

# Introduction

This manual describes service and troubleshooting procedures for 1900 series instruments. This manual is written with the service technician in mind, and contains no information for clinical chemistry analysis, or other applications. For details on instrument operation and specifications, please refer to the Owner's Manual specific to the instrument.

The 1900 series instrument is a general-purpose, microprocessor-controlled bichromatic photometer system. In the standard configuration, the instrument is equipped with six optical filters and 37° C incubation, accepts standard 12 mm round tubes, and includes an incubation block with 12 round tube stations. Both the incubation block and the read well are temperature controlled to 37° C. An internal thermal printer provides a printed record of all samples and test parameters. All calibration data, test parameters, and other information is stored in battery-backed (nonvolatile) RAM. An aspirating flowcell with control module is available as an accessory.

## WARNING

**Hazardous line voltages are present on the rear panel and beneath the incubation block. Always disconnect the external AC power cable before opening the instrument.**

## Layout

Figure 1 shows the exterior of the instrument, Figure 2 shows the rear panel, Figure 3 shows the internal chassis layout, and Figure 4 shows the bottom of the instrument.

The instrument housing is comprised of a chassis (base and rear panel combined) and a formed plastic cover. The cover is secured to the base by five #4 self-tapping screws.

A 16-character alphanumeric LED display is mounted to the printer bracket inside of the cover. A 20-column thermal printer and the printer PCB mount to a metal printer bracket, which in turn mounts to the inside of the cover. The display and the printer assembly both connect to the main PCB via 14-conductor ribbon cable terminated with DIP (dual in-line pin) plugs. The keypad is a membrane-switch type sealed beneath a graphic overlay and connects to the main PCB by the 8-conductor extension of the switch layer, referred to as the "keytail". The serial port connector (DB-9) is mounted to the rear panel and connects to the main PCB with a 4-conductor cable and SIP (single in-line pin) header.

The photometer assembly connects to the main PCB via a 14-conductor ribbon cable and DIP plug as well as a 10-conductor rainbow ribbon cable and double row header. The incubation block connects to the main PCB via a 4-conductor cable and SIP header. The 12VDC cooling fan is mounted to the chassis base and connects to the main PCB via a 2-conductor cable and SIP header.

All AC mains components are mounted on the chassis. Three 18 AWG wires feed 115VAC with ground to the incubation block heat PCB. Note that the incubation block itself is tied directly to this ground wire.

The EPROM is located beneath a hatch on the underside of the instrument to facilitate easy software upgrades. Early models which do not incorporate the EPROM hatch require the removal of the cover for software upgrade.

### CAUTION

**The block heat PCB beneath the incubation block is connected to the mains supply. Disconnect AC power cable before servicing.**

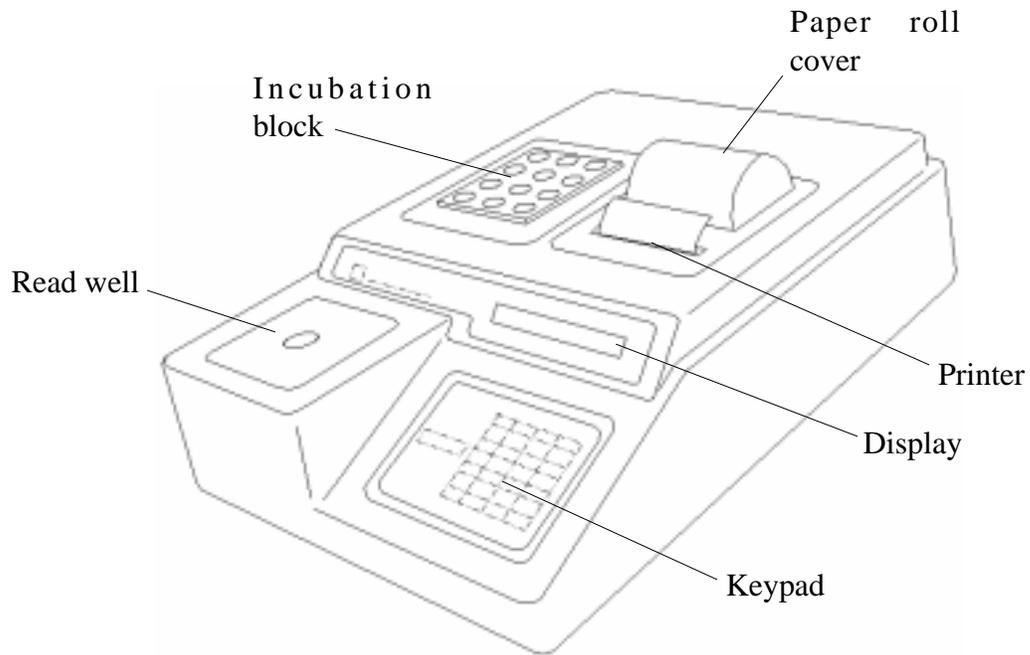
Your particular 1900 series instrument may differ from the configuration described in this manual. To describe each instrument model in detail would be impossible due to space limitations. Omitted features may be ignored. Differences which affect calibration or service procedures are noted where applicable.

1900 series variations:

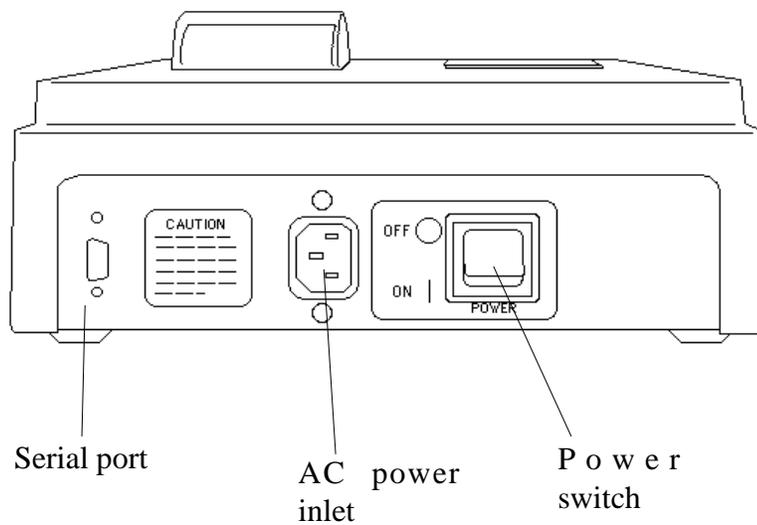
- 4 - position filter wheel
- Incubation block omitted
- Photometer read well not temperature controlled
- Block and photometer accept 13 mm, 15 mm, or other tubes or cuvettes
- Thermal printer omitted
- Printer assembly mounted to main PCB
- Non-removable power cord installed
- Serial port omitted
- EPROM hatch omitted and EPROM mounted to component side of main PCB
- Calibration trimpots accessible from bottom of instrument
- Calibration not performed in software (no "keypad calibration")
  
- EPROM device may be one of:
  - 2764      8K bytes
  - 27128    16K bytes
  - 27256    32K bytes
  - 27512    64K bytes
  
- RAM device may be one of:
  - 6116      2K bytes volatile
  - 48T02    2K bytes nonvolatile
  - DS1243   8K bytes nonvolatile
  - 48T08    8K bytes nonvolatile

an additional volatile/static SRAM device 6264 (8K bytes volatile) may be used in conjunction with a 48T08 RAM device in some instruments

- PCB revisions—installed components, locations, and jumpers. Refer to the appropriate PCB layout in the “PCB Layouts” section of this manual.



*Figure 1. Instrument Exterior*



*Figure 2. Rear Panel*

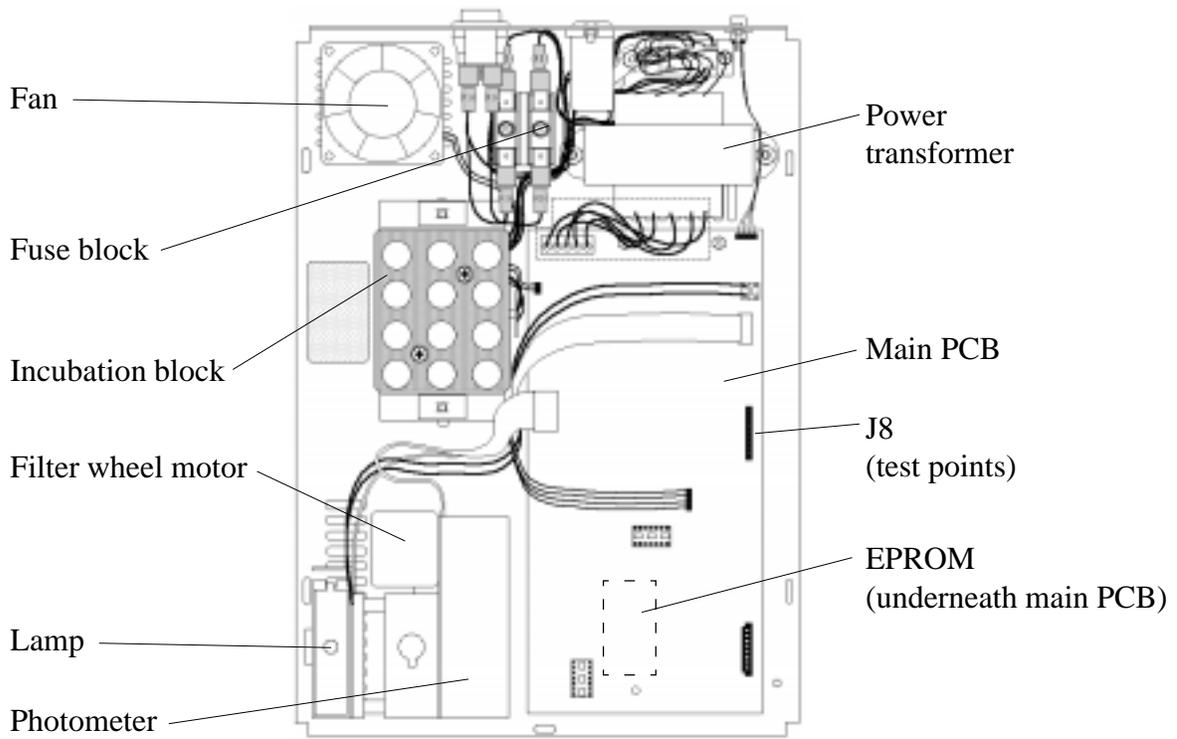


Figure 3. Chassis Layout

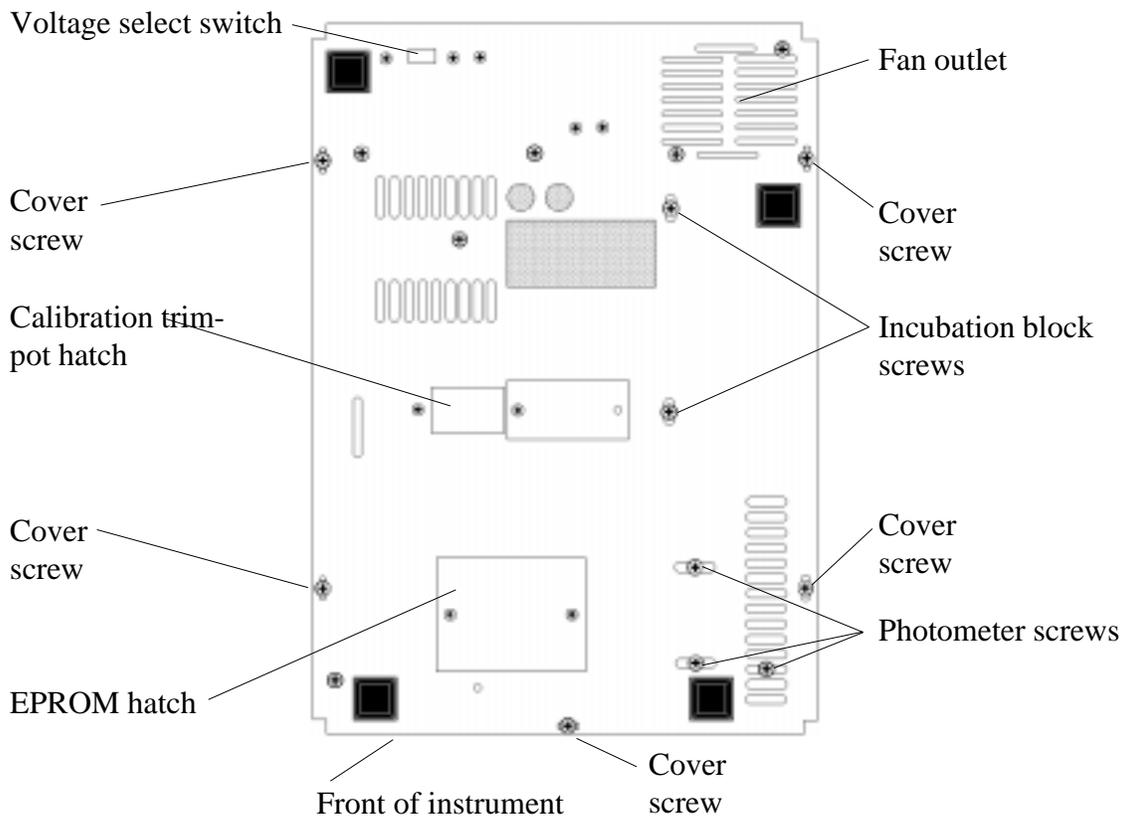


Figure 4. Chassis Bottom

## General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

**Warning: Only qualified personnel should perform service procedures.**

### To Avoid Fire or Personal Injury

- Use Proper Power Cord. **Use only the power cord specified for this product and certified for the country of use.**
- Ground the Product. **This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground.**
- Observe All Terminal Ratings. **To avoid fire or shock hazard, observe all ratings and markings on the product. Consult this manual for further ratings information before making connections to the product.**
- Do Not Operate Without Covers. **Do not operate this product with covers or panels removed.**
- Use Proper Fuse. **Use only the fuse type and rating specified for this product.**
- Avoid Exposed Circuitry. **Do not touch exposed connections and components when power is present.**
- Do Not Operate With Suspected Failures. **If you suspect there is damage to this product, have it inspected by qualified service personnel.**
- Provide Proper Ventilation. **Refer to the installation instructions for details on installing the product so it has proper ventilation.**
- Do Not Operate in Wet/Damp Conditions.
- Do Not Operate in an Explosive Atmosphere.
- Keep Product Surfaces Clean and Dry.

### Safety Terms and Symbols

Terms in This Manual. **These terms may appear in this manual:**

**Warning: Warning statements identify conditions or practices that could result in injury or loss of life.**

**Caution: Caution statements identify conditions or practices that could result in damage to this product or other property.**

Terms on the Product. **These terms may appear on the product:**

**DANGER indicates an injury hazard immediately accessible as you read the marking.**

**WARNING indicates an injury hazard not immediately accessible as you read the marking.**

**CAUTION indicates a hazard to property including the product.**

Symbols on the Product. **These symbols may appear on the product:**



WARNING  
Risk of Shock



Protective Ground  
(Earth) Terminal



CAUTION  
Refer to Manual

## Instrument Specifications

Linear measurement range:	0.00 to 2.50 Absorbance Units (A)
Photometric accuracy :	± (1% of the reading + 0.005 A) at 1.5A ± (2% of the reading + 0.005 A) at 1.5-2A
Stability:	drift of no more than 0.005A in 8 hours/bichromatic
Light source:	tungsten Halogen Lamp
Wavelengths:	340, 405, 450, 505, 545, 600nm
Typical half bandpass:	10nm
Type of filter:	Multiple-cavity sealed interference
Tube size:	12mm round standard
Minimum fill volume:	1 mL
Maximum fill volume:	2 mL (for temperature control to 37½C only)
Temperature:	37½C (±0.3½), Block stays on , Cell has on/off switch
Warm up times:	
lamp in rate mode	120 seconds, built-in
lamp in Mosquito™ Mode	240 seconds, built-in
lamp in other modes	45 seconds, built-in
cell	20-30 minutes, dependent on ambient temperature
incubation block	20-30 minutes, dependent on ambient temperature
Lamp saver time:	after 15 minutes idle, 30 minutes in Mosquito™ Mode
Speed:	reads, calculates and prints results in 3 seconds
Display:	alphanumeric, LCD
Printer:	thermal, dot matrix, 20 characters per line
Keyboard:	16 key, membrane switch, 4X4, audible response
Calculation modes:	single point calibration by standard or factor, multipoint calibration with point to point curve fit, multipoint percent absorbance, rate by standard or factor (batch or singly), fixed time kinetic
Fuse requirements:	120VAC - 0.6 A, 3AG slo blo
Power requirements:	120 V or 240V AC, 50-60 Hz (switch selectable)
Enclosure:	painted flame retardant ABS Plastic cover with metal base
Dimensions:	9.5 X 13.25 X 3.75 inches (24 X 34 X 10 cm)
Weight:	approx. 10 lbs (4.5 Kg)
Recommended operating temperature:	18-35½C
Recommended operating humidity:	less than 85%
Optional Accessories:	Redi-Check® Photometer QA (for instrument QC), Mosquito™ Aspiration Flow Cell Accessory, Stat Tracks™

*Environmental Conditions for Safe Operation:*

Indoor Use

Altitude up to 2000 m

Temperature 5°C to 40°C <sup>1</sup>

Humidity 80% for temperatures up to 31°C decreasing linearly to 50% humidity at 40°C.

Mains supply voltage fluctuations not to exceed  $\pm 10\%$  of the nominal voltage.

*Recommended Environmental Conditions*

Recommended Operating Temperature: 18-35°C

Recommended Operating Humidity: less than 85%

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<sup>1</sup> Although it may be safe to operate in these conditions, it may not be suitable for the performance of your tests. Check with your supplier.

# Principles of Operation

## Photometer

The light from a tungsten-halogen lamp is passed horizontally through the tube or flowcell and the sample it contains. The sealed box on the opposite side of the read well contains a rotating filter wheel and photodiode. The filter wheel contains optical bandpass filters at various wavelengths, and is speed controlled, via drivers U9A and U9B in parallel, to approximately 4 rps under software control. As each filter passes in front of the photodetector, an infrared optical switch generates a pulse (FCNT) at U13. C14 charges to the peak voltage produced by the photodetector and amplifiers U16 and U14B. The sampled voltage is buffered by U15A and then fed to comparator U15B which compares the sampled voltage to the output of an exponential capacitor decay circuit built around Q3 and C16. The positive voltage at the comparator output enables a counter in 8254 timer U4. The photodetector output is proportional to the intensity of the light, whereas the width of the positive phase of the comparator output is proportional to the absorbance. An oscilloscope can be used to view the important signals at connector J8 while the instrument is in operation. See Figure 5, Oscilloscope Waveforms.

## Display, Keypad, and Printer

A 16 character alphanumeric LED display is mounted to the printer bracket inside the cover. The display connects to the Z80 data and address buses on the main PCB via a 14-pin DIP cable, which also supplies +5VDC power. A 4 x 4 membrane switch keypad is sealed behind the front panel overlay. The tail of the keypad switch layer is fed through the cover and installed to connector K1 on the main PCB, which then connects to 8255 PPI U5. The printer assembly which consists of a 20-column thermal printer, printer PCB, and metal support is mounted to the cover and is connected to the main PCB via a 14-pin DIP cable, which provides +5VDC power and the control lines from 8255 PPI (Programmable Peripheral Interface) U5. On early models the printer assembly is mounted to the main PCB with standoffs.

## Temperature control

The incubation block and read well are maintained at 37½°C. Thermistors (10k @25½°C) mounted in the incubation block and in the read well measure the temperature. These thermistors are multiplexed at a 0.5 second rate into the feedback path of oscillator U14A. The waveform at pin 1 is a sawtooth of approximately 1.2 Vpp amplitude centered at +2.5 V. Schmitt triggers U11 convert this to a square wave for current reversal and to drive the CLK2 input of U4. The microprocessor heats the system to maintain the frequency of this signal at 2.08 kHz, the 37½°C set point.

Power resistors located on the bottom of the incubation block are switched to 115VAC via an optotriac which is driven by U9C. A red LED located on the block heat PCB illuminates when block heat is on, and a red LED located on the main PCB illuminates when cell heat is on. For the read well, driver U10 applies 12VDC (raw) across heater resistors located on the cell heat PCB.

