UNICO 1100 SERIES

SPECTROPHOTOMETER

Model 1100 Spectrophotometer
Model 1100RS Spectrophotometer

SERVICE MANUAL

UNITED PRODUCTS & INSTRUMENTS INC.

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MANUFACTURER OF QUALITY OPTICAL SYSTEMS

CONTENTS

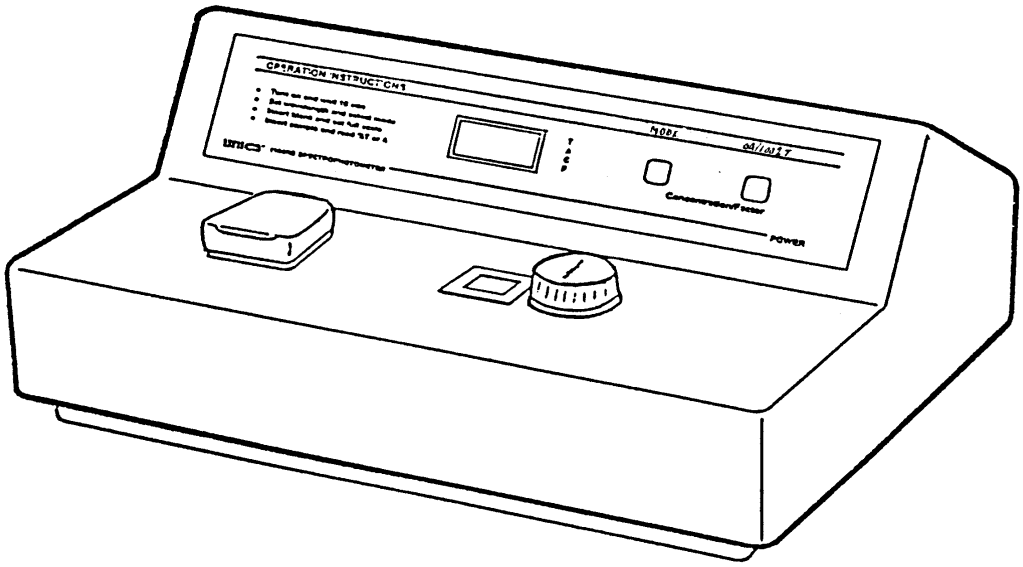
1. GENERAL

1.1 INTRODUCTION

The UNICO model 1100 Series spectrophotometers are single beam general purpose instruments designed for use in conventional laboratories. The instruments are ideal for various applications such as: Clinical Chemistries, Biochemistry, Food and Beverage Laboratories, Environmental Protection, Water and Waste Water Labs and other fields of quality control.

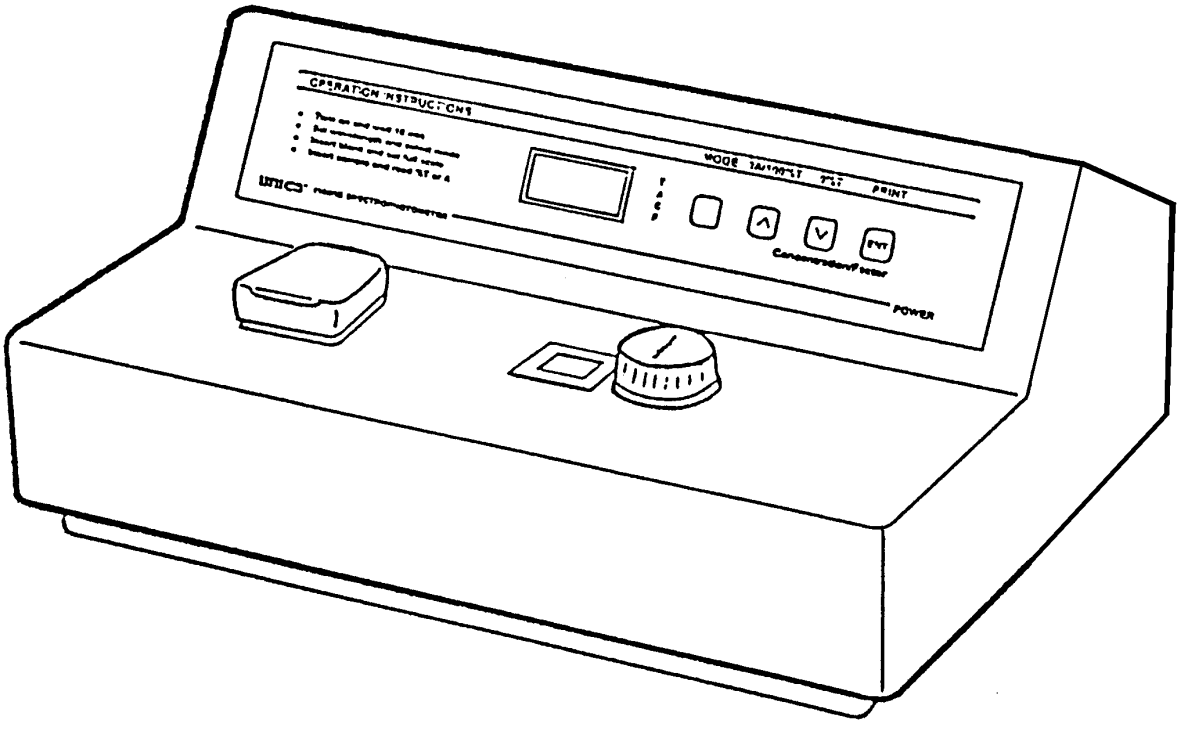
The UNICO 1100 Series spectrophotometers cover the visible wavelength range from 335nm to 1000nm. The analytical grating system has 1200 lines/mm for higher dispersion of the spectrum.

Figure 1-1.1



UNICO Model 1100 Spectrophotometer

Figure 1-1.2

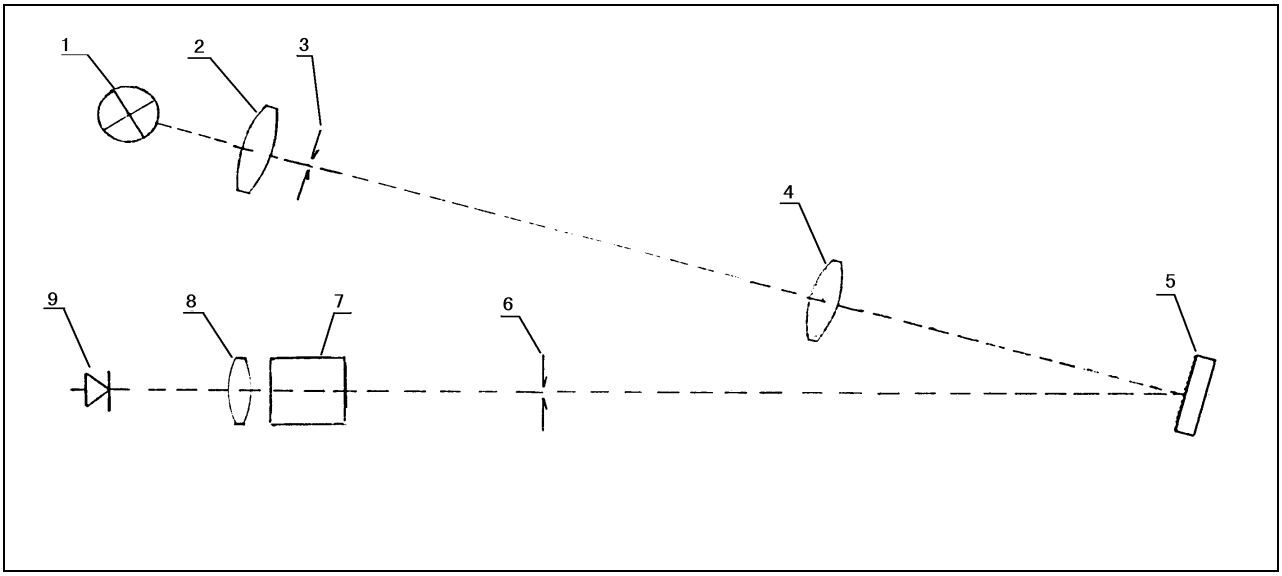


UNICO Model 1100RS Spectrophotometer

1.2 OPTICAL SYSTEM

As shown in Figure 1-2 the white light coming from the Halogen Lamp is focused by the collecting lens, pass through the Entrance slit of the Monochromator, through a collimating lens to the Analytical grating where it is dispersed into its spectrum, then through the Exit slit of the monochromator, continues through the Sample compartment and finally to the Photo detector.

Figure 1-2



OPTICAL SYSTEM SCHEMATIC DIAGRAM

1. Halogen Lamp
2. Collecting Lens
3. Entrance Slit
4. Collimating Lens
5. Grating
6. Exit Slit
7. Sample
8. Collimating Lens
9. Photodiode

1.3 ELECTRONIC SYSTEM

The photo detector receives the monochromatic light and generates photocurrent. A direct current signal which is proportional to the amount of light energy to the photo detector. The signal is then amplified and processed. The processed signal is sent to the digital display and also to the external outputs 0 Volt to 1 Volt analog output and an RS-232C output. Figure 1-3-1 and Figure 1-3-2 demonstrates the electronic systems of Model 1100 and Model 1100RS respectively

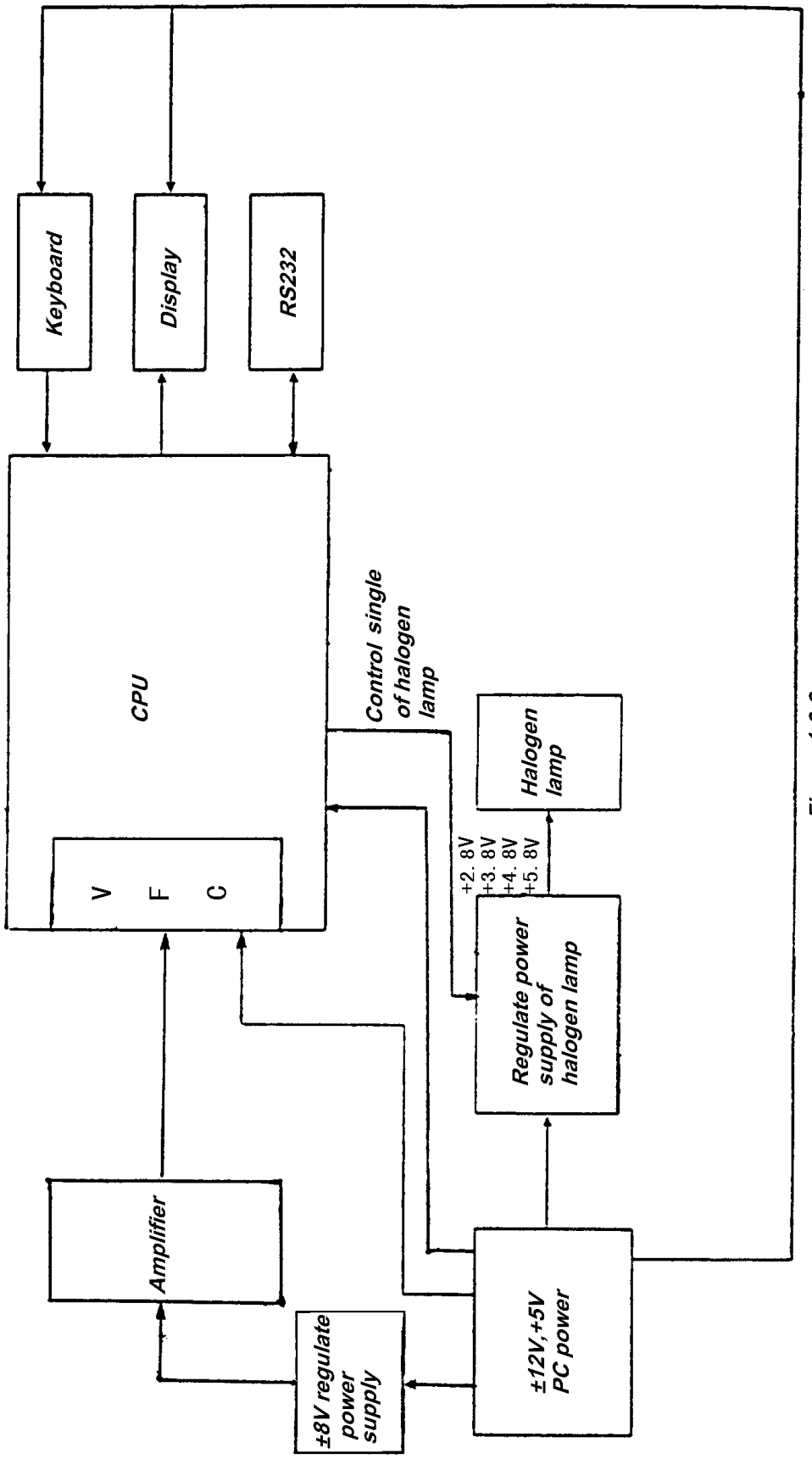

Keyboard
Display
RS232
CPU
V
F
C
Control single of halogen lamp
Halogen lamp
+2. 8V
+3. 8V
+4. 8V
+5. 8V
Regulate power supply of halogen lamp
Amplifier
±8V regulate power supply
±12V,+5V PC power

