100 SERIES Cell Counters Service Manual

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Manual No. DS-601

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Part No. 08 400 500-020

This manual is a guide for servicing the
100 Series Cell Counters

Data in this manual have been verified and validated, and are believed to be adequate for the intended use of the instrument. If the instrument or the procedures are used for purposes beyond the capabilities specified in this manual, confirmation of their validity and suitability should be obtained from Baker Instruments Corporation; otherwise, Baker Instruments Corporation does not guarantee results and assumes no obligation or liability. This publication is not a license to operate under, nor a recommendation to infringe upon, any product or process patents.

NOTES, CAUTIONS, AND WARNINGS are used throughout this manual to emphasize pertinent or critical instructions to Service Personnel according to the following definitions:

A WARNING flags a procedure that, if not followed properly, can prove to be extremely hazardous to either Service Personnel or the environment (or both).

A CAUTION emphasizes a procedure that must be followed to avoid possible damage to the instrument.

A NOTE highlights important information about the instrument or procedures associated with maintenance of the instrument.

Safety Notes

Electrical Safety

Voltages exceeding 100 Vac are present in the analyzer. Unless otherwise instructed, always remove electrical power before performing maintenance on the instrument.

Chemical Safety

Infectious materials may be present in the test specimens. Always wear protective gloves when emptying the waste container. Dispose of waste materials in accordance with standard laboratory guidelines. Wash hands with a germicidal cleanser or rinse after working on the system.

DS-601
September 1984

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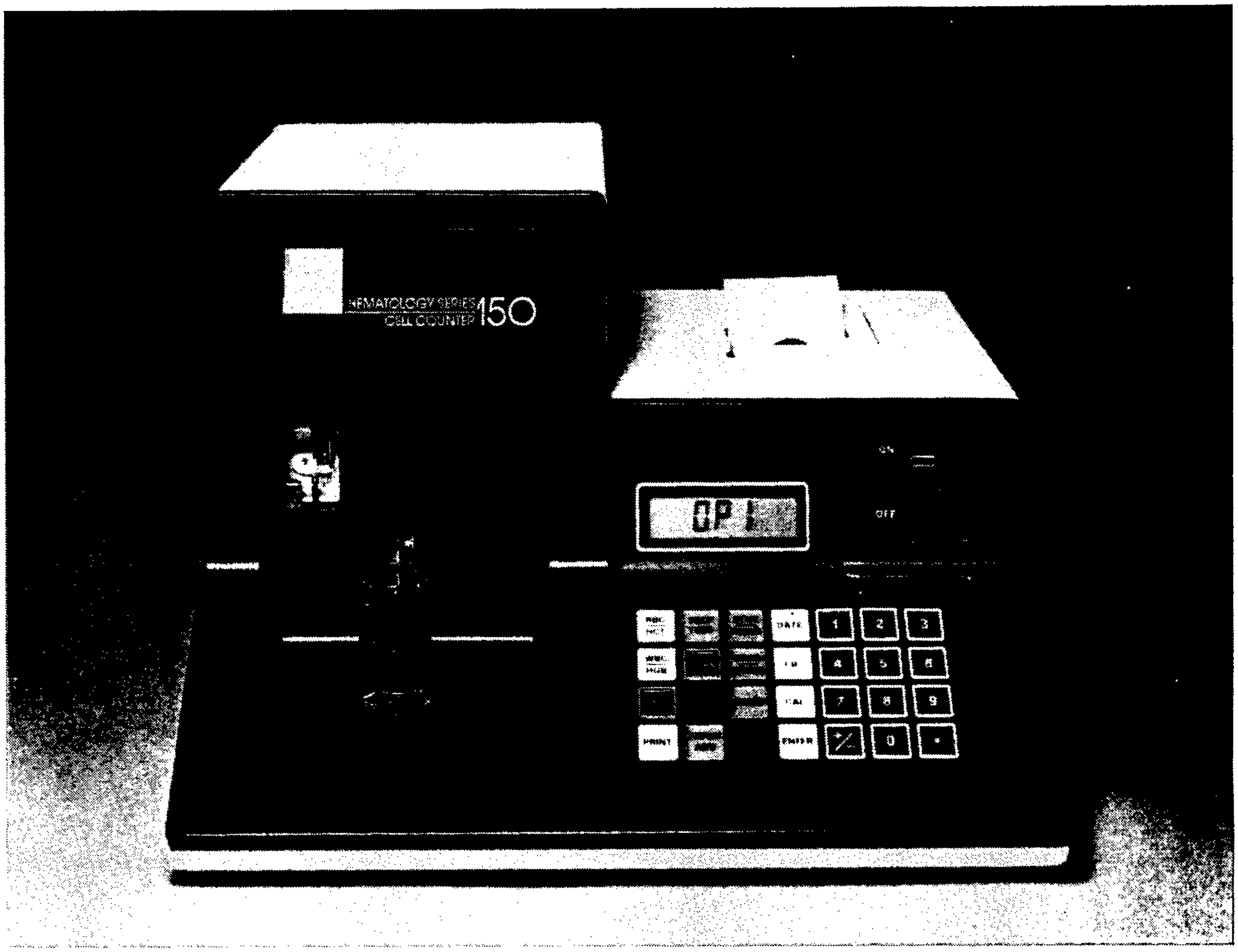
1. INTRODUCTION



Hematology Series 150™ Cell Counter

1-1 PURPOSE OF MANUAL

This service manual includes descriptions and procedures that are necessary to install, calibrate, and service the complete line of Baker Instruments Corporation Hematology 100 Series Cell Counters. (Not all sections may apply to your system.) Observance of the procedures outlined in this manual will ensure optimum performance of the instrument. To locate the necessary information, refer to the Table of Contents. This section provides a system description, a dilutor (optional) description, and system specifications.

1-2 SYSTEM DESCRIPTION

The Baker Instruments Hematology 100 Series Cell Counters are microprocessor-controlled, semi-automated cell counters used for in-vitro diagnostic testing of whole blood specimens.

Approximately 30 samples can be tested per hour on the 100 Series Cell Counter. The precise analysis rate depends upon the proficiency of the operator, since the procedures include manual specimen preparation, sample analysis, and printing of test results. The system is available with an optional built-in printer for the recording of test results.

NOTE

The following systems are available in this product line:

- **The Series 121™ is a 2-parameter, semi-automated Cell Counter. Tests performed on this system include White Blood Cell (WBC) and Red Blood Cell (RBC) count. Test results are obtained via the display.**
- **The Series 131™ is a 3-parameter, semi-automated Cell Counter. The tests performed on this system include: White Blood Cell (WBC) count; Red Blood Cell (RBC) count; and Hemoglobin (HGB). Test results are obtained via the display.**
- **The Series 130™ is a 3-parameter, semi-automated Cell Counter available with a printer for hard copy print-out of test results. The tests performed on this system include: White Blood Cell (WBC) count; Red Blood Cell (RBC) count; and Hemoglobin (HGB).**
- **The Series 150™ is a 5-parameter, semi-automated Cell Counter available with a printer for hard-copy printout of test results. The tests performed on this system include: White Blood Cell (WBC) count; Red Blood Cell (RBC) count; Hemoglobin (HGB); Hematocrit (HCT); and Mean Corpuscular Volume (MCV).**
- **The Series 170™ is a 7-parameter, semi-automated Cell Counter available with a printer for hard-copy printout. The tests performed on this system include: White Blood Cell (WBC) count; Red Blood Cell (RBC) count; Hemoglobin (HGB); Hematocrit (HCT); Mean Corpuscular Volume (MCV); Mean Corpuscular Hemoglobin (MCH); and Mean Corpuscular Hemoglobin Concentration (MCHC).**

The paragraphs immediately following briefly describe the four major operations performed by the system:

1. White Blood Cell (WBC) Count and Red Blood Cell (RBC) Count - The instrument electronically counts red blood cells (RBC) and white blood cells (WBC) by employing the IMPEDANCE principle. This principle of electronic cell counting is based on the difference in conductivity between blood cells and the diluent in which they are suspended.
2. Mean Corpuscular Volume (MCV) - Measurement of sample mean corpuscular volume (MCV) is based on the RBC impedance pulse amplitude. RBC signals are sized according to their voltage, and an average is taken. This average is then compared to the MCV reference that is set internally during the hematocrit (HCT) calibration.
3. Hemoglobin (HGB) - The hemoglobin (HGB) determination is accomplished by a cyanmethemoglobin procedure. The color intensity of this reaction is measured by a photometric cell.
4. The other parameters such as Hematocrit (HCT), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) are calculated from the measured parameters in the system.

Series 121™, Series 131™, Series 130™, Series 150™, and Series 170™ are trademarks of Baker Instruments Corporation, Allentown, PA.

1-3 DILUTOR DESCRIPTION

The Baker Instruments Hematology 105 and 106 Dilutors are two-cycle automatic dilutors designed for sampling and dispensing the sample with reagent diluent. The dilutor aspirates 40 µL of sample and when cycled again, dispenses the 40 µL along with 10.0 mL of diluent. Increased speed, accuracy and reliability of the sample determinations are possible with the 105 and 106 Dilutor.

1-4 SPECIFICATIONS

Counting Ranges:	WBC 0.1 to 70.0 x 10^3/(mm)^3) RBC 1.00 to 8.00 x 10^6/(mm)^3) HGB 0.0 to 25.0 g/dL HCT 16.0 to 75.0% MCV 50.0 to 200.0 μ^3
Aperture Size:	100 microns in diameter
Dilution Ratio:	1:251 for WBC/HGB 1:62,500 for RBC/HCT/MCV (using dilutor) 1:63,001 for RBC/HCT/MCV (using SILO STIX PAK)
Patient Sample and Diluent Volume:	40.0 µL sample dispensed into 10.0 mL of HAEMA-LINE® 2
Diluent Consumption:	PRIME: 3.0 - 4.5 mL (maximum) COUNTING: 250.0 µL
Time per Count:	30 seconds (approximately) PRIME: 8.0 seconds COUNTING: 18.6 seconds (nominal)
System Vacuum:	-2.4 ± 0.1 PSI
Power Requirements:	100 Series Cell Counter Line Voltage: 100/120 Vac; 220/240 Vac Frequency: 50/60 Hz Power Consumption: 90 watts
Fuse:	100 Series Cell Counter 0.75 Amperes Slo-Blo (for 100/120 Vac) 0.375 Amperes Slo-Blo (for 200/240 Vac)
Dimensions and Weight:	100 Series Cell Counter Height: 9.5 inches (24.13 cm) Width: 14 inches (35.56 cm) Depth: 14 inches (35.56 cm) Net Weight: 28 lbs. (12.7 kg) Shipping Weight: 30 lbs. (13.6 kg)
Printer Paper Dimensions:	2.25 inches wide (5.72 cm) Thermal Paper

HAEMA-LINE® 2 is a registered trademark of Baker Instruments Corporation, Allentown, PA.

1-5 PERFORMANCE SPECIFICATIONS

General

The Baker Series 150™ Cell Counter performance characteristics are listed in Tables 1-1; 1-2a, b; 1-3a, b, c; 1-4, and 1-5.

The Series 150™ performs five parameter profiles (WBC, RBC, HGB, HCT, and MCV) with precision equal to standard reference methods and with very small biases (relative to reference methods) in studies on randomly chosen patient samples. The analysis rate for patient profiles is approximately 30 samples per hour. The automatic prime feature of the instrument provides a sample-to-sample carryover of less than 1 percent.

Expected Results

An analysis of 65 whole blood patient specimens and controls was performed using the following instruments or procedures: Series 150, Coulter Counter Model ZF, Microhematocrit and manual cyanmethemoglobin. The correlation coefficients were as follows:

WBC (0.999)
RBC (0.996)
HGB (0.998)
HCT (0.994)
MCV (0.949)

An analysis was performed from a population of 52 females and 49 males. Table 1-1 indicates the normal ranges obtained from this population:

Table 1-1. Normal Ranges

	FEMALE (N = 52)	MALE (N = 49)
WBC $(\times 10^3/(mm)^3)$	7.0 ± 4.2	6.9 ± 3.2
RBC $(\times 10^6/(mm)^3)$	4.37 ± 0.68	5.08 ± 0.74
HGB (g/dL)	13.8 ± 2.0	15.6 ± 1.6
HCT (%)	41.2 ± 6.2	47.1 ± 5.4
MCV (μ^3)	94.6 ± 7.6	93.2 ± 8.8
MCH (pg)	31.6 ± 3.0	30.7 ± 3.0
MCHC(%)	33.5 ± 2.0	33.1 ± 2.0

NOTE

Expected values will vary with sample population and/or geographic location. It is recommended that each laboratory establish its own normal ranges based on the local population.

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Linearity - Seven serial dilutions were prepared on whole blood samples for RBC and HGB, and nine dilutions were prepared for WBC; each dilution was analyzed four times on the Series 150 Cell Counter. The data shown in Tables 1-2a and 1-2b demonstrates excellent recovery on all samples versus the expected (theoretical) values:

Table 1-2a. RBC and HGB Linearity

SERIAL DILNS	x0.166	x0.333	x0.666	x1.0	x1.333	x1.666	x2.0
RBC - OBS	0.64	1.26	2.53	3.74	5.00	6.21	7.49
EXP	0.62	1.25	2.49	3.74	4.99	6.23	7.48
HGB - OBS	2.1	4.0	8.0	11.8	15.5	19.6	23.5
EXP	2.0	3.9	7.9	11.8	15.7	19.7	23.6

Table 1-2b. WBC Linearity

SERIAL DILNS	x0.066	x0.166	x0.333	x0.666	x1.0	x1.5	x2.0	x2.333	x2.666
WBC - OBS	2.2	5.5	11.4	23.1	35.0	54.2	71.3	83.7	94.8
EXP	2.3	5.8	11.6	23.3	35.0	52.4	69.9	81.6	93.2

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PRECISION: Within-run and day-to-day reproducibility were performed on whole blood patient samples and HAEM-QC.

Table 1-3a shows the summary of the results of within-run reproducibility of five whole blood patient samples run 25 times.

Table 1-3a. Within-Run Reproducibility of Whole Blood Samples

	WBC	RBC	HGB	HCT	MCV
Normal Mean	7.6	4.58	14.2	42.6	93.0
SD	0.19	0.09	0.20	0.83	0.93
Ave. CV (%)	2.53	1.98	1.37	1.94	1.00
Claimed CV (%)	3.0	3.0	2.0	3.0	2.0

Within-run reproducibility of four abnormal whole blood patient samples, each run 25 times.

Table 1-3b. Within-Run Reproducibility of Abnormal Samples

	WBC	RBC	HGB	HCT	MCV
Low RBC and HGB Mean	7.6	2.27	7.5	21.74	95.9
SD	0.14	0.06	0.12	0.63	0.82
Ave. CV (%)	1.89	2.84	1.62	2.89	0.85
High RBC and HGB Mean	4.24	7.57	23.1	69.9	92.4
SD	0.12	0.10	0.15	0.73	0.92
Ave. CV (%)	2.80	1.27	.64	1.04	1.00
Low WBC Mean	2.31	3.77	11.85	34.98	92.7
SD	0.07	0.05	0.06	0.40	0.87
Ave. CV (%)	3.10	1.37	0.54	1.15	0.94
High WBC Mean	24.6	3.94	13.1	37.83	96.2
SD	0.42	0.06	0.13	0.61	0.73
Ave. CV (%)	1.75	1.47	1.02	1.60	0.76

Within-run reproducibility of two pediatric whole blood samples run ten times.

Table 1-3c. Within-Run Reproducibility of Pediatric Samples

	WBC	RBC	HGB	HCT	MCV
Sample 1 (5 year old)					
Mean	19.1	4.50	13.7	39.0	86.6
SD	0.25	0.06	0.11	0.55	0.70
Ave. CV (%)	1.31	1.33	0.80	1.41	0.81
Sample 2 (3 year old)					
Mean	7.9	4.49	13.5	39.1	87
SD	0.16	0.09	0.11	0.75	0.48
Ave. CV (%)	2.03	2.00	0.82	1.92	0.55

HAEM-QC™ is a trademark of Baker Instruments Corporation, Allentown, PA.

DAY-TO-DAY REPRODUCIBILILTY - Day-to-day reproducibility of two lots of HAEM-QC™ (Normal and Abnormal) and three lots of other control blood run in duplicate for 20 consecutive days. Table 1-4 shows the summary of the results.

Table 1-4. Reproducibility

		WBC	RBC	HGB	HCT	MCV
HAEM-QC						
Normal	Mean	8.3	4.47	13.9	36.0	80.6
	SD	0.16	0.10	0.21	1.04	1.23
Ave. CV	(%)	1.94	1.97	1.47	2.90	1.53
Abnormal	Mean	15.2	2.30	7.5	18.9	82.0
	SD	0.46	0.09	0.13	0.78	1.19
Ave. CV	(%)	3.01	3.93	1.70	4.12	1.45
CONTROL BLOODS						
Abn. Low	Mean	4.2	2.76	9.0	22.7	82.5
	SD	0.08	0.09	0.12	0.80	1.05
Ave. CV	(%)	1.84	3.2	1.28	3.52	1.27
Normal	Mean	8.3	4.40	13.8	35.2	80.2
	SD	0.20	0.09	0.16	0.62	1.04
Ave. CV	(%)	2.38	1.96	1.16	1.75	1.30
Abn. Hi	Mean	23.9	5.75	17.7	44.9	78.1
	SD	0.37	0.11	0.28	0.90	0.76
Ave. CV	(%)	1.54	1.83	1.59	2.00	0.97

HAEM-QC™ is a trademark of Baker Instruments Corporation, Allentown, PA.

ACCURACY - Correlation between the Series 150™ (Y) and recommended reference methods* (X) was compiled from in-house and field evaluations.

Table 1-5. Accuracy

PARAMETER	NO. OF SAMPLES	RANGE OF X	$\bar{X}$	$\bar{Y}$	CORR. COEFF (r)	SLOPE	INTER-CEPT
WBC ($x10^3/(mm)^3$)	65	1.8 - 51.2	9.57	9.89	0.999	1.099	-0.640
RBC ($x10^6/(mm)^3$)	55	1.62 - 7.63	4.64	4.66	0.996	1.054	-0.228
HGB (g/dL)	55	5.4 - 22.3	14.49	14.55	0.998	0.999	0.060
HCT (%)	54	16.7 - 65.0	43.15	43.88	0.994	1.040	-0.101
MCV (μ^3)	55	80.6 - 103.6	92.3	93.7	0.949	0.950	5.990

*Reference methods: WBC/RBC - other impedance counting instrumentation - Coulter Counter Model Z_F
HGB - Manual cyanmethemoglobin
HCT - Manual microhematocrit (spun)
MCV - Calculated from RBC and HCT

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2-1 INTRODUCTION

This section provides the installation requirements for the Baker Instruments 100 Series Cell Counters and the 106 Dilutor. Also provided are the installation reports that must be filled in by the field service engineer who performs the unpacking and installation operations.

2-2 UNPACKING AND INSPECTION

The instrument should be unpacked close to the site of operation. Carefully open the carton, as shown in Figure 2-1, and check the contents against the packing slip. If any parts on the shipping list are missing, immediately notify Baker Instruments Corporation. If shipping damage is found, immediately file a claim with the commercial carrier, and then notify Baker Instruments Corporation at (215)-264-2800. Outside the United States and Canada, contact your distributor.

NOTE

Retain the shipping carton and all packing material, since it can be reused to ship the instrument.

2-3 INSTALLATION REQUIREMENTS - 100 Series Cell Counter

The electrical, space, and environmental requirements outlined here must be met by the purchaser before the 100 Series Cell Counter can be installed.

2-4 Electrical

The 100 Series Cell Counter can be adjusted by means of a Corcom Voltage Selector to operate at 100 Vac, 120 Vac, 220 Vac, and 240 Vac. The fuse must be changed accordingly.

2-5 Space

A flat area 2 feet wide x 1.75 feet deep (3.5 square feet) free of dust, drafts, vibration, electrical disturbances, and rapid temperature fluctuations must be provided.

2-6 Environment

The 100 Series Cell Counters may be operated over a temperature range of 53°F to 90°F (12°C to 32°C) and a relative humidity range of 0-80% RH, without condensation.

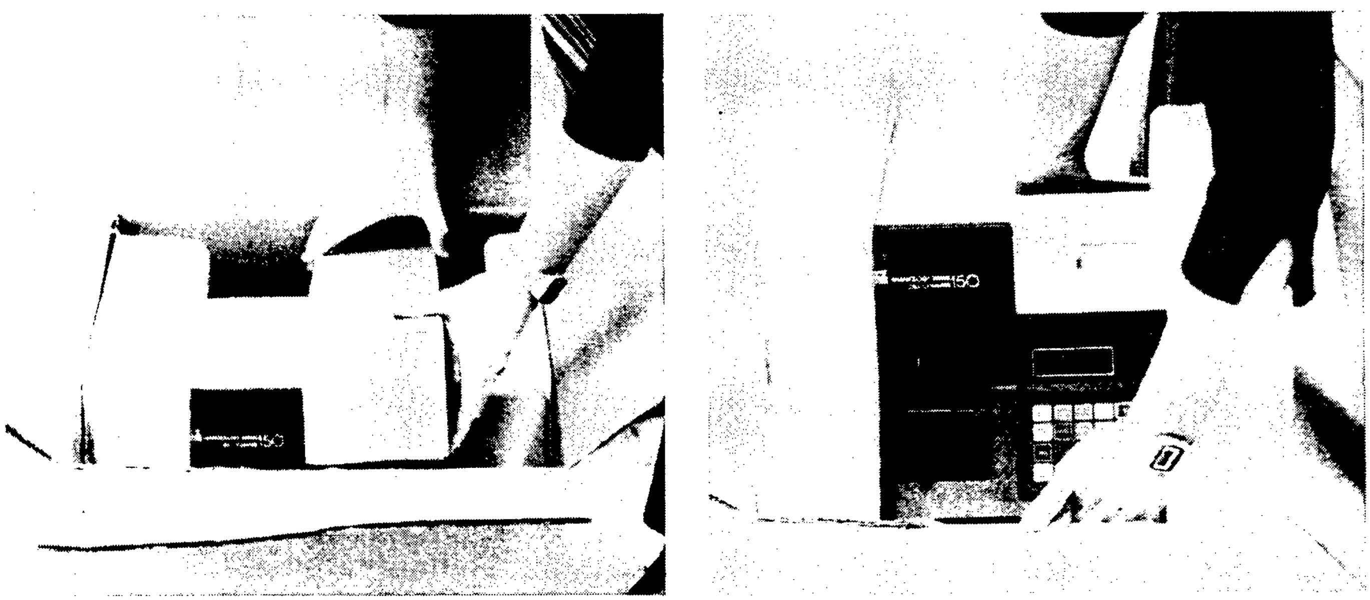

Figure 2-1. 100 Series
Unpacking the Cell Counter

2-7 INSTALLATION REQUIREMENTS - 106 Dilutor

The 106 Dilutor is an optional accessory (to the 100 Series Cell Counters) that is shipped partially assembled. The 106 Dilutor must be fully assembled before it is used.