## System Control

The instrument is based on the 8 bit 2 MHz Z80 microprocessor (U1). The software is permanently stored in an EPROM (U2). In most instruments a battery-backed nonvolatile RAM (random access memory) chip (U3) incorporating a real-time clock is used to store data such as calibration, test setups, samples, and also maintains the date and time. Some instruments use the 6264 static RAM (U22) in addition to the nonvolatile RAM for RAM functions that need not be maintained at power-off. Most digital I/O is accomplished with 8255 PPI U5. Time intervals and pulse widths are measured using the counter channels of 8254 timer U4.

### WARNING

**Hazardous line voltages are present on the rear panel and beneath the incubation block. Always disconnect the external AC power cable before opening the instrument.**

### CAUTION

**Do not make any hardware adjustments until you have read the section "Calibration".**

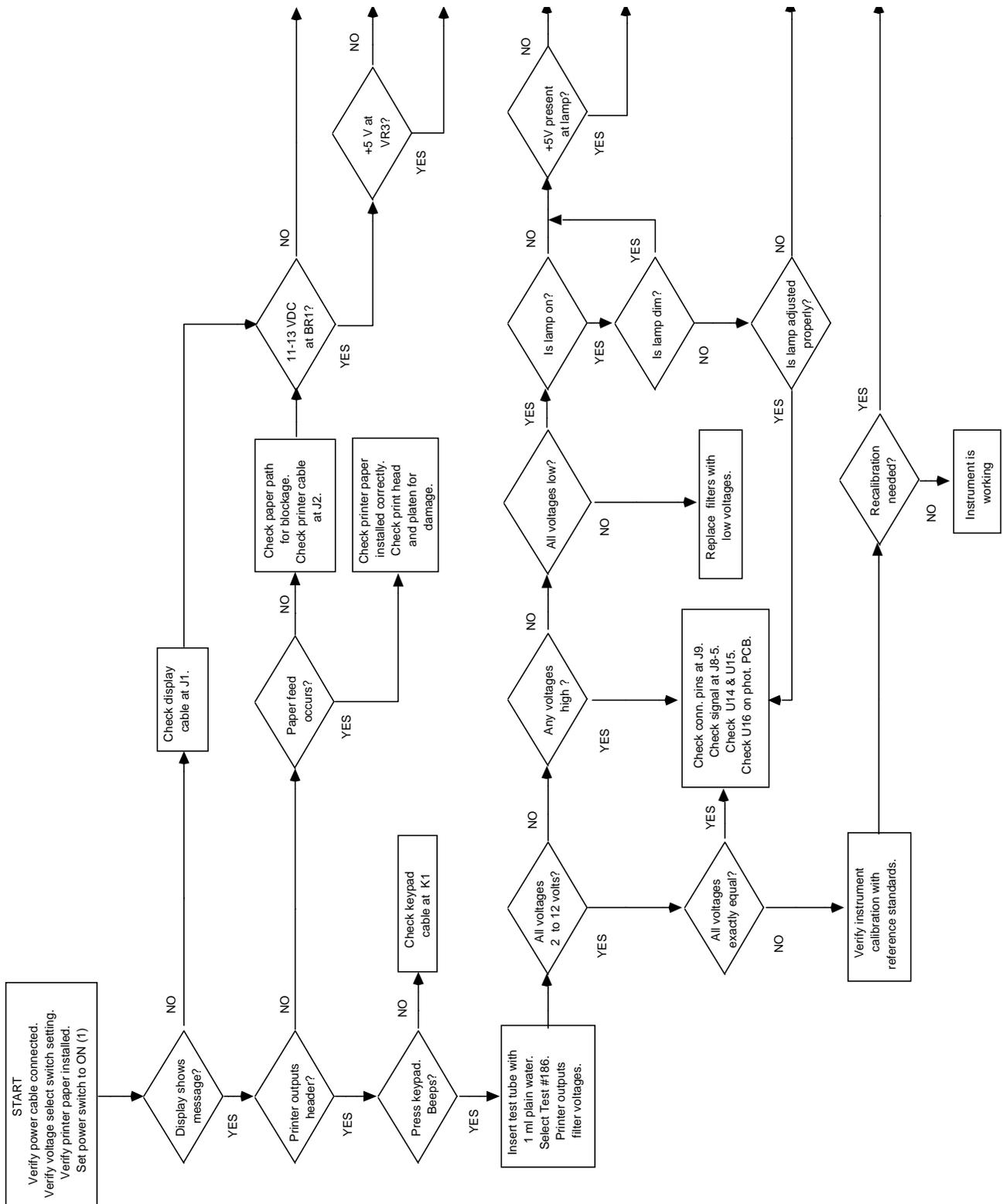


Figure 5. Troubleshooting

# Troubleshooting

The flowchart in Figure 5 describes the logical steps to take if the instrument is malfunctioning. It is only a guide to troubleshooting, and is intended to assist in determining problems which are routine. It is not intended to take the place of an experienced technician, nor does it attempt to cover all possible problems. Note, for example, that the temperature control system is not covered.

In the following section, each subassembly or component group and possible problems and solutions are outlined.

## Power Supply

The power supply consists of a transformer, two diode bridges, and three regulators. Line voltage supplied to the transformer is converted to 36 VAC, center tapped, which feeds diode bridge BR2. The center tap is used as a reference for regulators VR4 and VR5, which provide +15 VDC and -15 VDC for analog circuitry. Another transformer output supplies 11VAC to diode bridge BR1, which in turn provides +12 VDC (raw, 11-13 VDC nominal) to the system, and VR3 regulates this down to +5 VDC for the logic and other low voltage control circuits.

### WARNING

**Hazardous line voltages are present on the rear panel and beneath the incubation block. Always disconnect the AC power cable before opening the instrument.**

A "dead" instrument may be caused by just a blown fuse. However, a blown fuse may indicate a problem on the main PCB or transformer. Also, the voltage select switch setting must match the line voltage. If there is no input voltage present at J6, check the fuse. To replace the fuse, disconnect the power cable and open the instrument. Locate the double clip fuse holder mounted on the inside of the rear panel. Locate the blown fuse and remove it with a fuse puller, or carefully pry it out with a small screwdriver. Install two (2) **0.6 A 3AG** slow-blow fuse. Replace only with fuse of the specified type and current ratings.

If voltage is present at J6, check for input voltage on VR3, VR4, and VR5. If no voltage is present, the diode bridge BR1 or BR2 may have failed.

## Photometer

The photometer assembly can be examined as several component systems:

- Read well assembly and cell heat PCB
- Lamp and brackets
- Photometer PCB
- Filter wheel and motor.

The read well assembly serves to hold the tube centered on the cell block, between a fixed plate and a spring loaded plate. A microswitch mounted to the cell heat PCB operates when a tube is inserted.

The lamp is tungsten-halogen, rated at **6V 10W**. The lamp bracket holds the lamp and lens in alignment with the rest of the assembly, that is, the filament is centered on the optical path.

The filter wheel turns on a shoulder screw shaft and is driven by the filter wheel motor via a neoprene belt. The filter wheel itself requires no adjustments.

The rotation of the photometer filter wheel is under micro-processor control. The processor turns the wheel on and off and maintains it rotating at a constant average speed. If the processor fails to detect motion of the wheel within 7 seconds of the command to start, the “Filter Wheel Err” message occurs.

Possible causes:

The belt has come off the wheel.

The motor does not respond to drive circuit.

The drive circuit and or connections are missing or defective.

The wheel detection circuit connections are missing or faulty.

Analysis process:

Note: In general the wheel only rotates while the instrument is in a reading mode and the lamp is on.

Remove the instrument cover per the cover removal procedure.

Check that the photometer cable J9 (blue) and the rainbow cable J5 are seated.

Turn the unit on. Measure 5-6 volts at the yellow wire of the filter wheel motor.

Ground the brown wire-the motor should rotate at a rapid rate.

Confirm that the filter count pulses appear at test points J8#2.

In a reading mode, check that pin# 1 of U9, ULN2003, is high (motor on) or pulsing.

Check that U9 pin #16 is low or pulsing.

The photometer PCB contains a photodiode, a very sensitive opamp circuit (U16) and phototransistors Q7 and Q8. Because the photodetector and related circuitry is solid-state, it should require no service. Avoid unnecessary handling of the photometer PCB or removal of the optical cover.

The lamp is intended to be maintenance free for the life of the instrument, since the lamp is turned off automatically after 30 minutes of instrument inactivity. Under heavy usage the lamp remains on for longer periods and so may require replacement. Also, a physical shock to the instrument could cause filament breakage. The lamp must be replaced if output becomes low or the lamp fails completely. To check for low or no lamp output, insert a borosilicate tube filled with plain water into the read well. Do not use a soda-lime glass tube, since it does not transmit at 340 nm. Select test #186. The instrument prints the wavelength, position, and the detected voltage for each filter. The voltages should be between 2 and 10 volts. If all of the voltages are below 2.0 volts, the lamp is the likely suspect. As a final check, measure the voltage at the lamp terminals. If the lamp voltage is much lower than 4.5 VDC, the regulator circuitry on the main PCB (Q6 and VR1) may be the problem. Otherwise, replace the lamp. Refer to the section “Lamp Replacement”.

If only one or two filters report low detected voltages, degraded filters or a misadjusted lamp may be the cause. To check for misadjusted lamp, refer to Figures 7 and 8, as well as the procedure “Lamp Replacement”. The optical interference filters contained in the wheel are of metal-deposition type construction and are intended to be maintenance free for the life of the instrument. Some older instruments incorporated emulsion-type filters whose transmittance can be reduced dramatically if subjected to high humidity over very long periods. Refer to the section “Filter Replacement”.

## Temperature Control

The temperature control system is very stable and ordinarily does not require adjustment or recalibration. In the event calibration must be verified or reestablished, refer to the section "Calibration". Be sure to read the entire section on calibration before attempting any adjustments.

## Main PCB

Under normal circumstances, there are no adjustments to be made to the main PCB. Circuit failures are highly unlikely, but if they occur, it is recommended that the repairs be performed by factory authorized technicians. There are ten test points on J8 which provide access to a number of vital signals. The instrument can be observed in operation with an oscilloscope. Typical test point waveforms are shown in Figure 6.

## Internal Printer

The internal printer is a 20 column thermal type device which prints ASCII characters using a 5 x 7 dot matrix. (Graphics printers use a 5 x 8 dot matrix, with the extra bit used only in graphics mode.) A printer PCB, incorporating a microcontroller, manages the print head motor and the head drivers. There are no adjustments, and service is limited to replacement of the entire printer mechanism. A printer jam can occur if the printer paper tears and becomes lodged in the printer mechanism, thus preventing the print head from moving freely. Refer to the section "Printer Jams".

## Display

The display should be clearly legible with no missing or dim characters or segments. There are no adjustments, and service is limited to replacement.

## Keypad

The keypad is a sealed membrane switch layer which is serviceable only by replacement. You can test the keypad by pressing **AUX**, then pressing all keys except **CLEAR** and **ENTER**. Note that each key causes the instrument to beep and display a character. Press **CLEAR** and the display clears. Press **ENTER** to end the test.

## Serial Port

The serial port is intended for use with either the aspirating flowcell accessory or with an external serial printer. Early models only support a serial printer. By using a special cable, a serial printer or computer with a serial port may be connected. The port is a female 9-pin DB-style connector using RS-232 signals in a nonstandard pinout. The data format is 2400 baud, 8 bits, 1 stop bit, and no parity. There are two different pinouts for the serial port:

Early models		Current models	
1	GND	1	GND
2	TX	2	TRANSMIT / MOSQUITO
3	RX/DTR	3	NC
4-9	NC	4	TX / DATA
		5-8	NC
		9	+12VDC

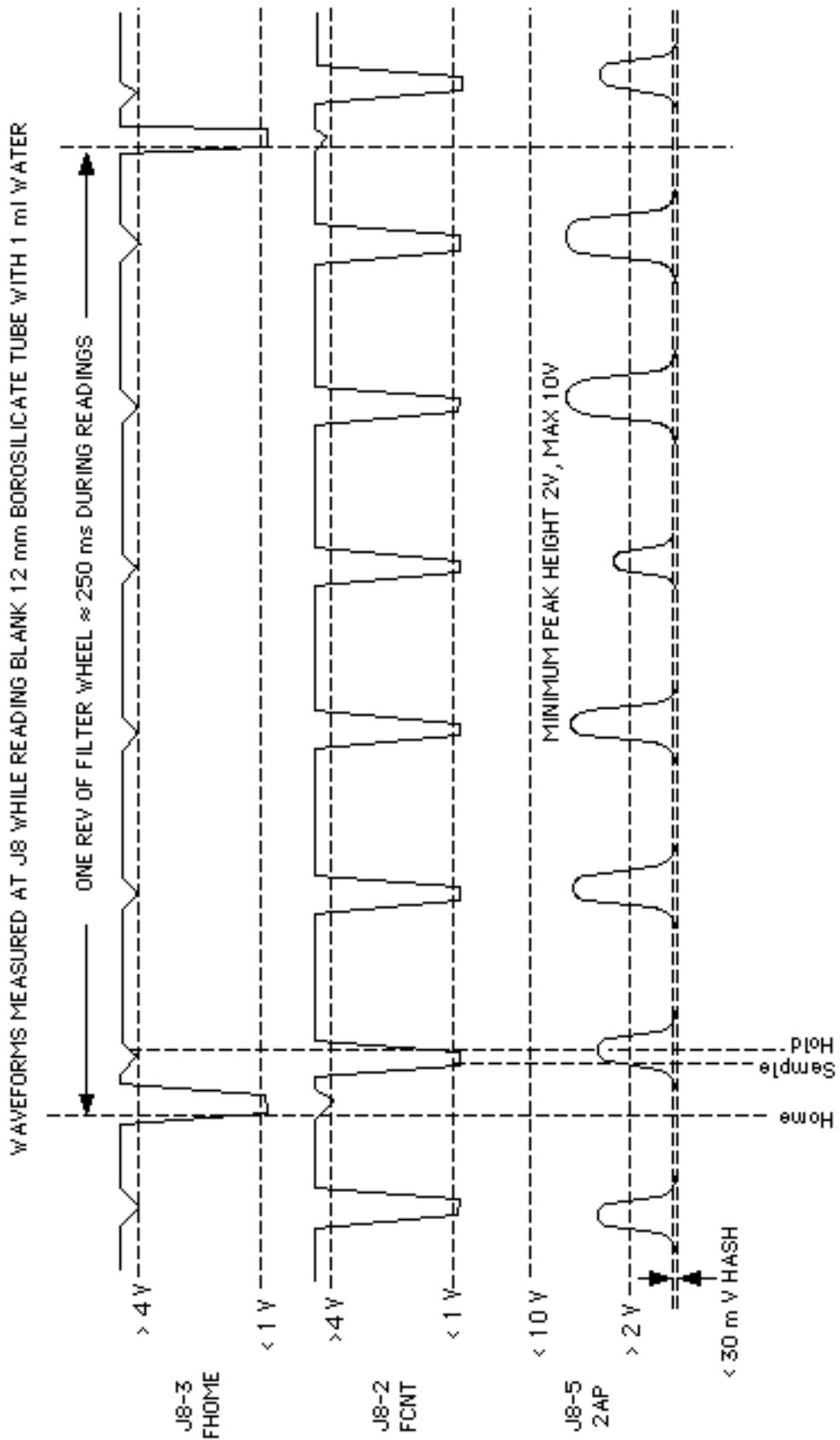


Figure 6. Oscilloscope Waveforms

## Error Messages

Error messages are displayed to inform the user of a possible problem. They are intended to help the operator locate the problem. If error messages appear frequently, the most likely cause will be a hardware problem.

The following error messages indicate possible interface or component problems.

LAMP FAILURE	The lamp does not appear to illuminated at all. Low voltages were detected for all filter positions. See the section "Photometer" under "Troubleshooting".
PRINTER PAPER JAM	The internal printer paper path is obstructed. Clear the paper path. If the paper path is clear, Check the 14-pin DIP cable connecting the printer PCB to the main PCB.
FILTER WHEEL ERR	The instrument cannot detect pulses from the filter wheel. Check for rotation of the filter wheel as a dislodged or broken drive belt will prevent the filter wheel from turning. Check for signal at J8-2. Check the photometer LED board and the phototransistors Q7 and Q8 on the photometer PCB. See the section "Photometer" under "Troubleshooting".

The following error messages indicate possible failure of the NV RAM U3. U3 can be checked by substitution.

MEMORY ERROR	The checksum failed when a stored test was recalled. The test was deleted.
WATER VALUES RESET	The stored water absorbances were corrupted or not found.
DO TEMP SET TEST 210!	The stored temperature calibration values were corrupted or not found. See the section "Restore Calibration Data".
DO ABS SET TEST 212!	The stored absorbance calibration values were corrupted or not found. See the section "Restore Calibration Data".

**Note that these messages may occur when doing software upgrades, due to different memory space locations for stored data.**

# Service Procedures

## Opening the Instrument

The cover must be removed to allow access to the inside of the instrument. Disconnect the power cable and the serial cable (if connected) from the rear panel. Invert the instrument on a soft nonabrasive padded surface such as a terrycloth towel, to prevent scratching. Refer to Figure 4, Chassis Bottom. Locate and remove the (5) cover screws from the bottom of the instrument. Do not remove or loosen any other screws. While holding the instrument cover in place with both hands, return the instrument to the upright position.

On some models, the printer mechanism is mounted to the main PCB and the printer paper roll must be removed to allow cover removal. Press inward on the sides of the paper roll cover and lift it off. Lift out the paper roll and tear off the paper where it enters the printer mechanism.

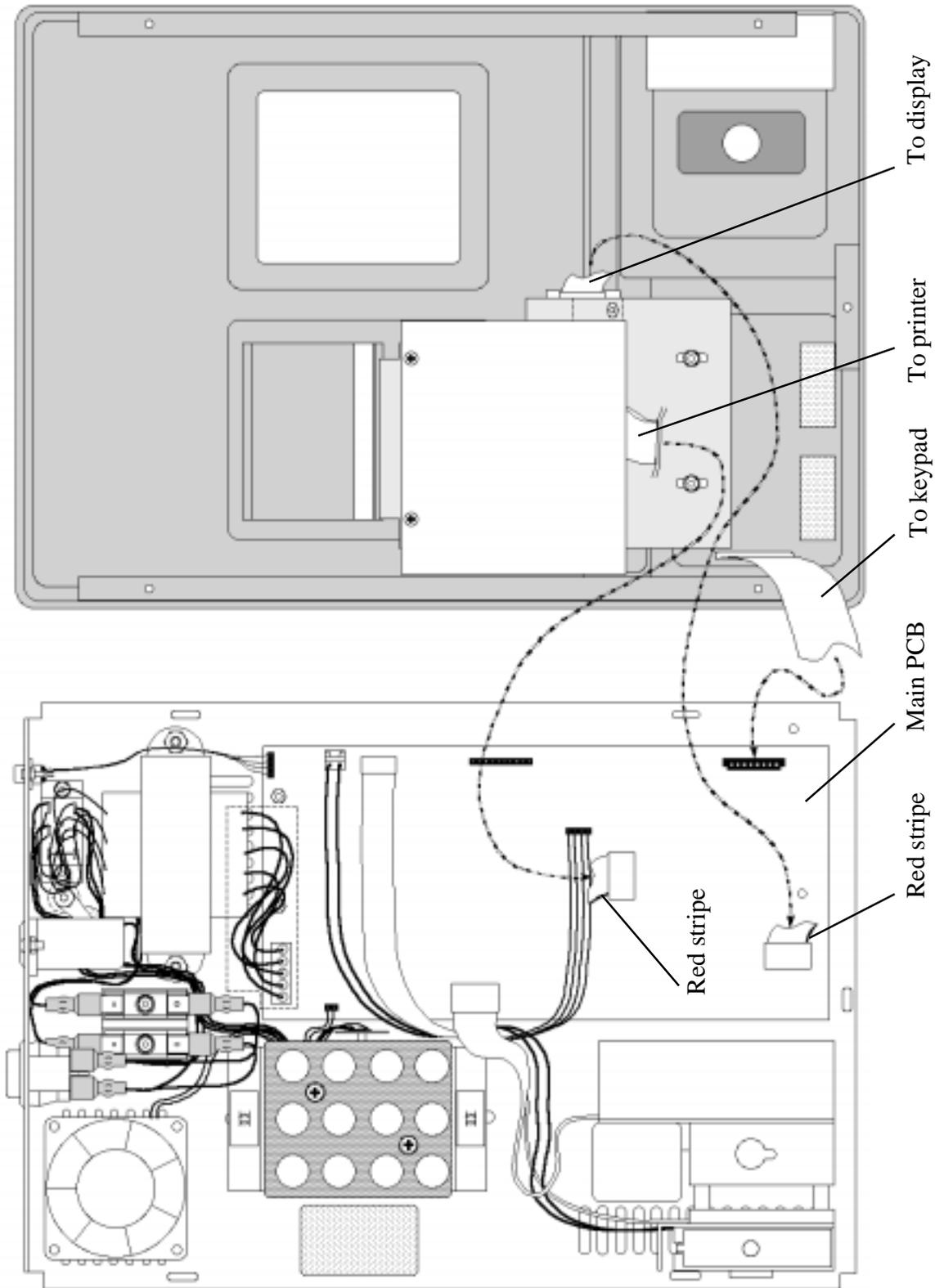
Grasp the cover at the left side. Gently lift the cover upward and to the right, until the cabling is visible. You can rest the cover on its side while you disconnect the cables. Refer to Figure 7, Cover Connections. Disconnect the display cable at the left front of the main PCB assembly. Place a screwdriver between the 14-pin DIP plug and its socket and pry gently upwards. Do not bend the pins. Disconnect the printer cable in the same way. Disconnect the keypad cable from its connector.