Figure 1-3-2

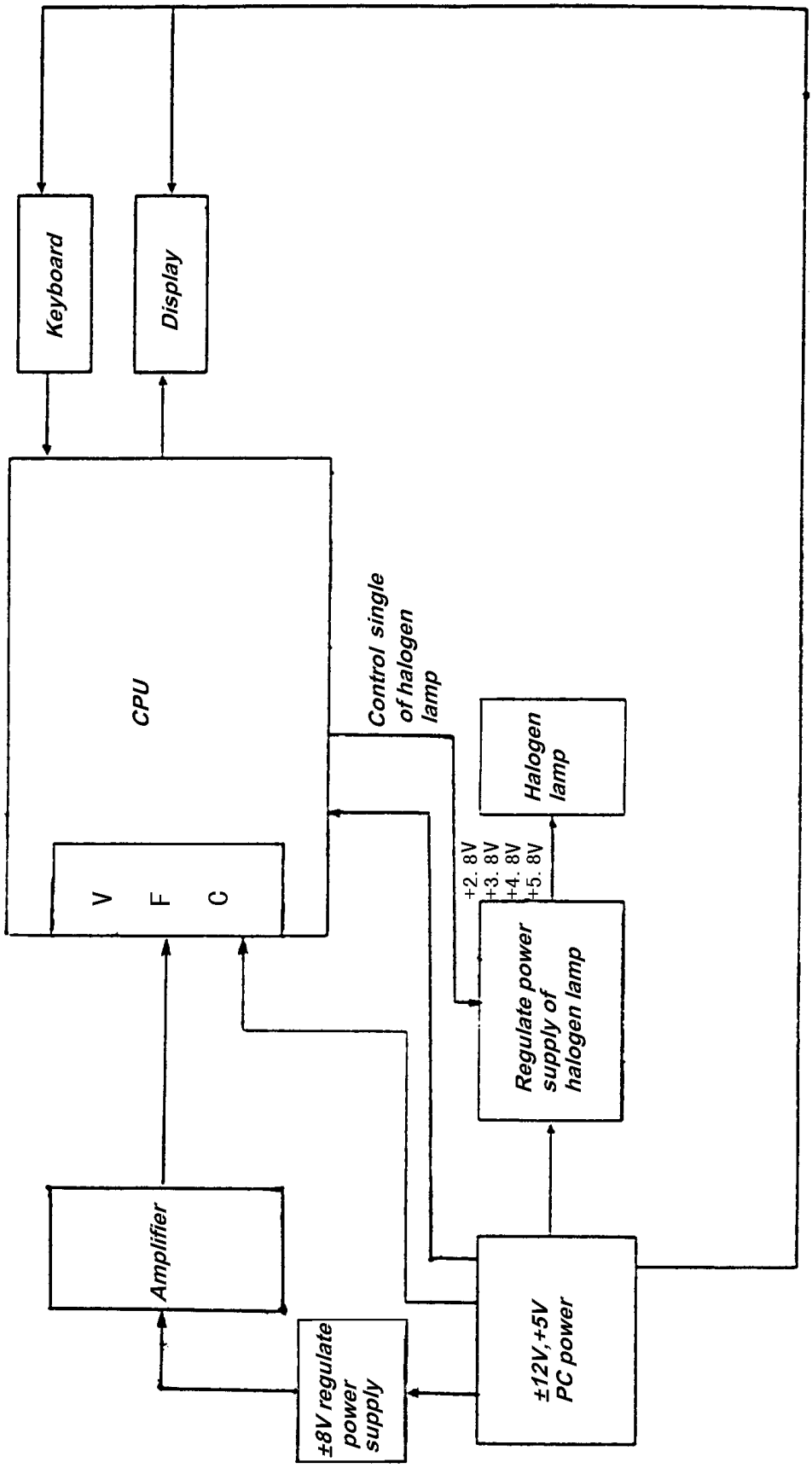

Keyboard
Display
CPU
V
F
C
Control single of halogen lamp
Halogen lamp
+2. 8V
+3. 8V
+4. 8V
+5. 8V
Regulate power supply of halogen lamp
Amplifier
±8V regulate power supply
±12V,+5V PC power

Figure 1-3-1

1.4 SPECIFICATIONS

Table 1-1

MODEL	1100	1100RS
Wavelength Range	335-1000nm	335-1000nm
Spectral Slit Width	20nm	10nm
Wavelength Accuracy	±2nm	±2nm
Wavelength Readability	2nm	
Stray Radiant Energy	≤0.5%T@340nm &400nm	≤0.5%T@340nm & 400nm
Transmittance	0%T to 125%T	0%T to 125.0%T
Absorbancy	0A to 2A	0A to 2A
Photometric Accuracy	±2.0%T	±1.0%T
Photometric Noise Level	±2.0%T	±1%T
Power Requirement	115-volt, 60Hz, or 230-volt, 50Hz	
Size	408mm(W)×308mm(D)×180mm(H)	
Weight	5.5kg	

Specifications subject to change without notice

1.5 NOMENCLATURE

Figure 1- 4

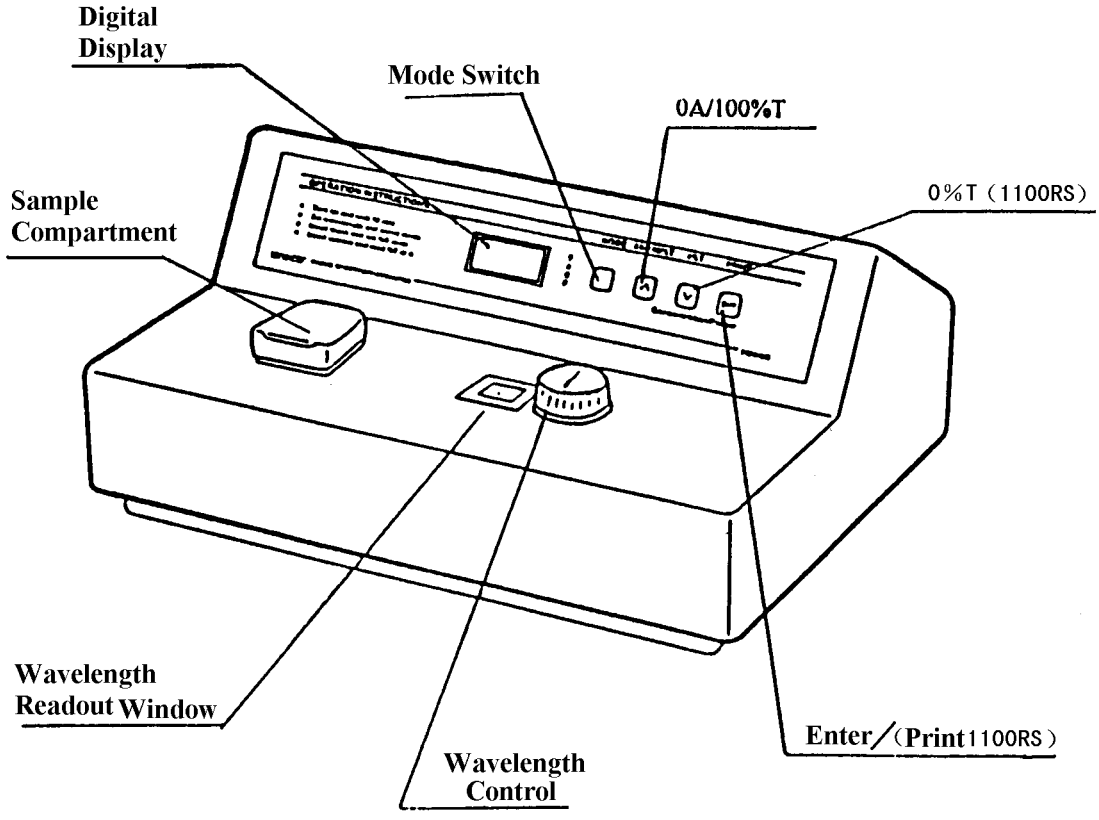
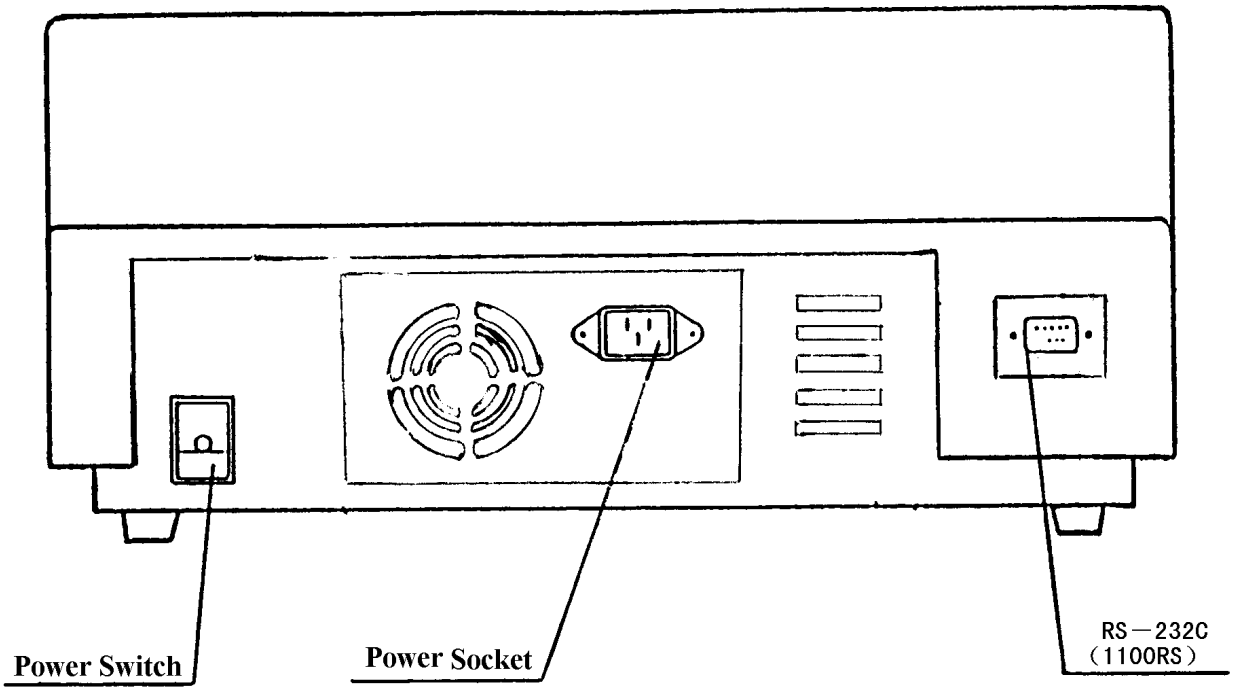


Figure 1- 5



UNICO 1100 SPECTROPHOTOMETER AND NOMENCLATURE

2. INSTALLATION

2.1 *The instrument should be installed in a clean environment which is free of corrosive materials, dust and severe vibrations. Furthermore, it should be kept away from any strong electric magnetic fields and high frequency fields.*

2.2 LINE VOLTAGE

The power can be selected by means of the built-in switchable power switch to match the line voltage in your country.