The main installation requirement is that the diluter be situated on a clean, dry, and level surface.

2-8 Unpacking and Inspection

All the parts necessary to fully assembly the 106 Dilutor are shipped in a single carton with the partially assembled unit. The carton should be opened carefully and the contents inspected for possible shipping damage. If the dilutor or any of the unassembled parts show signs of shipping damage, immediately file a claim with the commercial carrier and then notify Baker Instruments Corporation.

2-9 Dilutor Probe Installation

1. Inspect the tapered end of the probe for cleanliness; clean, if necessary.

2. Insert the large, threaded end of the probe into the probe support and turn it in a clockwise direction until it is finger tight. See Figure 2-2.

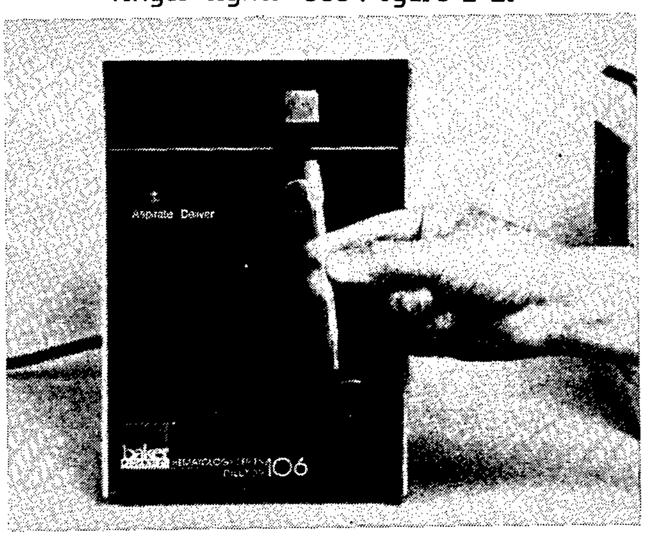

Figure 2-2.
Dilutor Probe Installation

CAUTION

OVERTIGHTENING THE PROBE NEITHER INCREASES NOR IMPROVES THE SEAL AND CAUSES DAMAGE TO THE PROBE.

2-10 Reagent Inlet Tube Installation

1. Remove the reagent inlet tube assembly from its plastic envelope and carefully inspect the tube for obstructions.

2. As shown in Figure 2-3, insert one end of the reagent inlet tube over the inlet port located on the lower, left-rear corner of the dilutor.

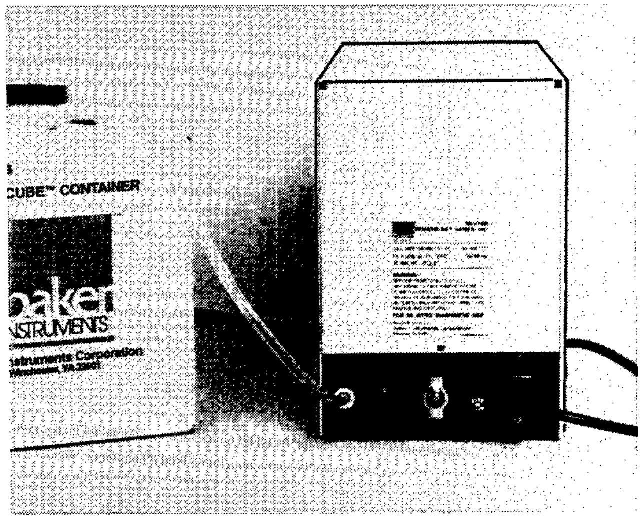

Figure 2-3.
Reagent Tube Installation

3. Position a container of HAEMA-LINE® 2 diluent directly behind the 106 Dilutor and insert the free end of the reagent inlet tube through the hole in the diluent cap into the diluent container.

4. Insert the U-ground plug into an outlet.

5. Toggle the power switch to the ON position.

6. Position an empty beaker under the dilutor probe so that the probe tip touches the side of the beaker, preventing splashing.

7. Press the dilution control button to initiate the aspiration portion of the dilution cycle.

8. Press the dilution control button again to dispense 10.0mL of diluent into the beaker. Complete ten dilution cycles to ensure that the dilutor is properly flushed.

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2-11 INSTALLATION REPORT - 100 Series Cell Counter

Customer		Installation	
Name	______________________	Date	______________________
Address	______________________	Serial No.	______________________
City	______________________	FE Name	______________________
State/Zip	______________________	FE Number	______________________
T-lephone	______________________	Intended Testing Per Day:	
Contact	______________________	0-20 20-40 40-80 OVER 80	

If any of the following installation requirements are not met after three attempts, mark as failed and take corrective action. Repeat requirement until successful, mark as passed, and explain the corrective actions in the comments section at the end of this report.

PASS FAIL

1. Site Requirements

   a) Primary Power. Adjust the Corcom voltage selector for the necessary voltage. Select the desired voltage with the numbers facing you. Figure 2-4 shows the voltage being selected for 120 Vac operation. _____ _____

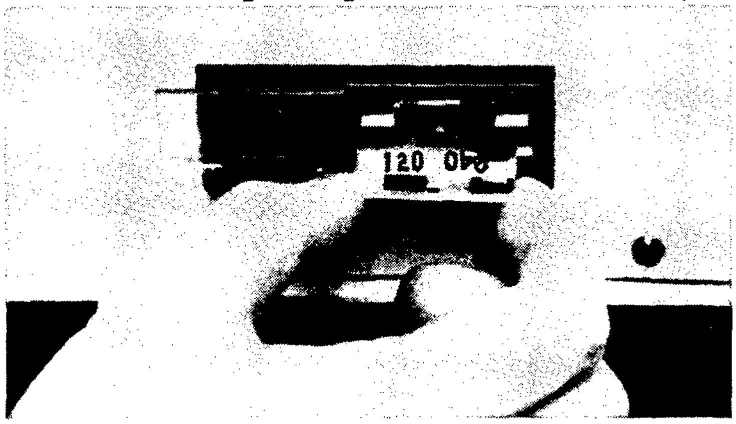

Figure 2-4. 100 Series-Line Voltage Selector

Check one

Selection:	Range:	Rated Fuse:	PASS	FAIL
100 Vac	90-110 Vac	0.75A Slo-Blo	____	____
120 Vac	105-125 Vac	0.75A Slo-Blo	____	____
220 Vac	200-240 Vac	0.375A Slo-Blo	____	____
240 Vac	220-260 Vac	0.375A Slo-Blo	____	____

Verify prime power within range:

	PASS	FAIL
Hot to neutral (see selection range above)	____	____
Hot to ground (see selection range above)	____	____
Neutral to ground (0-0.5 Vac)	____	____

	PASS	FAIL
b) Room temperature (53°F to 90°F or 12°C to 32°C)	____	____
c) Humidity 0-80% (without condensation)	____	____
d) Airborne contamination	____	____
e) Surface 3.5 square feet (2 feet wide x 1.75 feet deep) or 3252 square centimeters (60.96 cm wide x 53.34 cm deep). (Free from dust, drafts, vibration, electrical disturbances, and rapid temperature changes.)	____	____

2. Instrument Preparation

   a) Remove the instrument from the shipping container. Check for complete contents. ____ ____

   b) Remove the front panel retainer screws; there are three screws on the bottom.

   c) Install the waste bottle and stopper assembly; observe the tubing polarity.

   d) Insert a roll of printer paper into the printer.

   e) Plug the instrument in and turn the system on; it displays "000."

3. Keypad and Printer Check

   a) Enter the date.

   b) Enter I.D. 0 - 9.

   c) Press the PRINT key; verify the date, I.D., and print quality. ____ ____

   d) Exercise all other keypad entries; verify operation. ____ ____

4. Clean System, Check Prime Volume

   Check that prime volume is between 3.0 mL and 4.5 mL.

   a) Flush approximately 20 mL of HAEMA-CLEAN™ 100.

   b) Flush approximately 20 mL of HAEMA-STANDBY.

5. Check HGB Cell Voltage

   a) Flush HAEMA-STANDBY once.

   b) Press SCAN key and check the HGB cell voltage (the HGB enunciator that doesn't flash). ____ ____

   c) Run the SELF TEST. (SELF TEST Solution is prepared by mixing 10mL of HAEMA-LINE® 2 with three drops of HAEMA-LYSE™ 100. Backgrounds must be <5.) ____ ____

HAEMA CLEAN™ is a trademark of Baker Instruments Corporation, Allentown, PA.
HAEMA-LINE® 2 is a registered trademark of Baker Instruments Corporation, Allentown, PA.
HAEMA-LYSE™ 100 is a trademark of Baker Instruments Corporation, Allentown, PA.

	PASS	FAIL
6. Check Flow Timing (during self test)		
a) Mix 10 mL of HAEMA-LINE® 2 diluent with three drops of HAEMA-LYSE 100 (SELF TEST solution).		
b) Run SELF TEST and check flow times (average of three runs).		
(1) Dead Time = the time interval between the time the vent solenoid closes for the third and final time until the three zeroes appear on the display. Dead Time = 11 seconds ± 2.4 seconds	____	____
(2) Count Time = the time interval between the time the three zeroes appear on the display until the RBC sign appears on the display. Count Time = 8.5 seconds ± 1.6 seconds	____	____
7. Pump Shut Off		
Approximately 23 seconds after a Standby/Shutdown cycle is completed, the pump shuts off.	____	____

8. Dilution Check
Record the control assay in step 10.

Refer to Operator's Manual, Section VII, for preparing dilutions.

a) Run three control dilutions manually using a 40-µL pipettor (preferably the lab's equipment) and the 10 mL dispensed from the dilutor. Average the results for each parameter (RBC, HCT, WBC, HGB) and record them on the data sheet. Step 11a under manual.

b) Run three control dilutions using the dilutor. Average each parameter (RBC, HCT, WBC, HGB) and record the results in step 11a under dilutor.

c) Figure the change in percent (Δ%) between the manual and dilutor dilutions using the following formula: $\Delta\% = \frac{\text{manual-dilutor}}{\text{dilutor}} \times 100$ ____ ____

If the Δ% is greater than ± 3%, check fail, and adjust the dilutor. After adjustment is made, rerun step 8 and record the results in step 11b.

9. Calibration and Precision Check (attach all printer tape)

a) Run three dilutions of either whole blood with known values or Haem-QC to obtain RBC, HCT, WBC and HGB readings. Refer to the Operator's manual section VIII for a more detailed procedure with examples. Record results in step 12a of worksheet.

b) Average the readings for each parameter and compare with the known value.

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PASS FAIL

c) RBC, WBC and HGB may be calibrated using the following formula to determine the new calibration factor:

New Cal. Factor = $\frac{R-A}{A} \times 100$ where R is known mean value; A is actual reading

d) HCT must be recalibrated if the RBC calibration factor has changed or if the reading is not within 2% of the mean value. If calibration is required, first use the formula above under step c. Next, subtract the RBC calibration factor. Because any change in the RBC calibration factor results in a corresponding shift to the HCT, the RBC factor must be subtracted from the HCT calibration factor.

e) To verify calibration results run three dilutions, recording the results in step 12b of the worksheet. Also run one dilution each of abnormal high and low control and record the results.

f) Run a normal patient sample or control 15 times and obtain a C.V. for each parameter and record the results in step 13. If more than two uncorrecting or four correcting flow messages are incurred out of ten samples, proceed to resolve flow problem. Once problem is resolved, rerun the 15 sample C.V. Maximum allowable C.V. for each parameter is RBC=3.0% HCT=3.0% MCV=2.0% WBC=3.0% HGB=2.0% as follows: ____ ____

RVC< NCV<
HCT≤ WBC≤
HGB≤

Data Worksheet

10. Control Data

Control Supplier:_______________/Lot #:_______________/Expiration Date:_______________

	Normal		Abnormal - Hi		Abnormal - Lo	
	Mean	Range	Mean	Range	Mean	Range
RBC						
HCT						
MCV						
WBC						
HGB						

11. Dilution Sample Results

a)

	Manual	Dilutor	Δ%
RBC			
HCT			
WBC			
HGB			

b)

	Manual	Dilutor	Δ%
RBC			
HCT			
WBC			
HGB			

12. Control Run

a) Calibration

	Normal Control				
	(1)	(2)	(3)	Mean	Δ%
RBC					
HCT					
MCV					
WBC					
HGB					

b) After Calibration

	Normal Control			Abnormal Control	
	(1)	(2)	(3)	Lo	Hi
RBC					
HCT					
MCV					
WBC					
HGB					

13. Precision Check

a) First Trial

	RBC	HCT	MCV	WBC	HGB
1)					
2)					
3)					
4)					
5)					
6)					
7)					
8)					
9)					
10)					
11)					
12)					
13)					
14)					
15)					
C.V.%					

b) Second Trial

	RBC	HCT	MCV	WBC	HGB
1)					
2)					
3)					
4)					
5)					
6)					
7)					
8)					
9)					
10)					
11)					
12)					
13)					
14)					
15)					
C.V.%					

NOTE

The installation is not complete until the system passes each test. If any test failed, detail the corrective action taken.

General Comments: ____________________

Signature ____________________ Date __________

Customer # ____________________ SRO # __________

Return completed installation report by the end of the week to:

Manager, Quality Assurance
Baker Instruments Corporation
P.O. Box 2168
Allentown, PA 18001

2-12 SHUTDOWN - 100 Series Cell Counter

1. Standby/Flush with HEAMA-CLEAN™ 100 for three minutes. ____________
2. Standby/Flush with distilled water six times. ____________
3. Remove vial.
4. Press SHDN/CLEAN; when OP2 appears, shut instrument off. ____________
5. Apply back pressure to the aperture assembly using syringe and tubing; attach it to the snorkel assembly five times, refer to procedure in paragraph 4-53 or repeat the procedure 5 times. ____________
6. Install circuit board retainer.
7. Insert three screws to tighten front panel (if needed). ____________
8. Insert all eight screws in rear panel (if needed). ____________
9. Package the power cord with a warning tag. ____________
10. Package the waste detector assembly and bottle. ____________

2-13 SHUTDOWN/PACKAGING - 106 Dilutor

1. Replace the diluent container with a distilled water container.
2. Aspirate/Dispense ten times with distilled water.
3. Aspirate/Dispense three times with air only.
4. Remove and package diluent tube on rear of dilutor.
5. Remove and package dilutor probe.
6. Remove and package power cord.
7. Place instrument in packaging container, secure tightly.

HAEMA-CLEAN™ 100 is a trademark of Baker Instruments Corporation, Allentown, PA.

3. THEORY OF OPERATION

3-1 INTRODUCTION

The 100 Series Cell Counter is divided into two subsystems: the Fluid Subsystem and the Electronic Subsystem. Figure 5-1, a System Functional Block Diagram, shows the interrelationships between the subsystems and the major electronic signals between them. Each of these subsystems is discussed in the following paragraphs.

3-2 FLUID SUBSYSTEM (Figures 3-1 and 5-3)

Under control of the electronics subsystem, the Fluid Subsystem directs air pressure and sample flow in five separate operating modes: STANDBY/FLUSH, SELF TEST, RBC/HCT, WBC/HGB and SHUTDOWN/CLEAN. These operating modes are explained following the major component descriptions.

As shown in Figure 3-1, the Fluid Subsystem consists of the following major components:

- Cell Assembly
- Volumetric Assembly
- Prime and Count Valves
- Hemoglobin Cell Assembly
- Pump
- Vacuum Regulator
- Waste Assembly

Tubing lengths are detailed in Figure 5-3.

3-3 Cell Assembly (Figure 5-4)

The cell assembly counts red blood cells (RBC), white blood cells (WBC), and measures the mean corpuscular volume (MCV). The constant electrical current supplied from the analog board travels from the cold electrode, located in the prime chamber, through the aperture (Red Jewel) to the hot electrode located in the count chamber of the assembly. The aperture, a 100-micron orifice, simulates a load resistance of approximately 18 kΩ when diluent is present. Blood cells, when suspended in diluent, act as a momentary resistance, producing a temporary voltage spike when passing through the aperture.

Each voltage spike is counted as a cell and the amplitude of each peak determines the mean corpuscular volume (MCV). The sample is pulled through the cell assembly by vacuum acting upon both the volumetric tube and the prime-port barb fitting on the cell assembly. With the vent solenoid closed, the vacuum pulls the sample from the snorkel assembly through the snorkel tubing into the left side of the cell assembly. The vent solenoid opens and closes several times to allow air bursts through the aperture to keep it from becoming blocked with debris. The O-rings and screen inside the volumetric tube port ensure a tight seal, preventing air seepage and bubbles from rising into the volumetric tube during a count mode.

3-4 Volumetric Assembly (Figure 5-4)

The volumetric assembly monitors flow times in the system. This is necessary to detect any type of abnormal flow through the aperture that may interfere with the counting process. The volumetric assembly, comprised of a volumetric tube and photodetector assemblies, measures the 250 µL volume of sample. The inner diameter of the volumetric tube and the distance between photodetectors defines the monitored volume. The photodetectors consist of a light-emitting diode (L.E.D.) and a phototransistor. With no fluid in the volumetric tube, the phototransistor is in the off or high state, due to insufficient light transmission from the L.E.D. through the volumetric tube to the phototransistor. When fluid is present in the volumetric tube, the transmitted light activates the phototransistor to the on or low state.

3-5 Valves - Count, Prime (Figure 5-4)

The valves are solenoid-type, two-way, flow-through valves. The valve contains a coil, a spring, an armature a sleeve, O-ring, and a base. When the valve is energized, the armature pulls away from the input port, allowing fluid to travel through the valve and out the common port (marked C). When de-energized, the spring located behind the armature pushes it back to the closed position, stopping the fluid flow.

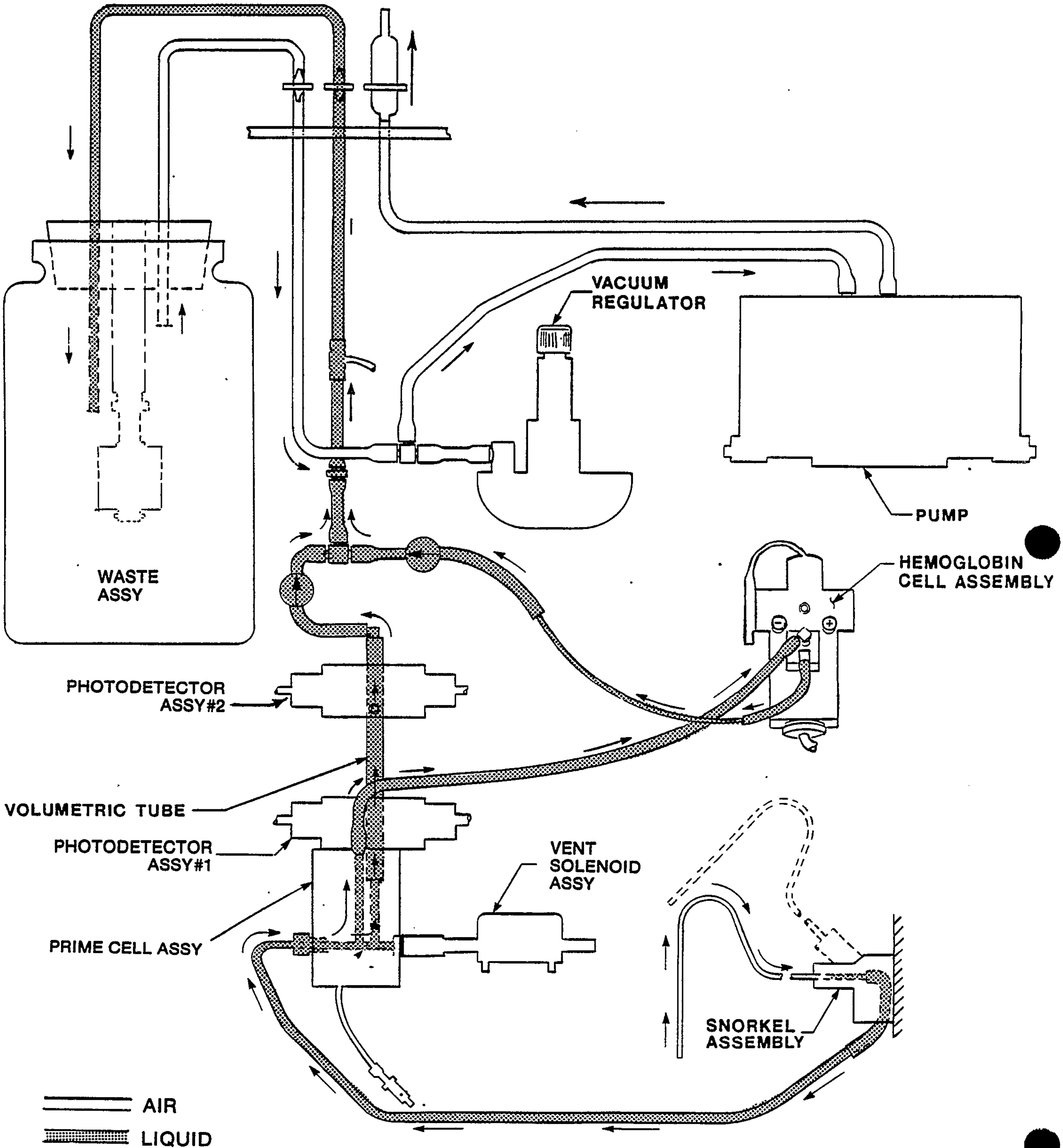

Figure 3-1. Fluid Subsystem

3-6 Hemoglobin Cell Assembly (Figure 5-5)

The hemoglobin (HGB) cell assembly measures the amount of hemoglobin contained in whole blood by means of a light absorption technique. After preparation of the sample by adding HAEMA-LYSE 100, it is aspirated into the HGB cell during the prime cycle; then, the HGB cell assembly (Figure 5-5) utilizes a tungsten lamp, a 540nm filter, and a silicon photodiode, to optically read light absorption. During the RBC mode, the light passes directly through the clear solution in the HGB cell, with no loss in absorbance. This maximum reading is then stored by the instrument so it may be used as a reference against the subsequent HGB sample. This maximum reading of cell voltage is obtained by adjusting the lamp intensity with the R13 potentiometer on the Power Supply PWB.