Remove the cover and set it aside.

To reinstall the cover, reverse the procedure. Position the cover on its side to the right of the chassis base. Connect the printer, display, and keyboard cables. Carefully fit the cover to the chassis base. Install the cover screws. Do not overtighten the cover screws.

### WARNING

**Hazardous line voltages are present on the rear panel and beneath the incubation block. Always disconnect the AC power cable before opening the instrument.**



*Figure 7. Cover Connections*

## Lamp Replacement

The lamp should be replaced only if it fails to light, or several filter voltages are reported as low.

Materials and equipment:

- Replacement lamp
- Phillips screw driver
- Flat blade screw driver

Procedure:

1. If using the flowcell accessory, remove the flowcell and place the instrument in tube mode.
2. Set the power switch to OFF (O). Open the instrument. Locate the photometer and the lamp at the left side of the photometer. Refer to Figure 8, Lamp Replacement.

### CAUTION

**Lamp is HOT. Allow the lamp to cool before handling.**

3. Loosen but do not remove the lamp terminal screws. Do not loosen or remove any other screws. Remove the lamp by lifting it upward out of the connector.
4. Use a pair of pliers or tweezers to handle the new lamp. Do not handle with bare skin. Insert the lamp leads into the connector until they bottom out. The lamp filament must be centered on the lens and the lamp body must be parallel with the lamp bracket. While holding the lamp in alignment, tighten the lamp terminal screws. You should be able to visually confirm the lamp alignment by sighting through the lamp and lens to view the aperture on the spring plate behind the lens. All three elements should be aligned. With the newer lamp bracket (Figure 8a), you can adjust the height of the lamp using the indicated screw to raise or lower the plate height.
5. Set the power switch to ON. Shield your eyes from the lamp beam and observe the projection of the beam onto the aperture. Refer to Figure 9, Spot Alignment. The spot should be small and centered on the aperture. The spot should be sufficiently large to just encircle the aperture. If the spot is not centered, repeat step 4.
6. Insert a borosilicate tube filled with plain water into the read well. Do not use a soda-lime glass tube, since it does not transmit at 340 nm. Select test #186. The instrument prints the detected voltage for each filter position. All voltages should be between 2.00 volts and 10.00 volts. If all the voltages report low, repeat step 5 until optimum lamp position is obtained.

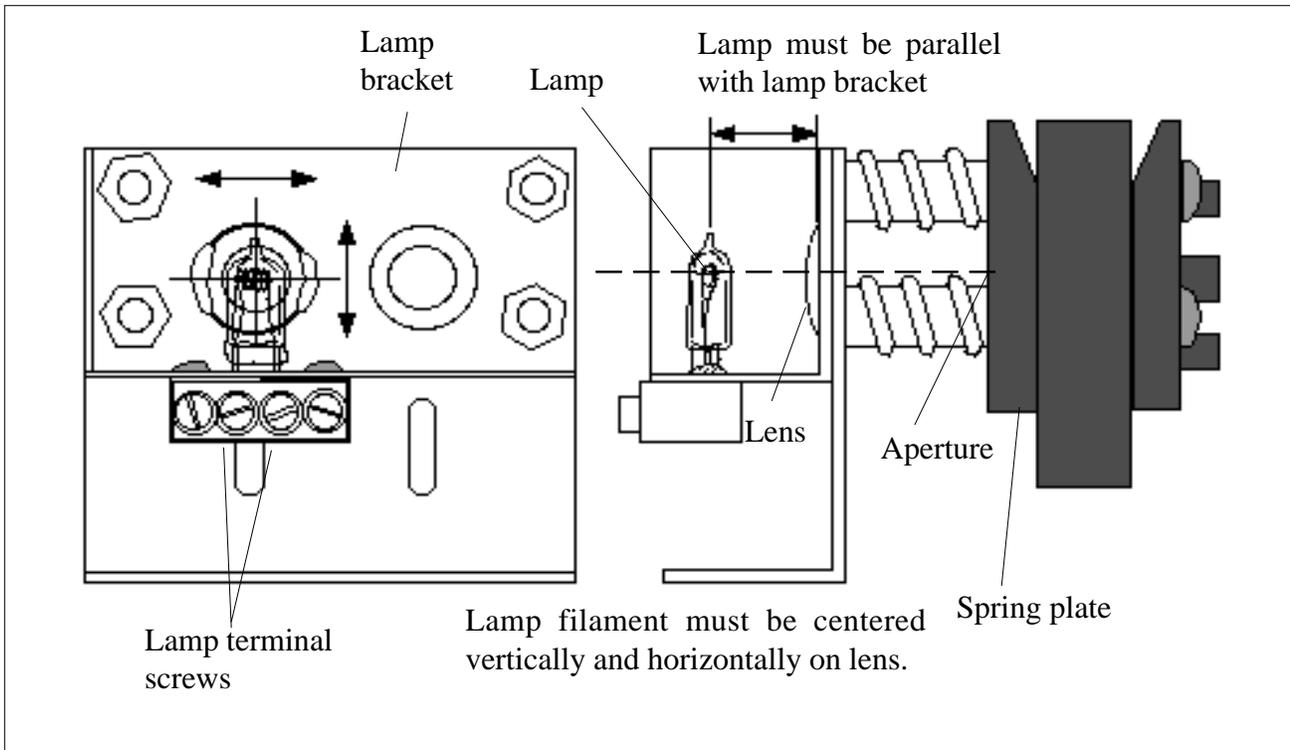


Figure 8. Lamp Replacement

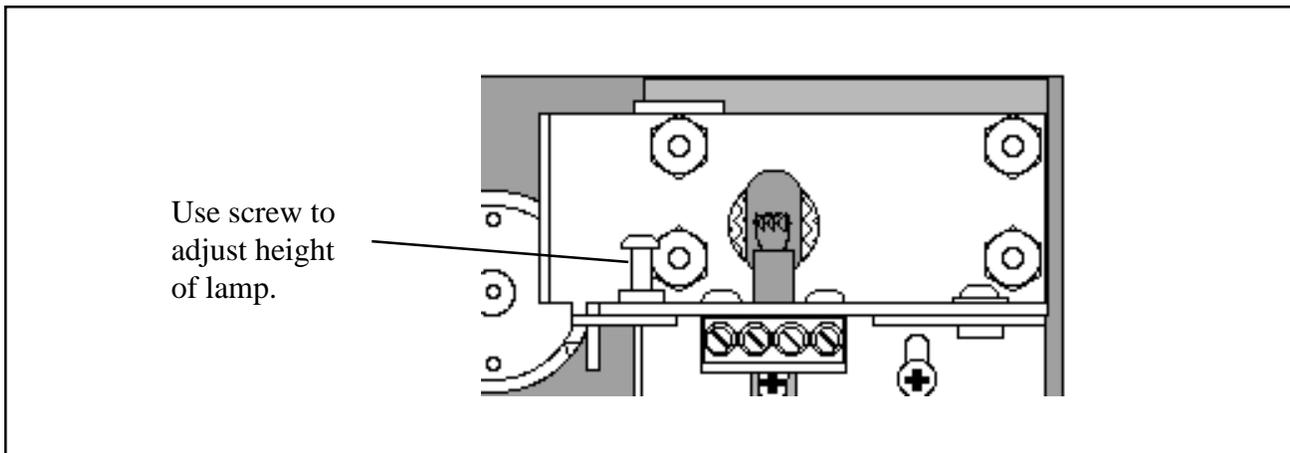


Figure 8a. Lamp Alignment with Newer Lamp Bracket

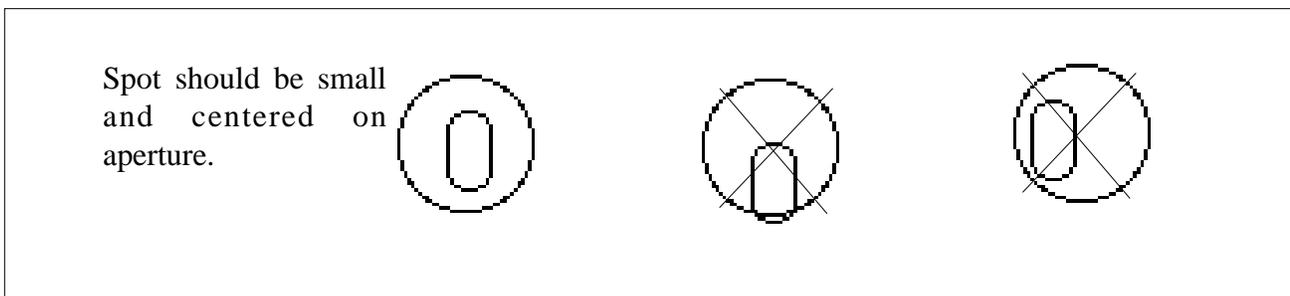


Figure 9. Spot Alignment

## Filter Replacement

### Materials and equipment:

- Replacement filter set
- Phillips screw driver
- Flat blade screw driver

### Procedure:

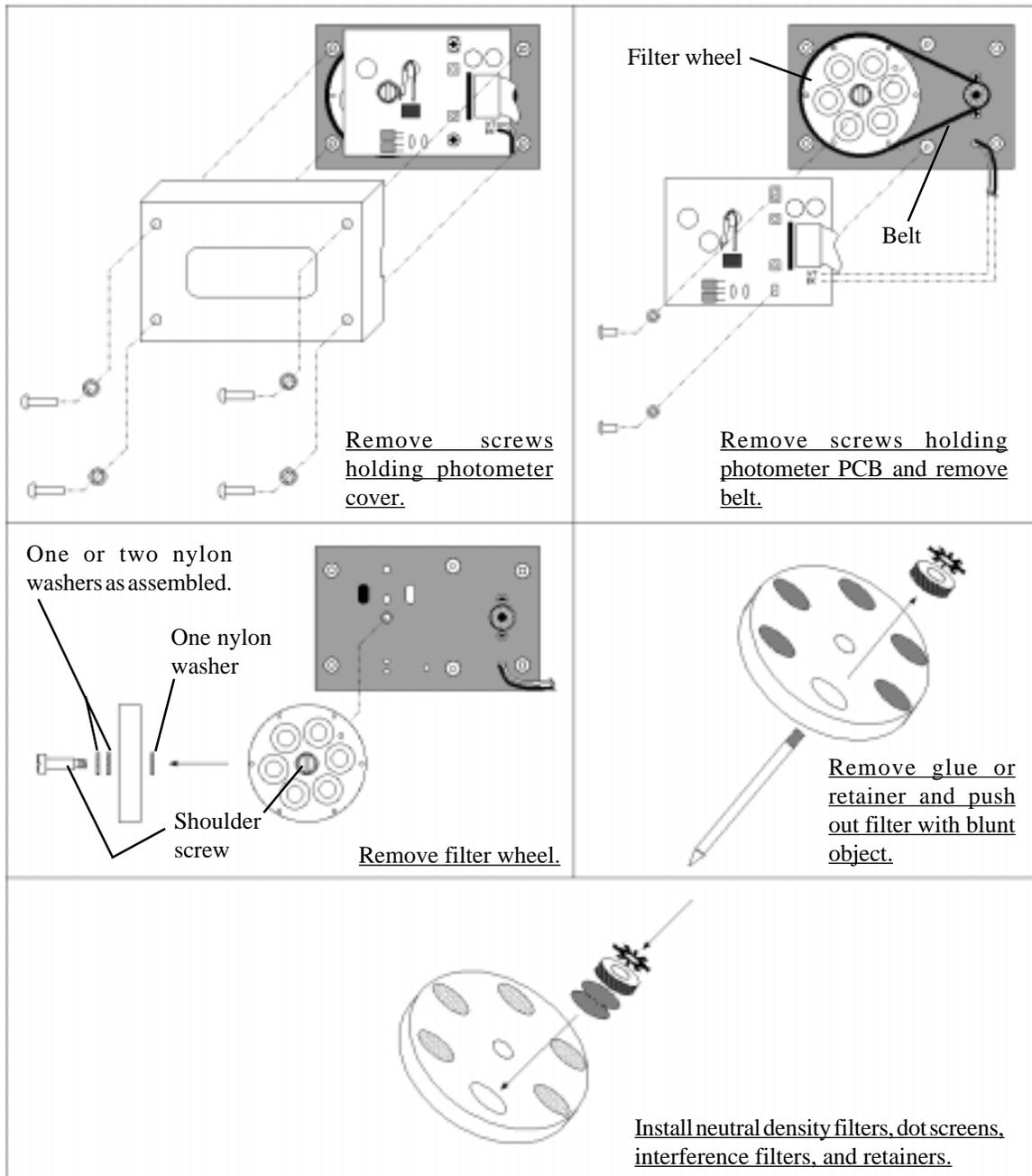
1. Open the instrument. Refer to Figure 3. Locate the photometer. Unplug both photometer cables from the main PCB.
2. **Use a pencil to mark the front and side edges of the photometer on the chassis so that the photometer can be installed in its original position.**
3. Locate the (3) #6 screws holding the photometer assembly to the chassis. From the bottom of the instrument, remove these screws and washers **while noting the screw lengths and locations from which they were removed.**
4. Refer to Figure 10, Filter Replacement. Remove the four 6-32 screws retaining the photometer cover. Set the photometer cover aside.
5. Remove the two 4-40 screws securing the photometer PCB. Gently move the PCB aside without disconnecting any wires.
6. Remove the belt from the filter wheel and pulley. Loosen the shaft (shoulder screw). Remove the shaft and filter wheel. Note the number of nylon washers and the order of installation.

### WARNING

**Retaining Rings (used on later production filter wheels) will pop out from filter wheel when its spring tension is released during removal. Shield the opening with hand and wear safety glasses.**

7. Refer to Figure 11. Locate the filter to be removed. There are currently two means of filter retention in field use; silicone glue or a Retaining Ring. Refer to Figure 10 and determine if a Retaining Ring is used. If a Retaining Ring is used, carefully pry two to three of the retaining ring teeth away from the filter until the ring is dislodged and remove the ring and filter. If silicone glue is present, remove the silicone and push the filter out of the wheel using the eraser end of a pencil or other soft blunt object and the glue should release. Remove any remaining filter components from that position in the wheel.
8. Locate the neutral density filters, dot screen, and transmittance filters that were included with the replacement filter and drop them first into the cavity. Install the interference filter with the mirror side down. Place the replacement retainer over the filter so that the tabs are angled away from the filter and press in place with a 7/16 diameter wooden dowel or similar object.
9. Install the filter wheel taking care not to pinch washers under the shaft. Reassemble the shaft and washers as disassembled. Tighten the shaft securely. The filter wheel should spin freely.
10. Install the filter wheel belt. Be sure that the belt is centered on the filter wheel and is not twisted.
11. Install the photometer PCB taking care to center the board around the shaft.
12. Replace the photometer cover, taking care to position the cable in the slot of the cover. Do not pinch the cable under the cover. Tighten cover screws only until snug. Do not overtighten the photometer cover screws! Doing so will bend the photometer cover and create light leakage.

13. Install the photometer subassembly to the chassis by replacing the (3) #6 self tap screws through the chassis base **in their original locations**. Line up photometer with locating marks made in step 2. Connect the (2) cables removed in step 1.
14. Attach the power cord and connect the instrument to the mains supply. Set the power switch to ON (1). Insert a borosilicate tube filled with plain water into the read well. Do not use a soda-lime glass tube, since it does not transmit at 340 nm. Select test #186. The instrument prints the detected voltage for each filters. All voltages should now be between 2 and 10 volts. If not, check lamp alignment. If the lamp alignment is properly set, the neutral density filters may need to be changed. Add neutrals to lower the voltage. Remove neutrals to increase the voltage.

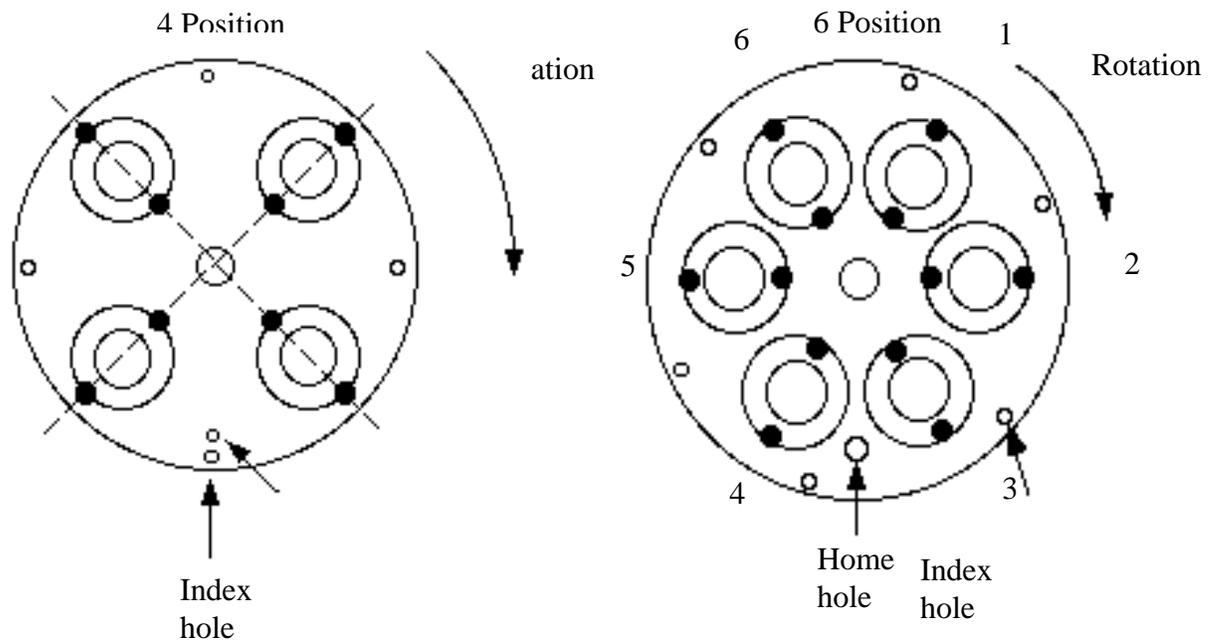


*Figure 10. Filter Replacement*

## Filter Label

The filter label located on the photometer cover describes the specific filter wheel configuration for your particular instrument. Filter wheel position is the physical placement of the filter on the wheel. The filter wheel position numbers are shown in Figure 11. Note the position of the Index hole and the Home hole.

Each filter position can have several filter elements installed. The four-digit filter wheel number identifies the filter wheel batch, including filter lot codes, dot screens, neutral density filters, and assembly date for that particular manufacturing lot of filter wheels. Some earlier filter label styles may include this individual information. If you require specific information for a filter wheel number, contact the manufacturer.