3. MAINTENANCE

3.1 WORKING ENVIRONMENT

The optimum environment for the instruments is as follows

TEMPERATURE	*5-35° C*
HUMIDITY	*85%*

Install the instrument in a clean non-vibrational area. Avoid direct strong light and air flow. The instrument will give better performance if the power supply stability is at 1% and line frequency less than 1Hz. Always allow the instrument to warm up for 20 minutes prior to taking any readings.

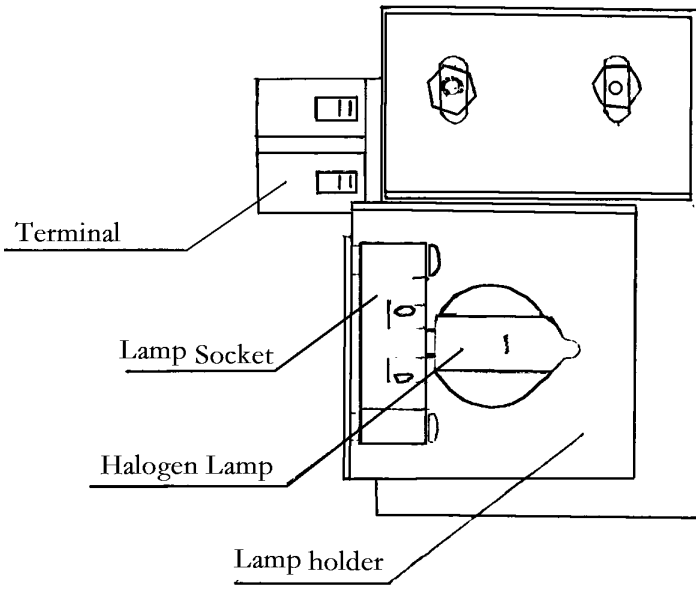
3.2 REPLACING LAMPS AND ADJUSTMENTS

1. *Turn off and unplug the instrument.*
2. *Turn the instrument upside down.*
3. *Remove the grill plate on bottom of the instrument by removing fixing Screw.*
4. *Unplug the lamp from the white connector.*
5. *Insert the new lamp, pushing it in as far as it will go. The lamp filament should face the center of the collecting lens.*

CAUTION: DO NOT HANDLE HALOGEN LAMP WITH BARK FINGERS. USE TISSUE OR CLOTH WHEN HANDLING LAMP.

8. *Reinstall the grill plate.*

Figure 3-1



Replacing the lamp

3.3 Wavelength Calibration:

NORMALLY THE UNICO 1100 SERIES SPECTROPHOTOMETER RETAINS ITS WAVELENGTH CALIBRATION INDEFINITELY. HOWEVER IF THE INSTRUMENT RECEIVES A SEVERE SHOCK OR IS ABUSED, USE THE FOLLOWING METHODS TO CHECK WAVELENGTH CALIBRATION. PLEASE NOTE THAT THIS TEST REQUIRES THE UNICO DIDYMIUM FILTER, P/N 1100-110, OR THE HOLMIUM OXIDE FILTER, P/N 1100-109.

IN THE FILTER METHOD, THE DIDYMIUM FILTER HAS TWO DISTINCT ABSORBANCE PEAKS AT 529NM AND 807NM. THE HOLMIUM FILTER HAS A DISTINCT PEAK AT 361NM. WHEN THE INSTRUMENT IS CALIBRATED PROPERLY YOU WILL FIND MINIMUM TRANSMITTANCE (MAXIMUM ABSORBANCE) AT THE RANGE ±2NM FROM THESE PEAKS. NOTE THAT THE SPECIFIC TRANSMITTANCE VALUES ARE NOT IMPORTANT AS YOU ARE ONLY LOOKING FOR THE WAVELENGTH WHERE THE MINIMUM TRANSMITTANCE (MAXIMUM ABSORBANCE) OCCURS.

Holmium Oxide Filter Method:

1. TURN INSTRUMENT ON AND ALLOW IT TO WARM UP FOR 15 MINUTES.

2. SELECT THE ABSORBANCE OPERATING MODE.

1. SET THE WAVELENGTH TO 350NM.

2. MAKE SURE THE CUVETTE HOLDER IS EMPTY AND PLACE IT IN THE SAMPLE COMPARTMENT. CLOSE THE SAMPLE COMPARTMENT LID.

3. SET ZERO ABSORBANCE BY PRESSING THE 0A/100%T. WAIT A FEW SECONDS WHILE THE DISPLAY FLASHES 'BLA'. THE READING SHOULD THEN BE 0.000A. IF NOT, REPEAT STEP 5.

4. REMOVE THE CUVETTE HOLDER AND INSERT THE HOLMIUM FILTER INTO IT. PLACE IT IN THE SAMPLE COMPARTMENT AND CLOSE THE LID.

5. RECORD THE ABSORBANCE READING ON THE DIGITAL DISPLAY.

6. ADVANCE THE WAVELENGTH SETTING BY 1NM AND REPEAT STEPS 4 TO 7.

7. REPEAT STEP 8 UNTIL THE WAVELENGTH SETTING REACHES 370NM.

8. LOOK FOR THE MAXIMUM ABSORBANCE READING OBTAINED, AND THIS SHOULD BE FOUND BETWEEN 359 AND 363NM. THE WAVELENGTH ACCURACY OF THE 1100/1100RS IS ± 2NM.

Didymium Filter Method:

1. SET THE WAVELENGTH TO 800 NM.

2. MAKE SURE THE CUVETTE HOLDER IS EMPTY AND PLACE IT IN THE SAMPLE COMPARTMENT. CLOSE THE SAMPLE COMPARTMENT LID.

3. SET ZERO ABS BY PRESSING THE 0A/100%T. WAIT A FEW SECONDS WHILE THE DISPLAY FLASHES 'BLA'. THE READING SHOULD THEN BE 0.000A. IF NOT, REPEAT STEP 3.

4. REMOVE THE CUVETTE HOLDER AND INSERT THE DIDYMIUM FILTER INTO IT. PLACE IT IN THE SAMPLE COMPARTMENT AND CLOSE THE LID.

5. RECORD THE ABSORBANCE READING ON THE DIGITAL DISPLAY.

6. ADVANCE THE WAVELENGTH SETTING BY 1NM AND REPEAT STEPS 2 TO 5.

7. REPEAT STEP 6 UNTIL THE WAVELENGTH SETTING REACHES 815NM.

8. LOOK FOR THE MAXIMUM ABSORBANCE READING OBTAINED, AND THIS SHOULD BE FOUND BETWEEN 805 AND 809NM. THE WAVELENGTH ACCURACY OF THE 1100/1100RS IS ± 2NM.

9. IF A "MIDDLE" WAVELENGTH CHECK IS DESIRED, SET THE WAVELENGTH TO 522NM (OPTIONAL)

10. MAKE SURE THE CUVETTE HOLDER IS EMPTY AND PLACE IT IN THE SAMPLE COMPARTMENT. CLOSE THE SAMPLE LID.

11. SET ZERO ABS BY PRESSING THE 0A/100%T BUTTON. WAIT A FEW SECONDS WHILE THE DISPLAY FLASHES 'BLA'. THE READING SHOULD THEN BE 0.000A. IF NOT REPEAT STEP 11.

12. REMOVE THE CUVETTE HOLDER AND INSERT THE DIDYMIUM FILTER INTO IT. PLACE IT IN THE SAMPLE COMPARTMENT AND CLOSE THE LID.

13. RECORD THE ABSORBANCE READING ON THE DIGITAL DISPLAY.

14. ADVANCE THE WAVELENGTH SETTING BY 1NM AND REPEAT STEPS 10 TO 13.

REPEAT STEP 14 UNTIL THE WAVELENGTH SETTING REACHES 536NM. AGAIN, LOOK FOR THE MAXIMUM ABSORBANCE READING. IT SHOULD BE BETWEEN 527 AND 531NM.

Absorbance Accuracy Checks

SPECIFICATION: ±2% AT 1A (1100), ±1% AT 1A AND 2A (1100RS).

THE ABSORBANCE ACCURACY SHOULD BE CHECKED AGAINST A SET OF NEUTRAL DENSITY FILTERS ACCURATELY CALIBRATED TO THE NIST STANDARDS. CONTACT YOUR UNICO REPRESENTATIVE FOR MORE INFORMATION (800-588-9776).

AN ALTERNATIVE METHOD USING POTASSIUM DICHROMATE IS DESCRIBED BELOW. DUE TO THE MANY FACTORS THAT MIGHT AFFECT THE RESULTS (I.E. TEMPERATURE, BANDPASS, WEIGHING AND DILUTING ERRORS), THIS METHOD IS LESS ACCURATE AND SHOULD ONLY BE USED AS A GUIDE.

REFERENCE: JOHNSON E A
POTASSIUM DICHROMATE AS AN ABSORBANCE STANDARD
PSG BULLETIN 1967, NO. 17, PAGE 505

1. MAKE UP N/100 SULFURIC ACID AS THE SOLVENT AND USE PART OF IT TO MAKE A SOLUTION CONTAINING 120 +0.5 MG/LITRE OF POTASSIUM DICHROMATE.

2. WASH OUT A SQUARE CUVETTE WITH SOLVENT, AND FILL WITH SOLVENT.

3. PUT THE CUVETTE IN THE ADAPTER INTO THE SAMPLE COMPARTMENT AND CLOSE THE LID.

4. SET THE WAVELENGTH TO 350 NM.

5. SET THE MODE BUTTON TO A.

6. SET THE READING TO 0.000A USING THE 0A/100%T BUTTON.

7. EMPTY THE CELL. WASH OUT WITH DICHROMATE SOLUTION, AND FILL WITH DICHROMATE SOLUTION.

8. PUT THE CUVETTE IN THE ADAPTER INTO THE SAMPLE COMPARTMENT AND CLOSE THE LID.

9. READ THE ABSORBANCE OF THE STANDARD FROM THE DISPLAY. THE VALUE SHOULD BE 1.288 $\pm$ 0.04A. REFER TO THE NOTES ABOVE WHEN INTERPRETING THE RESULT.

Stray Light Check

SPECIFICATION: LESS THAN 0.5%T AT 340NM BY ASTM E 387

A GOOD INDICATION AS TO WHETHER THE STRAY LIGHT LEVEL IS WITHIN SPECIFICATION MAY BE OBTAINED AS FOLLOWS:

1. SET THE WAVELENGTH TO 340NM.

2. SET THE MODE SWITCH TO %T.

3. WITH THE SQUARE CELL ADAPTER IN THE SAMPLE COMPARTMENT, BUT NO CELL, CLOSE THE LID AND PRESS THE 0A/100%T BUTTON TO SET THE DISPLAY TO 100.0%.

4. REMOVE THE CELL ADAPTER FROM THE SAMPLE COMPARTMENT AND CLOSE THE LID. MAKE A NOTE OF THE READING THAT SHOULD BE AT OR NEAR 00.0.

5. PREPARE A SOLUTION CONTAINING 50GM/L OF SODIUM NITRITE ($NaNO_2$) IN DISTILLED WATER AND FILL A SQUARE CUVETTE WITH THIS SOLUTION.

6. INSERT THE CUVETTE INTO THE ADAPTER AND PLACE IN THE SAMPLE COMPARTMENT. CLOSE THE LID. THE DISPLAY SHOULD READ <0.5%T. NOTE THAT IF THE READING OBTAINED IN STEP 4 IS GREATER THAN 00.0, THIS VALUE SHOULD BE SUBTRACTED FROM THE DISPLAYED READING TO GIVE THE CORRECT READING FOR THE STRAY LIGHT VALUE.

SERIVCE

4.1 PHYSICAL INSPECTION

Thoroughly inspect the instrument for physical indications that might cause a malfunction. The following categories are usually checked:

Apparent damage, Dirty Optics, Broken wire, loose connection, P.C. Board loose, Broken lands on pc board, any sign of overheated components.

4.2 OPERATING PROCEDURE CHECK

Each time an instrument has a malfunction, the operating procedure should be checked. If necessary such procedures should be repeated to see the patterns that the malfunction occurs.

The basic operating procedure is as follows:

Basic Operation:

SIMPLE OPERATING INSTRUCTIONS ARE PRINTED ON THE FRONT PANEL OF YOUR UNICO 1100/1100RS.