The HGB cell assembly is mounted at a 27-degree angle on the volumetric arm assembly, with the detector at the front. The angle ensures that any bubbles passing through the cell, rise so they do not interfere with the absorption reading. The lamp, mounted in the rear, provides maximum heat transfer through the lamp block to the volumetric arm assembly (see Figure 3-2.

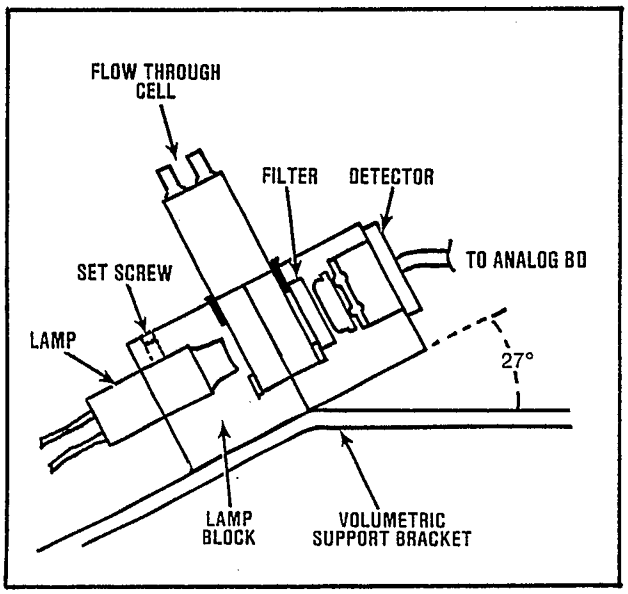

Figure 3-2. HGB Cell Assembly

3-7 Vacuum System (Figure 5-3)

The pump, regulator, and waste assembly supply regulated vacuum (negative pressure) to the fluid subsystem. In all operating modes, except OP1 (STANDBY) and OP2 (SHUTDOWN), pressure from the pump is regulated down to -2.4 ± 0.1 PSI. The regulated pressure is then contained in the waste bottle and acts upon the common ports of the prime and count valves which control sample flow.

The waste assembly contains a waste sensor, stopper, tubing, and the waste bottle. As the waste sensor float begins to rise, a magnetic reed switch, encased inside the green stem in the normally closed mode, opens because of the magnetic field from the float. This signal, in turn, appears as an H40 message on the display.

The blue tubing inside the stopper is always shorter than the clear tubing. Since the clear tubing carries fluid, it must drop the fluid at a lower height than the blue (vacuum) tubing to avoid fluid entry into the vacuum system.

The pump assembly operates at 120 Vac and 50 or 60 Hz and is controlled by the relay PWB. The pump assembly used is unique because of its low heat dissipation and low maintenance, which is due to the fact that there are no moving parts or ball bearings. The pump produces a minimum pressure of -6 PSI, with extremely fast recovery.

3-8 STANDBY/FLUSH, SHUTDOWN/CLEAN Mode

During the STANDBY/FLUSH and SHUTDOWN/CLEAN modes, the functional operation of the fluid subsystem is nearly identical, with program differences that are explained in the following paragraphs. During these modes, the system aspirates between 3.00 and 4.50 mL of liquid into the prime and count pathways (see Figure 3-1) in order to clean and lubricate the system.

The STANDBY/SHUTDOWN cycle begins flushing the snorkel by opening the prime valve for eight seconds (see Figure 3-3). Four seconds into this cycle the count valve opens, allowing liquid to travel through the aperture. Simultaneously, the vent solenoid opens for a two-second air purge of the

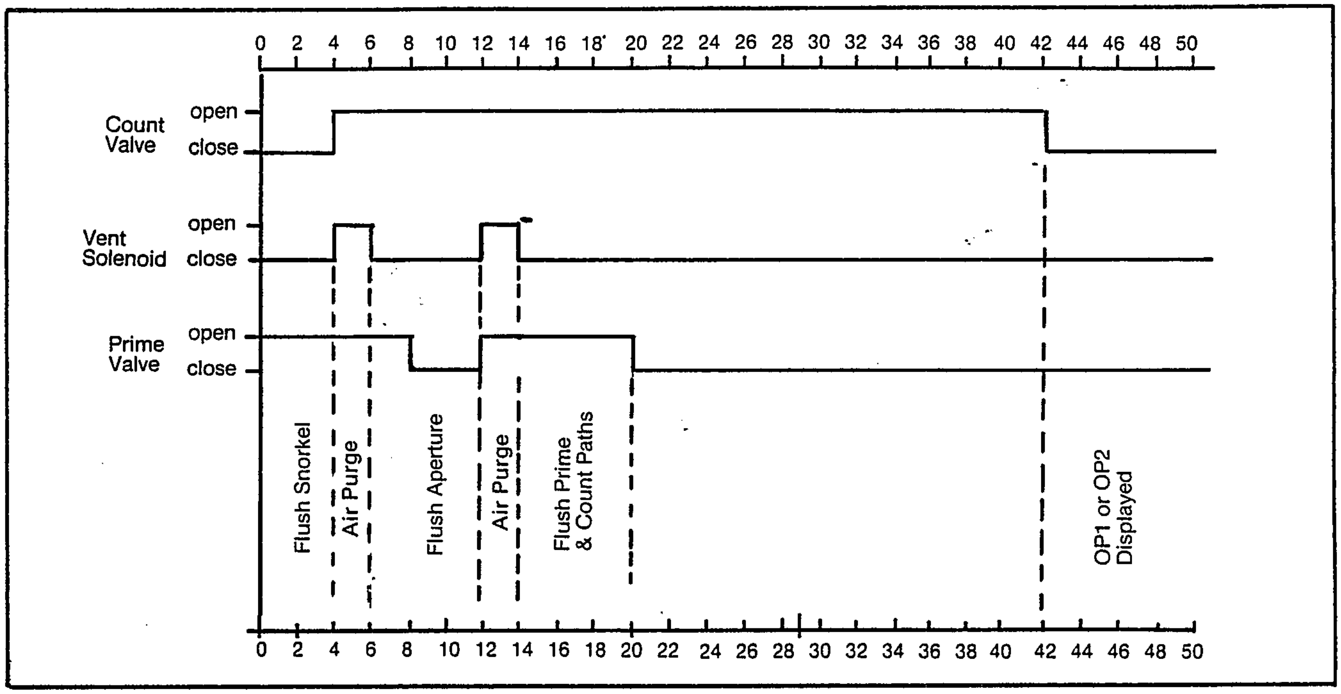

Figure 3-3.
STANDBY/SHUTDOWN Timing Diagram

aperture. Next, the prime valve closes for four seconds, allowing liquid to flush the aperture.

Next, the vent solenoid opens for another two-second air purge. The prime valve opens, flushing the prime path. After the prime valve closes, the count path is thoroughly flushed for an additional 22 seconds. At the conclusion of this time OP1 or OP2 is displayed.

OP1 is displayed at the conclusion of a STANDBY/FLUSH cycle. All keyboard entries are operational during the STANDBY mode.

OP2 is displayed at the conclusion of a SHUTDOWN/CLEAN cycle. Once displayed, the entire keyboard is inoperative except for the RESET key. If the RESET key is pressed, the program takes the unit back to a READY condition, displaying three zeroes. When exiting OP1 or OP2, the system performs a countdown on the display. This countdown permits the pump to build stable pressure throughout the system.

3-9 Analysis Mode

For purposes of discussion, the SELF TEST mode, RBC/HCT mode, and the WBC/HGB mode are referred to in the following description as the analysis modes. The fluid subsystem operation is nearly identical in all analysis modes with minor program differences that are described in the following paragraphs (see Figure 3-4).

The analysis mode consists of the prime cycle and the count cycle. The prime cycle directs the sample through the HGB cell, while the count cycle directs the sample through the count path. The system initially energizes the vent solenoid, count valve, and prime valve. The vent solenoid initially opens for two seconds, then closes for approximately five seconds, allowing priming of the sample to occur. After the first prime, the vent solenoid opens for two seconds providing bubble back, clearing any debris at the aperture. The vent solenoid closes for a second time, allowing additional priming to occur for five seconds. On the third opening, the vent solenoid is held open for approximately four seconds, with the prime valve closed, allowing an air blast up the volumetric tube only. The vent solenoid is then closed for the third and final time, with the prime valve momentarily opening once again, clearing the aperture. Then, the count cycle begins. During the count cycle, the dead time is checked by the computer before the actual measuring of cells occurs. Dead time is defined by the computer to be the time interval between the last time the vent solenoid closes until the fluid triggers

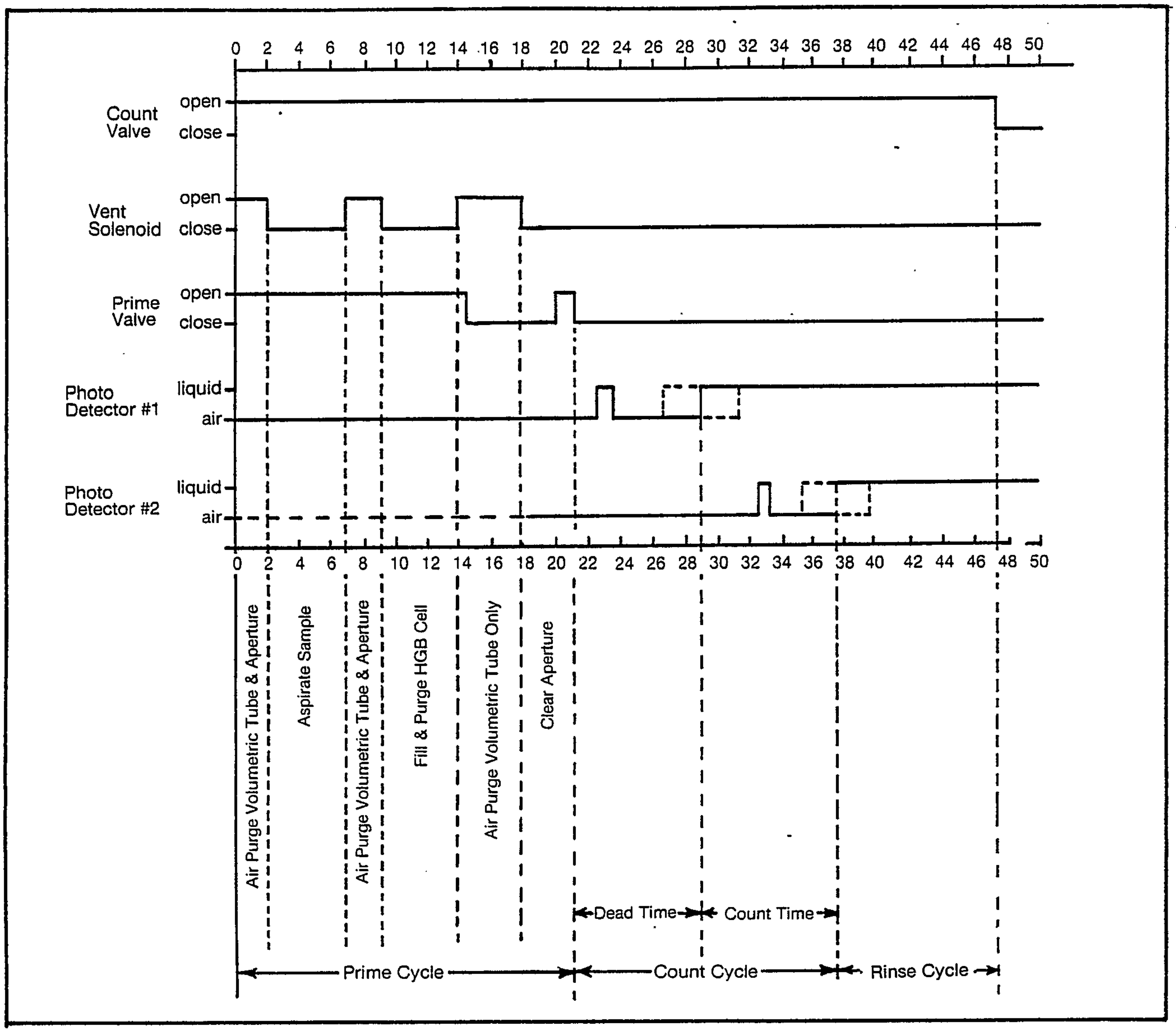

Figure 3-4.
Analysis Mode Timing Diagram

the first photodetector. The dead time permits stabilized sample flow through the aperture and, simultaneously, prepares the aperture with sample for counting. Once the sample has triggered the first photodectector, the counting actually begins. During the count time, which is the time interval the sample takes to travel from photodetector 1 to photodetector 2, the computer analyzes the sample conductivity, hemoglobin cell voltage, and flow rate of the sample through the aperture. Once the sample has reached the second photodetector, the analysis stops, and the results are displayed. However, the count valve is held open for approximately five more seconds to allow adequate lubrication of the fluid pathway.

During the SELF TEST mode the computer, aside from checking sample conductivity, monitors flow times and checks the electronic circuitry. During the dead time, the flow rate must be within 11 ± 2.4 seconds. During the count time, the flow rate must be within 8.5 ± 1.6 seconds; otherwise, an H10 (flow too slow) or H11 (flow too fast) help code is displayed. During SELF TEST, the computer measures the flow time for both the dead and count times. The computer then establishes a range around that mean one-half of the acceptable range during SELF TEST. These parameters are then used for all analysis modes, until another SELF TEST is performed, thus resetting the expected flow times. For example, if the dead time measured during a SELF TEST was 10 seconds, the computer establishes a window with a range of ± 1.2 seconds (one-half the range of 2.4 seconds allowed during SELF TEST). The count time is analyzed and set in the same manner.

Also, during the SELF TEST mode the electronic circuitry in the HGB cell assembly, analog, I/O, and computer PWBs is checked. The sample conductivity must be below 5 or an H23 (background too high) help code is displayed. The HGB cell assembly is tested by reading the output voltage from the photodiode and comparing it to an error criteria. If the voltage is outside the range of 3.5 to 5.0 Vdc or is fluctuating greater than 0.02 Vdc, an H24 help code is displayed. To test the PWBs the computer PWB generates a test signal through the data bus. The test signal simulates cell activity testing the count, threshold, and sizing circuitry on the analog PWB. The output drives the speaker on the I/O PWB, partially testing that PWB and is compared back on the computer PWB for errors. The threshold values may be verified by pressing the SCAN key. A more detailed description of the electronic circuitry is presented in subsequent paragraphs.

The RBC/HCT mode key activates the analysis mode as described previously, with a difference in the software selection of measured parameters and calculations. During this mode, the red blood cells (RBC) and mean corpuscular volume (MCV) are measured at the aperture assembly, and the hematocrit (HCT) calculated. The RBCs are differentiated from noise and debris by selection of the RBC threshold on the Analog PWB (humans = 0.65 ± 0.01). HCT is a calculated function represented by the following equation:

$$\%HCT = \frac{RBC\ (10^6/mm^3) \times MCV(\mu^3)}{10}$$

During this mode, the HGB cell voltage is read for optimum light transmission. This voltage is then used as reference during the upcoming WBC/HGB mode in order to obtain a corrected absorption reading. Upon the conclusion of the RBC/HCT mode, the RBC and HCT results are displayed alternately. The MCV can be displayed by pressing the IND (indice) key.

The WBC/HGB key activates the analysis mode as described above with minor differences in software selection, measured parameters, and calculations. During this mode, the white blood cells (WBC) are measured at the aperture assembly. The hemoglobin (HGB) is measured at the HGB cell assembly. During this mode the hemoglobin is measured eight times during the counting cycle. All eight readings are then averaged for a single result. The mean corpuscular hemoglobin (MCH) is a calculation that uses the hemoglobin and the previous RBC count.

$$MCH\ (pg) = \frac{HGB(g/dL) \times 10}{RBC\ (10^6/mm^3)}$$

The mean corpuscular hemoglobin concentration (MCHC), in percent, is a ratio of the hemoglobin to the hematocrit.

$$\%MCHC = \frac{HGB\ (g/dL) \times 100}{HCT\ (\%)}$$

The MCH and MCHC functions can be obtained by pressing the IND (indice) key after the WBC count is displayed. The WBCs are differentiated from noise and debris by selection of the WBC threshold on the Analog PWB (humans = 0.90 ± 0.01). Upon the conclusion of the WBC/HGB mode, the system alternately displays the WBC/HGB results. The MCH and MCHC can be displayed by pressing the IND (indice) key.

3-10 ELECTRONIC SUBSYSTEM

As shown in Figure 5-7, the electronic subsystem consists of the following major components:

- Motherboard, Display Assembly
- Computer PWB
- I/O PWB
- Keyboard
- Relay PWB
- Analog PWB
- Printer Assembly
- AC/DC Power Distribution

The microprocessor executes the 100 Series system program residing in the ROM on the computer PWB. Under program control, the microprocessor controls the valves and monitors the photodetectors via the I/O PWB, reads digitized pulse measurement data from the analog PWB, and uses RAM on the computer PWB for temporary data storage.

3-11 Motherboard Assembly
(including Display Assembly)
(Figure 5-8)

The motherboard assembly is part of the instrument card cage and contains a printed circuit motherboard which interconnects the I/O, Computer, and Analog PWBs that plug into its on-board edge connectors. The motherboard assembly also contains a power wire harness for connection to the power supply assembly, a jack for connection to the keyboard, and a hard-wired display assembly.

The motherboard itself contains three dedicated, 80-pin edge connectors, labeled CPU, I.O., and ANL., for connection to the described PWBs. The power wire harness is soldered to the motherboard, terminated by plug connector P5, and used to provide dc power and the MEMORY PROTECT signal from the power supply assembly. The motherboard receives +2V (HGB lamp), +5V, +12V, ±15V, +18V, and +100V from the power Supply assembly for distribution to the PWBs and other system components.

The keyboard cable connects to an 11-pin jack connector, J17, at the motherboard. The keyboard is an X-Y membrane panel. Pressing a key places a ground on the appropriate lines for decoding on the I/O PWB.

The display assembly consists of a separate PWB containing a socketed, custom LCD device, and provides direct connection between the LCD and the motherboard via two soldered ribbon cables. Refer to Table 5-7 for the motherboard wire list.

3-12 Computer PWB (Figures 5-9 and 5-10)

The Computer PWB controls system operation including electronics, fluids, computation, and reporting of parameters and results. For purposes of the following discussion, the PWB may be divided into four functional blocks: the CPU, decoders, memory, and interface circuitry.

A. The CPU, at the heart of the system, is composed of the oscillator, the microprocessor, and the address latch. The oscillator consists of a 4.096 MHz crystal, Y1, and capacitor C7, which drives the X1 and X2 inputs of the microprocessor. The microprocessor divides the clock signal to 2.048 MHz for use on the external bus as the system clock (SYS CLK).

The microprocessor, U1, is an Intel™ 8085. Refer to the Intel Microprocessor and Peripheral Handbook for detailed information on this device. Operating from a software program stored in an on-board PROM, the 8085 controls the fetching of data and instructions from memory or I/O devices and performs arithmetic and logic operations.

The 8085 uses a multiplexed address/data bus, with the address split between the higher 8-bit address (A8-A15) and the lower 8-bit address or data bus (A0-A7 or D0-D7). During the first state of the machine cycle, the low order address at A0-A7 is latched in U2 by the address latch enable (ALE) signal. The full 16-bit address is then applied to the address bus. During the remaining states of the machine cycle, the lower 8-bits (D0-D7) are used for memory or I/O data.

The microprocessor is normally initialized when power is applied via the POWER switch. However, the $\overline{\text{RESET}}$ line at U1-pin 36 remains in a low, active state, forcing initialization for approximately one second after the power supplies stabilize. This delay assures a successful initialization and an orderly transfer of U1 control to the system program when $\overline{\text{RESET}}$ goes high. At this point U1 reads and executes the system code, beginning with the first instruction, located at 0000 Hex, and remains under program control until the instrument power is removed. In the rare event that a power or control line disturbance causes U1 to stall, U1 can be manually initialized

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by momentary depression of switch S1 (RESET). Upon release of S1 the RESET line slowly charges to a high level via R1 and C1 to prevent re-triggering.

Other input signals include RST 6.5 and SID. The RST 6.5 signal, produced by the I/O PWB, is used by U1 as a real-time clock signal to compute flow times and control system timing. The serial input data (SID) line (U1-pin 5) is used to read the condition of the printer BUSY signal from connector P2.

The microprocessor also generates a number of control signals: SYS RESET, $\overline{RD}$, $\overline{WR}$, and IO/$\overline{M}$. The high active RESET OUT signal (U1-pin 3) is used as a system reset (SYS RESET). The read ($\overline{RD}$) and write ($\overline{WR}$) signals are used along with the peripheral or memory (IO/$\overline{M}$) signal to direct the instrument's operation.

B. The decoding circuitry consists of PROM, RAM, printer, I/O PWB, and analog PWB decoders. Decoder/demultiplexer U6, using A11-A14 and IO/$\overline{M}$, enables either one of the four PROMs or the RAM. U7 enables the printer data latch, U13, via U3 logic gates, or the I/O PWB through control signals $\overline{PS0}$ and $\overline{PS1}$. U3 and U8 provide the strobe (STD1-STD5) signals for the I/O PWB and the ST ANALOG CONTROL, RD A/D HIGH, and RD A/D LOW control signals for the analog PWB.