*Figure 11. Filter Wheel Positions*

## Printer Jams

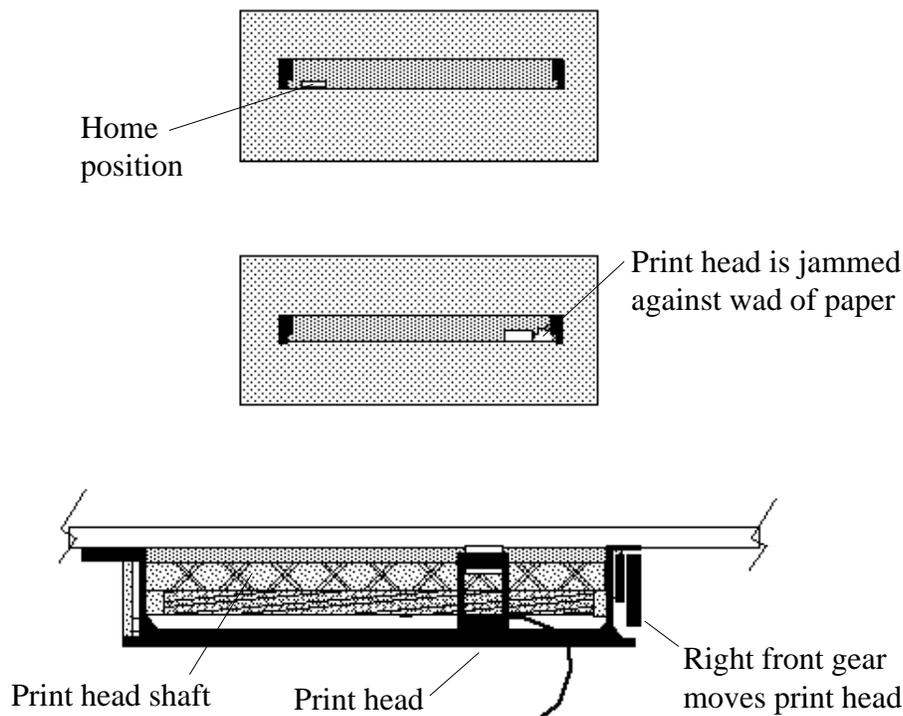
### CAUTION

**Do not apply force to the print head.**

**Do not scratch the platen or pry with sharp objects.**

If the instrument displays “Printer is jammed!”, or if the print head does not return to the home position, check for obstructions in the print head path. Refer to Figure 12, Clearing printer jams. Carefully remove any paper or debris with a pair of tweezers. Turn off the power switch, wait 5 seconds, then turn on the power switch. The print head should move to the right side and then return to home position at the left.

An alternate method of removing a particularly stubborn wad of paper is to move the print head manually. To do this, open the instrument. Remove the two nuts holding the printer bracket to the cover. View the front of the printer mechanism. Locate the small gear on the right side which turns the grooved steel print head shaft. Turn the gear so that the print head moves away from paper wad and the paper can be easily removed.



*Figure 12. Clearing printer jams*

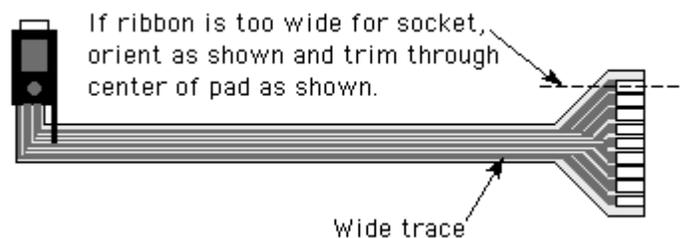
## Printer Repairs

A graphics capable printer has been introduced in recent instruments. Replacement printers are graphics capable and can be made compatible with earlier non graphics capable printer PCBs. One way to identify which type of printer is used is to remove the ribbon cable from the keytail socket on the printer interface PCB. Look at the connector on the ribbon cable. An earlier non graphics capable printer will have eight conductors. The graphics capable printer will have nine. Another way to identify which printer is used is to look at the blue inspection label on the printer interface PCB. If the number on the label is M020445 or higher, a graphics capable printer is used. Repairs to printer mechanisms can consist of print head replacement or printer mechanism replacement.

### Print Head Replacement

Replacement Print Heads are supplied for the graphics capable printer (nine conductor ribbon cable). Determine the size of the keytail socket on the Printer Interface PCB into which the ribbon cable from the Print Head being replaced is inserted (eight or nine slots). If there are eight slots, modify the replacement Print Head as shown in Figure 13.

Refer to Figure 14 and replace the Print Head as follows:



*Figure 13. Replacement Print Head Modification for Non Graphics Capable Printers*

1. Pry out the pin (1) which holds the gear (2) in place.
2. Remove the pin (3) from the side of the print head with tweezers and pry the pin (4) from the top of the Print Head. The Print Head should now be free to move along the Drive Screw (6).
3. Remove the snap ring (5) from the end of the drive screw (6) and withdraw the drive screw and gear assembly from the printer mechanism in the direction shown.
4. Press the end of the slider rod (7) out of the hole in the printer mechanism in the direction shown from the left side of the mechanism. It is not necessary to remove the slider rod completely from the mechanism.
5. Slide the Print Head off the slider rod and replace with the new Print Head. Reassemble the mechanism in reverse order of the above disassembly steps.

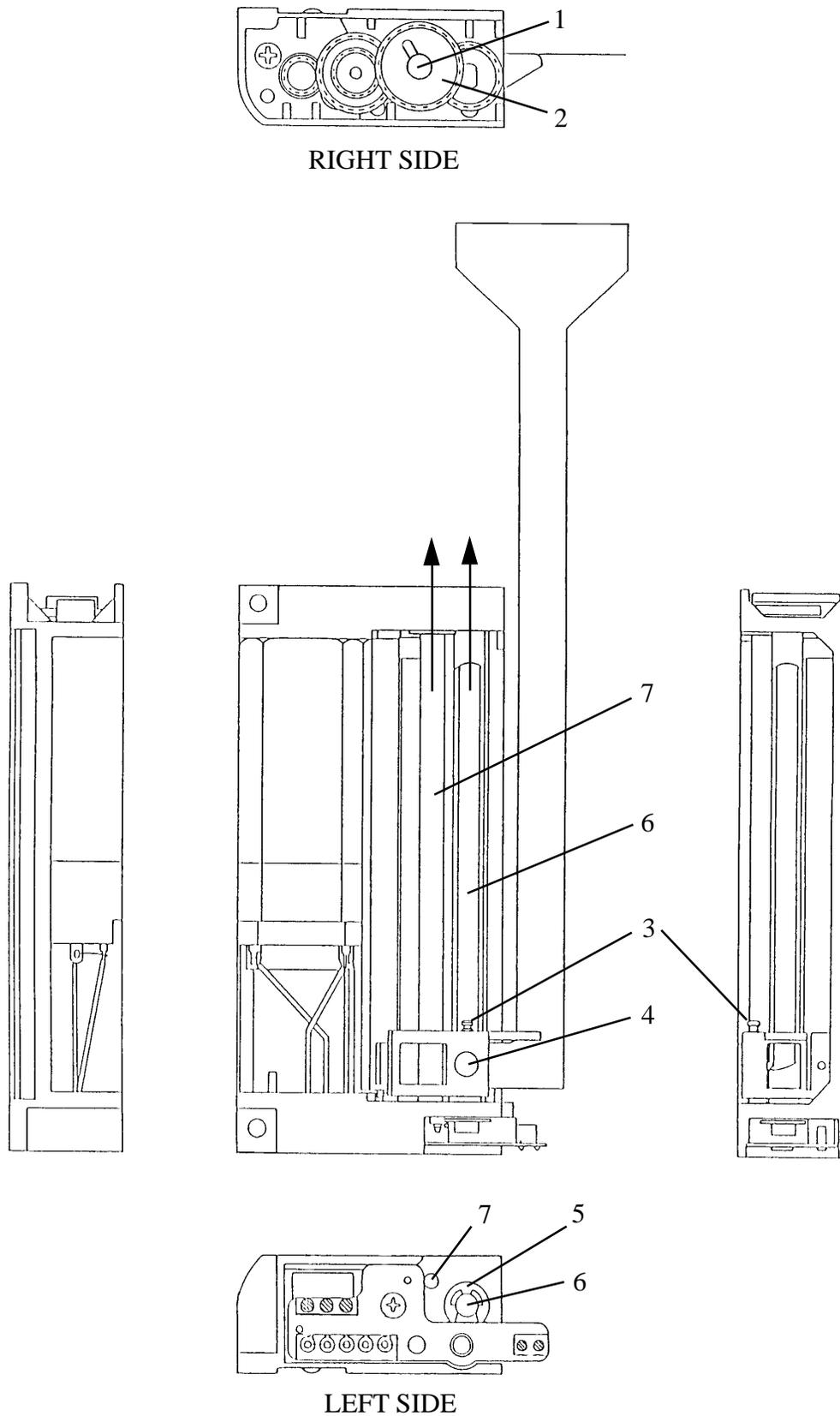
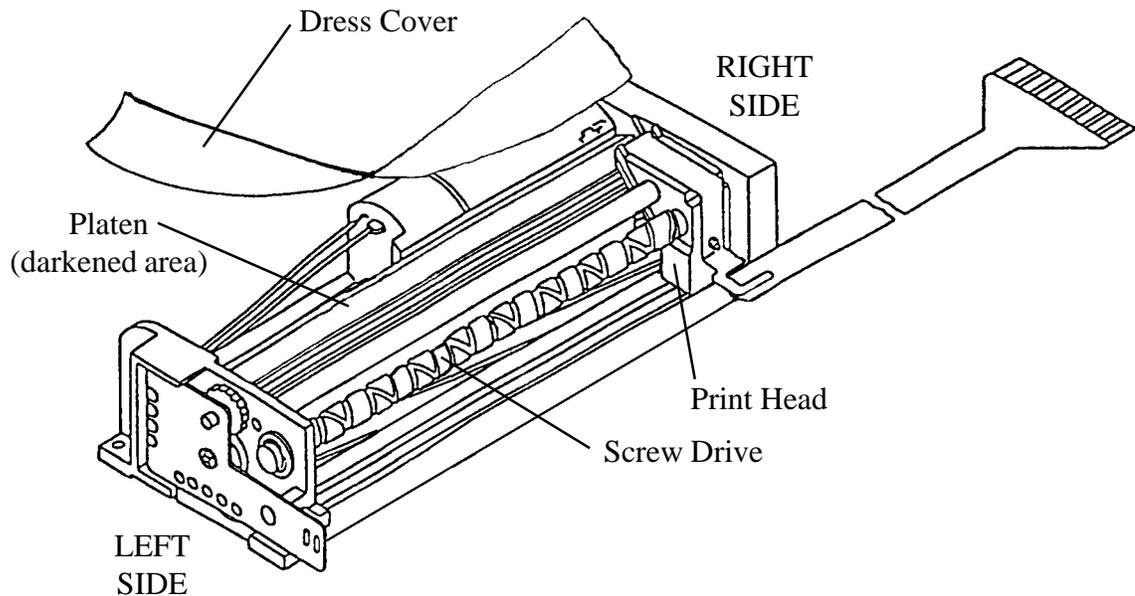


Figure 14. Printer Views for Print Head Replacement

## Printer Platen Replacement

1. Referring to Figure 15, remove the Paper Dress Panel.
2. Move the Print Head to the right-most position as shown by rotating the Screw Drive with its drive gear on the right side of the mechanism.
3. Lift out the left side of the platen.
4. Install the new platen so that the end which has the longer pin is oriented toward the right side of the mechanism. Insert the right end of the platen under the print head. Use a pen point or similar blunt instrument to push metal spring slightly forward, then slip the left side of platen in place.



*Figure 15. Printer Platen Replacement*

# Printer Interface PCB Replacement

Replacement PCBs are supplied in a configuration which will accommodate both graphics capable and non graphics capable printers. If the printer to which the PCB will be connected has an eight position ribbon cable (either from the factory or as modified) cut jumper J5 on the PCB and install the ribbon cable from the printer into the eight position keytail socket (see Figure 16.). Otherwise, install the ribbon cable in the nine position keytail socket and leave the jumper intact.

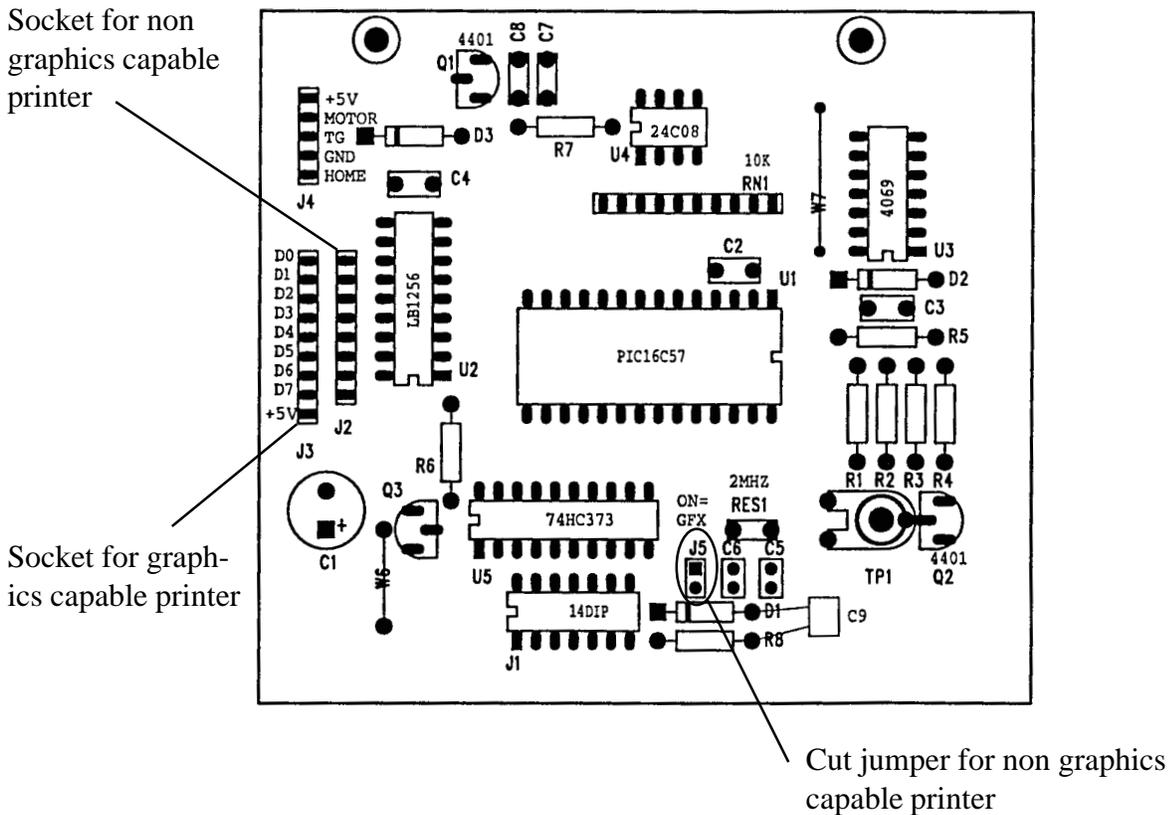


Figure 16. Printer Interface PCB.

## Main PCB and/or Photometer Replacement

Before installing a replacement Main PCB and/or Photometer, determine if a photometer adapter board will be required to insure compatibility between the photometer and the Main PCB:

The key feature to look for on the Main PCB is the J17 connector (Figure 17B). The replacement Main PCB will have J17.

Photometers are connected with either 2 or 3 cables depending on the configuration. The key feature to look for on the Photometer is whether or not the lamp socket is wired with yellow wires (referred to as a “3-Cable Photometer”). The replacement photometer will be a 3-Cable photometer with the yellow wires.

Refer to Table I and Figures 17A and 17B below to determine if an adaptor will be needed to insure compatibility.

CONFIGURATION		ADAPTOR
Main PCB	Photometer	
no J17	2 - Cable	None
no J17	3 - Cable	Figure 18A
J17	2 - Cable	Figure 18B
J17	3 - Cable	None

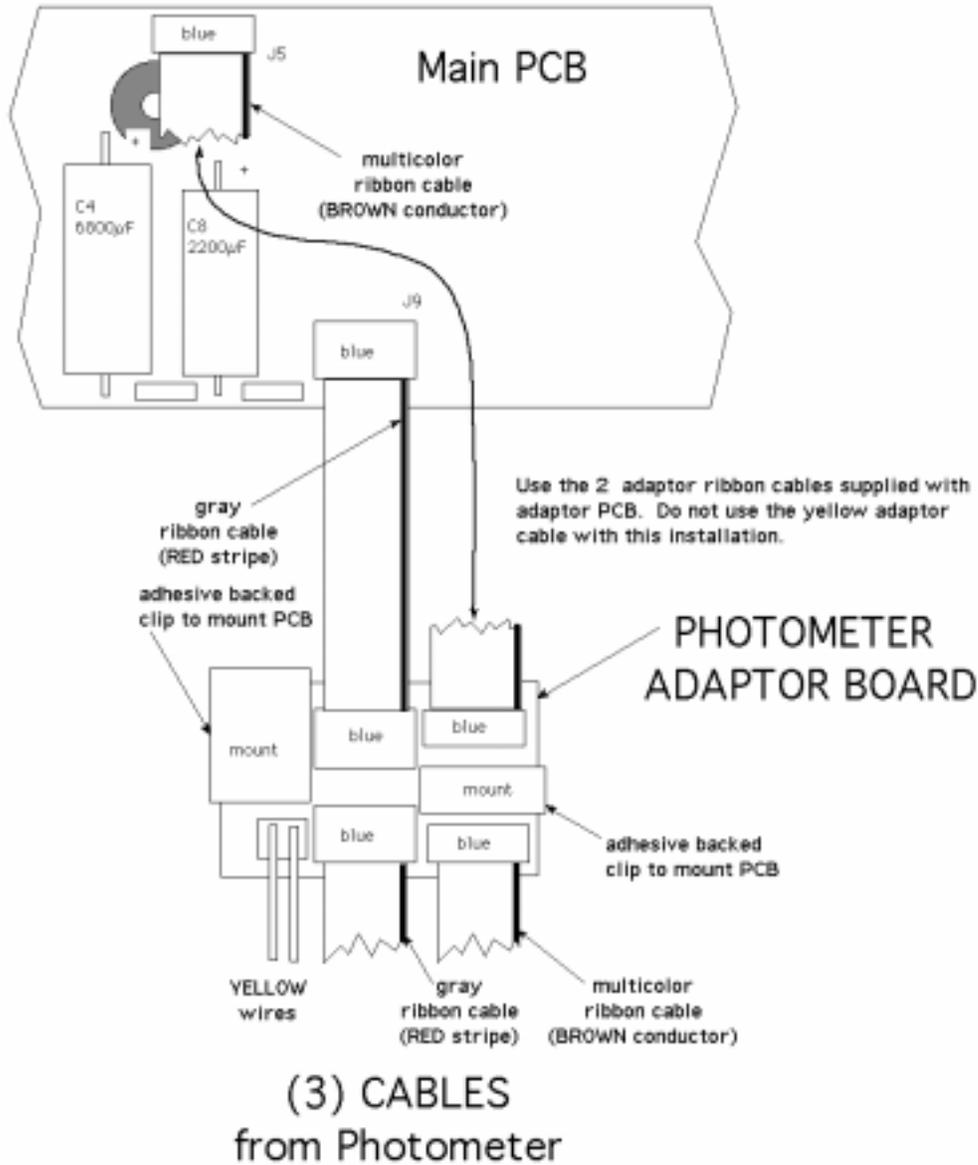
*Table I. Main PCB / Photometer Compatibility*

### Photometer Replacement.

1. Open the instrument as described in “Opening the instrument”. Refer to Figure 3. Locate the photometer. Note positioning of the cables leading from the photometer to the main PCB and unplug the cables from the main PCB.
2. Mark the perimeter of the photometer on the chassis with a pencil so the replacement photometer can be properly positioned.
3. Locate the (3) #6 screws holding the photometer assembly to the chassis. From the bottom of the instrument, remove these screws, washers, and the speed nuts from inside the instrument while noting the screw lengths and the locations from which they were removed.
4. Install the replacement photometer subassembly to the chassis by replacing the (3) #6 self tap screws in their original locations. Insure that internal tooth lock washers are installed between the screw heads and the chassis base. Line up photometer with locating marks made in step 2. Connect the cables removed in step 1.