A. Prepare the spectrophotometer

1. TURN ON THE SPECTROPHOTOMETER BY PRESSING THE POWER SWITCH (IO). ALLOW 15 MINUTES FOR THE INSTRUMENT TO WARM UP.

2. SELECT EITHER THE %TRANSMITTANCE OR ABSORBANCE OPERATING MODE BY PRESSING THE %T/A SELECTOR BUTTON (MODE) UNTIL THE RED LIGHT FOR T OR A IS ON.

3. SELECT THE DESIRED WAVELENGTH BY TURNING THE WAVELENGTH CONTROL KNOB (WAVELENGTH).

B. Prepare Sample

4. MAKE A BLANK REFERENCE SOLUTION BY FILLING A CLEAN CUVETTE (OR TEST TUBE) HALF FULL WITH DISTILLED OR DE-IONIZED WATER OR OTHER SPECIFIED SOLVENT. WIPE THE CUVETTE WITH TISSUE TO REMOVE THE FINGERPRINTS AND DROPLETS OF LIQUID.

5. FIT THE BLANK CUVETTE INTO THE SQUARE CUVETTE ADAPTER AND PLACE THE ADAPTER IN THE SAMPLE COMPARTMENT, ALIGNING THE GUIDE MARK (IF PRESENT) WITH THE GUIDE MARK AT THE FRONT OF THE COMPARTMENT. CLOSE THE LID.

6. SET 0.000A OR 100%T WITH THE (0A/100%T) CONTROL BUTTON. NOTE: THIS STEP FULFILLS THE INSTRUCTION ON THE FRONT OF THE SPECTROPHOTOMETER…(SET FULL SCALE).

7. REMOVE THE BLANK CUVETTE OR TEST TUBE. SET IT ASIDE IN THE CASE THAT YOU MAY NEED TO ADJUST THE (0A/100%T) CONTROL BUTTON LATER (I.E. CHANGE THE WAVELENGTH).

C. Analyze Sample

8. Rinse a second cuvette with a small amount of the sample solution to be tested. Fill the cuvette half full and wipe it.

9. Put the sample cuvette in the sample compartment. Close the lid.

10. Read the %Transmittance or Absorbance from the digital readout window. Remove the sample cuvette or test tube.

11. If you are to test the same sample at other wavelengths, repeat steps 3 to 10 for each wavelength.

12. For each new sample you analyze, repeat steps 2 to 11.

Additional Features of Model 1100RS

Although operating basically the same as the Model 1100, the 1100RS spectrophotometer offers two more features (Concentration Mode and Factor Mode) as follows:

Concentration (C) Mode for determining the concentration of unknown samples.

NOTE: *This method should only be used when the relationship between Absorbance and Concentration is known to be linear. The concentration of the Standard solution used to calibrate the instrument should be higher than the most concentrated sample.*

1. Select the desired wavelength by turning the wavelength control knob.
2. Using the MODE button, select Absorbance (A) mode.
3. Insert the cuvette containing the blank solution.
4. Set 0.000A with the (0A/100%T) control button.
5. Using the MODE button, select C (concentration) mode.
6. Insert a cuvette containing a standard solution of known concentration in the sample compartment and adjust the digital readout window to the value of the standard by using the ∧ and ∨ arrows.
7. Press the Enter button.

NOTE*: If the reading changes, the factor required is too high (i.e. >1999) to be displayed. In this case, divide the concentration by 10, re-select the C mode by successive presses on the Mode button, cycling through the F, %T, and A modes, and follow step 2 above to set the concentration of the standard to the reduced value.*

8. With the standard concentration set, determine the concentration values of samples with unknown concentration by inserting the sample cuvette into the sample compartment and reading the value direct from the display.
9. To read the value of the multiplier used to convert Abs to Concentration, after measuring all the samples, change the Mode to Factor (F) and read the multiplier from the display. Keep a record of this value for future use.

***Operational Note**: if the mode switch is changed to read Factor or Absorbance, the Concentration (C) reading is "frozen", and cannot be changed. This requires the operator to re-start at step 1.*

Factor (F) Mode

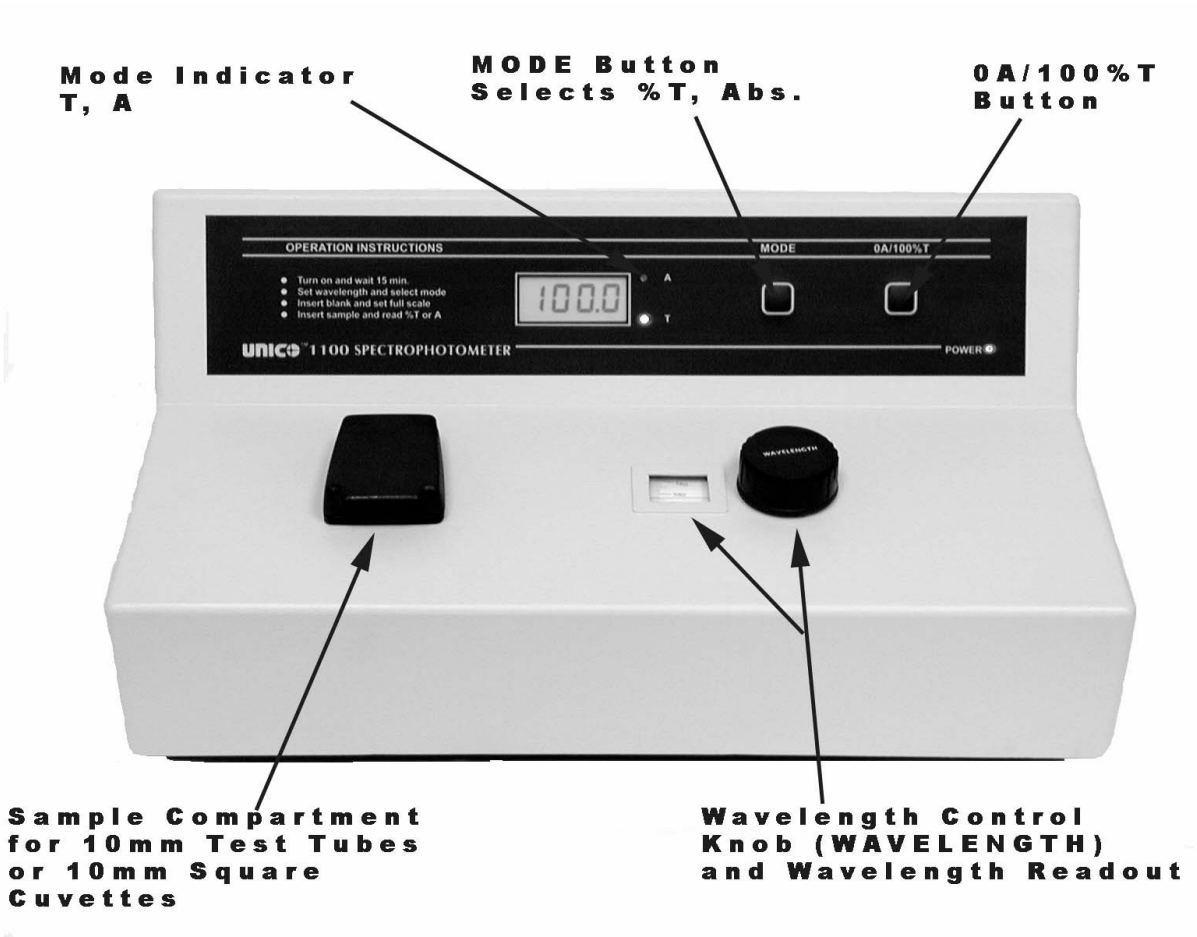
This is a special mode for measuring concentration values of unknown samples using a previously determined factor to convert Absorbance readings to concentration.

1. After setting the wavelength, and setting zero Abs on the blank solution, using the MODE button, select factor (F) mode.
2. Insert a cuvette containing a sample.
3. Using the ^ and v arrows, set the digital read-out window to the desired value of the multiplier.
4. Press the ENT button. The spectrophotometer switches to the Concentration (C) mode.

***Operational Note**: If the Concentration of the sample is too high to be displayed, the instrument will not switch to Concentration Mode when the ENT button is pressed. Dilute the sample and multiply the concentration reading by the dilution factor to obtain the original sample concentration.*

5. Read the concentration value of the sample direct from the display.
6. Insert a cuvette containing the next sample and read the result. Repeat until all samples have been measured.

***Operational Note**: If the MODE switch is changed to A or T, then the concentration reading is "frozen". This requires the operator to re-start at step 1.*



Model 1100 Spectrophotometer:

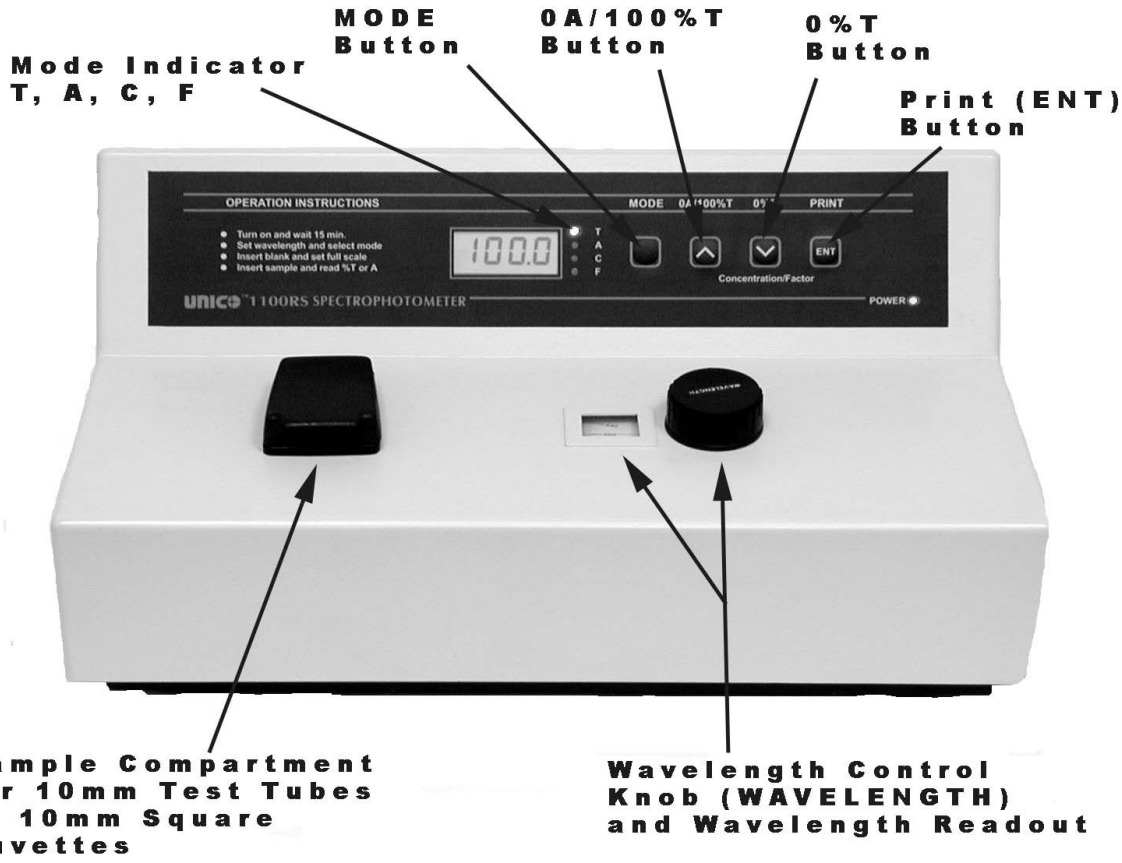
MODE INDICATOR: *Allows the operator to know the measurement mode currently in use (%Transmittance, Absorbance).*

MODE BUTTON: *Switches between %Transmittance and Absorbance operating modes at any time of measurement.*

0A/100%T BUTTON: *Adjusts digital readout to 100%T or 0.000A when blank reference solution is in sample compartment.*

SAMPLE COMPARTMENT: *Insert 10mm test tube and close lid or fit 10mm cuvette adapter and fit adapter (with holder to left of cuvette) into compartment.*

WAVELENGTH CONTROL KNOB (WAVELENGTH): *Selects desired wavelength in nanometers (nm).*
WAVELENGTH READOUT WINDOW: *Displays desired wavelength.*