C. The memory is either read-only memory (ROM) or random-access memory (RAM). Two configurations are possible depending on the number of parameters desired and selected by S2 and S3 switch positions; see Table 5-9.

The first configuration, labeled standard memory, allows up to five-parameter determinations (120, 130, and 150 Series). There are 8K bytes of PROM and 256 bytes of RAM. The PROM is composed of four 2K, 8-bit EPROM (Intel™ 2716), identified as U9 through U12. Similarly, the scratchpad and calibration factors are stored in two 256 x 4-bit RAM (NEC™ 5101), identified as U4 and U5.

The second configuration, labeled expanded memory, allows seven parameter determinations (170 Series). There is 12K bytes of PROM and 2256 bytes of RAM. The PROM is composed of three, 4K x 8-bit EPROM (Intel 2732) identified as U9 through U11. There are two, 256 x 4-bit RAM (NEC 5101), identified as U4 and U5 and additionally, one 2K x 8-bit RAM (NEC 6116), identified as U12.

The remainder of the discussion on memory is common to both configurations. The program resides in the PROM and consists of machine code to direct the microprocessor to control various peripheral devices and decipher inputs from other peripheral devices. Mathematical algorithms are also stored in PROM.

Temporary data storage and scratchpad operations occur in RAM. This includes operator-entered calibration factors. To avoid the need for data reentry after turning off the system power, battery backup is provided. Two rechargeable 1.25V nickel-cadmium (nicad) batteries provide a nominal 2.5 Vdc to U4 and U5, and thereby preserve memory. Whenever the system power is on, the power supply assembly provides +5 Vdc, +12 Vdc, and +18 Vdc to the computer PWB. Through diodes CR2 and CR3, +5 Vdc is applied to RAM and the nicad batteries, charging the batteries. When system power is turned off, the power supply assembly sends a low MEMORY PROTECT signal to RAM-pin 17, (CE2) selecting the standby state. The FET, Q1, acts as a switch, with C4 responsible for the delaying action necessary at transition times. This delay protects the memory while the power supplies are stabilizing.

D. The interface circuitry consists of a resistor network, RN1, for data bus pull-up and data latch U13 for interfacing with the optional printer. The

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NEC™ is a trademark of NEC Corporation, Wellesley, Ma.

decoding circuitry selects the printer latch, allowing data to be fed to the printer at a speed it can handle. The BUSY signal from the printer notifies the microprocessor when the printer is available for another line of data. Data is presented in ASCII format along with +18 Vdc, +5 Vdc, and a clock (STROBE) to the printer via connector P2.

The microprocessor transfers data to the printer by first sending D0 through D6 with STROBE low, then sending identical data with STROBE high. While printing the BUSY signal, P2-pin 12, is held high. The BUSY signal is monitored by U1-pin 5 (SID). The microprocessor only sends data to the printer when the BUSY signal is low.

3-13 I/O PWB (Figures 5-11 and 5-12)

The I/O PWB interfaces between the Computer PWB and the fluid subsystem and the operator. Included in the fluid subsystem are count and prime valves, vent solenoid, photodetectors, pump, and waste detector. The operator interface includes the liquid crystal display (LCD), the keyboard, and, as an option, the thermal printer.

The PWB performs three major functions: LCD drive, time/counter, and interface for the keyboard and the fluid subsystem. The LCD drive function is performed by U10 through U16. The data bus provides display information while the $\overline{STD1}$ through $\overline{STD5}$ signals, from the computer PWB, strobe data into the desired driver. Drivers U10 through U13 are responsible for illuminating the appropriate enunciator in the custom LCD; see Table 3-1.

Table 3-1 - Enunciator Data

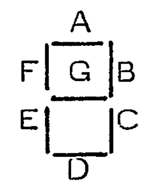
Active	Display $\overline{STD4}$	$\overline{STD5}$
D0	READY	RBC
D1	SELF TEST	WBC
D2	- (minus sign)	HCT
D3	CAL	HGB
D4	ID#	MCV
D5	DATE	MCV
D6	XX.X (WBC D.P.)	MCHC
D7	X.XX (RBC D.P.)	PRP

(X-digit)

Drivers U14 through U16 are responsible for illuminating the seven-segment character as either H or 0 through 9; see Table 3-2. The display frequency (DF) signal is generated by the timer/counter circuitry.

Table 3-2 - Digit Data

D3-D0 (hex.)	Segments Active*	Display
0	A-F	0
1	B,C	1
2	A,B,D,E,G	2
3	A-D, G	3
4	B,C,F,G	4
5	A,C,D,F,G	5
6	A, C-G	6
7	A-C	7
8	A-G	8
9	A-D,F,G	9
A	D-F	L
B	B,C,E-G	H
C	A,B,E-G	P
D	A-C,E-G	R
E	G	-
F	none	blank

*


The timer/counter circuitry centers about the programmable interval timer (U6). System clock (SYS CLK) from the computer PWB is divided by two at U8-pin 9 and by 16 at U9-pin 11. The clock is then fed into the CLK input of U1 for further division to a 100-Hz output at OUT for use as an interrupt (RST 6.5) for the computer PWB. The RST 6.5 clock is divided by two at U8-pin 5, developing the display frequency (DF) clock for the LCD drivers.

Counter 1 of U6 is set, via the data bus and $\overline{WR}$ command, to FFFF (hex). COUNT IN decrements the counter each time an RBC or WBC is detected by the Analog PWB.

Simultaneously the COUNT IN signal is fed to the CLK 2 input of U6 for division by 30. The result at OUT 2 is used to trigger U4, a 4-KHz oscillator, which drives the on-board beeper.

At the appropriate time the computer PWB sends a command, stopping the count and, using $\overline{RD}$, reads the contents of counter 1 via the data bus. Further calculations are performed on the Computer PWB.

The frequency of the beeps is dependent on the number of cells detected. A beep is initiated for each group of 30 cells detected during the count time.

The interface with the keyboard and the fluid subsystem is through the programmable peripheral interface, U1. Address lines A0 and A1 select the A, B, or C interface banks with the data bus, D0 through D7, providing the link with the microprocessor. Bank B and part of bank A receive data from the keyboard. The remaining portion of bank A controls the pump-vent solenoid, and the count and prime valves. Bank C receives data from the photodetectors and waste detector, and provides enable signals for the beeper and the programmable interval timer, U6, during the count time.

Resistor network RN1 provides pull-up resistors for the keyboard column and low signals. The keyboard consists of a group of membrane-type switches configured in four rows and seven columns. When a key is pressed, its row and column are grounded. The Computer PWB continuously scans the keyboard for operator requests. Dual peripheral drivers, U2 and U17, control the prime valve and vent solenoid, and count valve and pump, respectively. Comparator U5 detects the presence of fluid in the volumetric tube via the photodetectors. Diodes CR1 through CR3 provide the threshold voltage the photodetector must overcome to signify fluid in the tube. The photodetector voltage is nominally 3 volts without fluid and, typically, below a 9 volt with fluid. The diodes provide a transition point at 1.8 Volts. The LED portion of the photodetector assembly is powered by +5 V through R11 and R12.

3-14 Relay Board (Figures 5-13 and 5-14)

Pump relay, K1, is activated during RBC, WBC, SELF TEST, STANDBY, and SHUTDOWN. It is deactivated at the conclusion of STANDBY and SHUTDOWN operations. K1 is turned on when the I/O PWB provides a low signal to K1-pin 2. Once K1 is activated, it allows 110 Vac to route though K1-pins 4 and 6, energizing the pump. Resistor R3 provides a minimum necessary load, so that K1 latches reliably.

3-15 Analog PWB (Figures 5-15, 5-16, 5-17)

The Analog PWB can be divided into five functional blocks: cell counting, cell determination, MCV sampling, A/D conversion, and control circuitry. The cell counting circuitry is comprised of two circuits; the first develops cell current, and the second, cell voltage amplification. The cell current generator takes the 100V input from the Power Supply PWB, and using filters and a zener diode, CR6, maintains 9 Vdc. Applying this voltage across R3 and through Q1 yields a constant current of 0.6 mA. During the analysis mode, a low logic signal from U19-pin 6 de-energizes opto-coupler U1, enabling the cell current circuitry.

The constant current is applied to the cell assembly through two electrodes. The HAEMA-LINE® 2 solution completes the circuit, with an 18 kΩ nominal impedance. When a particle (cell) passes through the aperture, a momentary voltage spike results. The size of the cell determines the magnitude of the voltage rise. This signal is fed to U2, configured as a three-stage amplifier, with a gain of 2900. The cell voltage is then applied to Q2 where the base line is restored. At the output of buffer U6-pin 6, each cell pulse has a zero-volt base line and a maximum value of 5V.

The cell discrimination circuitry consists of U5, R1, R2, U8, and U20. Data latch U19-pin 12 provides either a high or low logic signal selecting either WBC or RBC, respectively. Inverter U5 provides the necessary ground for the voltage divider network consisting of +15 Vdc from the Power Supply PWB, R24, and either R1 or R2 (R47 or R46 on non-veterinary units). Since cell voltage is proportional to cell size, a threshold voltage must be met for a cell to be identified as either red or white. The threshold voltages are 0.65V and 0.90V, respectively. Comparator U8 passes cell voltages greater than the desired cell threshold. The output, U8-pin 6, is inverted by U20 to provide the COUNT signal for the Computer PWB.

The MCV sampling circuitry consists of C22, CR12, U3, U4, and U9. Analog switch U9 is selected by the control circuitry described later during this board description. Once selected, the cell output, U6-pin 6 is stored by C22 of the peak detector circuit. To reset for the next cell measurement, a signal from U10-pin 8 in the control circuitry turns on S1, discharging C22.

The A/D conversion circuitry consists of U14, U16, U17, and U18. Analog multiplexer, U14, selects one of four inputs for conversion at the A/D converter, U16. Control of U14 is provided by U19-pins 15 and 16, resulting in selection of an analog signal. Input S1 is the output of the MCV sampling circuit. To make an MCV determination, 1,000 random samples are taken during the count time. This date is digitized and then processed on the Computer PWB.

Next, the HGB cell voltage enters the analog PWB where current-to-voltage converter, U7 and associated circuitry, prepares input before application on to S2 of U14. The HGB lamp voltage, developed on the power supply PWB, is applied to MUX input, S3 for subsequent application to the A/D converter.

Finally, the threshold voltages, through unity amplifier U2, are applied to the S4 input of U14 during operation of the SCAN key.

During a COUNT cycle, U14 inputs, S1 and S2, are randomly selected for analysis of MCV and HGB data. At the conclusion of a COUNT cycle, the SCAN key may be selected, allowing display of inputs S3, HGB lamp voltage, and S4, threshold voltages for RBC and WBC.

The output of the MUX is applied, through inverter U15, to the input of the A/D converter, U16-pin 13. The ouput, D0 through D9, is latched into U17 and U18 by RD A/D LOW and RD A/D HIGH commands from the Computer PWB. The 10-bit output is transmitted as an 8-bit byte and 2-bits of data, on D0 and D1, and an end of conversion (EOC) signal on D7.

The control circuitry consists primarily of U10, U11, U12, U13, and U19. Data latch U19 uses strobe ST ANALOG CONTROL to load the data D0 through D7, from the Computer PWB. As described earlier, the outputs of U19 (1Q through 8Q) enable the cell current (3Q), selects the desired threshold (8Q), or self test of the cell counting and sizing circuitry (5Q), selects which analog signal to feed to the A/D converter (6Q and 7Q), and provides necessary signals for con-trol circuitry (1Q and 2Q). 4Q is not used.

Output 1Q is applied to NAND gate U12-pin 2 to activate one-shot, U13, which in turn provides the pulse that allows a conversion cycle to take place at U16. The Computer PWB initiates the A/D conversion when the SCAN key is pressed. RBC and WBC threshold voltages, as well as HGB lamp and cell voltages, are converted for display.

Output 2Q initiates the process for MCV data conversion. D-flop U10 is preset by 2Q and RD A/D LOW signals. The outputs of U10 feed U11 as input at pin 2 and clock (C) signals.

Each COUNT pulse and its complement, formed by U20, are used by U11 to form a low-going pulse at U12-pin 11. This signal, in turn, enables the analog switch, U9, connecting the cell output U6-pin 6 to the peak detector circuit. The trailing edge of the U12 pulse then triggers single shot, U13, which sends a 700-nsec, high-going pulse to U16 to initiate an A/D conversion.

The clear (CL) signal U10 comes from the STATUS and D8 outputs of the A/D converter.

Also, the computer PWB sends a logic low RD A/D LOW signal to U10, removing the EOC signal. Once the RD A/D LOW signal goes high, U1 may trigger subsequent cell pulse A/D conversions.

3-16 PRINTER ASSEMBLY (Figure 3-5)

The optional 100 Series printer is a five by seven dot-matrix, alphanumeric printer. The printer consists of a printer mechanism and a printer controller PWB and is powered with +5 and +18 Vdc.

The printer mechanism prints characters on a paper tally roll by means of ten thermal elements, each of which can print two characters, providing a total width of 20 characters per line.

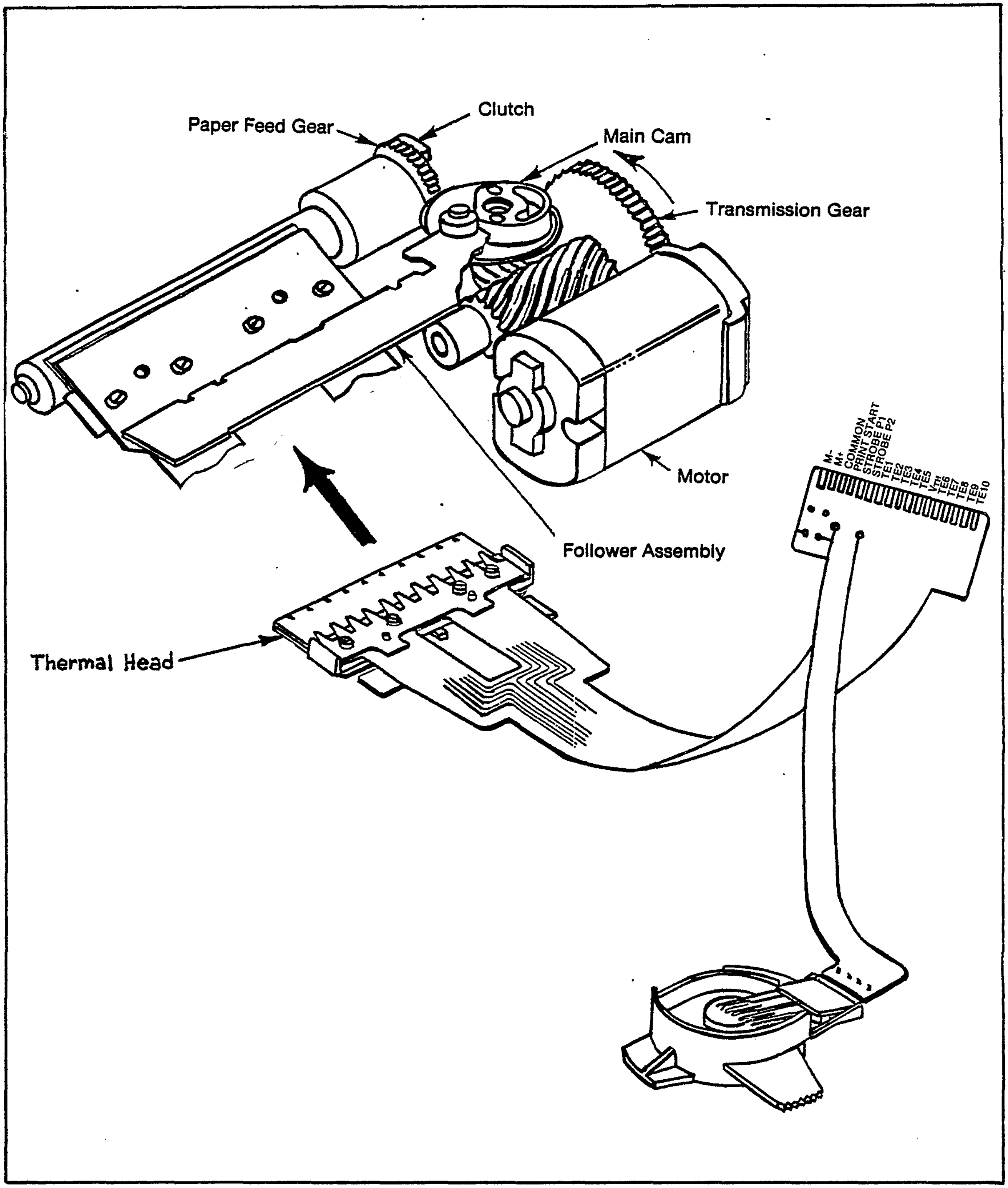


Figure 3-5. Printer Mechanism

The ten elements are discrete points on a single component, which assures uniform horizontal spacing. During a print cycle, the thermal head moves horizontally. Simultaneously, the platen advances the paper vertically by one dot increments. The individual thermal elements heat the sensitized paper as directed by the control logic to form the desired characters.

3-17 Printer Controller PWB

The printer controller PWB, mounted below the printer, consists of both VLSI controller IC, discrete components, and current drivers. In normal operation, the Computer PWB will send, via P2, a stream of character codes to the printer controller PWB corresponding to the 96 ASCII characters. These codes are sent as seven-bit, parallel data with an accompanying DATA-STROBE signal. Upon receipt of a line feed code, the controller initiates a print sequence for one line. If no characters have been sent prior to a line feed or carriage return, a blank line is printed. Because the printer uses a small direct current motor for paper and print head motion, sufficient time must be allowed by the controller for the mechanism to accelerate and decelerate during the transitions. Due to buffer size limitations of the controller and the intensive real-time demands of the printer mechanism, only a single line of 20 characters can be buffered, thus data cannot be received while a previously transmitted line is being printed.

The printer controller PWB provides a BUSY signal to inform the Computer PWB of the status of the controller. The BUSY line is active HIGH while transmitted characters are being inserted into the buffer, and while the printer is being operated by the controller. When BUSY line is low, data is sent to the printer.

The controller can function in three modes of operation: Parallel, Serial (not used), and Test mode. The modes are selected by adjusting the DIP switches in socket S1 provided on the board.

When PAPER ADV is pressed, the signal is driven low, providing paper feed.

The printer repeatedly and automatically cycles through the entire alphanumeric character set in SELF TEST mode, and is activated by turning switch 5 on (with switch 4 already on) in socket S1. Switch 5 should only be changed when there is no power applied.

3-18 DC POWER DISTRIBUTION

The dc power system is composed of the Power Supply assembly and the cabling necessary to connect the dc users. The Power Supply assembly consists of transformer, T1; rectifiers, CR1 and CR2; capacitors, C1 and C2; and the Power Supply PWB.

On the first secondary (S1) of the transformer the input power is stepped down to either 14.5 Vac or 9 Vac. After full-wave rectification at CR1 and CR2, respectively, the dc output voltages are filtered by C1 or C2 before application to the power supply PWB.

The second secondary (S2) of the transformer directly applies the 32 Vac, 19 Vac, And 100 Vac outputs to the power supply PWB.

3-19 Power Supply PWB
(Figures 5-18 and 5-19)

The power supply PWB, located within the power supply assembly, supplies regulated dc power to the instrument's card cage and beyond to the solenoid valves, optical detector assemblies, and optionally to the HGB cell and printer assemblies.

The + 14.5 Vdc input is regulated via R11, Q1, and 13 Vdc zener diode, CR9, and is fed to P5 as + 12 Vdc to power the valves and solenoid.

The + 9 Vdc input is regulated by U3 and fed to P5 as +5 Vdc for powering the card cage and the on-board HGB LAMP supply (below).

The 32 Vac input is rectified by U1, filtered by capacitors C1 and C2, and regulated by U4 and U5, and is fed to P5 as $\pm$ 15 Vdc for the analog circuitry located in the card cage.

The 19 Vac input is rectified by U2, filtered by C3, and regulated by U6, and is fed to P5 as + 18 Vdc for use by the optional printer.

The 100 Vac input is rectified by CR1-CR4, filtered by C4, and regulated by R9 and 62V zener diodes, CR7 and CR8, and is fed to P5 as + 100 Vdc (nominal) to power the cell current circuitry on the Analog PWB.

Another + 5 Vdc output is regulated by U8 and fed to P5 as "HGB LAMP" to power the hemoglobin cell lamp. The voltage can range from 1.25-2.38 Vdc and can be adjusted by R13.

Timer U7, and associated circuitry, is used to supply the "MEMORY PROTECT" signal, which is used by the Computer PWB to save RAM-based data.

When system power is applied, MEMORY PROTECT goes high (approximately 15-17 Vdc), reaching this state after +5 Vdc logic power is fully applied, via charging of a Computer PWB load capacitor by CR5, CR6, and R15. At this time Q2 is kept in the on state by pulses supplied by CR5 and CR6, preventing C5 from charging. Timer U7 is powered from the P5 + 12V output via CR10 and C6. When system power is removed, the Computer PWB load capacitor temporarily holds "MEMORY PROTECT" high. At this time Q2 turns off and C5 begins charging via R6 and the 3.15V reference voltage supplied by U7.

After approximately 1 ms (R6 x C5) U7-pin 3 reaches its triggering threshold of 2V and the U7 output transistor (collector at U7-pin 6) clamps the MEMORY PROTECT line to ground before the +5V logic power can drop significantly. Capacitor C6 keeps U7 powered until the process is completed and CR10 prevents C6 voltage from discharging through the + 12V line (+ 12V load) when system power is removed.

Separate ground connections are made to P5 DIGITAL GROUND, ANALOG GROUND, and VALVE GROUND.

Connector P5 feeds the motherboard, which distributes the proper power supply outputs to the Computer, I/O, and ANALOG PWBs for use by their control circuitry. In turn all dc voltages required by other system components (ie, valves, HGB cell lamp and photodetectors, printer) are distributed by cables from the appropriate PWB.