#### NOTE

**The internal tooth lock washer must make electrical contact (ground) with the chassis base for low noise operation.**



*Figure 17A 3-Cable Photometer to Main PCB without J17*

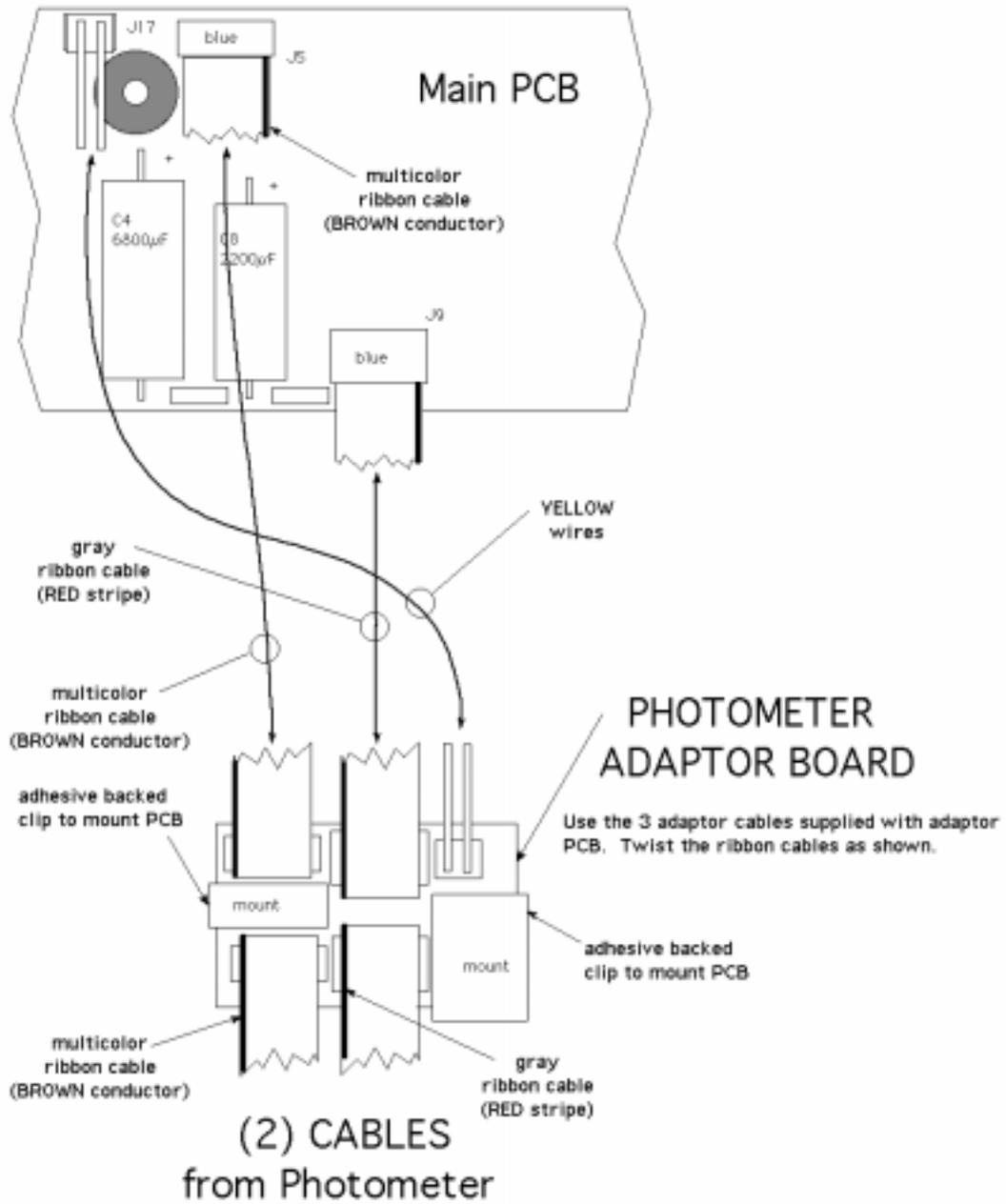
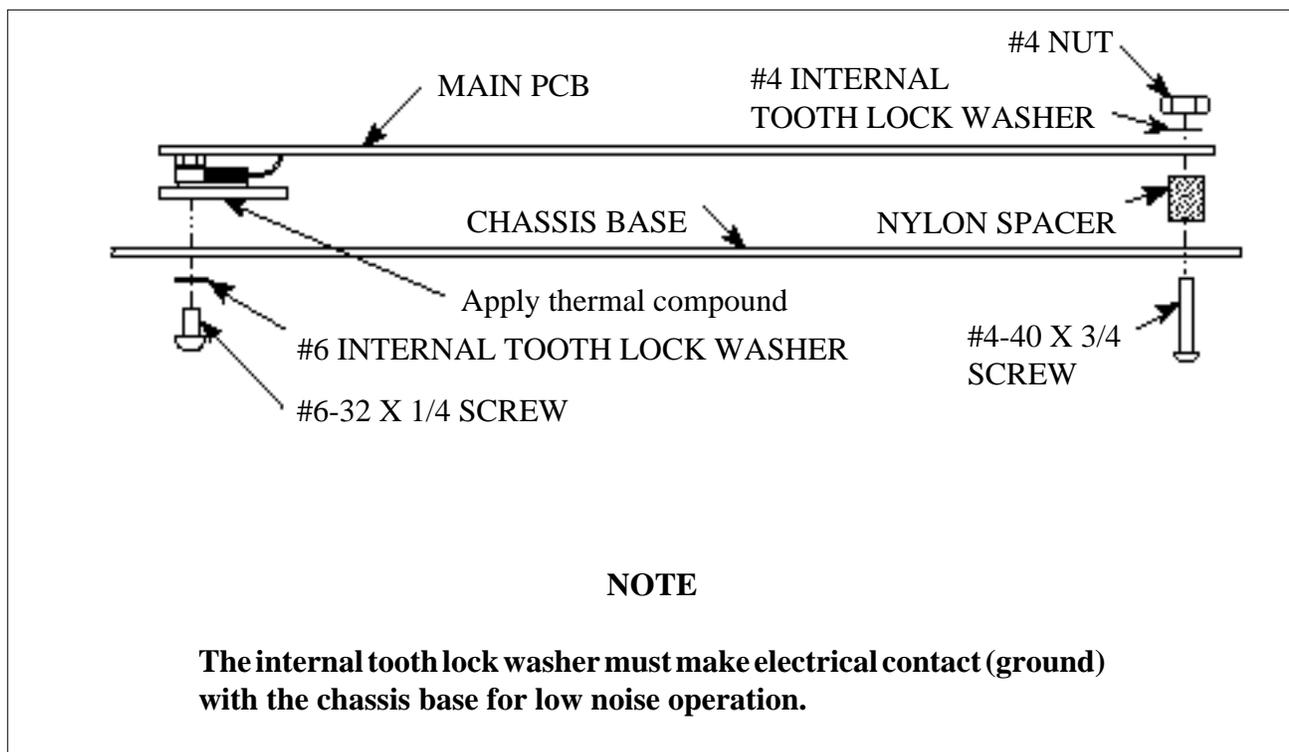


Figure 17B. 2-Cable Photometer to Main PCB with J17

## Main PCB Replacement.

1. Open the instrument as described in "Opening the instrument". Refer to Figure 3. Locate the Main PCB. Unplug cables from the main PCB and disconnect the wires from the transformer.
2. Refer to Figure 18. Remove the two screws securing the Main PCB. Apply Thermal Compound supplied with the replacement PCB to area between the heat sink on the PCB and the chassis as shown in Figure 18. Secure the replacement PCB in the same fashion as the removed PCB.
3. Reconnect transformer wires. See "Block Diagram" section of this manual for proper wire connections. Plug in all remaining cables.



*Figure 18. Main PCB Installation View*

# Calibration

Each instrument is calibrated during manufacturing using standards that are traceable to the National Institute for Standards and Testing (NIST), and is tested to verify its linearity to 2A. This preset calibration is very stable. Absolute calibration can be verified with the use of NIST filters, or by comparison to a reference instrument that is known to be calibrated to NIST filters. Calibration may be confirmed using a commercially available calibration check set which can be obtained from your distributor. A periodic verification of instrument accuracy and linearity is advised. Since most lab test results are based upon standards rather than upon absolute absorbances, the linearity of the instrument, rather than the accuracy, is the more critical indicator of instrument performance.

**Recalibration of the instrument should not be considered until all possible interfering factors have been ruled out!**

Standards and blanks should be closely checked for accuracy and results should be compared with a reference instrument. Use of a commercially available photometer check set to verify photometric accuracy and linearity is **strongly recommended**. If field recalibration is needed, it should only be performed with the proper reference materials and instruments.

## Software or Hardware Calibration?

**Most instruments manufactured after June 1993 rely on software calibration**, that is, on calibration data stored in nonvolatile RAM. The calibration data is used by the instrument to compensate for variations in electronic components. During factory calibration, any necessary hardware adjustments are made using precision reference standards and specialized electronic equipment. The calibration data are stored in the instrument memory and also recorded on a label located on the bottom of the instrument. In the unlikely event the instrument must be field recalibrated to meet specifications, new calibration data are derived using reference standards and these values are entered via the keypad. **This requires no hardware adjustments.**

**All instruments manufactured before June 1993 utilize hardware calibration**. This requires making adjustments to the trimpots for absorbance gain and offset, and temperature offset.

To determine whether the instrument incorporates software calibration features, select **test # 213**. If calibration data is printed, the instrument supports software calibration. Refer to the section "Software Calibration". If no calibration data is printed, refer to the section "Hardware Calibration".

In either case, if the trimpots have been disturbed or components C16, R12, R16, R11, R13, RN8, R24, U16, or the photodiode have been replaced, the instrument will require hardware calibration.

**CAUTION**

**Recalibration of the instrument should not be considered until all possible interfering factors have been ruled out, INCLUDING CHEMISTRY ERROR, OPERATOR ERROR, LAMP FAILURE, AND DEGRADED FILTERS.**

**Standards and blanks should be closely checked for accuracy and results should be compared with a reference instrument. Use of a commercially available photometer check set to verify photometric accuracy and linearity is strongly recommended.**

**Software calibration should always be attempted before resorting to hardware calibration.**

**In the event the software calibration data is lost or corrupted, the absorbance factor is set to 1.000 and the temperature offset adjustments for the block and cell are set to 0.0.**

## Software Calibration

Calibration data are entered at the keypad and are stored in nonvolatile memory with a checksum that is recalculated and compared each time the instrument is powered on, a new software mode is selected, or a stored test is recalled. Failure to recover the calibration data properly (checksum failure) will be indicated on the display and the internal printer:

```
DO ABS SET TEST 212!  
DO TEMP SET TEST 210!
```

If either of these messages are printed or displayed, it indicates that the calibration values have been lost. These messages will be printed each time the checksum failure occurs and until calibration is performed. The instrument also annunciates this condition with multiple beeps.

The absorbance calibration data is stored as a scaling factor, which is the ratio of a known reference absorbance to the instrument's reported absorbance. The value entered at the keypad is multiplied by the stored value to obtain a new scaling factor.

The temperature calibration data is stored as offsets which the instrument adds to the sensed temperatures. The value entered at the keypad is added to the stored offset to produce a net adjustment. Separate offsets are maintained for the incubation block and the read well.

The calibration data may be printed at any time by selecting test #213. This prints the serial number of the instrument, the date of last calibration, the stored calibration data: the absorbance scaling factor, the net block temperature offset, and the net cell temperature offset.

In the event of calibration data loss, the temperature offsets for both the incubation block and the read well are set to 0.0 and the absorbance scaling factor is set to 1.000. In this condition, the maximum temperature error is  $\pm 1.5 \frac{1}{2}^{\circ}\text{C}$  and the maximum absorbance error is  $\pm 10\%$ , provided the trimpots have not been disturbed. The calibration data can be restored as described below.

To recalibrate the instrument, refer to the sections "Software Calibration – Temperature" and "Software Calibration – Absorbance".

## Restore Calibration Data

This procedure restores the calibration data to the original factory settings recorded on the calibration data label.

Procedure:

1. Select test #213 to print the calibration data. Verify that the data is as follows:

```
ABS FACTOR  1.000  
BLOCK TEMP  0.0  
CELL TEMP   0.0
```

2. If the data printed in step 1 did not match the example, stop. Complete the procedure "Reset Calibration Data", then repeat this procedure. Otherwise, locate the calibration data label on the underside of the instrument. Copy the data from the label for reference in the following steps.
3. If the date and time are incorrect, set the date and time as described in the Owner's Manual.
4. Select test #210. The display shows:

```
BLOCK=
```

Enter the value from the Block Temp line on the calibration label.

5. The display shows:

```
CELL=
```

Enter the data from the Cell Temp line of the calibration label.

6. Select test #212. The display shows:

```
ABS FACTOR=
```

Enter the number from the Abs Factor line of the calibration label.

7. Select test #213 to print the calibration data. The printed data should now match the values shown on the calibration data label. If it does not, complete the procedure "Reset Calibration Data", then repeat this procedure.

## Reset Calibration Data

This procedure resets the calibration data. The absorbance scaling factor is set to 1.000, and the temperature offsets are set to 0.0.

Procedure:

1. Select test #213 to print the calibration data. Verify that the printed data is as follows:

ABS FACTOR 1.000  
BLOCK TEMP 0.0  
CELL TEMP 0.0

2. If the data printed in step 1 matches the example shown, stop. The calibration data is already reset. If the data printed in step 1 matches the data shown on the calibration data label on the bottom of the instrument, and you do not wish to alter the calibration, stop. Otherwise, make a note of the values printed in step 1.

3. Select test #210. The display shows:

BLOCK=

Enter the negative of the value printed for BLOCK TEMP. This will reset the block temperature offset to 0.0.

4. The display shows:

CELL=

Enter the negative of the value that was printed for CELL TEMP. This will reset the cell temperature offset to 0.0.

5. Select test #212. The display shows:

ABS FACTOR=

Enter the inverse of the value printed for ABS FACTOR in step 1. That is, calculate

$$\frac{1}{\text{ABS FACTOR}}$$

and enter the value.

6. Select test #213 to print the calibration data. The printed data should now match the example in step 1. If not, repeat this procedure.

## Software Calibration – Temperature

The object of this procedure is to establish agreement between the actual temperature and the displayed temperature by measuring the actual temperature, then entering the difference between the actual and the reported temperatures.

Note that precision thermistor probes are used. Do not use a thermometer. A typical mercury bulb or other glass thermometer adds a great deal of thermal mass to the system, as well as provides a conduction path for heat, thereby frustrating the instrument's heating capability.

Materials and equipment:

- (2) 12 mm borosilicate tube (or other cuvette appropriate for the instrument)
- (2) Reference thermistor probe  
YSI Inc. #44108 or equivalent.  
30K @ 25° C, ± 0.2° interchangeability
- Digital ohmmeter (DMM), 0.5% or better accuracy.

Procedure:

1. Complete the procedure "Reset Calibration Data".
2. Place a tube or cuvette filled with 1 ml of water into the incubation block. Immerse the thermistor probe in the approximate center of the tube. Place a similar arrangement in the read well. Select test #188 to extend the lamp time.
3. Allow 15 minutes for equilibration.
4. If the DMM being used is not autoscaling, set it so that 20K $\Omega$  is in range. Zero the meter and then read the resistance of the thermistors. If the resistance is between **17994  $\Omega$**  and **18435  $\Omega$** , no adjustments are needed. Otherwise, continue to the next step.
5. Calculate the temperature offsets using the following formula:

$$T = \frac{R - 18210}{C}$$

Where:

R is the measured resistance.

C is equal to 750 if the measured resistance is greater than 18210.

C is equal to 720 if the measured resistance is less than 18210.

6. Select test #210. The display shows:

BLOCK=

Type the offset calculated above for the block and press ENTER.

7. The display shows:

CELL=

Type the offset calculated for the cell and press ENTER.

8. Repeat steps 3 through 6 until the resistance is within the specified range and the displayed temperature is 37°C ± 0.3. Select test #213 each time to print the current net adjustments. The

net offset after the temperature is set should be  $\pm 1.5^{\circ}\text{C}$  or smaller.

9. When you are done, select test #213 to print the new calibration data. Enter these values on the calibration data label on the bottom of the instrument.

## Software Calibration – Absorbance

Materials and equipment:

- 12 mm borosilicate tube (or other cuvette appropriate for the instrument)
  - Reference spectrophotometer
  - Reference material which peaks at one of the filter wavelengths.
  - Precise 1:2 serial dilution of the reference material.
1. Complete the procedure "Reset Calibration Data".
  2. Place a borosilicate tube filled with plain water into the read well. Do not use a soda-lime glass tube, since it does not transmit at 340 nm.
  3. Select test #186 and confirm that all of the detected filter voltages are between 2.00 and 10.00 volts.
  4. Determine the absorbance of both the 1:1 reference material and the 1:2 dilution on a reference spectrophotometer. The 1:2 dilution should be in the range of .8 to 1.2 absorbance. The 1:1 material should be in the range of 1.6 to 2.4 absorbance.
  5. Select the absorbance mode (Press ABS). Select the required wavelengths. Select 0 for no differential filter. Blank on the same diluent material used to prepare the concentrations.
  6. Read the 1:2 dilution. Divide the absorbance as read on the reference spectrophotometer by the reported absorbance value. Note the result of this calculation for the next step.
  7. Exit the absorbance mode and select test #212. The display shows  
  
ABS FACTOR=  
  
Enter the result of the calculation performed in the preceding step. When this factor is entered the instrument will multiply by the old factor and display a net factor (the new calibration data).
  8. Select the absorbance mode again. Blank as before on the diluent. The 1:2 dilution absorbance should now agree with the reference to within  $\pm .005$  absorbance.
  9. Read the 1:1 concentration. It should agree within  $\pm 2\%$  of the reference. If necessary, carefully adjust trimpot TP3 to achieve this agreement. Read the section "Hardware Calibration" before making any adjustments. Re-blank and reconfirm the values. Refer to Figures 19 and 20 for trimpot locations.
  10. When you are done, select test #213 to print the new calibration data. Enter these values on the calibration data label on the bottom of the instrument.

## Hardware Calibration

### CAUTION

**Read and understand the section “Calibration” before making ANY adjustments.**

### Hardware Calibration – Temperature

The object of this procedure is to adjust the trimpots in series with the temperature feedback circuits to obtain an equilibrated temperature of 37°C. Refer to Figures 19 and 20 for the location of the trimpots. Depending on the particular instrument model, the trimpots may be mounted either on the solder side of the main PCB, accessible through the hatch shown in Figure 19, or on the component side, accessible only by opening the instrument, or a combination of both. The positions and designations of the trimpots shown in the two illustrations are the same for all models. The only difference is the side of the main PCB to which the trimpots are mounted.

Note that precision thermistor probes are used. Do not use a thermometer. A typical mercury bulb or other glass thermometer adds a great deal of thermal mass to the system, as well as provides a conduction path for heat, thereby frustrating the instrument's heating capability.

#### Materials and equipment:

- (2) 12 mm borosilicate tube (or other cuvette appropriate for the instrument)
- (2) Reference thermistor probe  
YSI Inc. #44108 or equivalent.  
30K @ 25°C, ± 0.2° interchangeability
- Digital ohmmeter (DMM), 0.5% or better accuracy.

#### Procedure:

1. Place a tube (or cuvette) filled with 1 ml of water into the incubation block. Suspend the reference thermistor probe in the approximate center of the tube. Do not allow the probe tip to touch the tube wall. Place a similar arrangement into the cell.
2. Press the LAMP key to turn on the lamp. Allow 15 minutes for equilibration.
3. Set the DMM to read 20K. Read the resistance of the thermistors. If the resistance is between **17994 Ω** and **18435 Ω**, no adjustments are needed. Otherwise, continue to the next step.
4. Refer to Figures 19 and 20. Adjust the trimpot(s) by a small amount. Turn it clockwise to lower the temperature; counterclockwise to raise the temperature. TP4 adjusts the cell temperature; TP1 adjusts the incubation block temperature.
5. Repeat steps 2 through 4 until the resistances of the probes are within range. You should attempt to get the resistance to read as close to 18210 Ω as possible.