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MODE INDICATOR: *Allows the operator to know the measurement mode currently in use (%Transmittance, Absorbance).*

MODE BUTTON: *Switches between %Transmittance and Absorbance operating modes at any time of measurement.*

0A/100%T BUTTON: *Adjusts digital readout to 100%T or 0.000A when blank reference solution is in sample compartment.*

0%T BUTTON: *When in transmittance (T) mode and sample compartment is empty, a flap blocks the beam. Pressing button adjusts readout to 00.0%T.*

PRINT BUTTON(ENT): *First press after selecting Concentration mode enters reading on digital readout. Other presses cause output of reading to printer. If using UNICO Application Software, press this button to communicate with software. If operating in Factor (F) Mode, then press to enter factor. This causes the Mode to enter the factor number and change to Concentration mode.*

SAMPLE COMPARTMENT: *Insert 10mm test tube and close lid or fit 10mm cuvette adapter and fit adapter (with holder to left of cuvette) into compartment.*

WAVELENGTH CONTROL KNOB (WAVELENGTH): *Selects desired wavelength in nanometers (nm).*
WAVELENGTH READOUT WINDOW: *Displays desired wavelength.*

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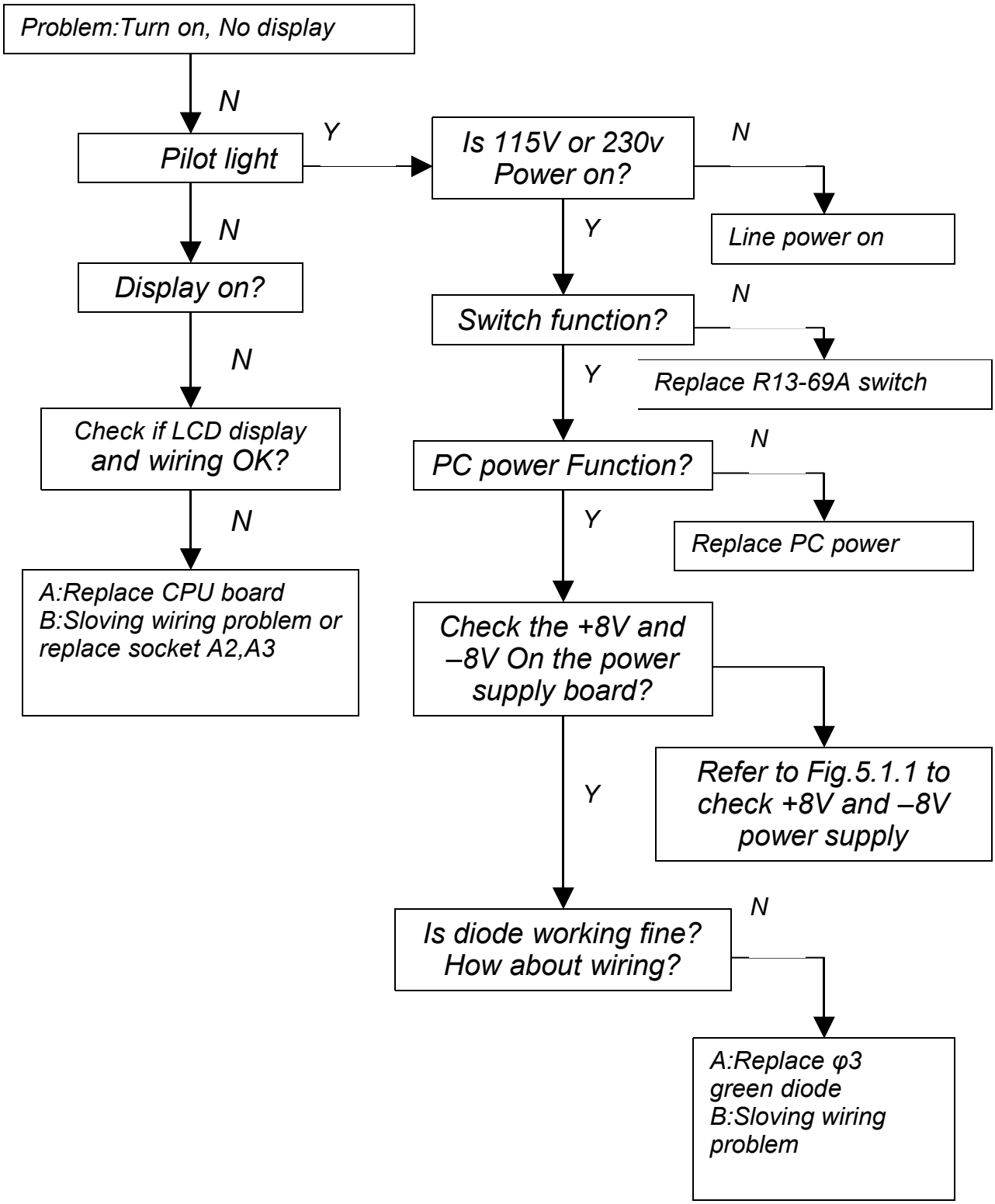
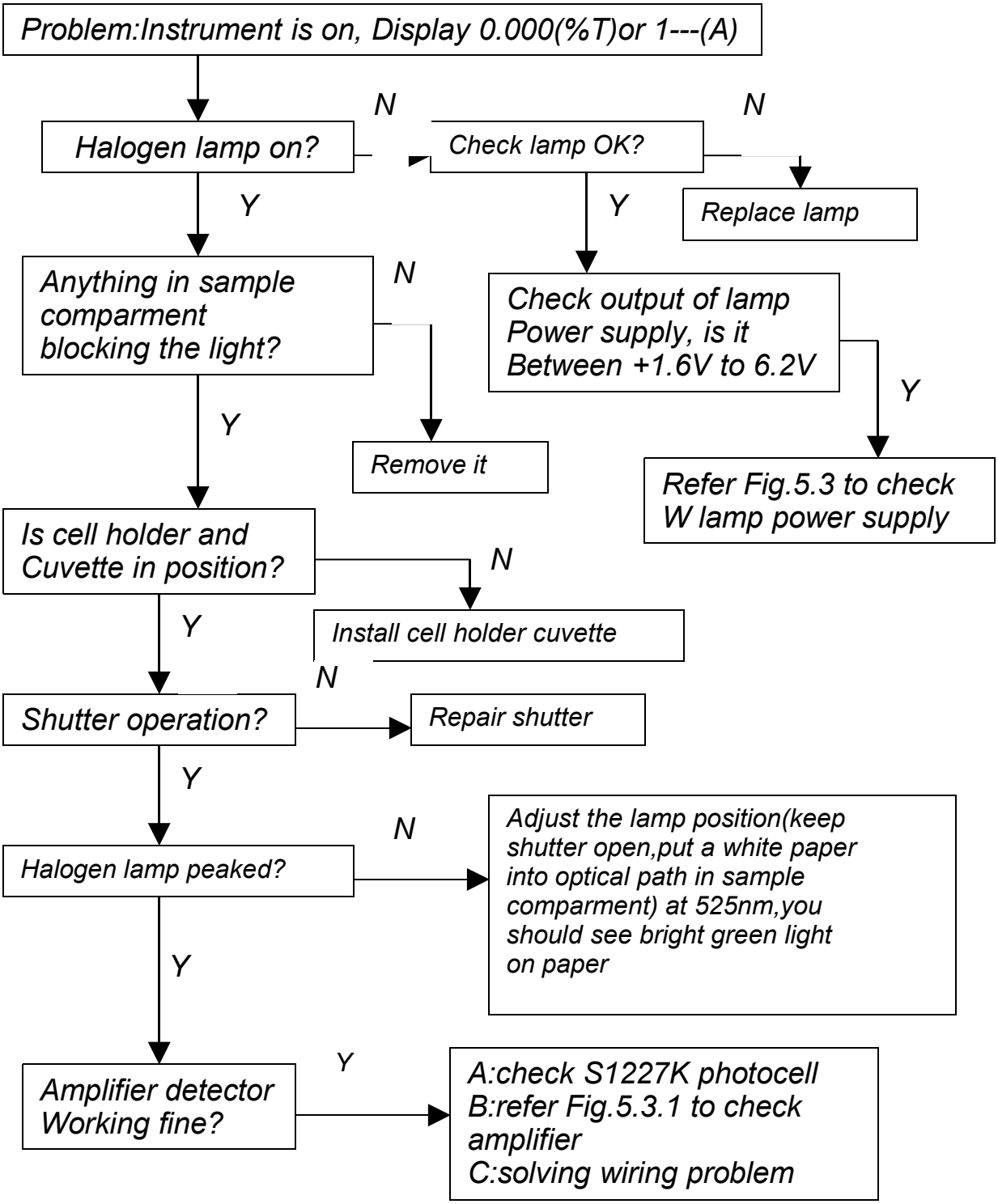
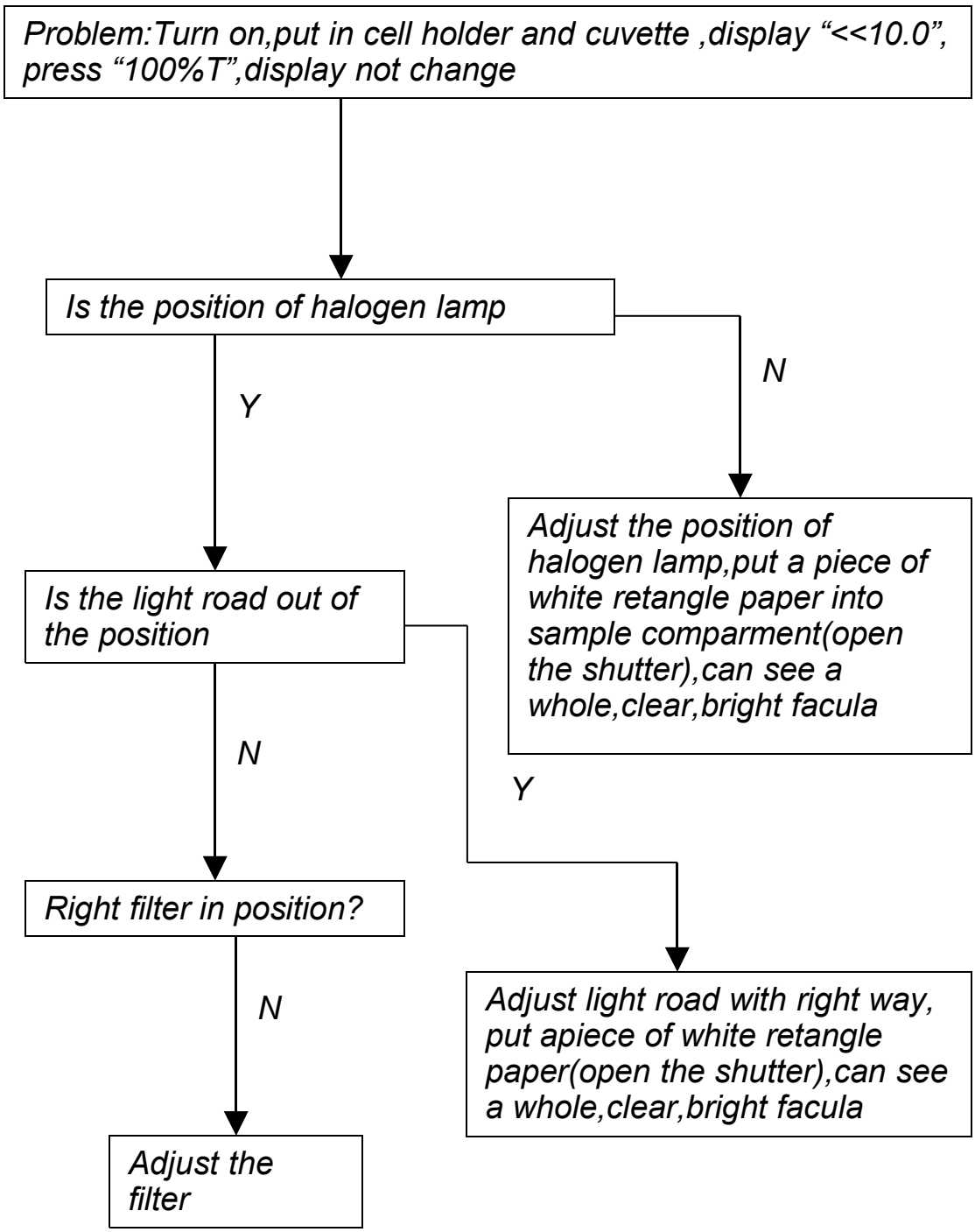
4.3 TROUBLE SHOOTING #1