3-20 AC POWER DISTRIBUTION

Prime power is applied to the instrument through the line cord to the Corcom filter. The fused power passes through the EMI filter built into the Corcom filter before routing to the POWER switch on the front panel. The double-throw switch provides AC HIGH and AC LOW to the voltage selection circuitry back in the Corcom filter. The voltage selection circuitry allows prime power of 100 Vac, 120 Vac, 220 Vac, or 240 Vac, all single phase.

The outputs of the line filter are either 100 Vac or 120 Vac. The outputs are applied to the lamp in the POWER switch; the pump under the control of the Relay PWB; and to the primary of the transformer T1 on the Power Supply assembly. Further discussion of the Relay PWB and transformer T1 may be found in preceeding paragraphs in Section 3.

4. MAINTENANCE

4-1 INTRODUCTION

This section provides information necessary to perform preventative and corrective maintenance of the 100 Series Cell Counters. Preventative maintenance includes periodic visual inspection and cleaning, and testing to determine any deterioration in system performance. Corrective maintenance includes the following:

- System Troubleshooting
- Subsystem Troubleshooting
- Removal and Installation
- Adjustments/Corrective Actions

4-2 TOOLS AND TEST EQUIPMENT REQUIRED

- Calculator, statistics capability
- Leak detector (Snoop™ or equiv.)
- Multimeter, digital: Fluke™ 8020A P/N 14-800-146, or equiv. Microchip leads and probe sets recommended
- Pressure gauge -10 to 0 PSI
- Phillips-head screw driver, #3
- Potentiometer tweeker
- Flat-head screw driver, #3
- Nut driver 5/16"
- Needle-nose pliers
- Razor blade
- Allen wrench 0.050" P/N 11-202-304-000
- Allen wrench 0.035" P/N 11-202-308-000
- Dummy Load; precision 18kΩ resistor

4-3 PREVENTATIVE MAINTENANCE

4-4 Parts Replacement Intervals:

6 Months

- Barb fittings 1/8" I.D., waste GND assembly
- Pressure filter (muffler)

12 Months

- Barb fittings 1/8" I.D., waste GND assembly
- Pressure out filter (muffler)
- All internal tubing (reference latest fluid schematic)
- Waste detector assembly tubing (reference latest fluid schematic)

4-5 Visual Inspection and Cleaning

1. Inspect all fluid/air pathways, tubing, junctions, and barb fitting.
2. Inspect valve internal paths (free from contamination).
3. Remove PWBs and inspect and clean all contacts.
4. Inspect all electrical connectors.
5. Inspect all hardware.
6. Clean all surfaces of dust and residue with non-abrasive cleaner.

4-6 Power Supply Subsystem Checks

Check the power supply and threshold voltages as shown in Table 4-1 - Reference Voltages; reference the measurement to chassis GND.

Table 4-1. Reference Voltages

Nominal Voltage	Range	Location
+5 Vdc	± 0.3	Power Supply PWB - Point A
+12 Vdc	10.8 - 12	Power Supply PWB - Point F
+15 Vdc	± 0.8	Power Supply PWB - Point C
-15 Vdc	± 0.8	Power Supply PWB - Point E
+18 Vdc	± 0.9	Power Supply PWB - Point I
+ 0.65 Vdc	± 0.01	Analog PWB TP7 (scan RBC thresholds)
+ 0.90 Vdc	± 0.01	Analog PWB TP7 (scan WBC thresholds)

4-7 Pressure Checks

1. Raw pump pressure should be a minimum of -6 PSI.
2. Regulated vacuum should be -2.4 ± 0.1 PSI before and after the waste bottle; there should be no pressure drop between the two points.

4-8 Keyboard and Printer Check

1. Enter date.
2. Enter I.D. 0 through 9.
3. Press PRINT; verify date, I.D. and print quality.
4. Exercise all other keyboard entries; verify operation through system response.

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Fluke™ is a trademark of the John Fluke Manufacturing Company, Seattle, Washington.

4-9 Check Prime Volume

Verify prime volume between 3.0 -4.5mL as follows:

1. Prepare a sample using the system dilutor to dispense 10 mL in a beaker.
2. Press the STANDBY/FLUSH key. A minimum of two and a maximum of three flush cycles verifies an acceptable prime volume.

4-10 Check Photodetectors

1. With fluid present in volumetric tube, measure the photodetectors (ON state).
2. Air purge the system and check photodetectors (OFF state).

Photodetector	Location	ON	OFF
1	I/O PWB-R7	<0.9 Vdc	>2.8 Vdc
2	I/O PWB-R6	<0.9 Vdc	>2.8 Vdc

4-11 Check HGB Cell Voltage

1. Clean system; refer to paragraph 4-52.
2. Press the SCAN key until the non-flashing HGB enunciator is displayed.

HGB cell voltage = 4.65 ± 0.25 Vdc.
(<0.02V fluctuation)

4-12 Check Flow Times (during SELF TEST)

1. Mix 10mL of diluent plus three drops Haema-Lyse™ (SELF TEST solution).

NOTE

No substitutions for Haema-Lyse 100 should be made in this test, since results will be affected adversely by use of other products.

2. Run SELF TEST and use a stopwatch to measure the flow times (average of three runs).

   A. Dead time is defined as the time in-terval between the time when the vent solenoid closes for the third and final time until the three zeroes appear on the display.

   Dead time = 11.0 ± 2.4 seconds

   B. Count time is defined as the time in-terval between the time when the three zeroes appear on the display until the RBC sign, appears on the display.

   Count time = 8.5 ± 1.6 seconds

4-13 Check Cell Voltage

1. Attach the probe to C3 on the Analog PWB.
2. Mix the SELF TEST solution.
3. Run the SELF TEST, and observe the cell voltage during the count. Ignore the background count results.
   Cell Voltage = 11.3 ± 1.1 Vdc

4-14 Pump Shut Off

After a FLUSH or CLEAN cycle, which requires approximately 42 seconds, is completed, the pump shuts off once OP1 or OP2 is displayed.

4-15 Dilution Check

Using a Data Worksheet (a copy is provided at the end of Section 4), record the control assay values in step 1.

If necessary, refer to Operator's Manual, Section VII, for preparing dilutions.

1. Prepare three dilutions of normal control manually, adding 40 µL of normal control (from a 40 µL pipet) to 10 mL of diluent dispensed from the system dilutor. Run the test and average the results for each parameter (RBC, HCT, WBC, HGB). Record each result on the data sheet in step 2a under Manual in the Data Worksheet.
2. Prepare three dilutions of normal control using the system dilutor. Run the test and average each parameter (RBC, HCT, WBC, HGB); then, record

Haema-Lyse™ is a trademark of Baker Instruments Corporation, Allentown, Pa.

the results in step 2a of the Data Worksheet under Dilutor.

3. Calculate the change, in percent, between the manual and dilutor dilutions using the following formula:

$$\Delta\% = \frac{\text{manual-dilutor}}{\text{dilutor}} \times 100$$

4. If the change is greater than $\pm$ 3%, adjust the dilutor (refer to paragraph 4-63). After adjustment is made, repeat steps 2 and 3 and record the results in step 2b of the Data Worksheet.

4-16 Calibration and Precision Check
(attach all printer tapes)

1. Record control values assay in step 1, Data Worksheet. Refer to section 2, page 6 for the calibration procedure with controls. Record results of calibration check (before and after) and change, in percent, in step 3 of the Data Worksheet.

2. After calibration, run three normal and two abnormal control tests. Record results in step 3b of the Data Worksheet and verify that parameters are within assayed values.

3. Run one normal patient sample or a control 15 times and calculate a C.V. for each parameter and record the results in step 4 of the Data Worksheet. If more than two uncorrecting, or four correcting, flow messages (H10 or H11) are incurred out of ten samples, proceed to the appropriate troubleshooting chart. Once the problem is resolved, rerun the 15 sample C.V. Maximum C.V. for each parameter is: RBC=3.0%; HCT=3.0%; MCV=2.0%; WBC=3.0%; HGB=2.0%.

   Using a calculator with statistics capability,

$$CV\% = \frac{\sigma}{\overline{X}} \cdot (100)$$

   The standard deviation (σ) is divided by the mean ($\overline{X}$) and multiplied by 100 to get the CV in percent.

The coefficient of variation (CV), is expressed mathematically as:

$$1)\quad \%CV = \frac{\sqrt{\dfrac{\sum_{i=1}^{15}(\overline{X}-X_i)^2}{14}}}{\overline{X}} \quad (100)$$

$$2)\quad \overline{X} = \frac{\sum_{i=1}^{15} X_i}{15}$$

Determine the mean value ($\overline{X}$) by adding the 15 samples and dividing by 15. Subtract each sample (S_i) from the mean. Square this result $(\overline{X}-X_i)^2$ for each sample and sum the resultant values. Take the square root of this sum and divide by one less than the number of samples (14). Divide the expression under the square root sign by $\overline{X}$.

4-17 CORRECTIVE MAINTENANCE

Corrective maintenance begins with system troubleshooting, then progresses through various H (help) code and specific malfunction troubleshooting charts. The removal and installation procedures for major assemblies and subassemblies follow next. Finally, corrective action and adjustment procedures are presented.

4-18 System Troubleshooting

Figure 4-1 provides a system troubleshooting chart that refers to Figures 4-2 through 4-16, symptomatic troubleshooting charts, which isolate component malfunctions.

