM RESISTOR 33 5% 1W  
R 022 CARBON FILM RESISTOR 100 1/4W 5%  
R 023 WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)  
R 024 CARBON FILM RESISTOR 10K 1/4W 5%  
#R 025 CARBON FILM RESISTOR 330 1/4W 5%  
R 026 CARBON FILM RESISTOR 100 1/4W 5%  
R 027 CARBON FILM RESISTOR 10K 1/4W 5%  
R 028 CARBON FILM RESISTOR 4.7K 1/4W 5%  
#R 029 CARBON FILM RESISTOR 15K 1/4W 5%  
#R 030 METAL OXIDE FILM RESISTOR 3K 10% 5W  
#R 031 WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)  
R 032 SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)  
R 033 SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)  
R 034 SVR 10KB CARBON FILM D=10mm (RIVER 10-C)  
R 035 SVR 220B CARBON FILM (RIVER 10-C)  
R 036 CARBON FILM RESISTOR 470 1/4W 5%  
R 037 CARBON FILM RESISTOR 470 1/4W 5%  
R 038 CARBON FILM RESISTOR 2K 1/4W 5%  
#R 050 CARBON FILM RESISTOR 15K 1/4W 5%  
#R 052 CARBON FILM RESISTOR 30K 1/4W 5%