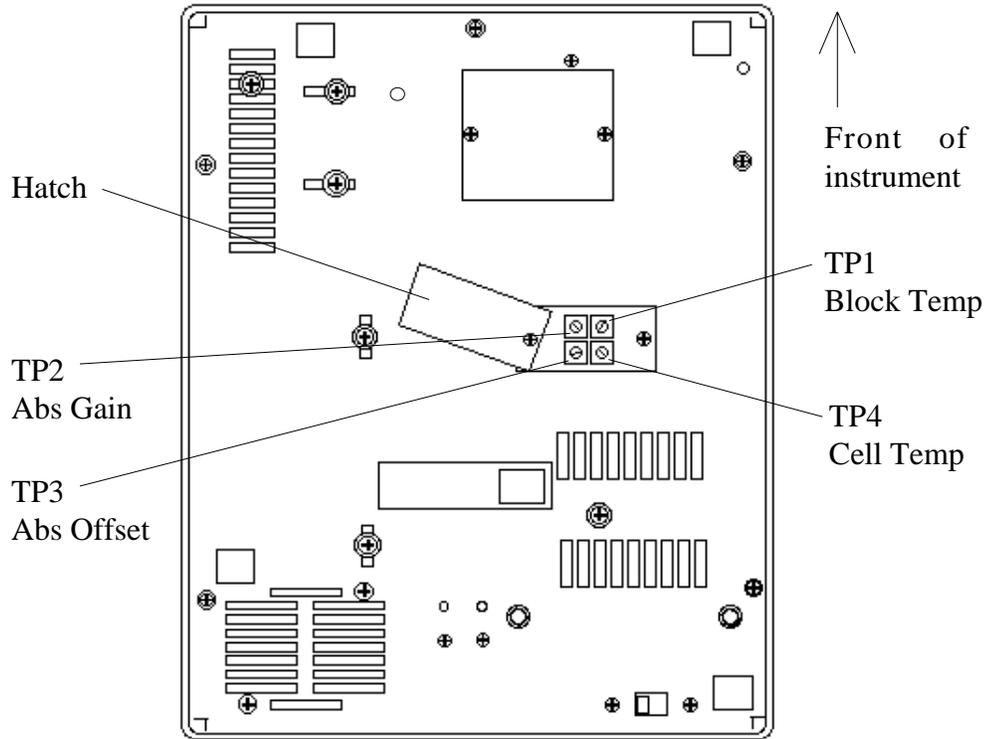


Figure 19. Trimpot Locations-bottom view

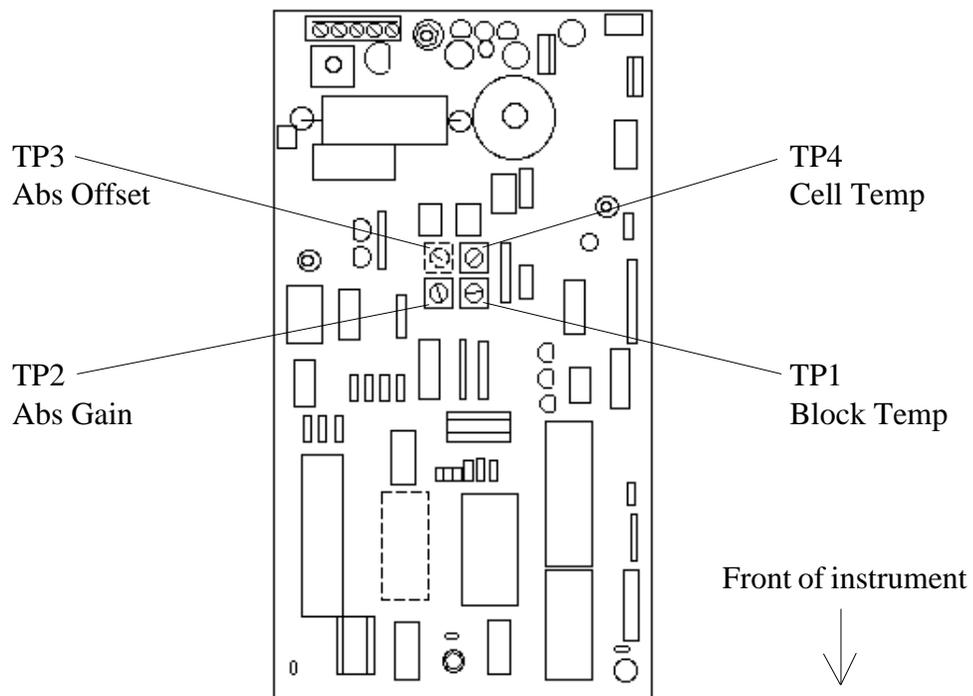


Figure 20. Trimpot Locations-top view

## Hardware Calibration – Absorbance

The objective of this procedure is to adjust the instrument so that the reported absorbance agrees with that of a reference instrument. Three criteria must be simultaneously met: the detected filter voltages must remain between 2.00 and 10.00 volts, the gain must be adjusted so that a relatively low absorbance is correctly reported, and the offset must be adjusted so that a relatively high absorbance is correctly reported. Certain models may require a different calibration procedure or may be calibrated to specifications other than shown here. Consult the Owner's Manual or contact the distributor for further information.

### Materials and equipment:

- 12 mm borosilicate tube (or other cuvette appropriate for the instrument)
- Reference spectrophotometer
- Reference material whose absorbance peaks at a filter wavelength, e.g. 405 nm.
- Precise 1:1 and 1:2 serial dilutions of the reference material.

### Procedure:

1. Place a borosilicate tube filled with plain water into the read well. Do not use a soda-lime glass tube, since it does not transmit at 340 nm.
2. Select test #186 and confirm that all of the detected filter voltages are between 2.0 and 10.0 volts. If the voltages are out of range, refer to the section “Troubleshooting”,
3. Determine the absorbance of both the 1:1 material and the 1:2 dilution monochromatically on a reference spectrophotometer. The 1:2 dilution should be in the range of .8 to 1.2 absorbance. The 1:1 material should be in the range of 1.6 to 2.4 absorbance. Note the absorbance values reported by the reference instrument.
4. Press ABS to place the instrument into the absorbance mode. Select the required primary wavelength. Select 0 for the differential wavelength (monochromatic). Blank on the same diluent material used to prepare the concentrations.
5. Read the 1:2 dilution. The reported absorbance should agree within  $1\% \pm .005$  of the reference. If not, adjust trimpot TP2 a small amount – clockwise to raise the value, counterclockwise to lower the value. Repeat this step as needed until the reported absorbance is within limits.
6. Read the 1:1 concentration. The reported absorbance should agree within  $2\% \pm .005$  of the reference. If not, adjust trimpot TP3 a small amount – clockwise to increase the value, counterclockwise to reduce the value. Repeat this step as needed until the reported absorbance is within limits.
7. Repeat steps 2 through 7 until all three criteria are met.: filter voltages, low absorbance (gain), and high absorbance (offset).

# Replacement Parts

## Consumable Items and Accessories

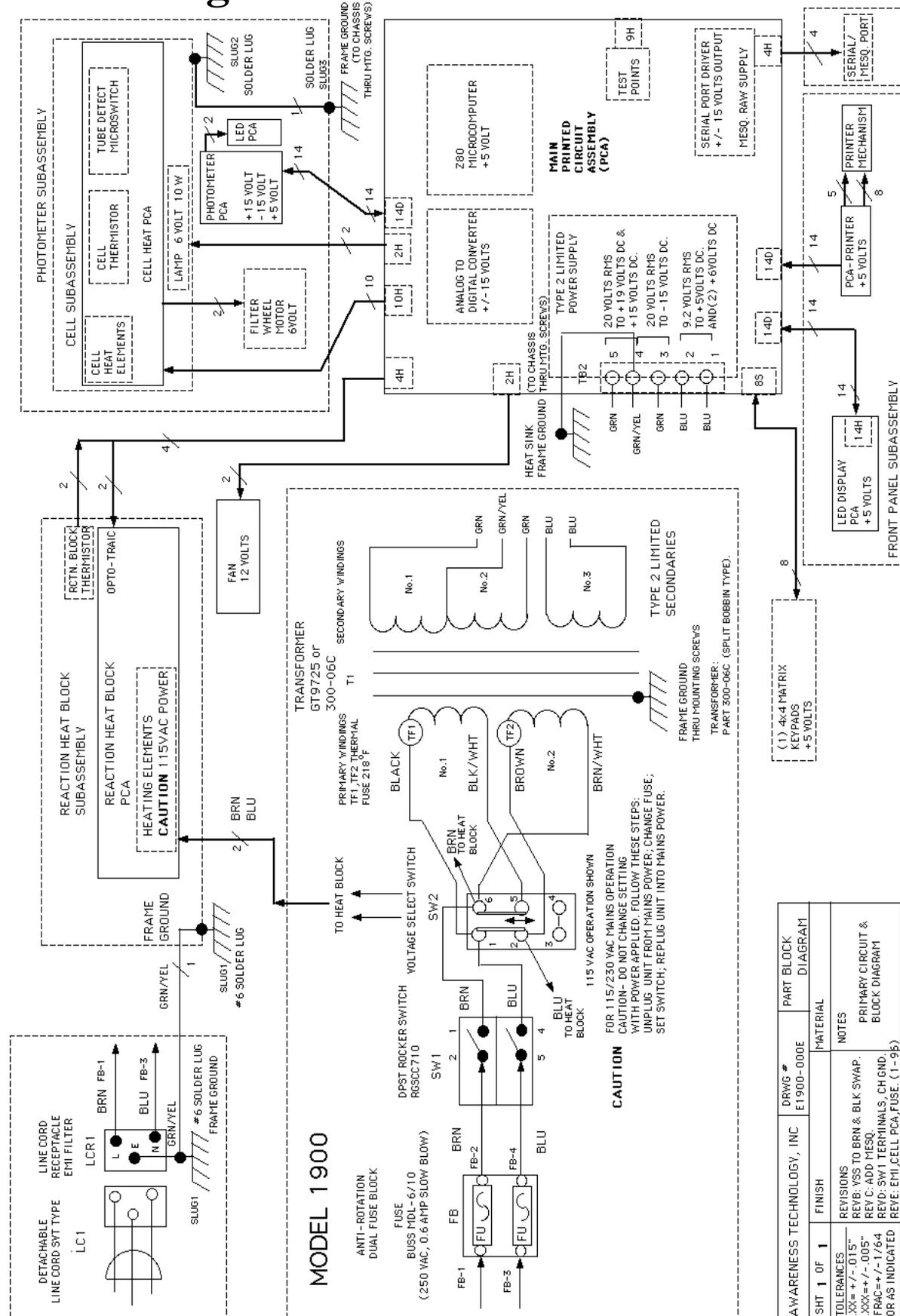
Lamp .....	112004
Fuses (set of 2) .....	102002
Printer paper (5 rolls) .....	150001
Carrying Case .....	000390
12x75 mm borosilicate tubes (250/box, 1000/case) .....	157302
Dust Cover .....	001990

## Nonconsumable Items\*

Keypad (flat) .....	183103
Keypad (domed) .....	183113
Keypad/overlay assembly .....	183354
Main PCB .....	995003
Battery RAM chip .....	163061
Belt, filter wheel .....	132059
Motor, filter wheel .....	105126
Photometer assy .....	(specify model)
Reaction block assy .....	(specify model)
Cover assy .....	(specify model)
Cooling fan .....	104502
Internal 14-pin cable (specify length) .....	104xxx
Printer mechanism .....	105601
Printer Platen .....	105651
Print Head (includes printer platen) .....	105652
Printer interface PCB .....	995006
Display .....	162519
Filter & Neutral replacement set .....	(specify wavelength)111XXX

\* Specify the instrument serial number when ordering so that replacement part compatibility issues can be addressed.

# Block Diagram

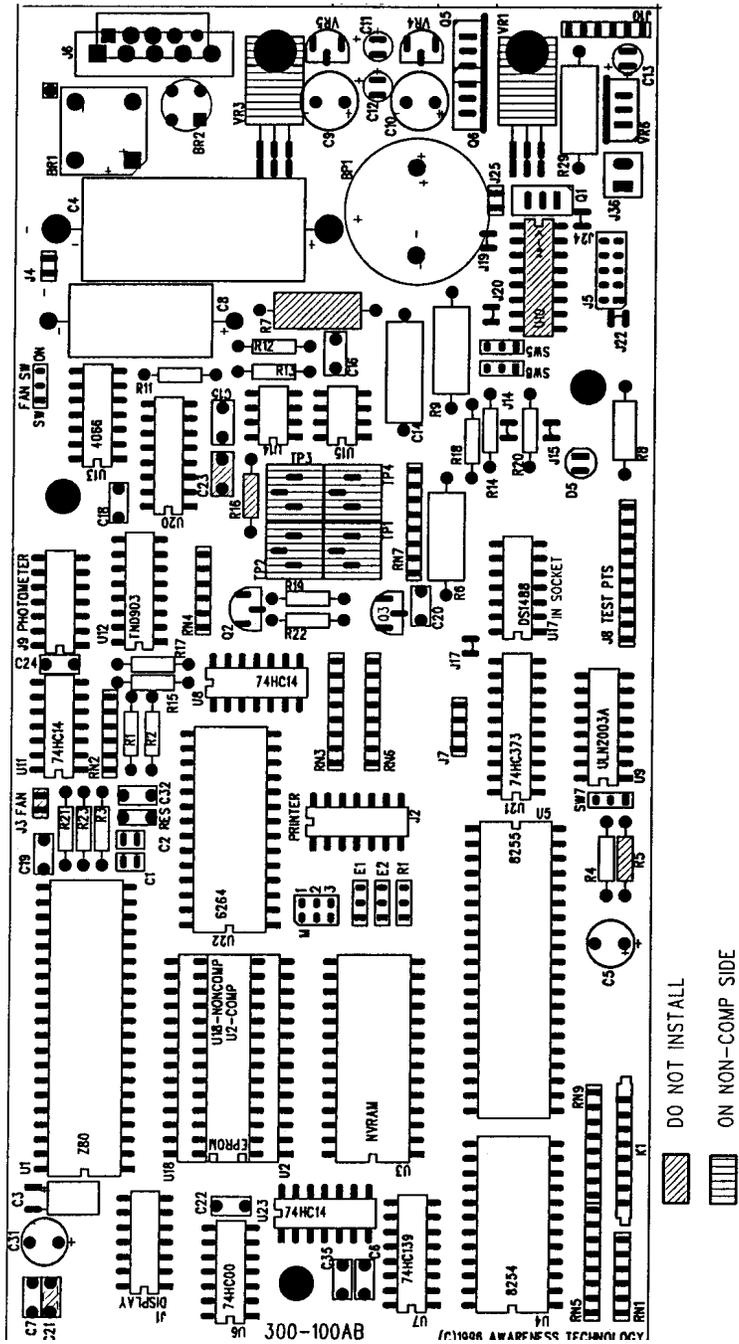


## 1900 Series Service Manual

# PCB Layouts

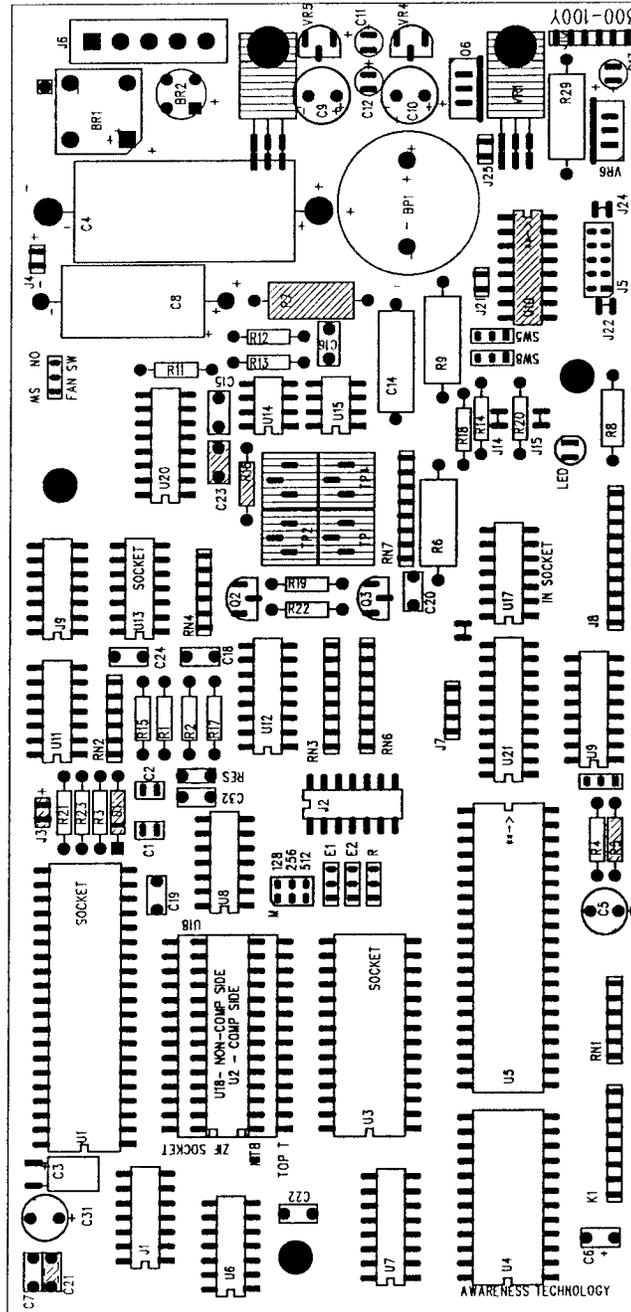
## Main PCB—from rev Z

AWAKESS TECHNOLOGY  
300-100AB (AR) 1900 MAIN PCB 995003

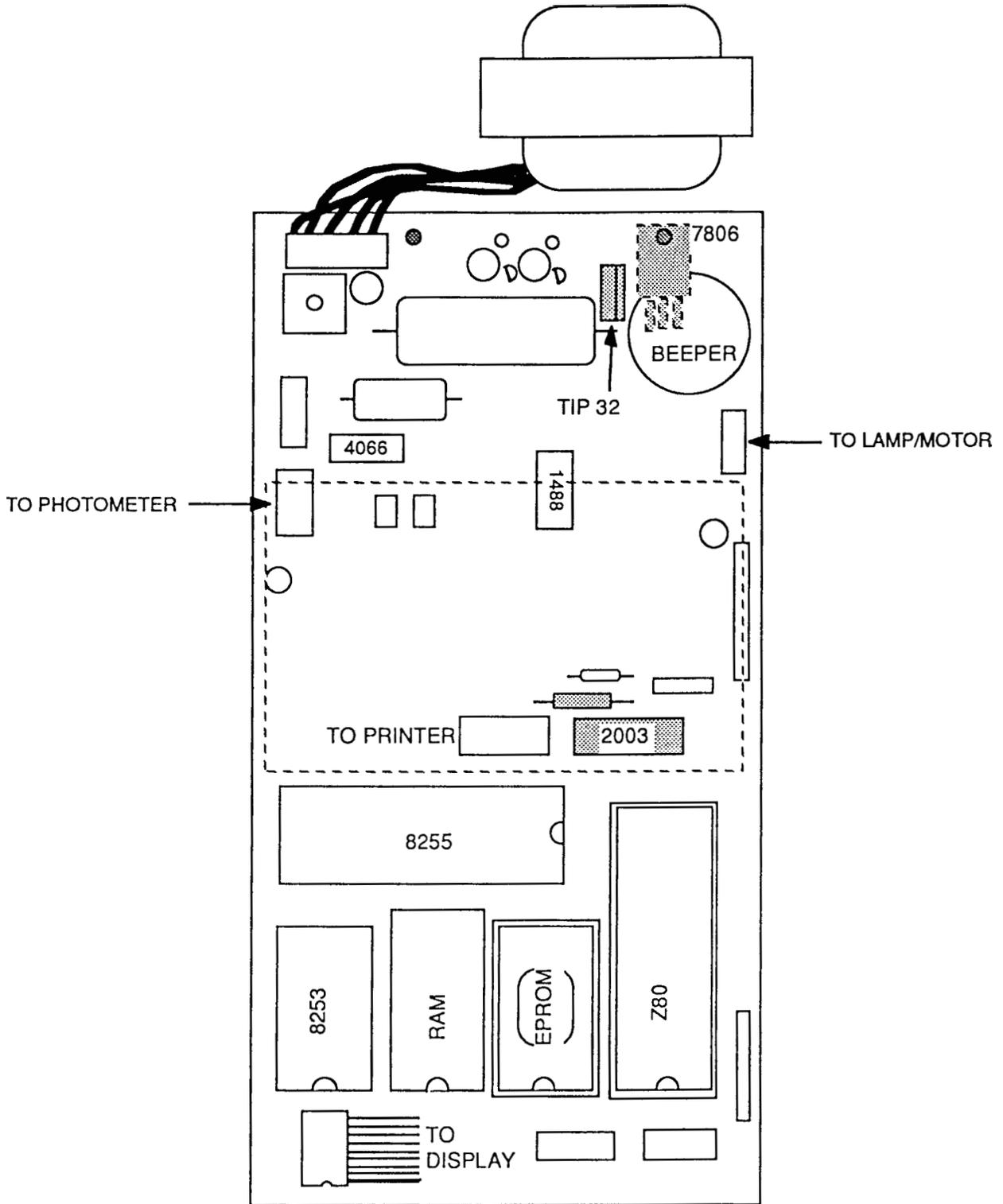


# Main PCB—from rev L to rev Y

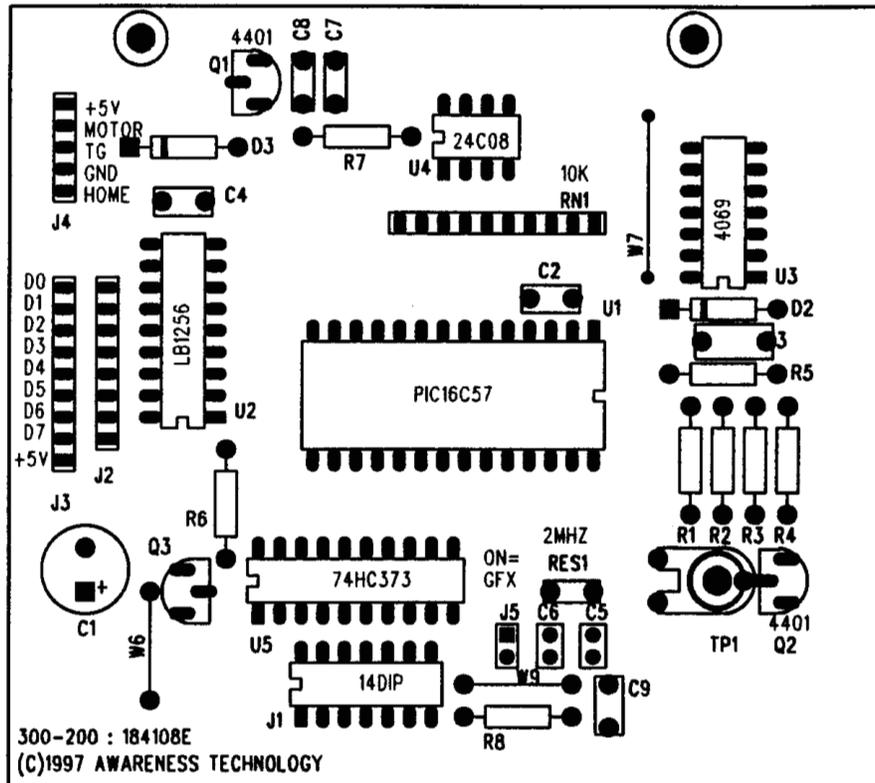
AWARENESS TECHNOLOGY  
300-100Y (AR) 1900 MAIN PCB 995003