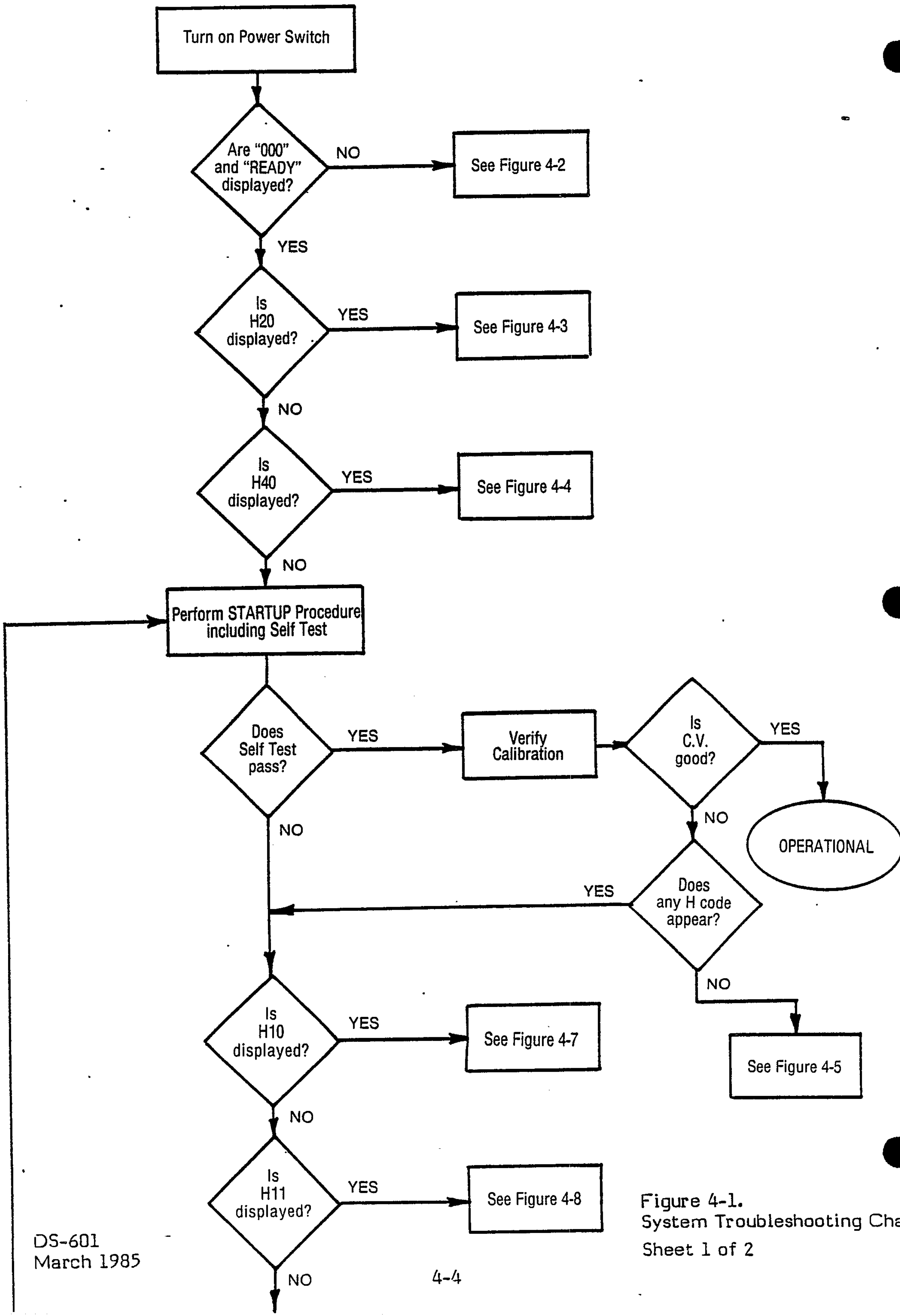

Figure 4-1.
System Troubleshooting Chart
Sheet 1 of 2

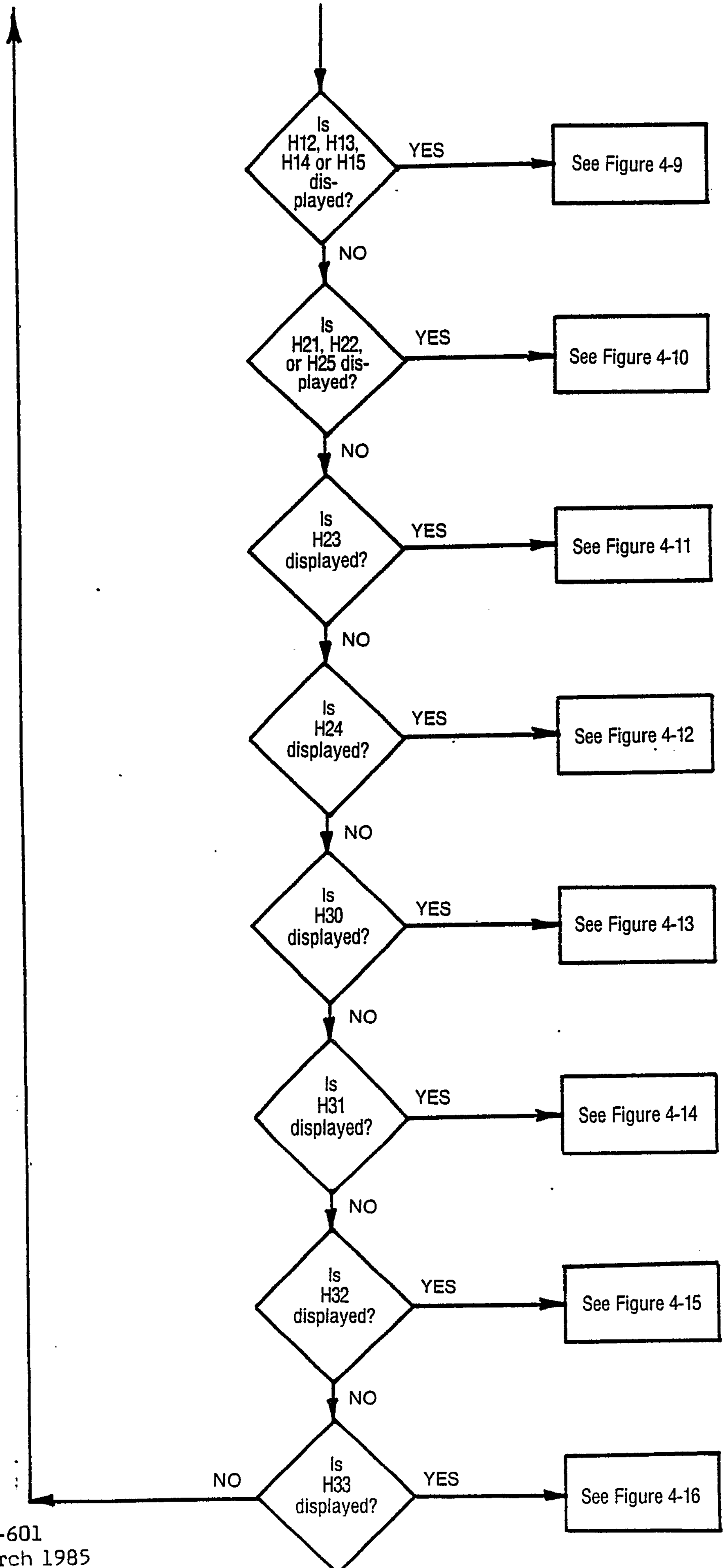

Figure 4-1.
System Troubleshooting Chart
Sheet 2 of 2

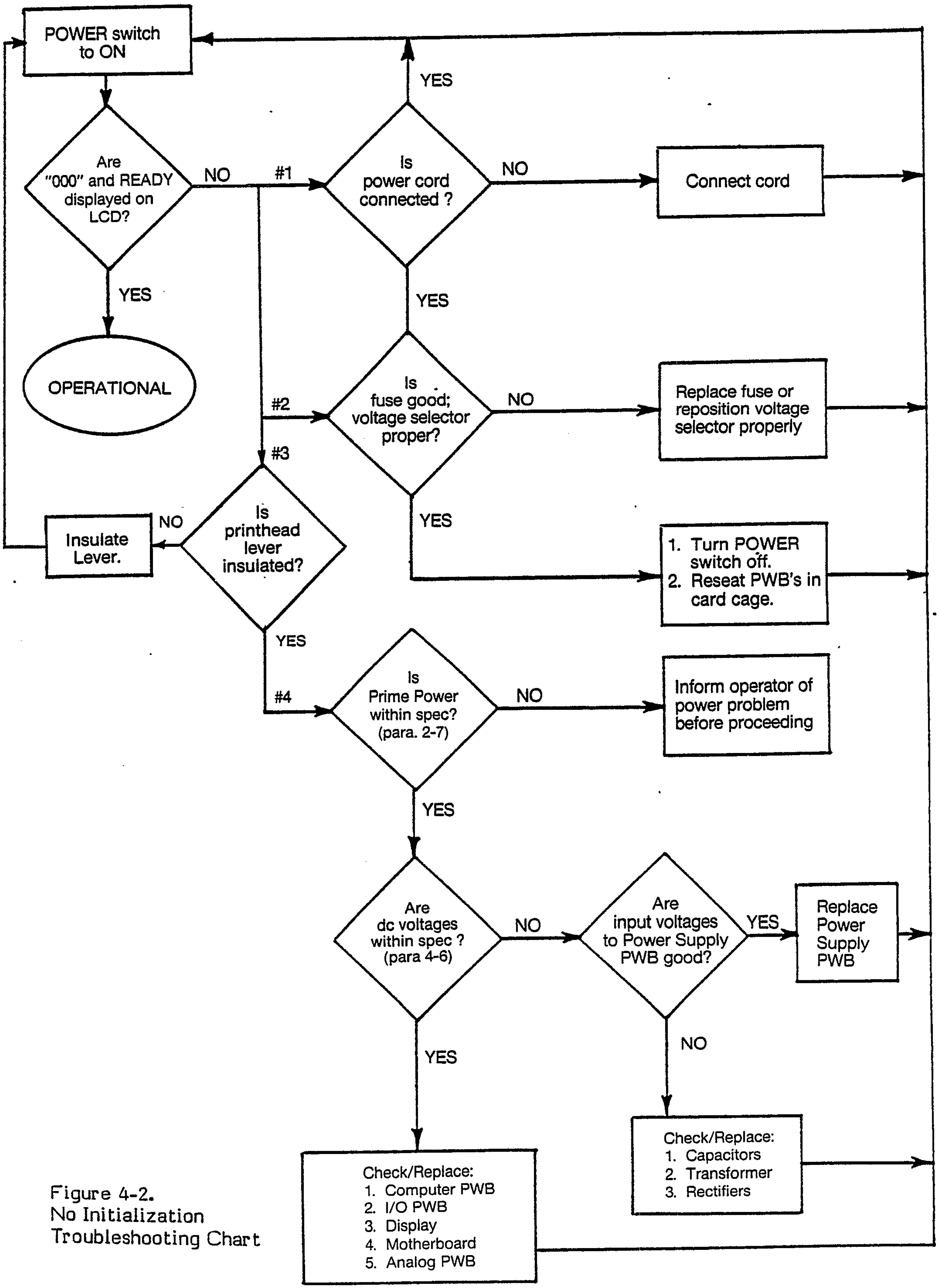

Figure 4-2.
No Initialization
Troubleshooting Chart

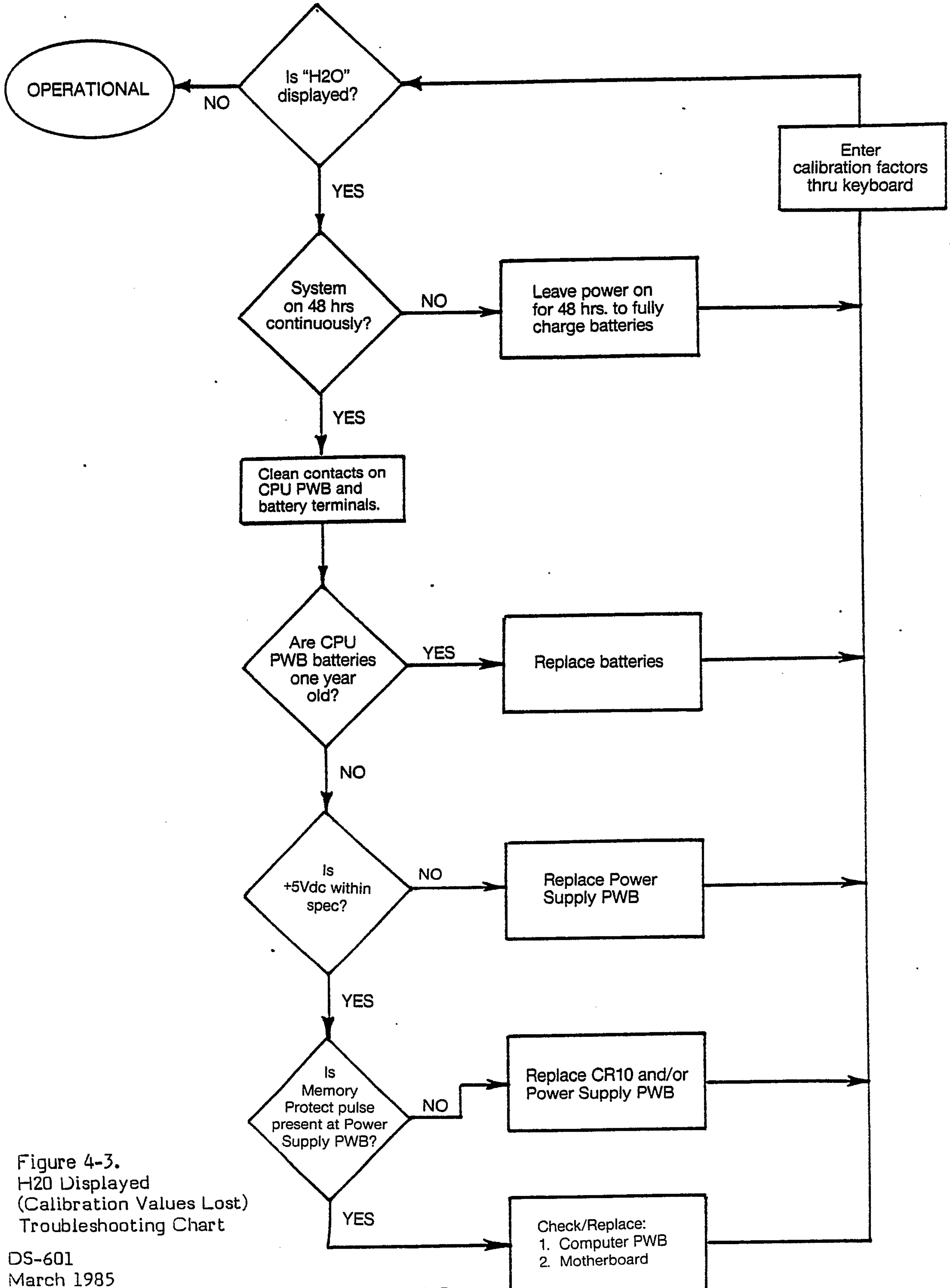

Figure 4-3.
H20 Displayed
(Calibration Values Lost)
Troubleshooting Chart

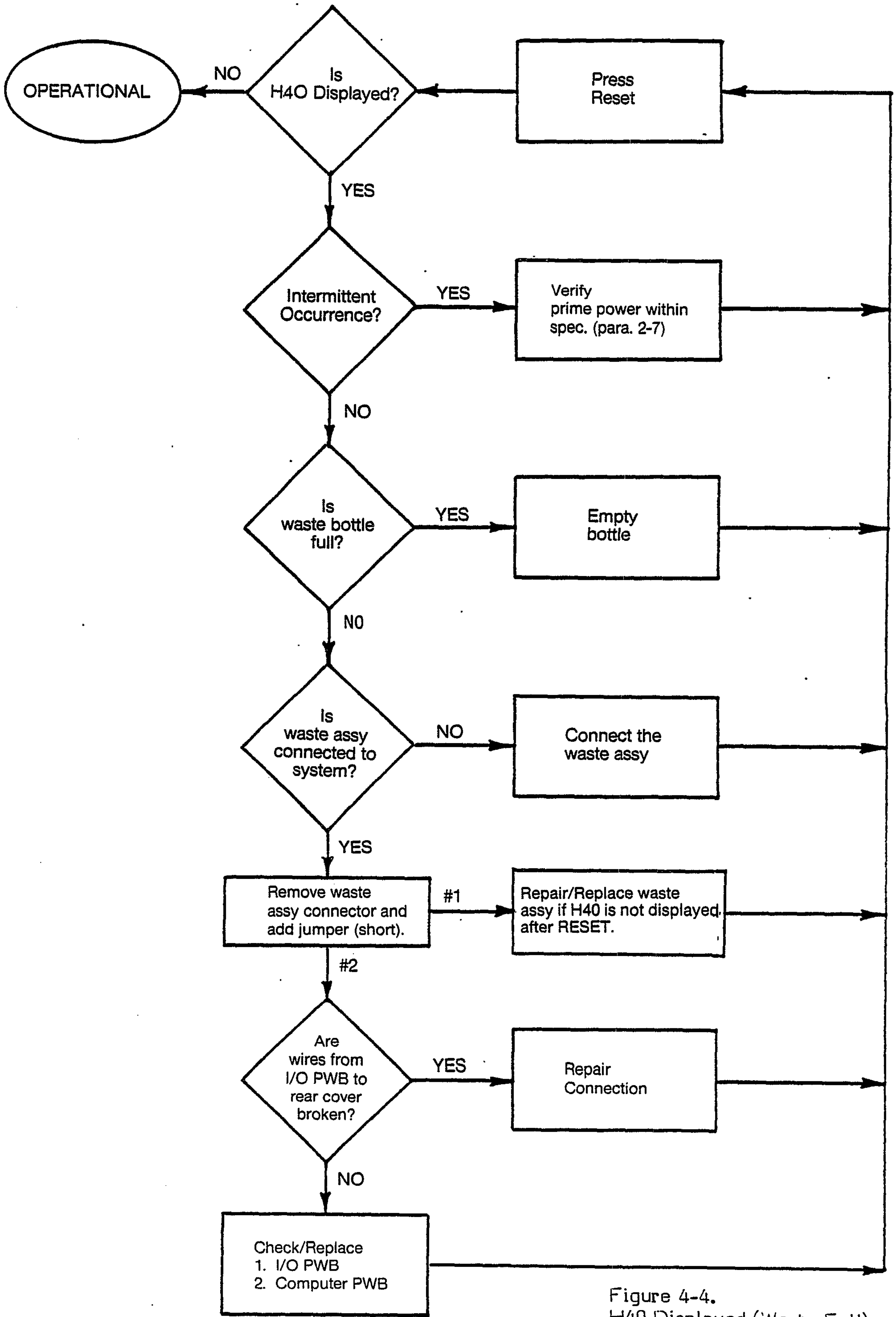

Figure 4-4.
H40 Displayed (Waste Full)
Troubleshooting Chart

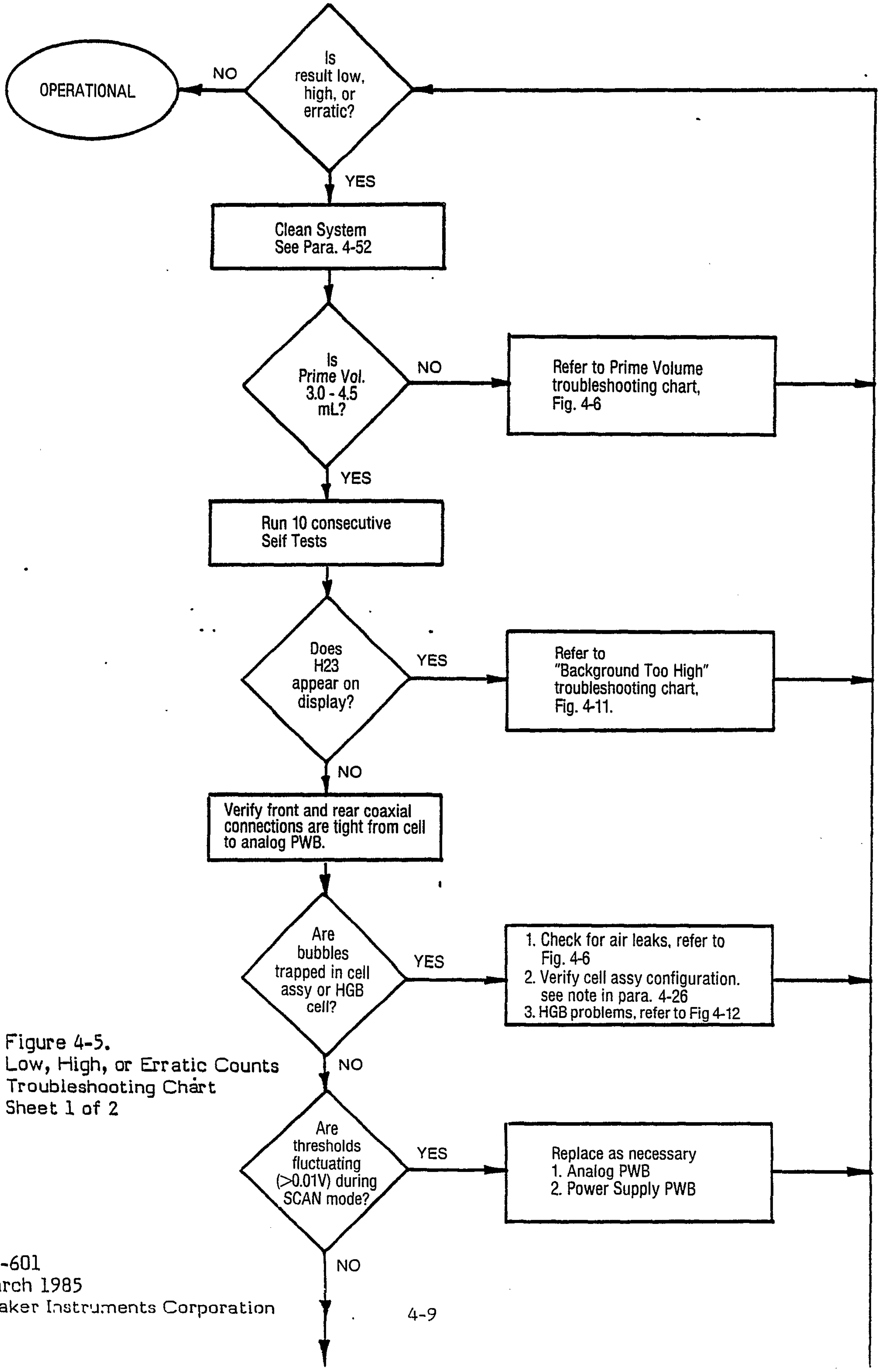

Figure 4-5.
Low, High, or Erratic Counts
Troubleshooting Chart
Sheet 1 of 2

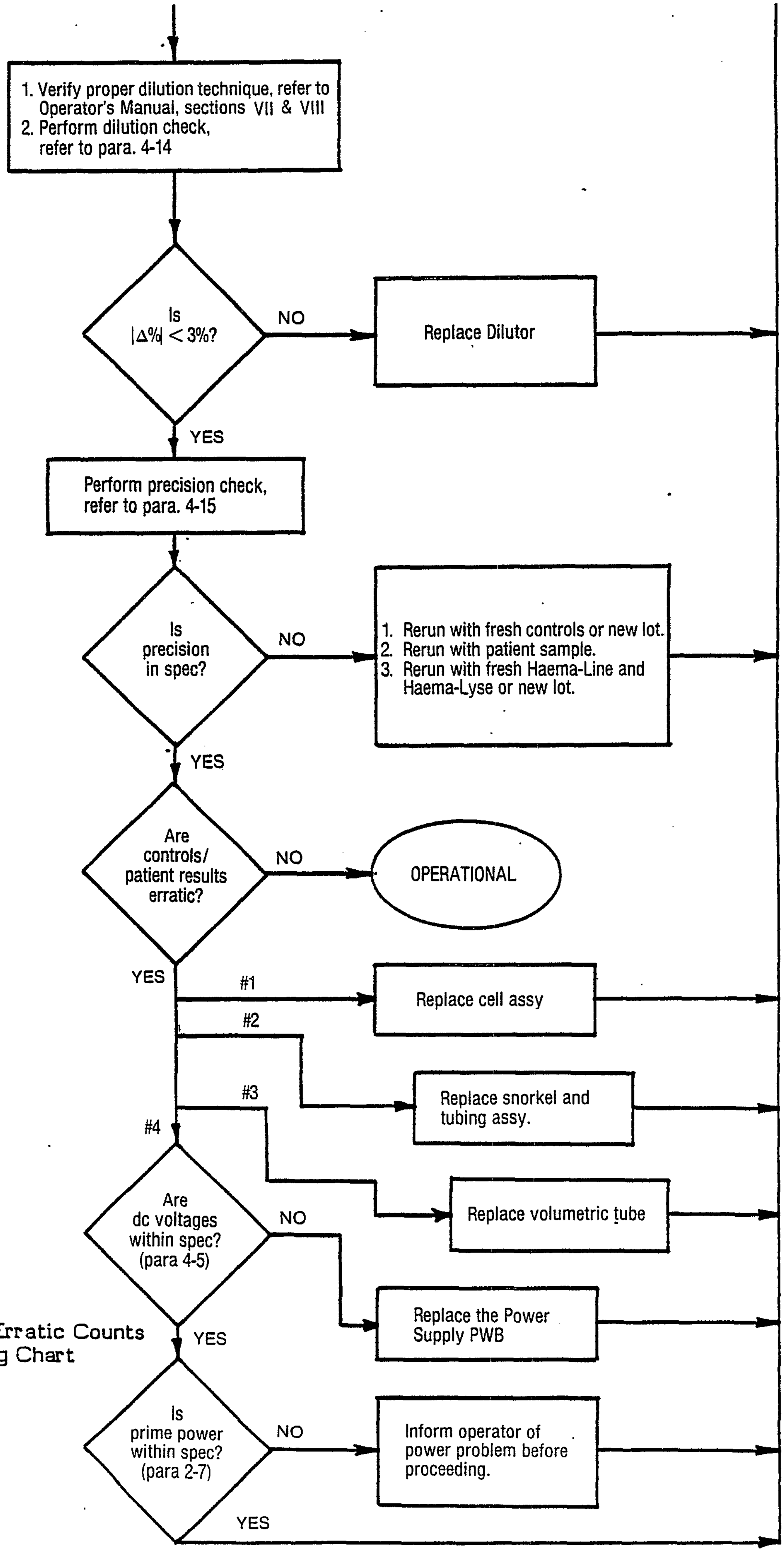

Figure 4-5.
Low, High, or Erratic Counts
Troubleshooting Chart
Sheet 2 of 2

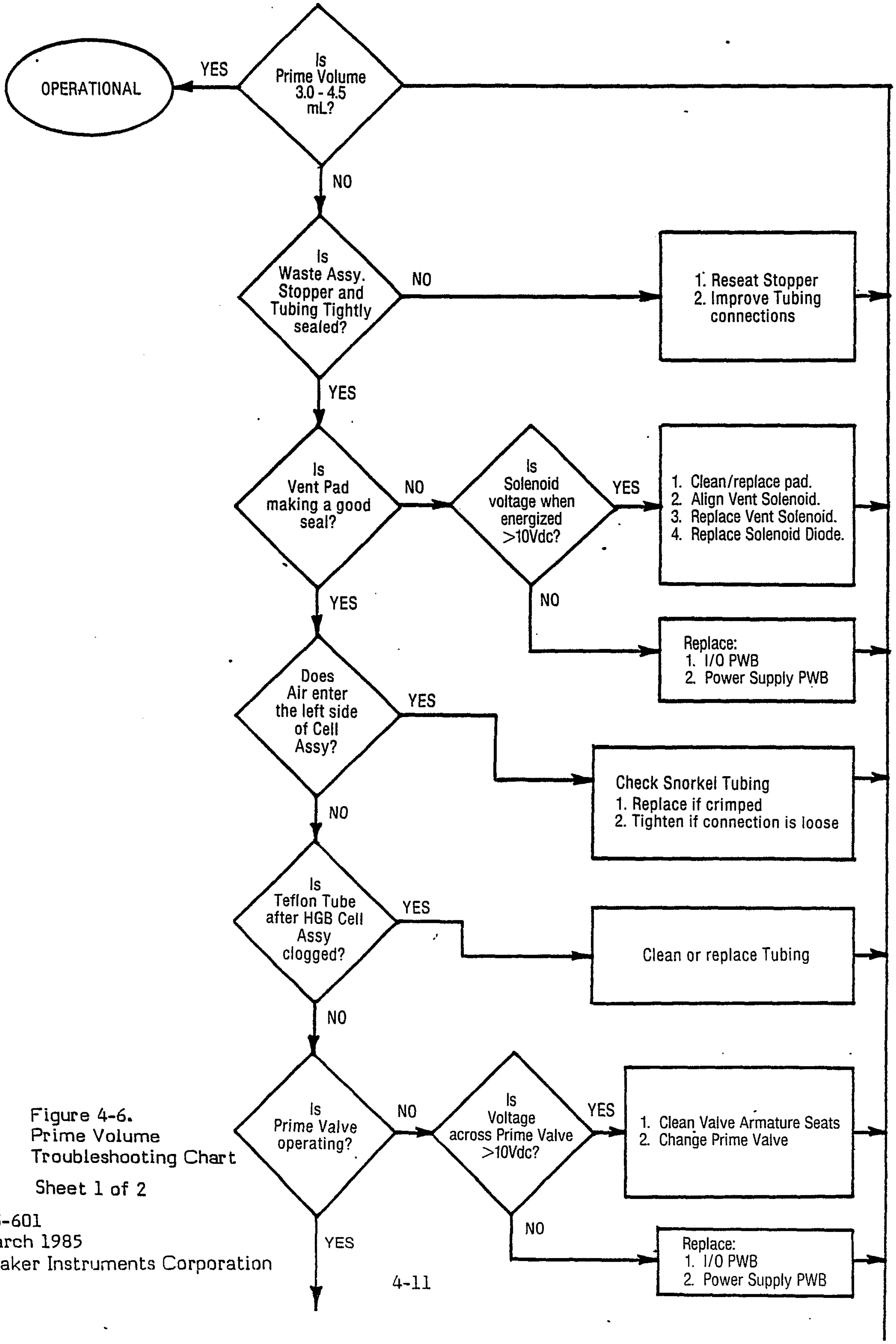