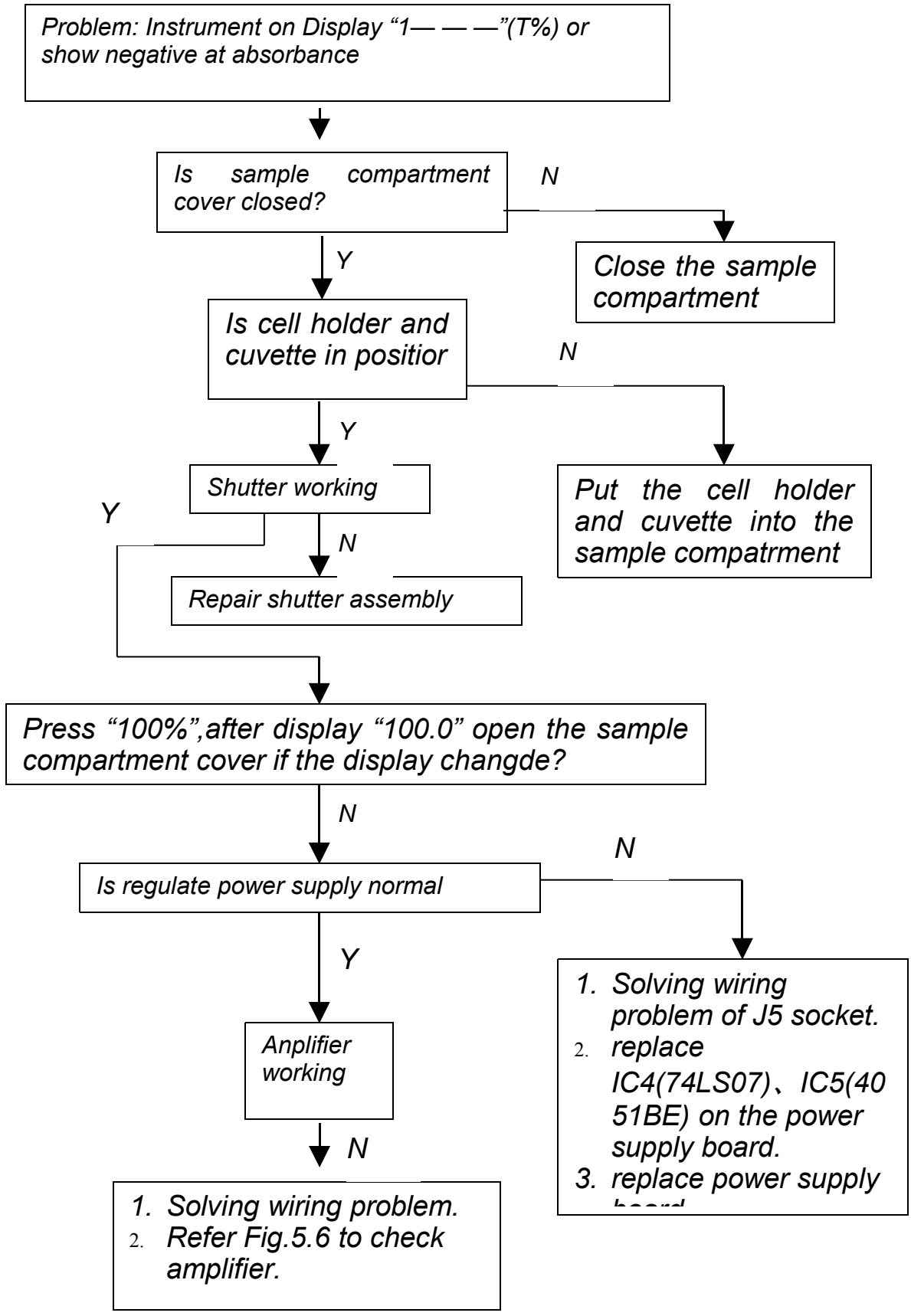
TROUBLE SHOOTING #2



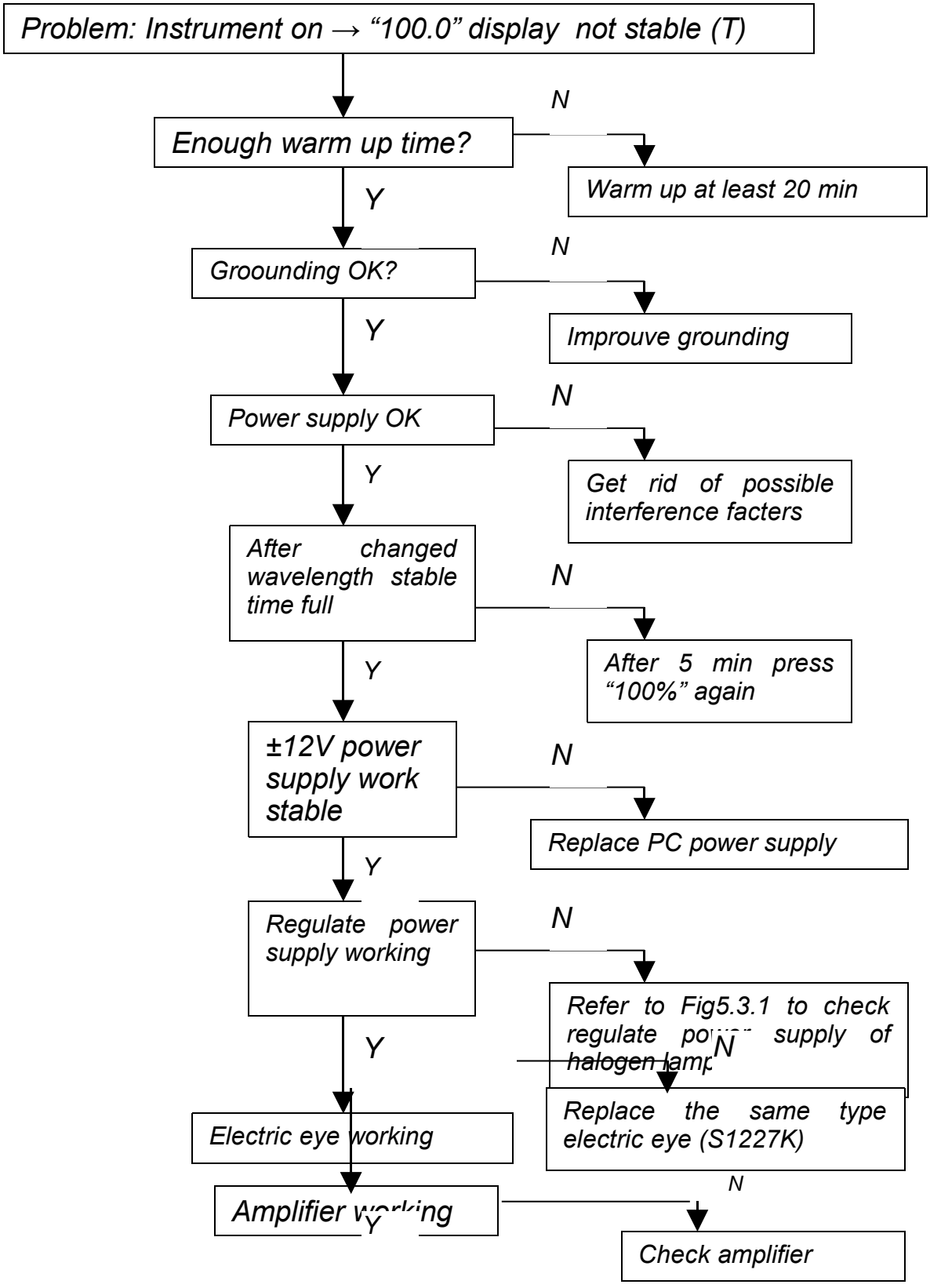
TROUBLE SHOOTING #3



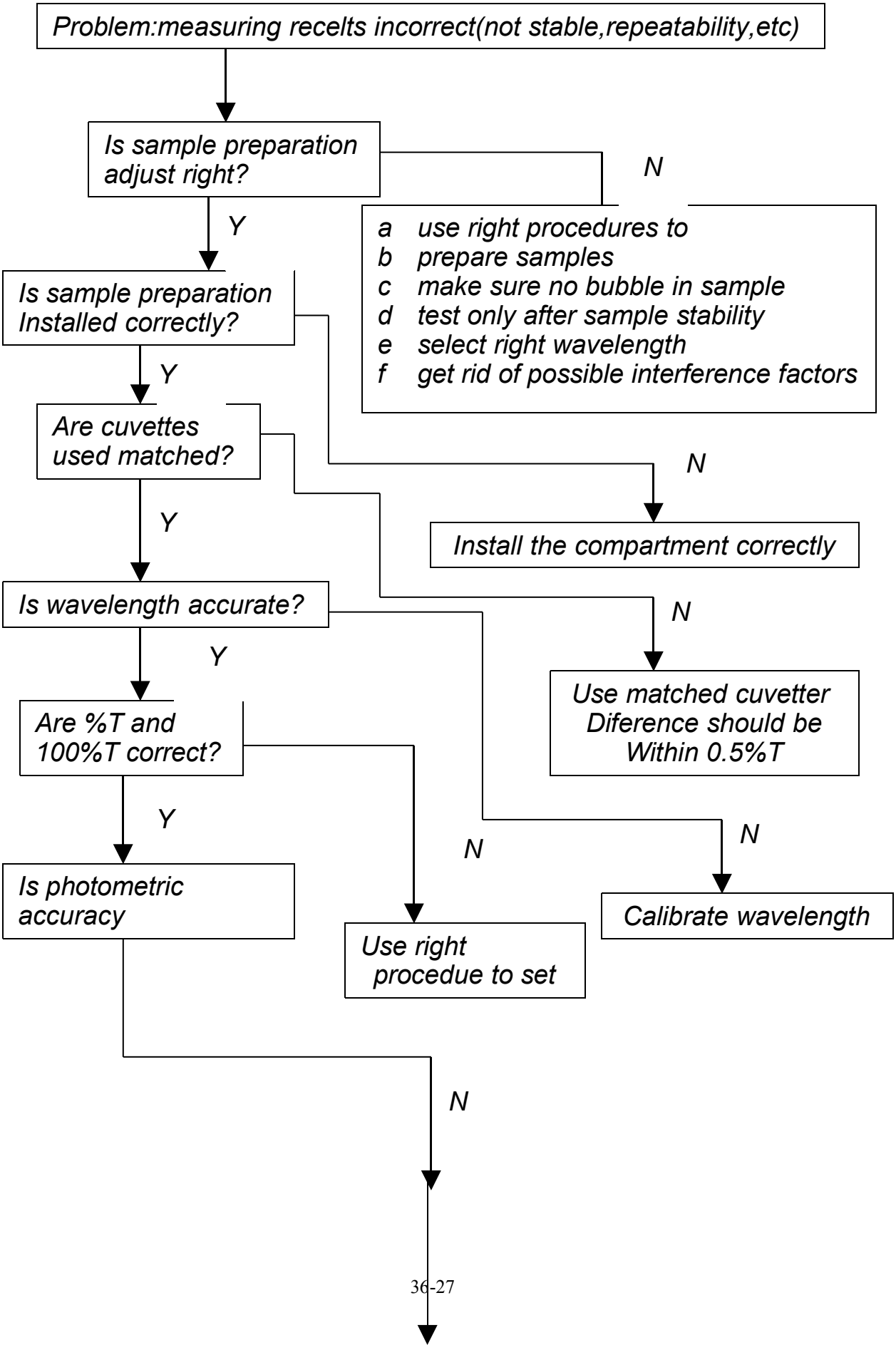
TROUBLE SHOOTING #4



TROUBLE SHOOTING #5



TROUBLE SHOOTING #6



5.Drawing&diagram

1. *Check if the monochromator light passed onto the detector at right angle and right position (area) of the detector if not, adjust it.*
2. *Amplifier output voltage (static): 20mV-30mV, put black body to prevent the light from light way, refer to Fig5.3 to adjust the potentiometer W to change the output voltage to 20mV-30mV(measure the voltage between pin3 and pin4).*
3. *Replace detector SI1227K.*
4. *Use NBS930D filter to check.*
5. *If the value of display too big, check the control single of halogen lamp*
   - *solving wiring problem of socket J5*
   - *replace IC4 IC5 on the power supply board*
   - *replace power supply board*