# Main PCB—through rev K



# Printer PCB (300-200E)



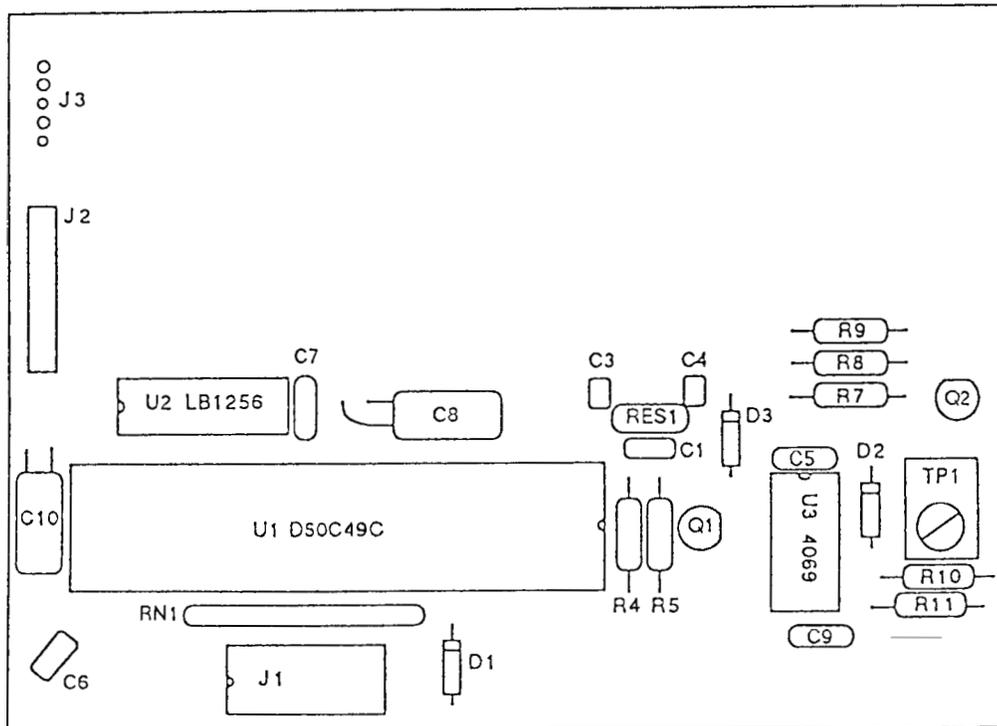
ORG

300-200E, PRINTER INTERFACE P/N 184108E

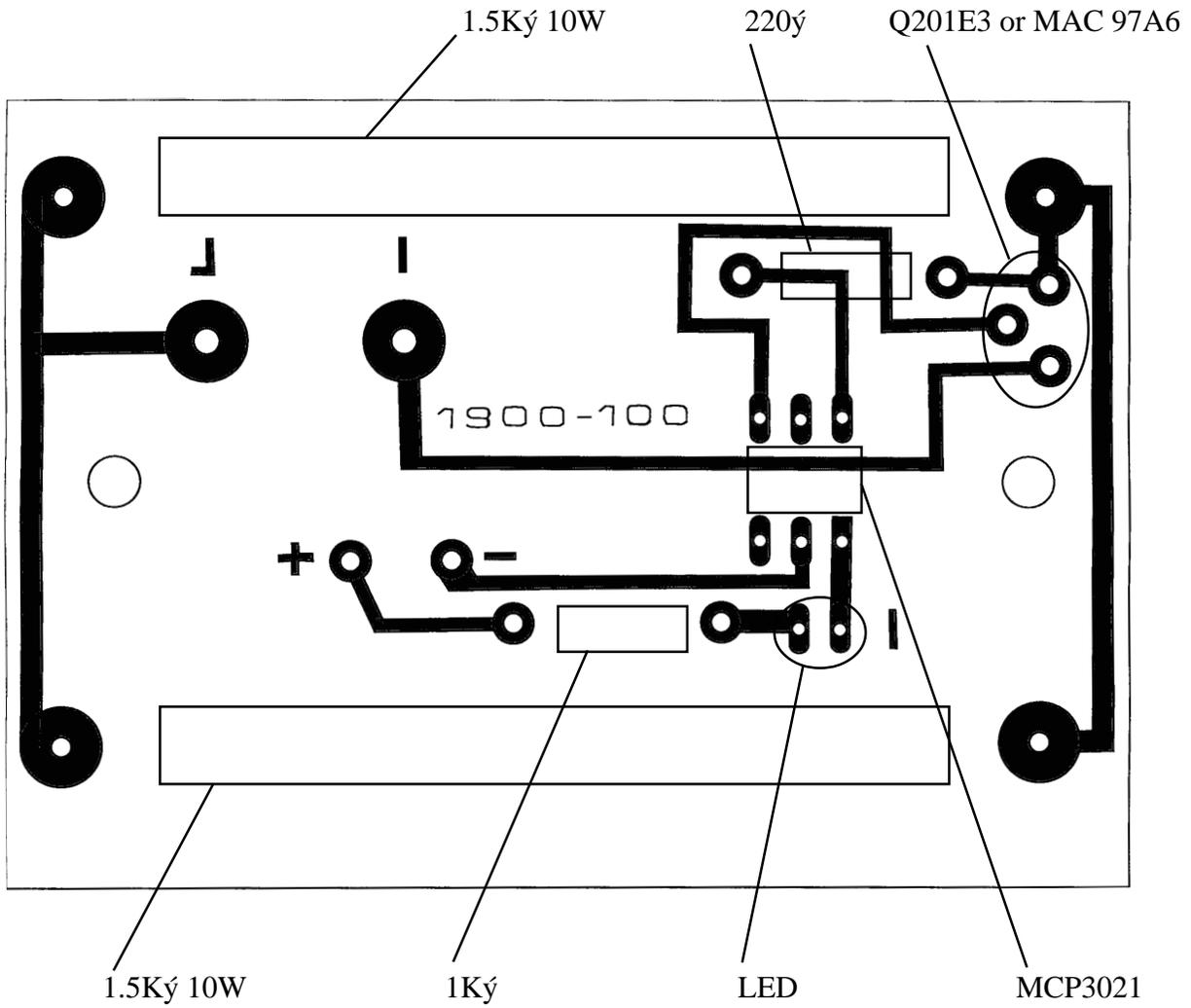
Note: cut jumper J5 for use with non-graphics printers.

# Printer PCB (300-200)

## 300-200 PRINTER INTERFACE PCB

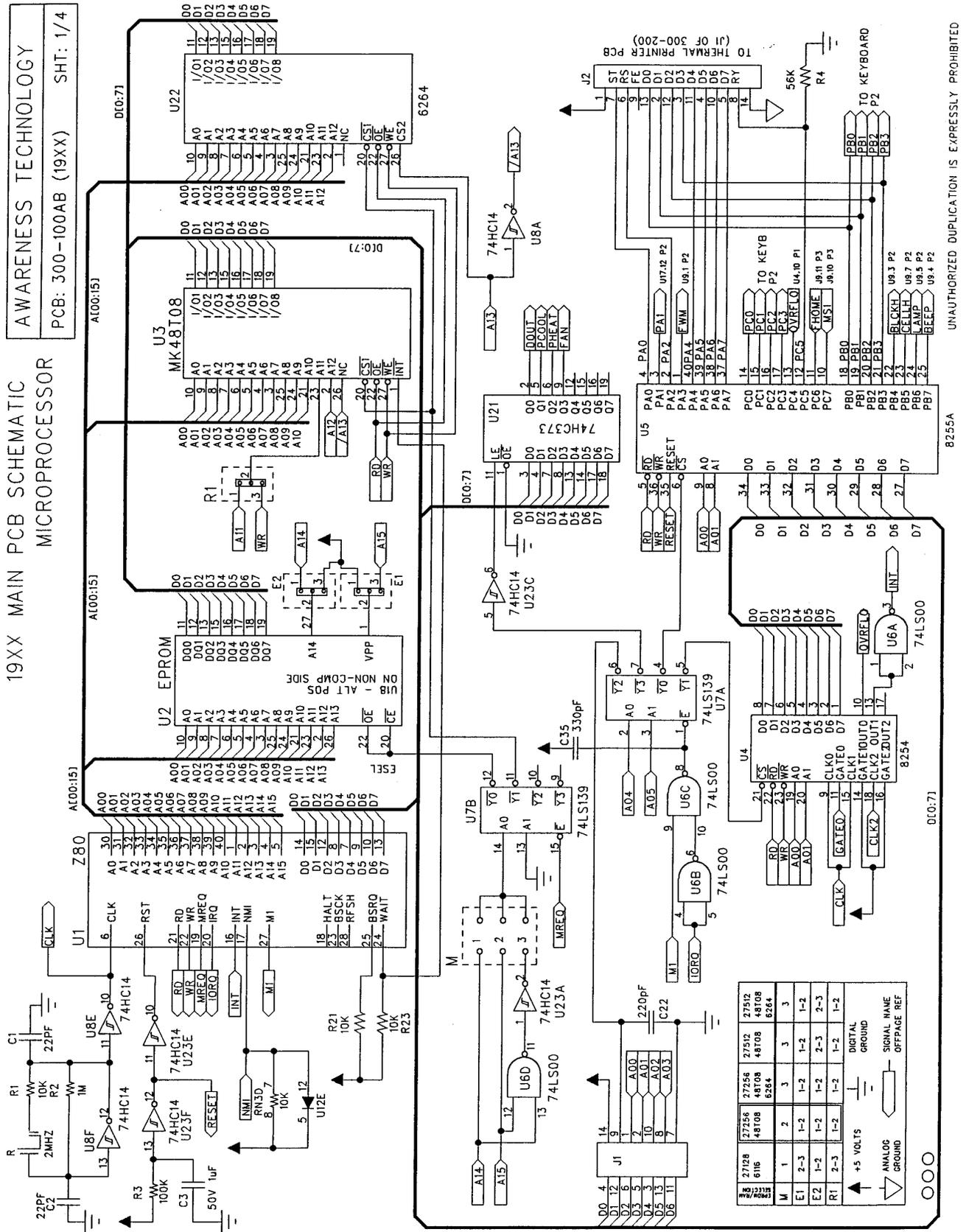


# Incubation Block PCB



# Schematics

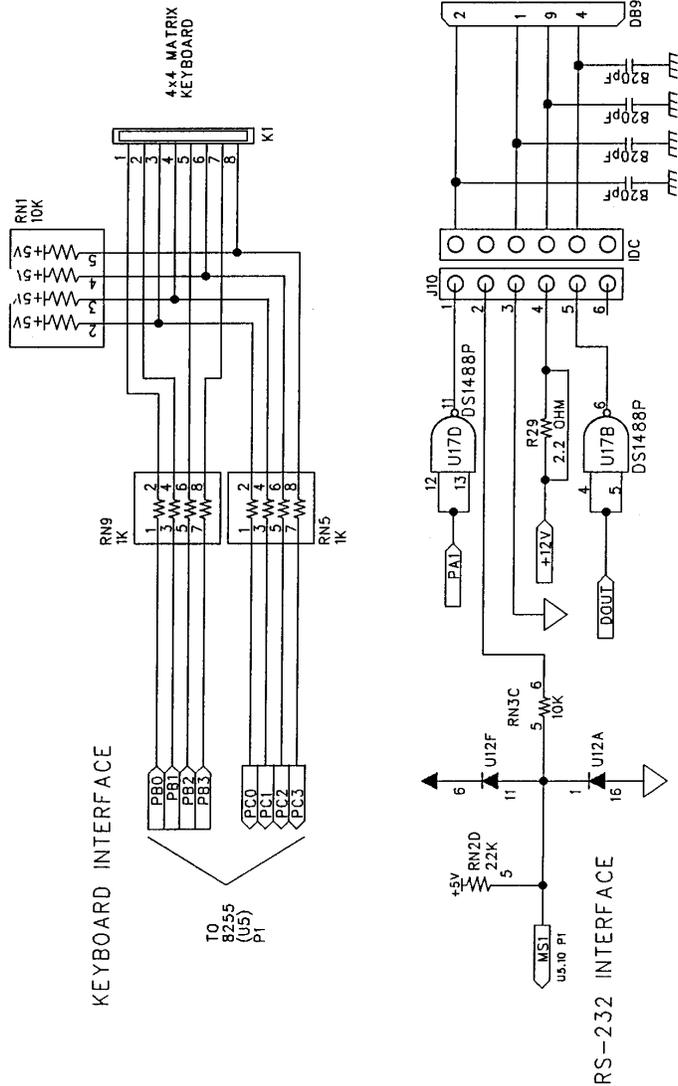
## Main PCB (from rev Z) 1 of 4



# Main PCB (from rev Z) 2 of 4

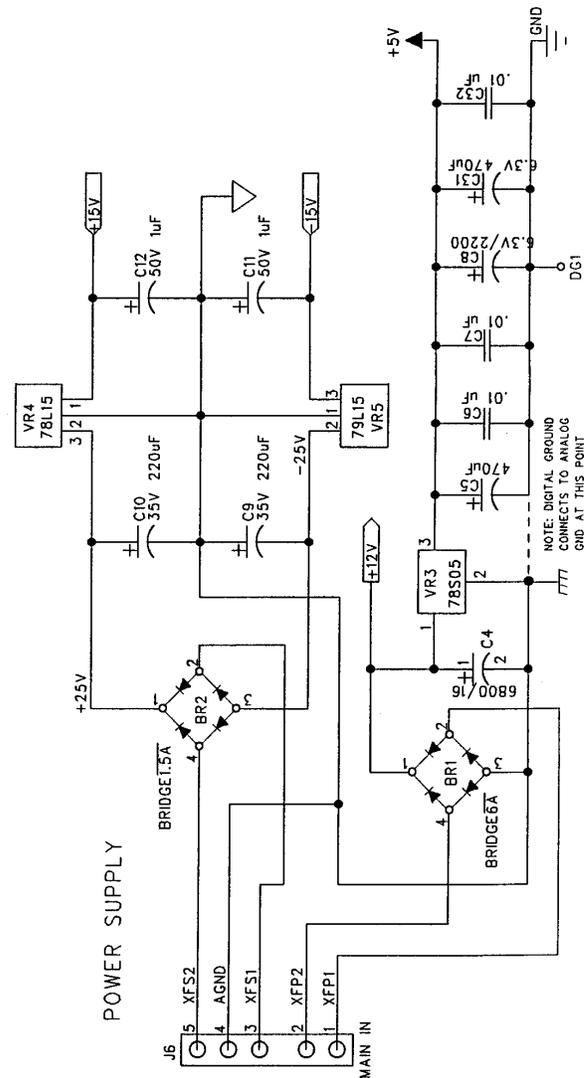
**AWARENESS TECHNOLOGY**  
 PCB: 300-100AB (19XX) SHT: 2/4  
 UNAUTHORIZED DUPLICATION IS EXPRESSLY PROHIBITED

## RS-232 INTF POWER SUPPLY



SIG PINS

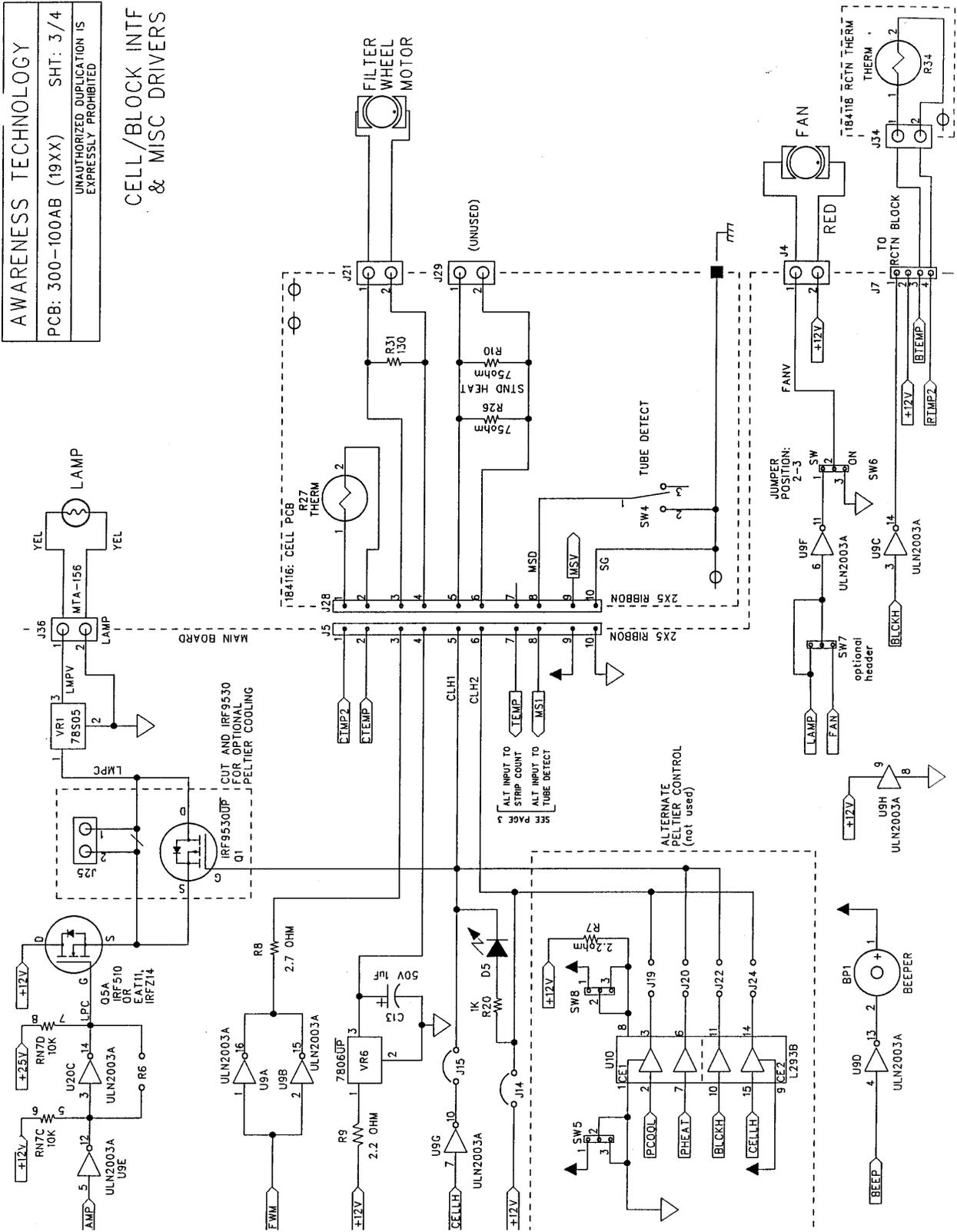
REF DES	DESCRIPTION	+5V	DIG GND	+12V	ANALOG GROUND
U1	780 CPU EPROM	11	29		
U2		28	14		
U3	MK48T08	28	14		
U4	B254	24	12		
U5	8255	26	7		
U6	74HC00	14	7		
U7	74HC139	16	8		
U8	74HC14	14	7		
U9	ULN2003A	16	9		8
U10	L293B	14	7		4,5,12,13
U11	74HC14	14	7		
U21	74HC373	20	10		
U22	6264 SRAM	28	14		
U23	74HC14	14	7		
U13	4066	+5V	+15V	-15V	ANALOG GROUND
U17	DS1488		14	1	7