Figure 4-6.
Prime Volume
Troubleshooting Chart

Sheet 1 of 2

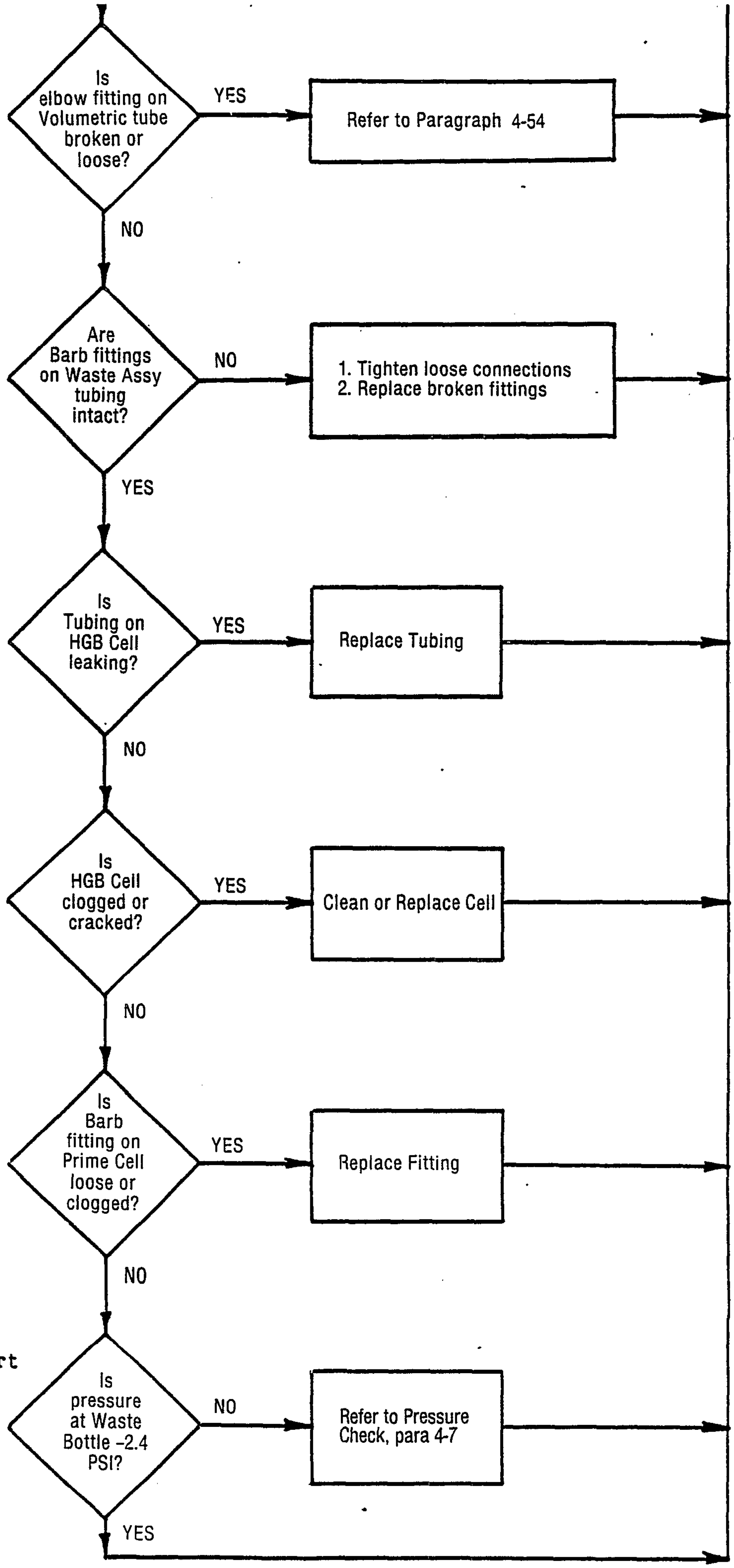

Figure 4-6.
Prime Volume
Troubleshooting Chart
Sheet 2 of 2

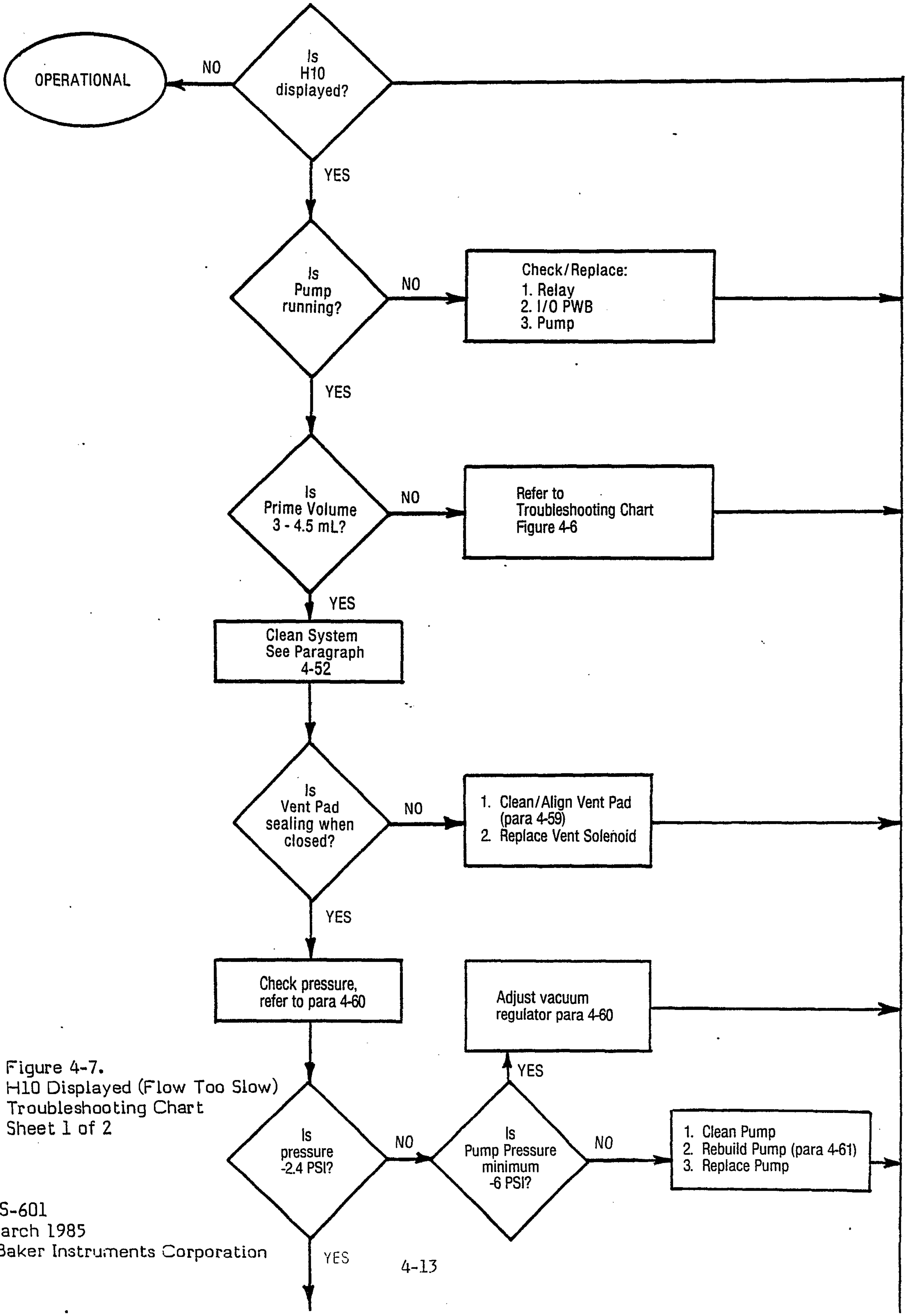

Figure 4-7.
H10 Displayed (Flow Too Slow)
Troubleshooting Chart
Sheet 1 of 2

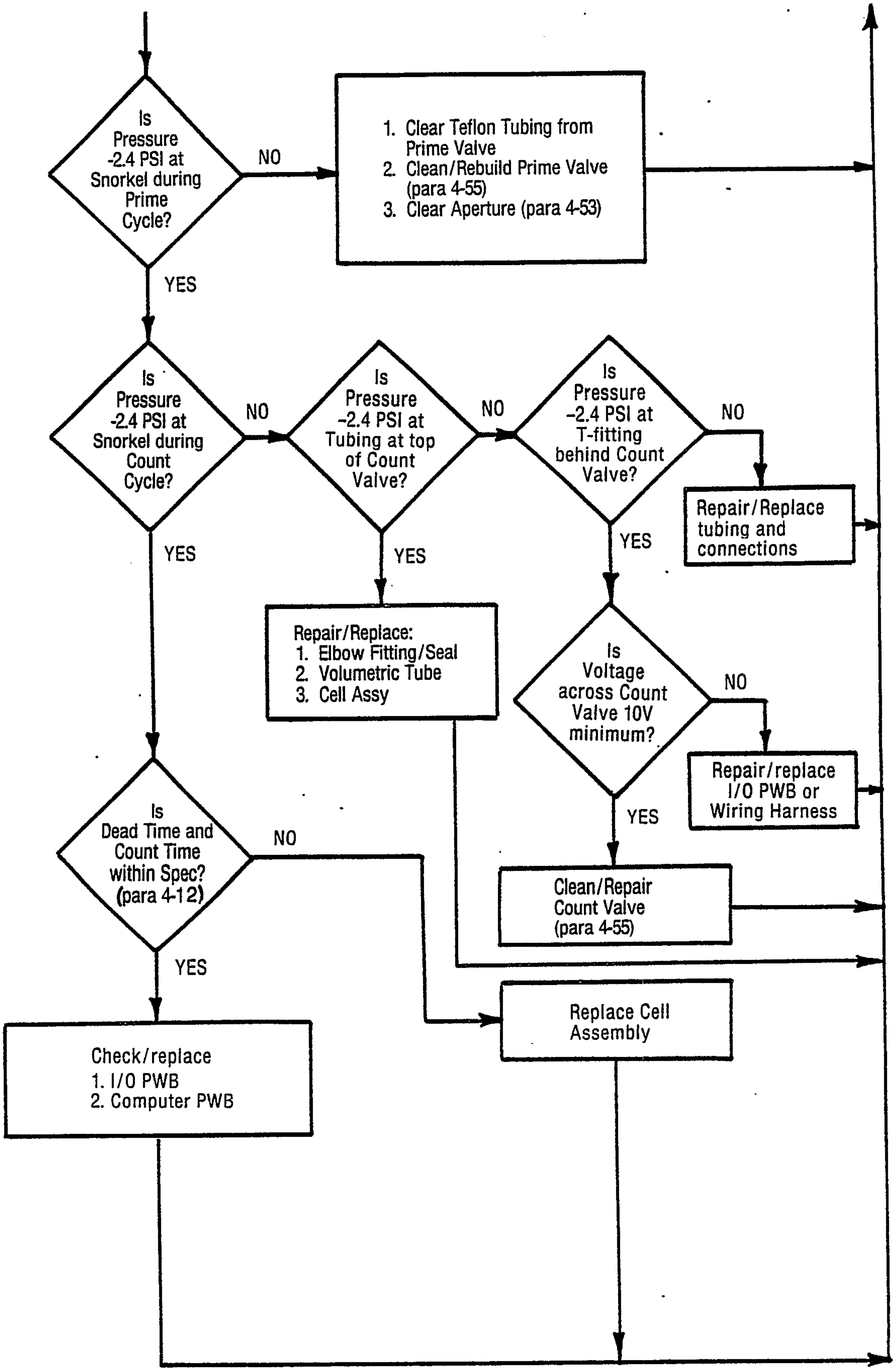

Figure 4-7.
H10 Displayed (Flow Too Slow) Troubleshooting Chart
Sheet 2 of 2

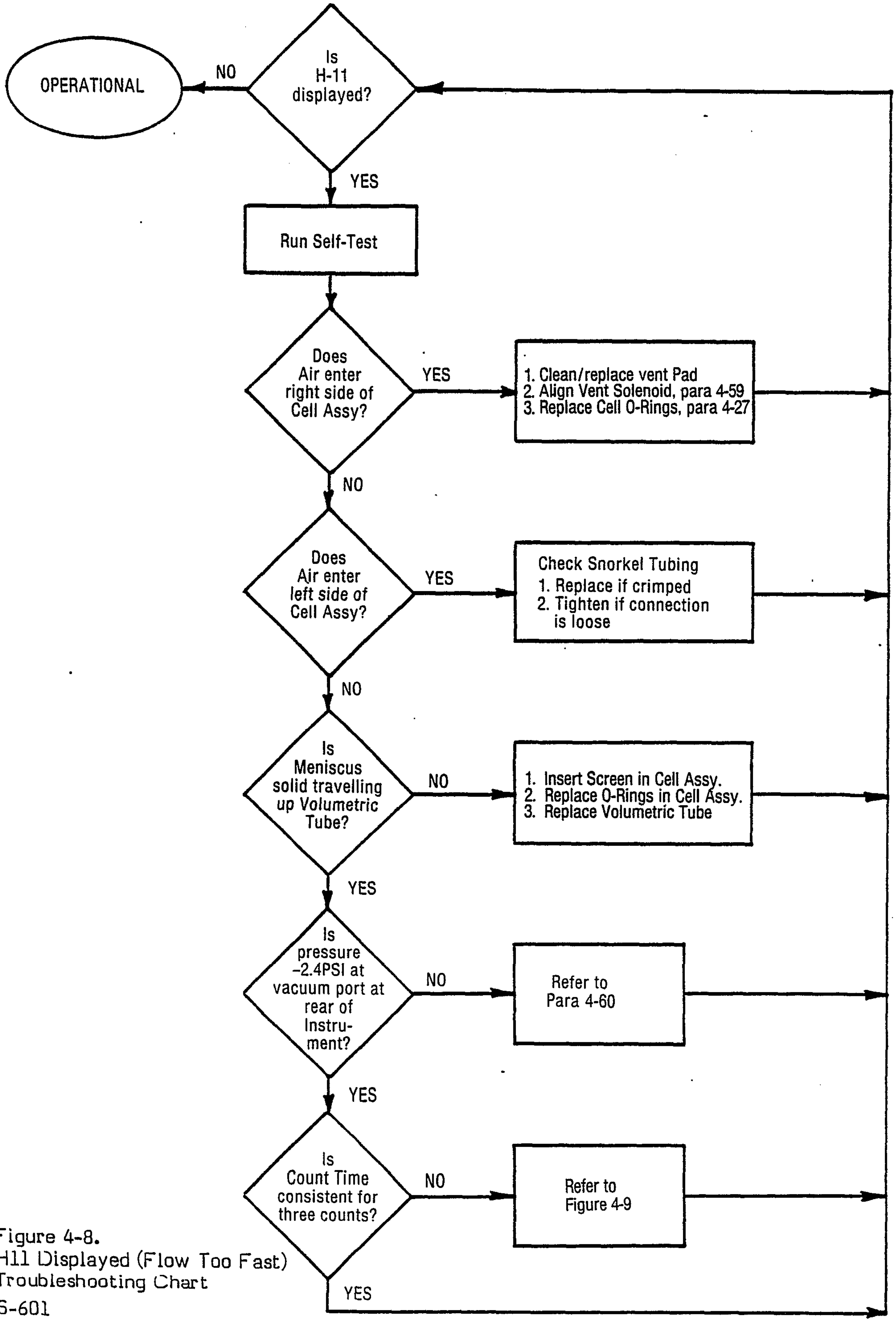

Figure 4-8.
H11 Displayed (Flow Too Fast)
Troubleshooting Chart

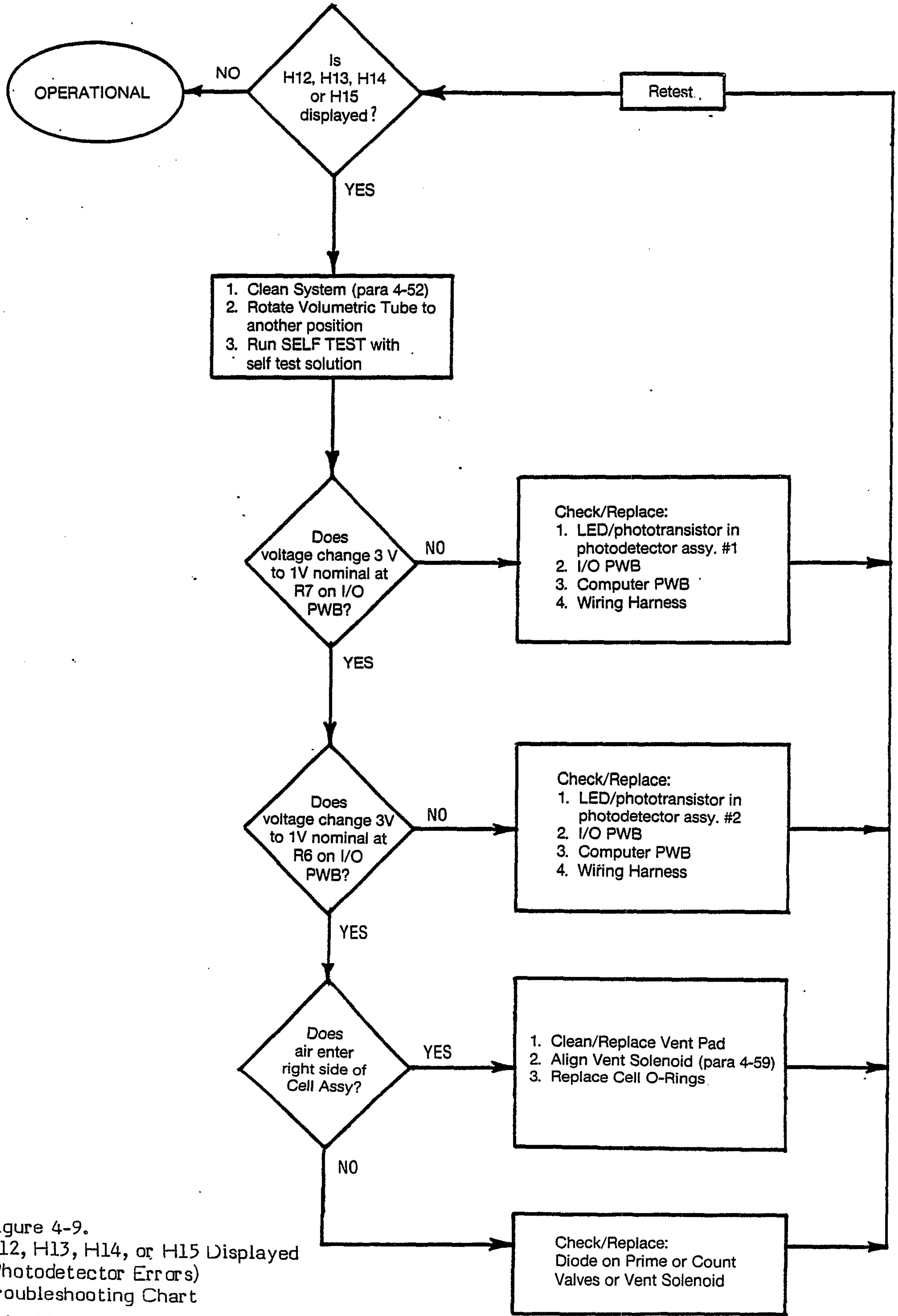

Figure 4-9.
H12, H13, H14, or H15 Displayed
(Photodetector Errors)
Troubleshooting Chart

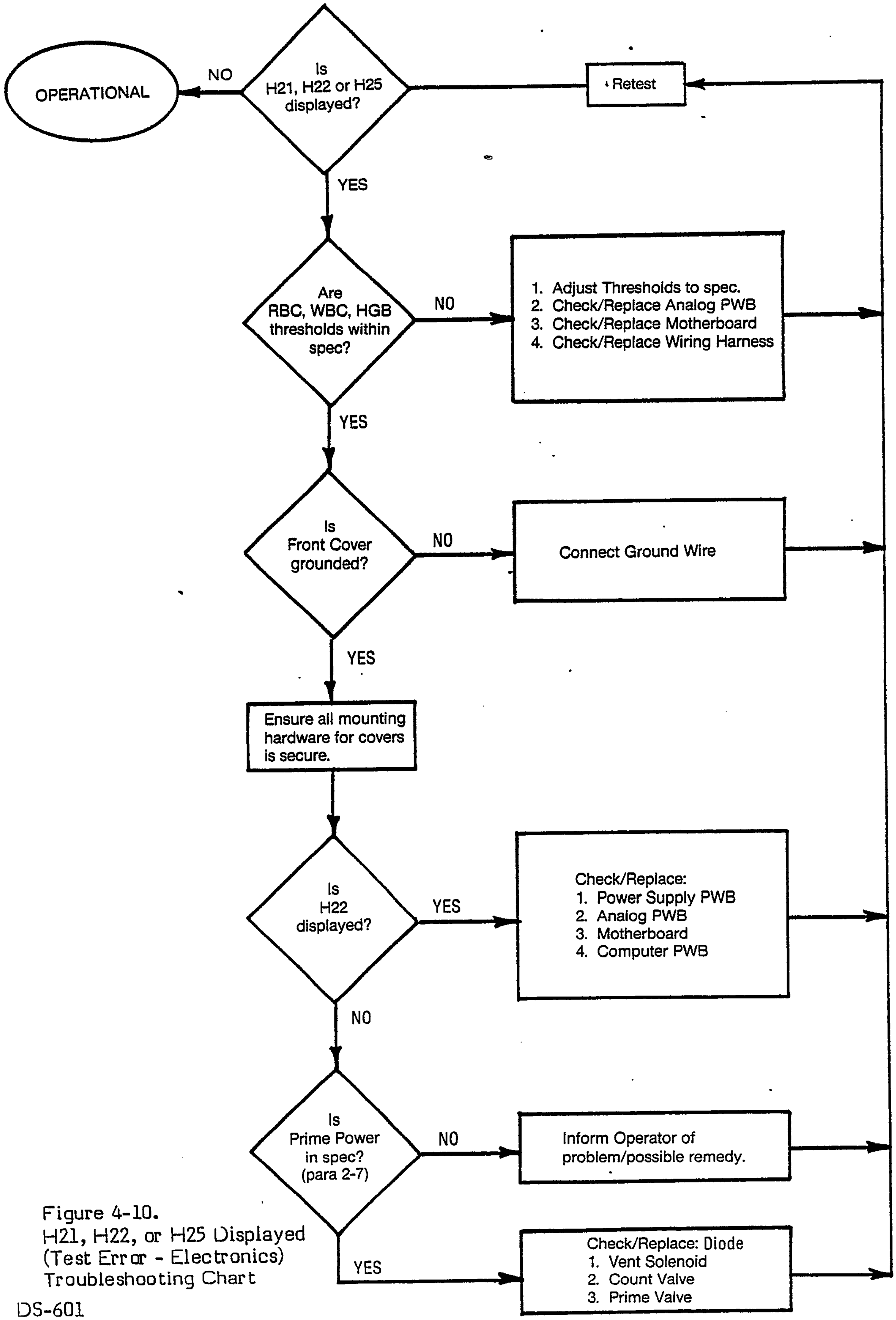

Figure 4-10.
H21, H22, or H25 Displayed
(Test Error - Electronics)
Troubleshooting Chart