J1 Socket:Pin1/Pin2 -- +5V input
Pin3 -- +12V input
Pin4 -- -12V input
Pin5/Pin6 -- GND

J2 Socket:+5V output to CPU A3

J3 Socket:±12V output to CPU A2

J4 Socket:±8V output to Amplifier J1

J5 Socket: CPU A1

J6 Socket:2SC2625

J7 Socket:Lamp

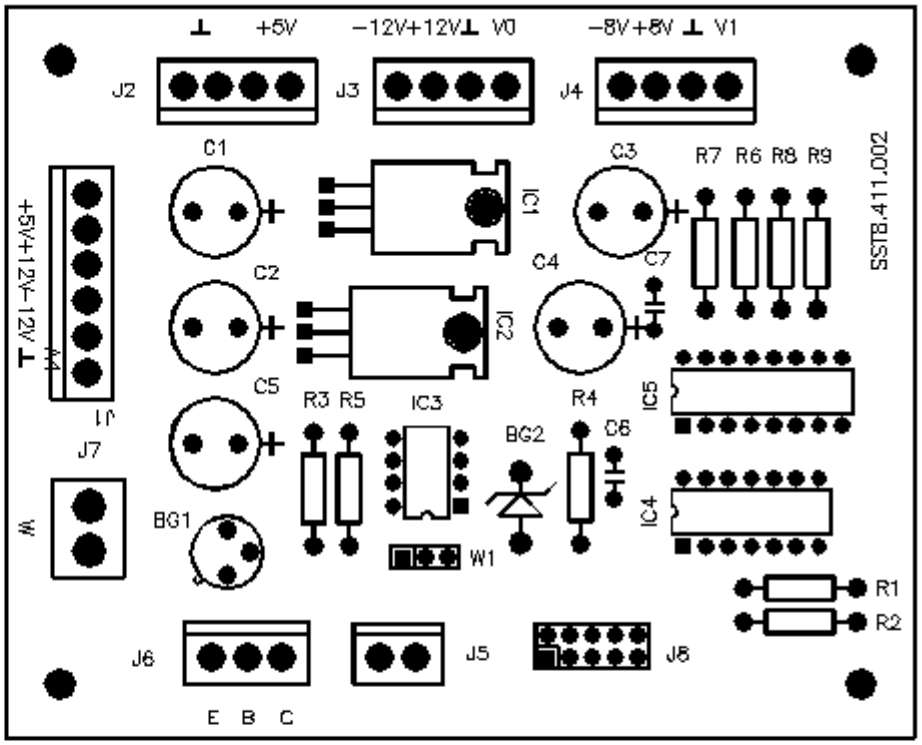


Fig5.1 PCB Arrangement of Power Supply

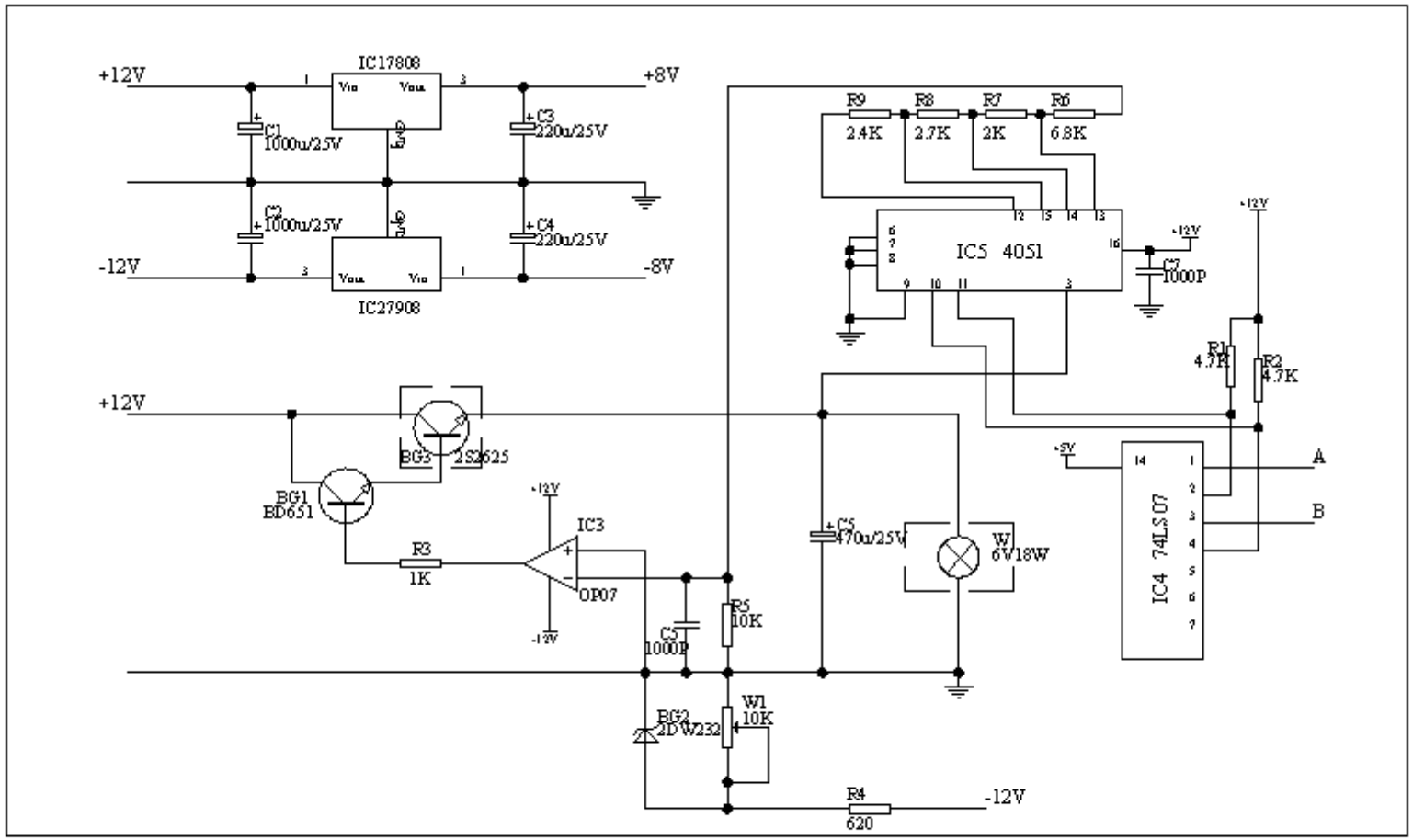
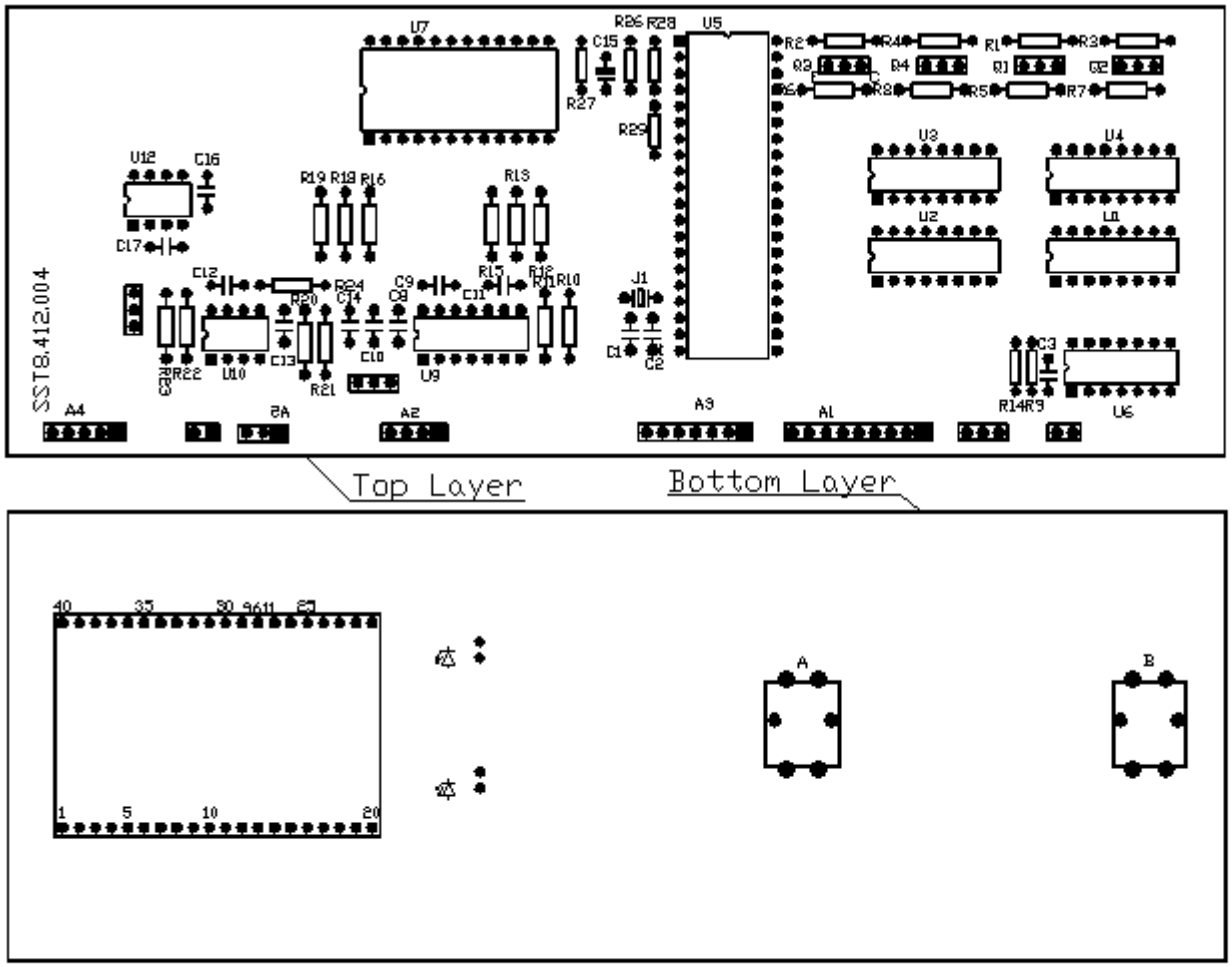