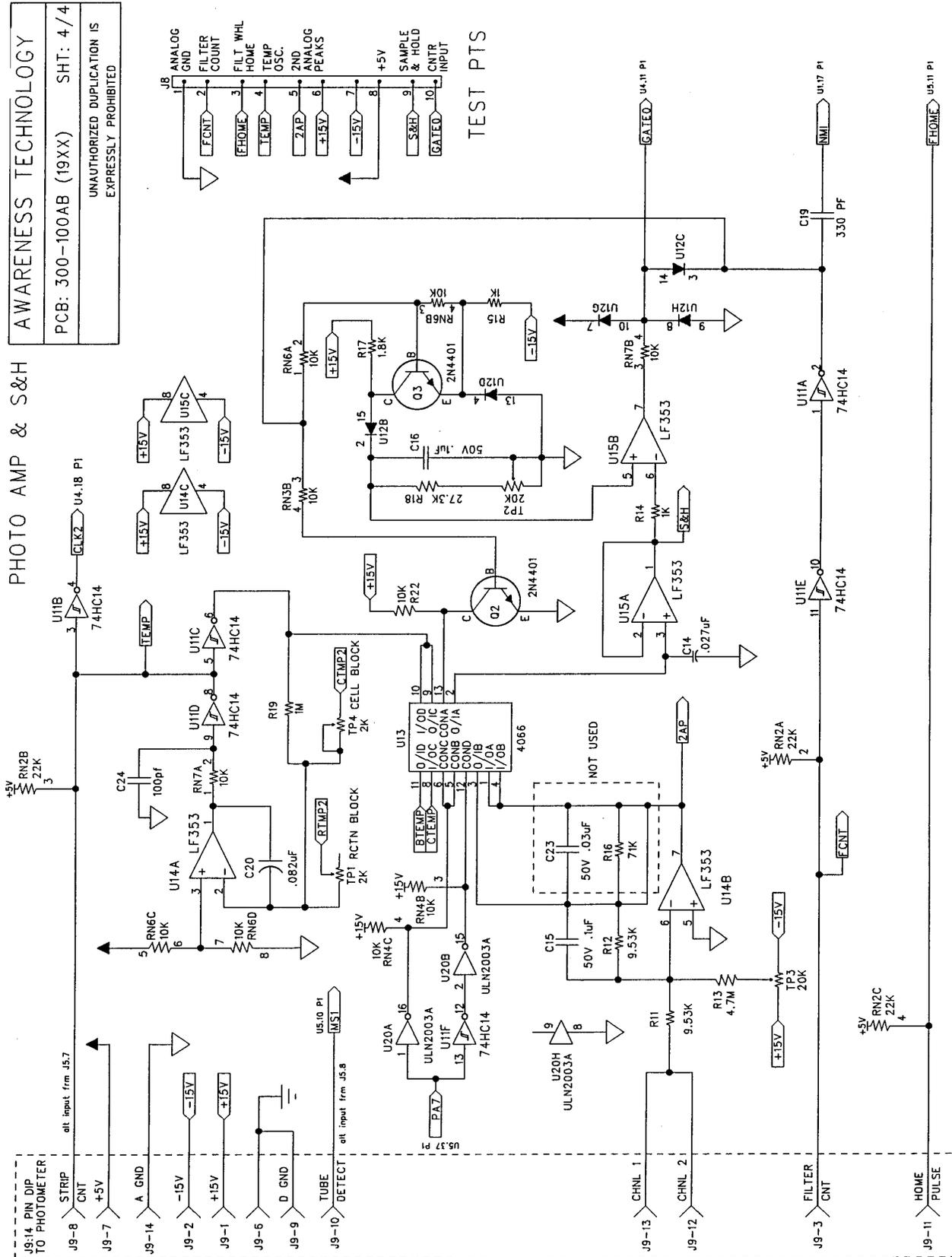
# Main PCB (from rev Z) 3 of 4

AWARENESS TECHNOLOGY  
 PCB: 300-100AB (19XX) SHT: 3/4  
 UNAUTHORIZED DUPLICATION IS EXPRESSLY PROHIBITED

## CELL/BLOCK INTF & MISC DRIVERS

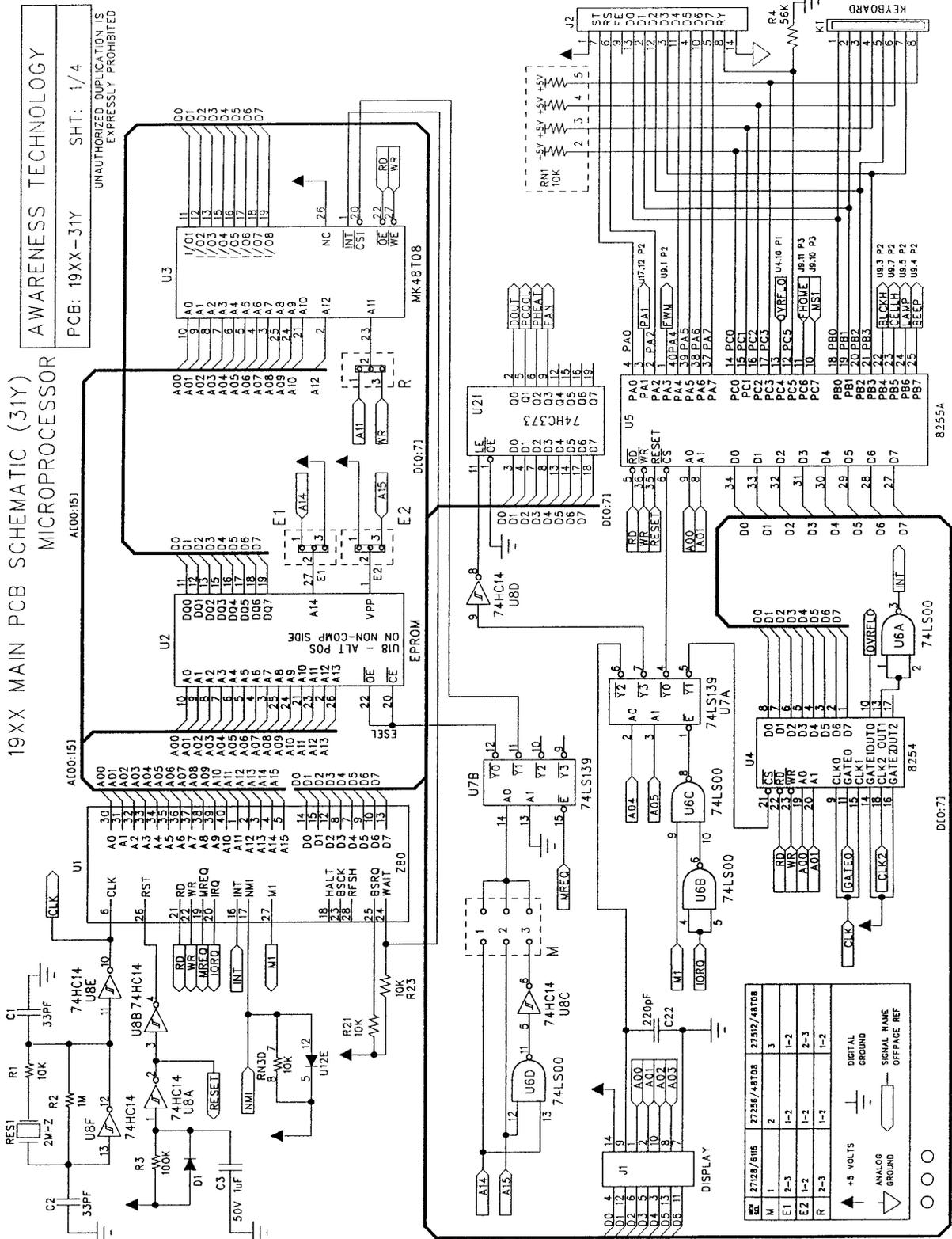


# Main PCB (from rev Z) 4 of 4



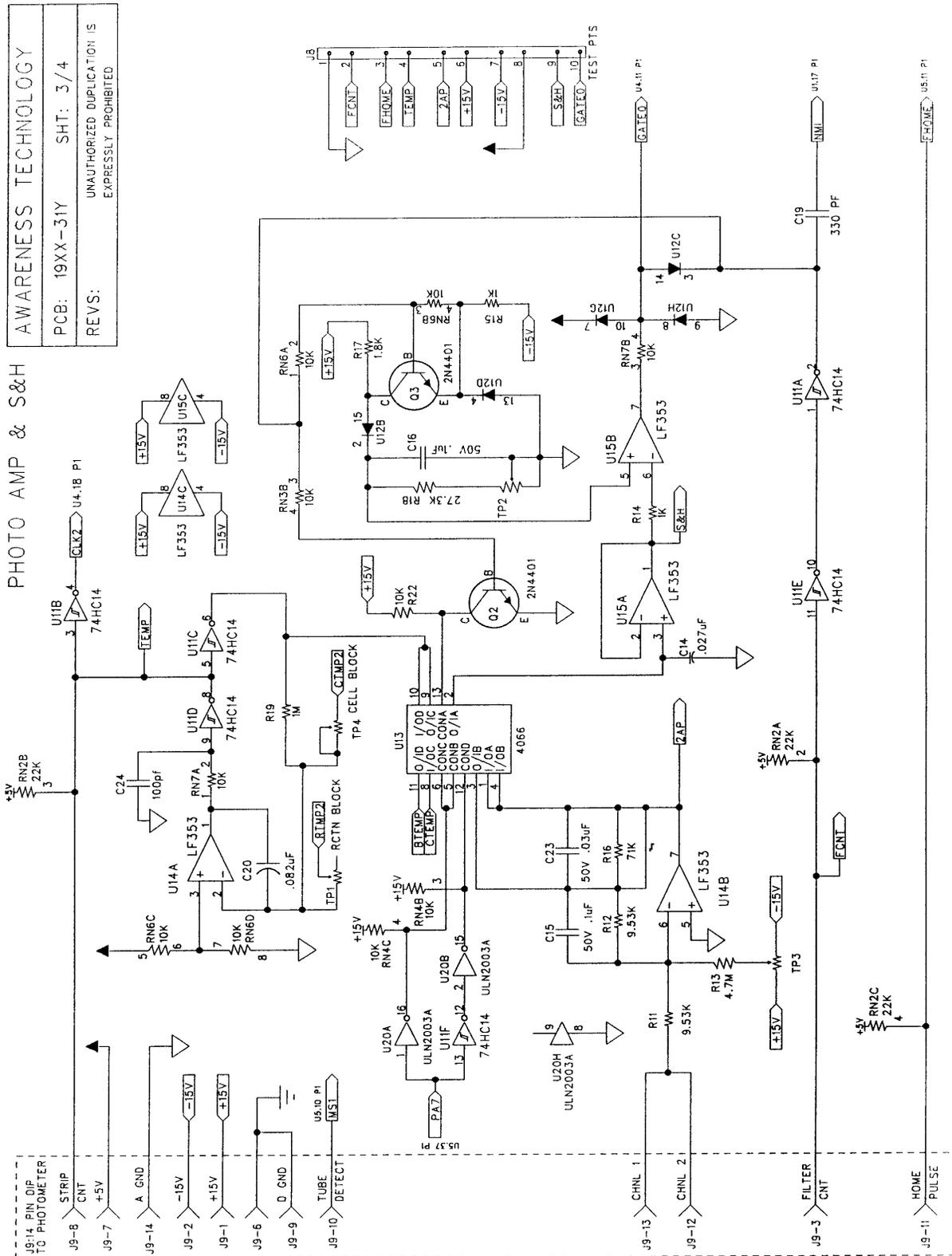
## 1900 Series Service Manual

# Main PCB (rev L to rev Y) 1 of 4





# Main PCB (rev L to rev Y) 3 of 4

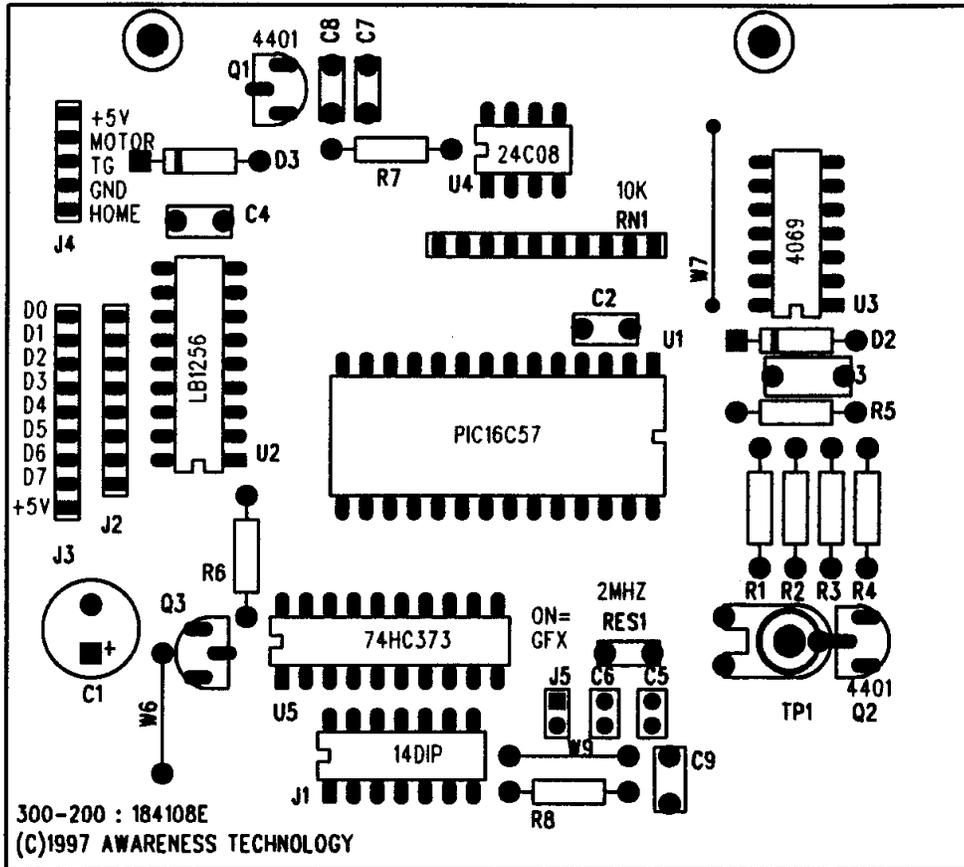


AWARENESS TECHNOLOGY  
PCB: 19XX-31Y SHT: 3/4  
REVS: UNAUTHORIZED DUPLICATION IS EXPRESSLY PROHIBITED

PHOTO AMP & S&H



# Printer PCB (300-200E)

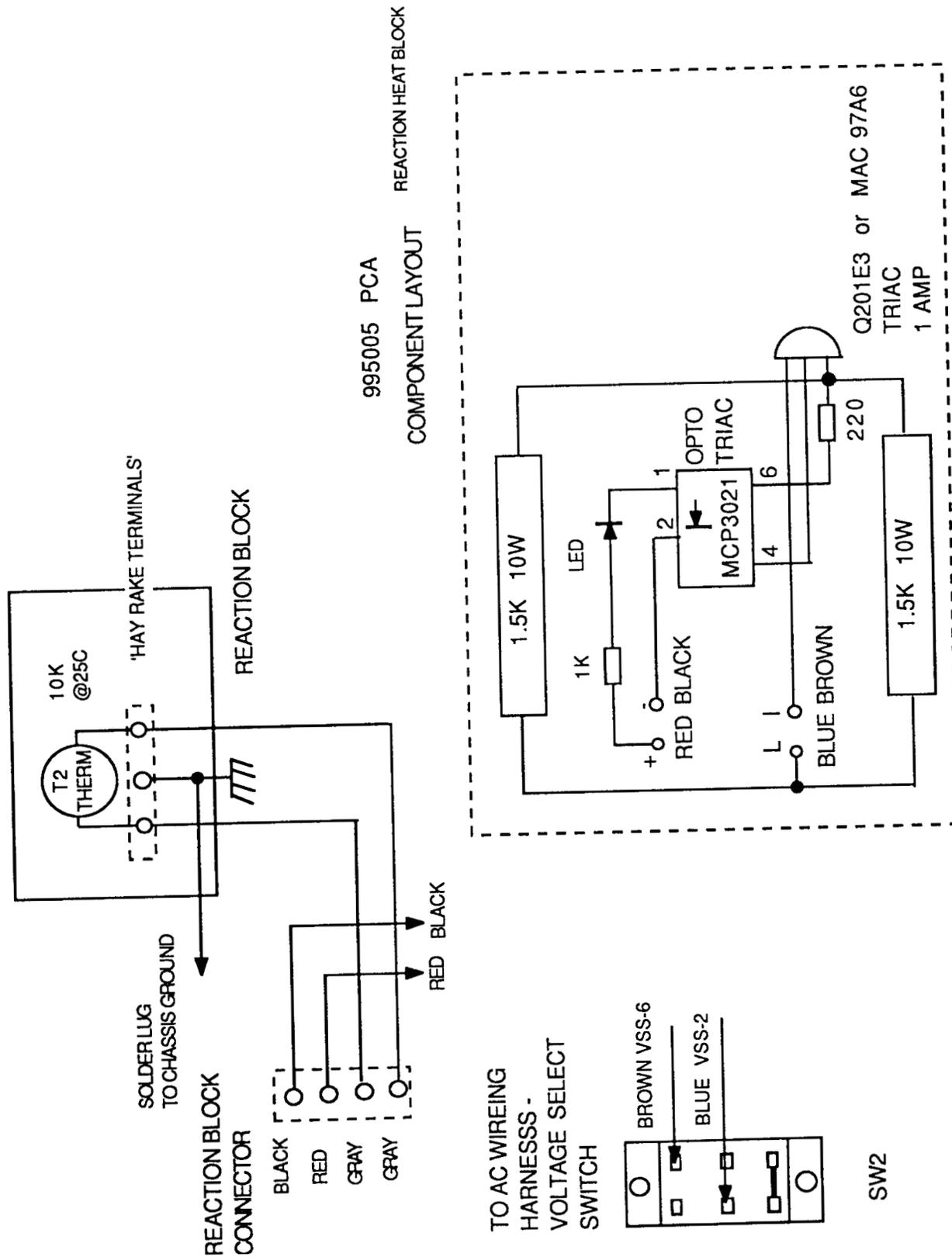


ORG

300-200E, PRINTER INTERFACE P/N 184108E



# Incubation block PCB



# Contact Information

If you continue to have problems after consulting your dealer, contact the factory.

Phone: USA 561-283-6540

Fax: USA 561-283-8020

e-mail: [chemwell-support@awaretech.com](mailto:chemwell-support@awaretech.com)

Mailing Address: Awareness Technology, Inc.  
P.O. Drawer 1679  
Palm City, FL. 34991  
USA

When contacting us, please have serial number of the ChemWell in question. Have a description of the problem with as much detail as possible. Save any relevant jobs or logs to disk (See File Management/ Using ChemWell Pack) and send or e-mail us the information.”

# 1900 Series

## Service Manual

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