Fig5.1.1 Circuit Diagram of Power Supply



A1 Socket:
to Power Supply J5

A2 Socket:
-12V betwen Pin1&Pin4
+12V betwen Pin2&Pin3
U0 betwen Pin3&Pin1

A3 Socket:
+5V betwen Pin6/Pin7
&Pin1/Pin2

Fig5.2 PCB Arrangement of CPU

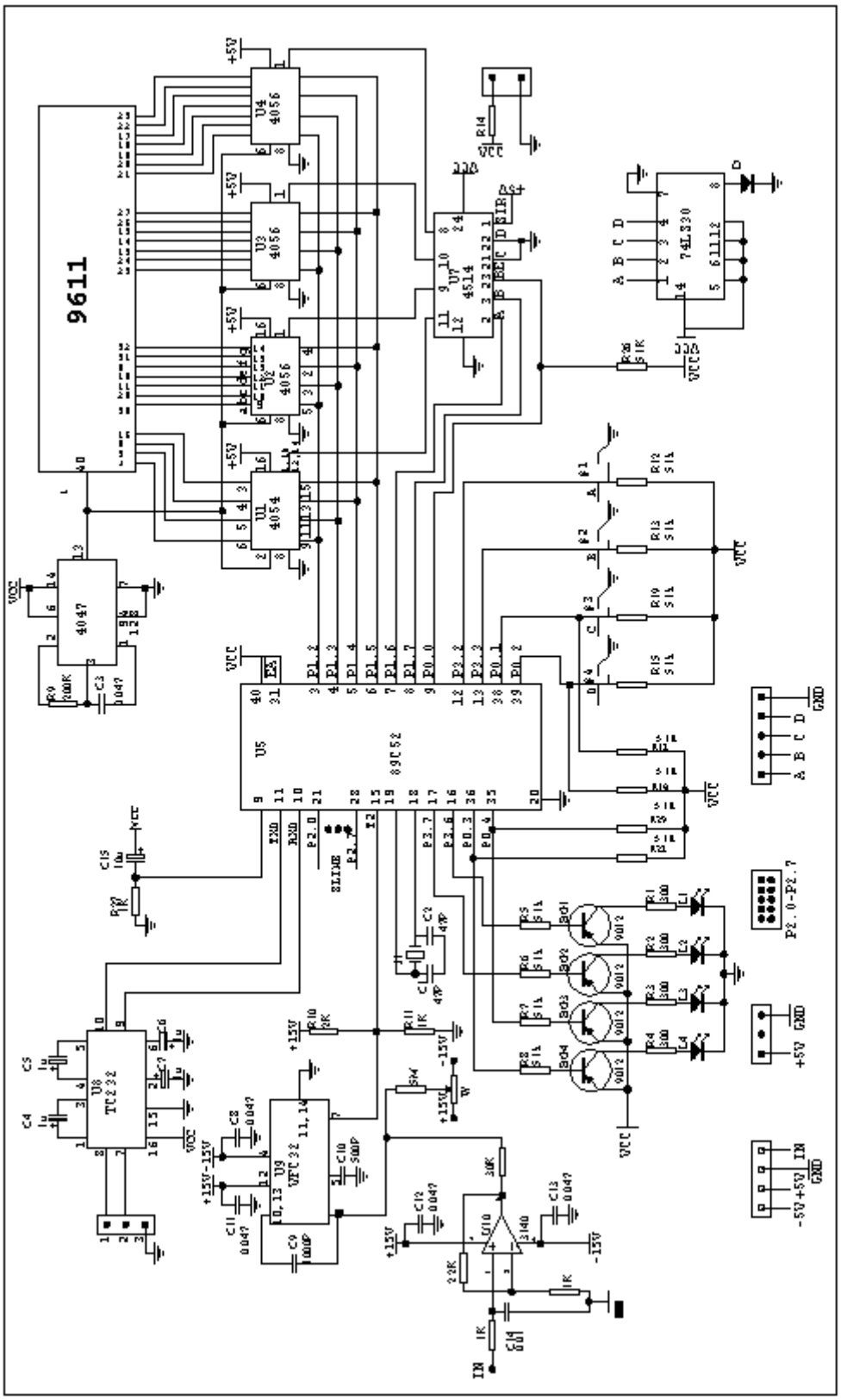


Fig5.2.1 Circuit Diagram of CPU

J1 Socket: −8V betwen Pin1&Pin3
+8V betwen Pin2&Pin3
U1 betwen Pin4&Pin3

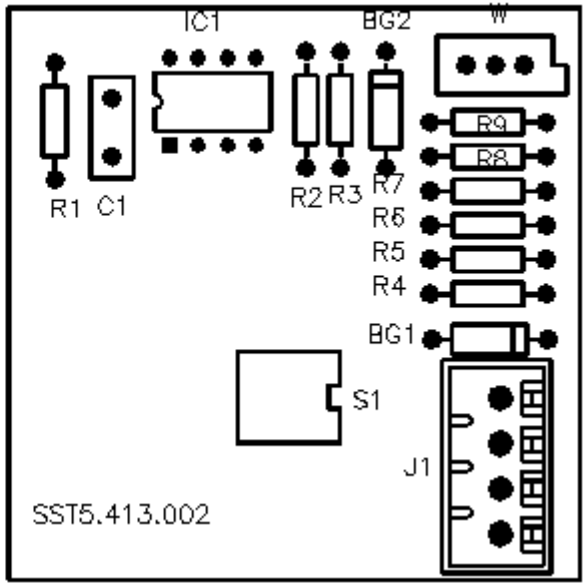


Fig5.3 PCB Arrangement of Amplifier

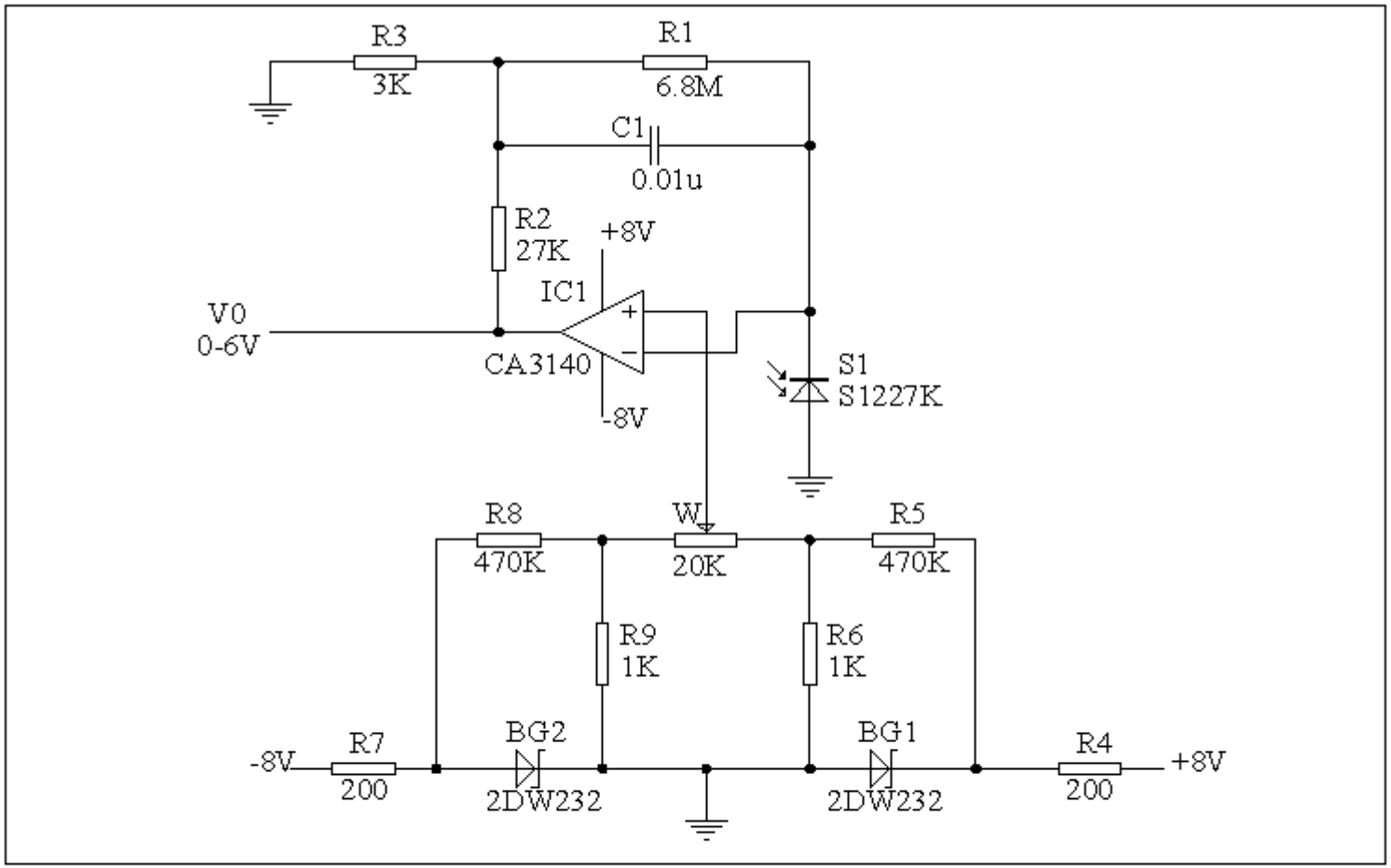


Fig5.3.1 Circuit Diagram of Amplifier

6 Schematic Layout

PART LIST OF UNICO 1100 SERIES SPECTROPHOTOMETERS

Number	*Description*
1	On/Off Switch
2	Pc-power
3	Power socket
4	Wavelength disc
5	Wavelength indicator
6	Part of grating
7	Monochromator
8	Sample compartment
9	Filter drive strap
10	Filter commutation cam
11	Amplifier dark box
12	Amplifier
13	Halogen lamp
14	Junction-box
15	Transistor
16	Radiator
17	Power supply board

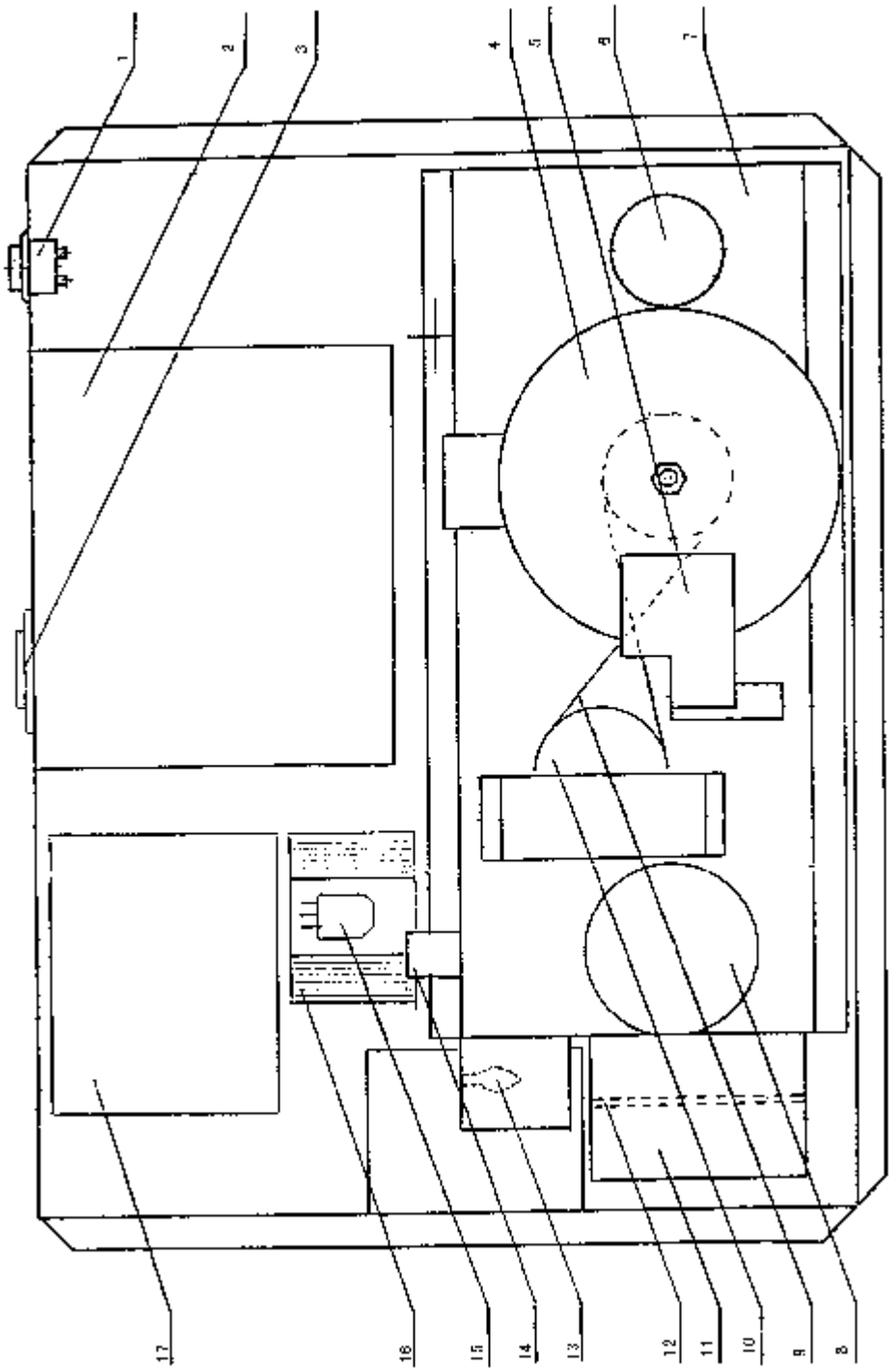


Fig. 6 Schematic Diagram of UNICO 1100 Series