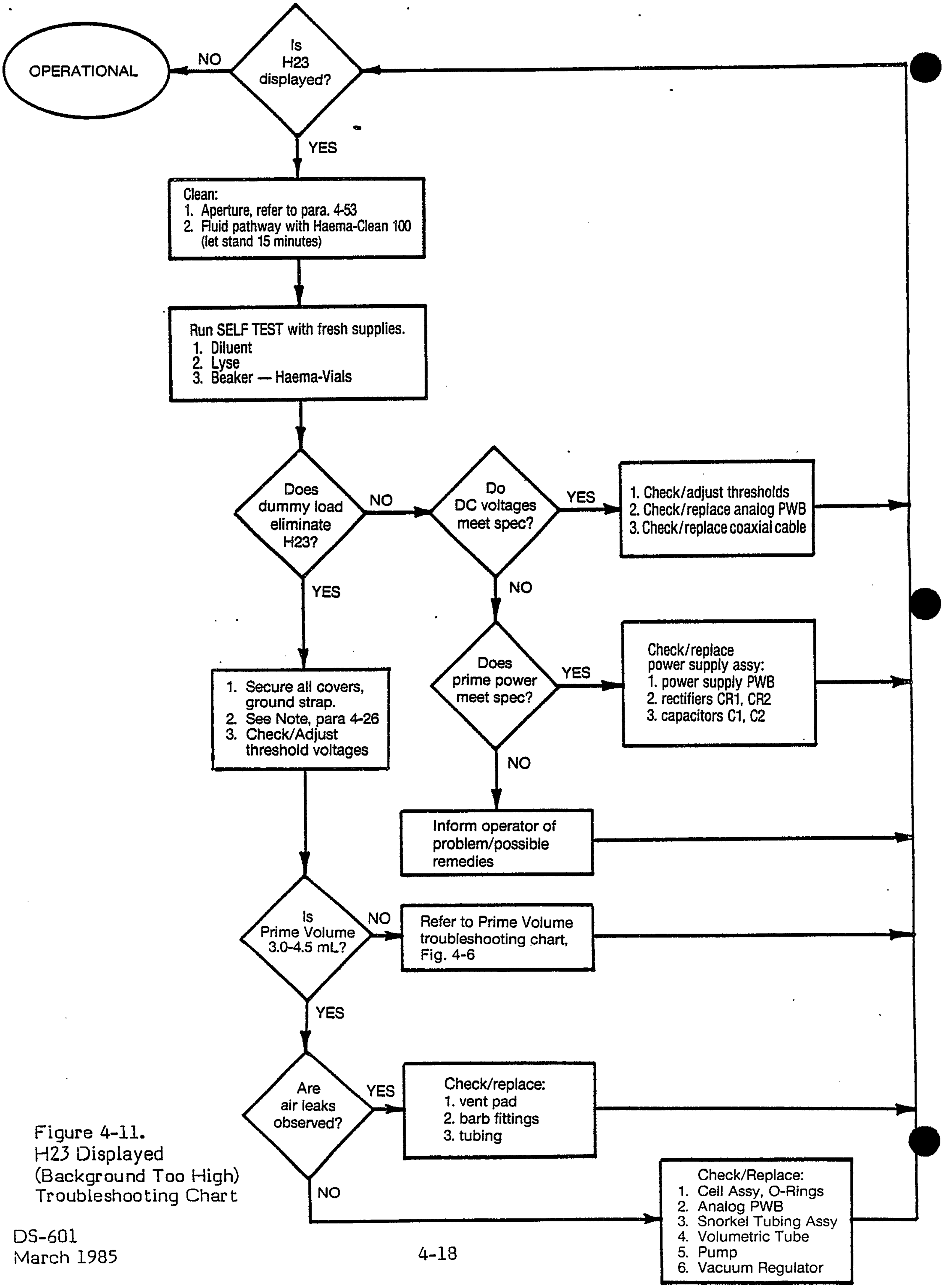

Figure 4-11.
H23 Displayed
(Background Too High)
Troubleshooting Chart

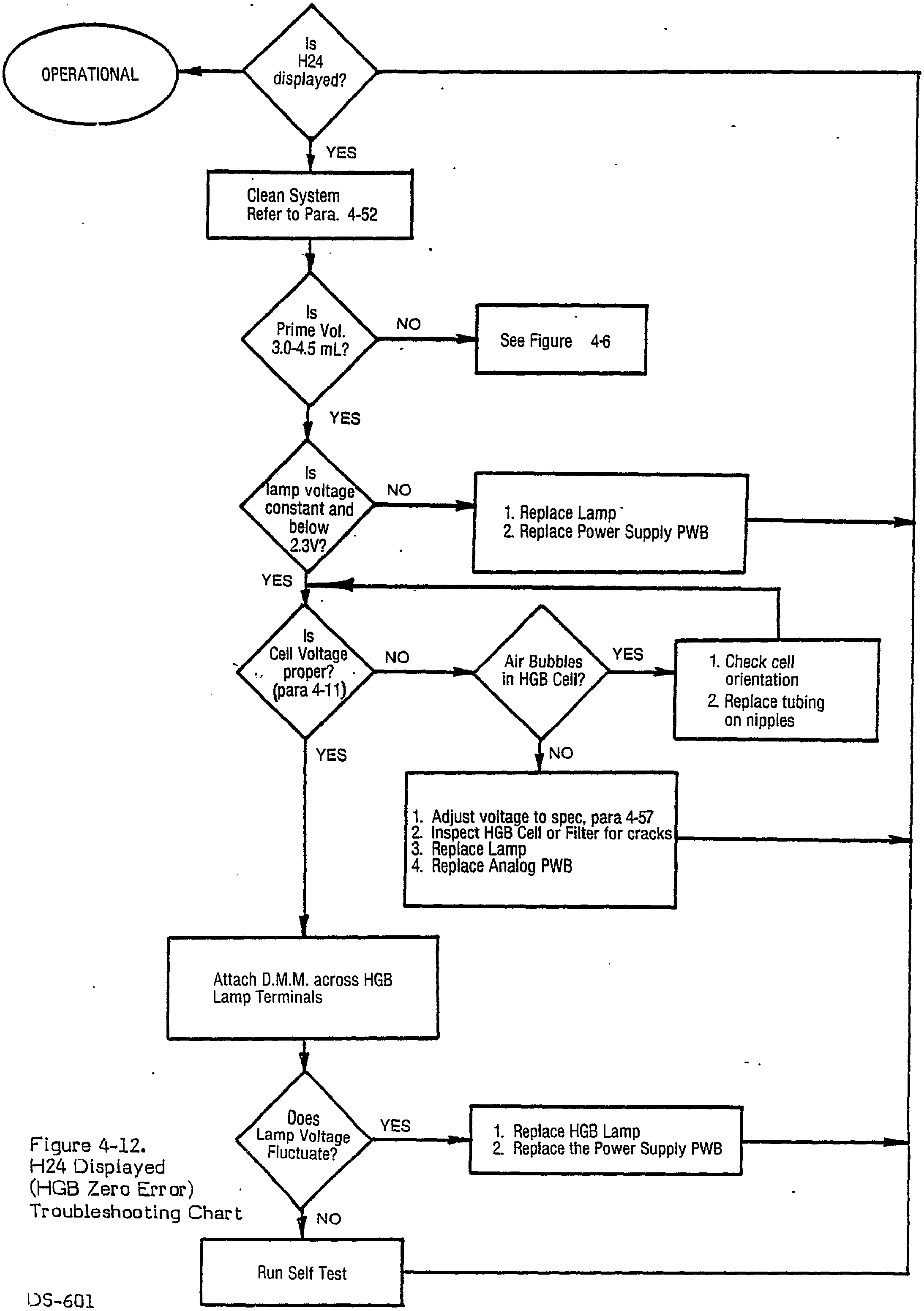

Figure 4-12.
H24 Displayed
(HGB Zero Error)
Troubleshooting Chart

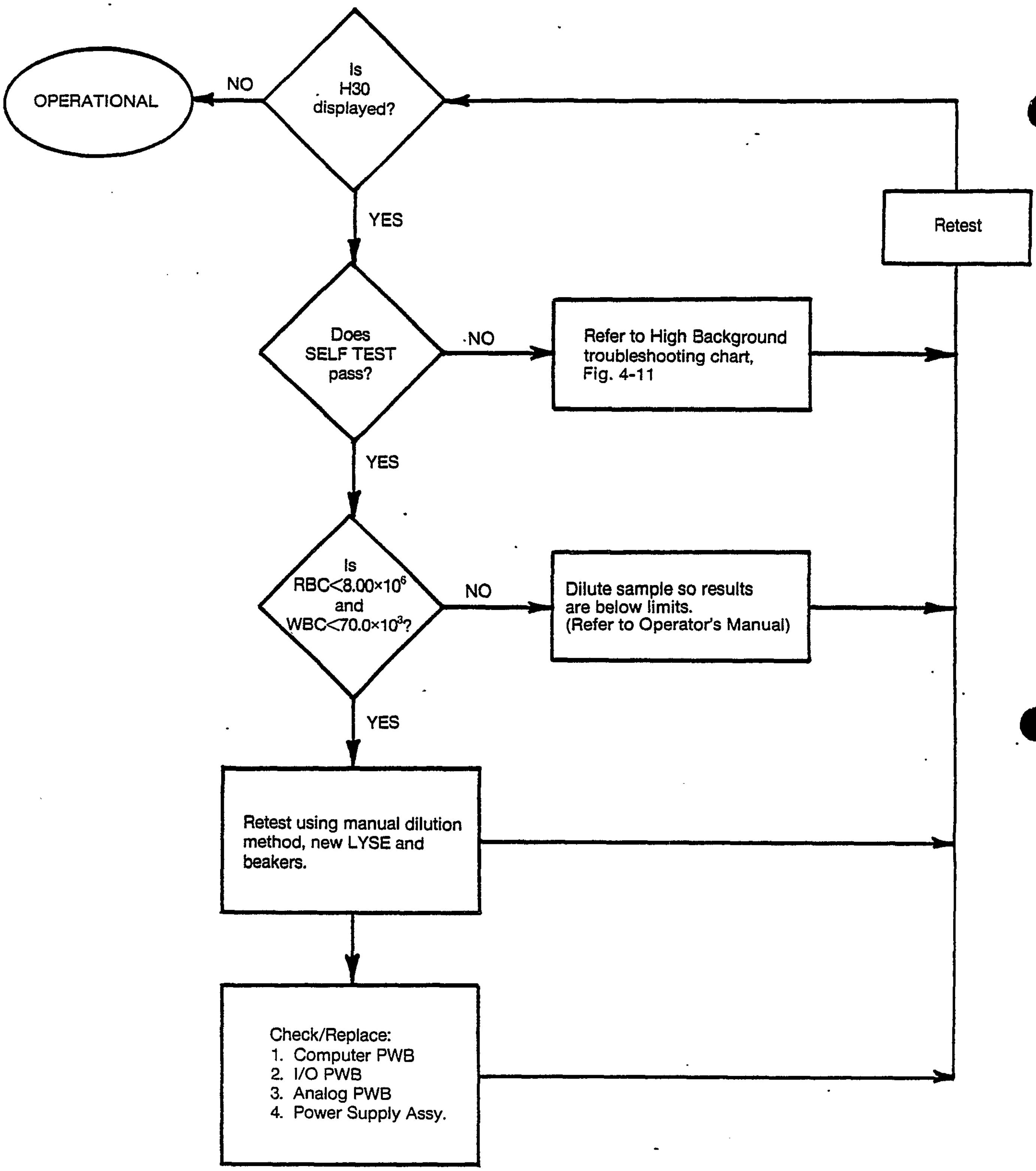

Figure 4-13.
H30 Displayed (Count Overflow)
Troubleshooting Chart

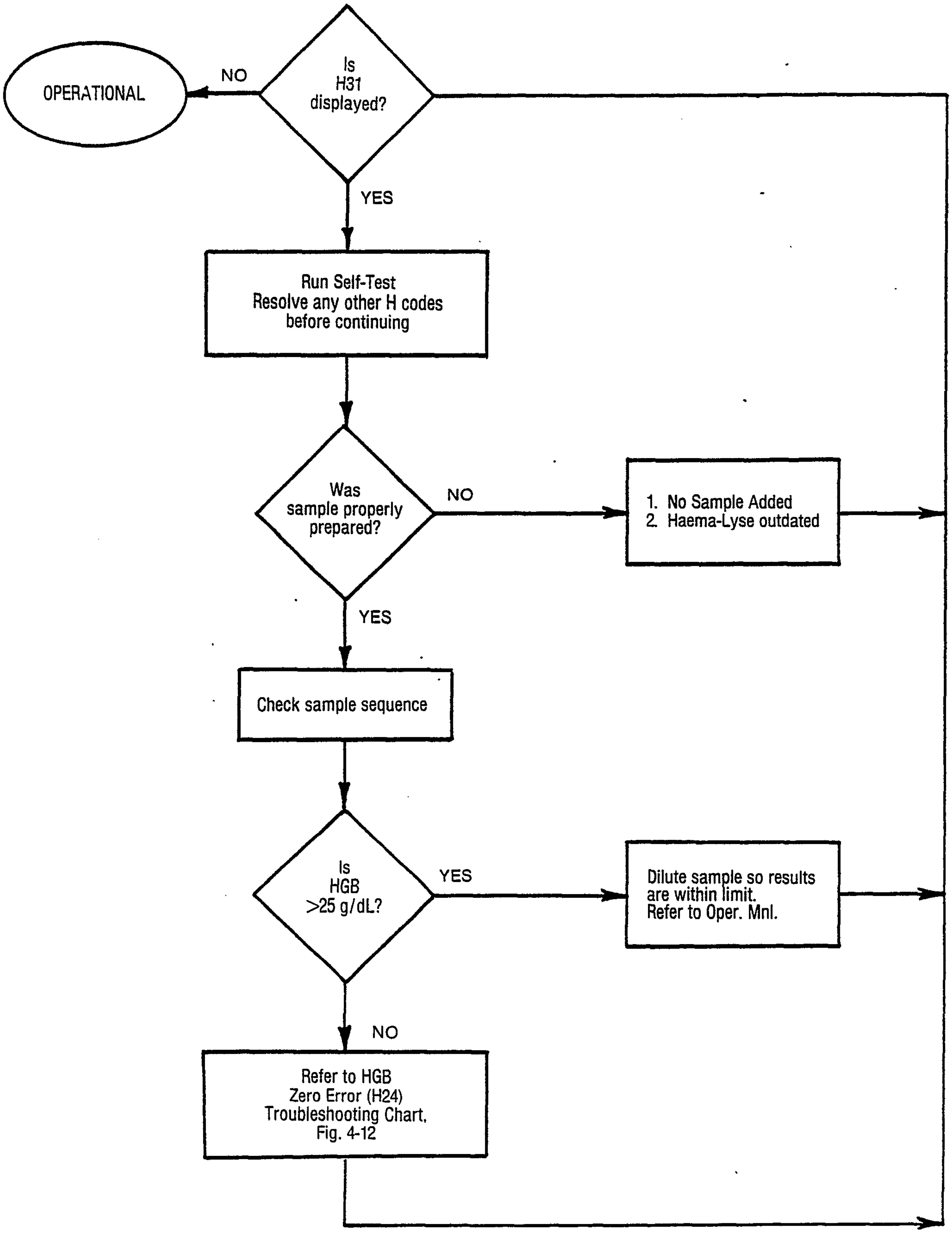

Figure 4-14.
H31 Displayed (HGB Overflow)
Troubleshooting Chart

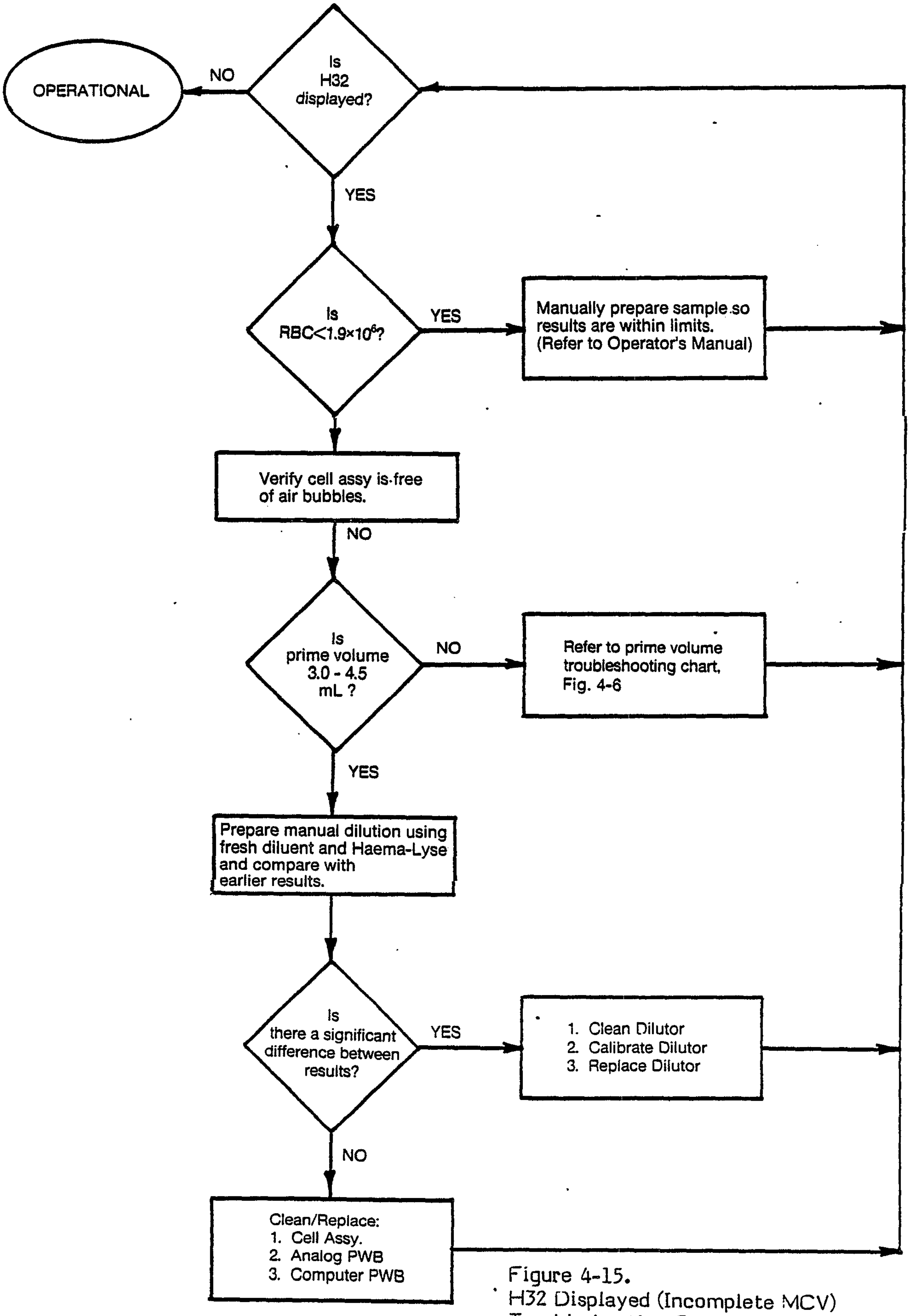

Figure 4-15.
H32 Displayed (Incomplete MCV)
Troubleshooting Chart

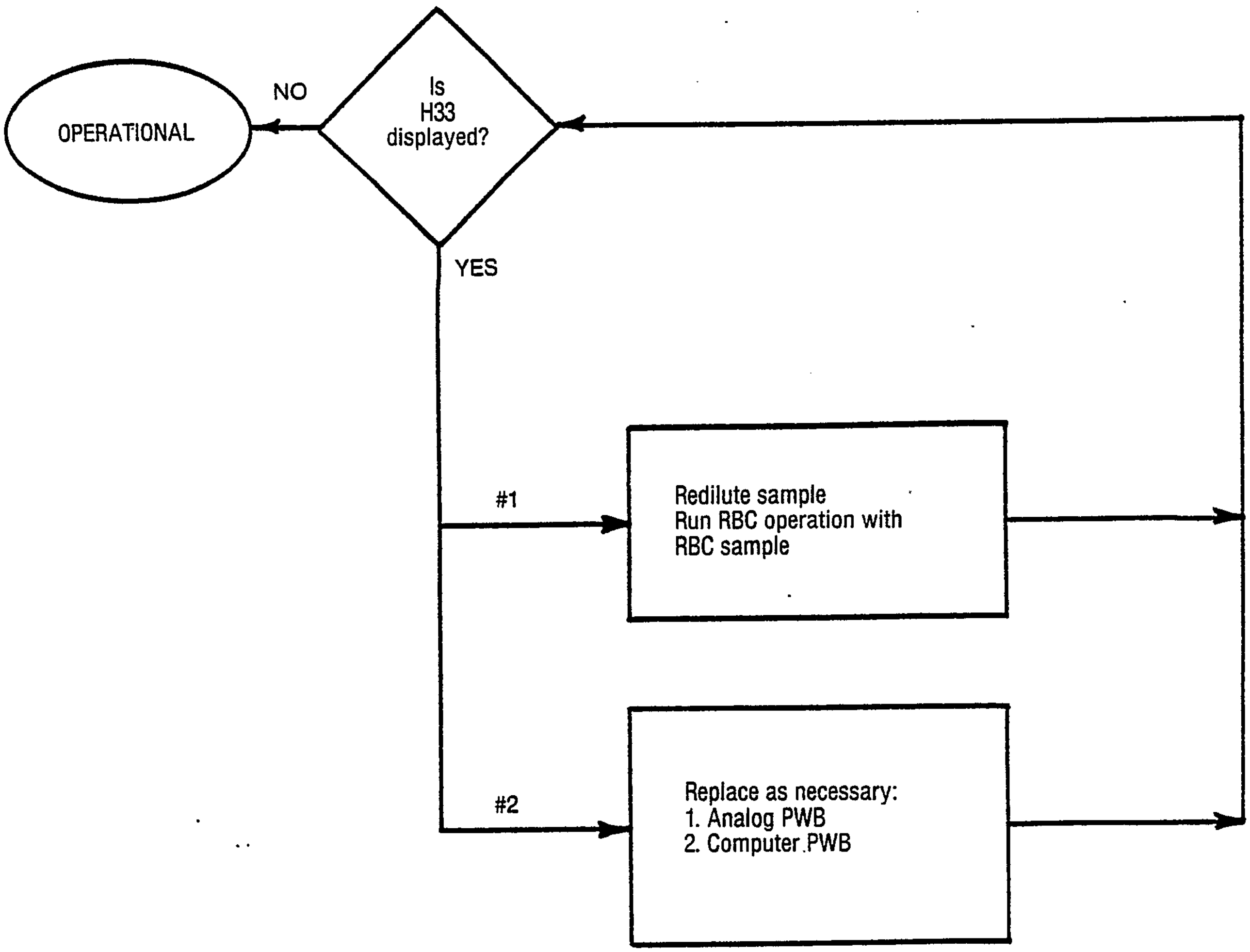

Figure 4-16.
H33 Displayed (MCV Error)
Troubleshooting Chart

4-19 Removal and Installation

Paragraphs 4-20 through 4-50 cover the removal and installation of various sub-assemblies and parts.

4-20 Front Cover

A. Removal

1. Remove the three retaining screws on the front-bottom of the instrument that hold the front cover in place.

2. Grasp the front cover on the left and right side and firmly pull forward approximately one inch until the retaining clips release.

3. Gently guide the front cover over the metal snorkel while simultaneously guiding the snorkel through the opening in the cover.

4. Rotate the cover to the left side of the instrument, face down.

5. Remove the grounding strap running from the cover to the volumetric arm plate.

B. Installation

1. Place the cover on the left side of the instrument, face down, and attach the ground strap, running from the right retaining pin on the cover, to the leftmost screw on the bottom of the volumetric arm plate.

2. Rotate the cover over the instrument toward the right, face forward.

CAUTION

BE CAREFUL NOT TO BEND THE METAL SNORKEL.

3. Gently insert the cover on the instrument, guiding the metal snorkel through the opening in the cover.

4. Gently guide the front cover pins into the receivers on the instrument and push in.

5. Attach the three retaining screws from the front bottom of the instrument up into the front cover.

4-21 Rear Cover

A. Removal

1. Remove the power cord, waste bottle assembly tubing, and the detector plug from the rear of the instrument.

2. Rotate the instrument so that the rear panel is facing you. Remove the eight Phillips-head screws retaining the rear cover.

3. With the rear cover laying face down, remove the top cover as described in paragraph 4-22A.

4. Disconnect the line filter plug.

5. Remove the waste detector socket wires from J16 of the I/O PWB.

6. Remove the rear cover.

B. Installation

1. Set the rear cover face down in back of the instrument.

2. Attach the line filter plug.

3. Attach the waste detector socket wires to J16 of the I/O PWB.

4. Install the top cover as described in paragraph 4-22B.

5. Align the rear cover and attach the eight mounting screws.

6. Attach the waste bottle detector plug and waste tubing.

7. Install the power cord.

4-22 Top Cover

A. Removal

1. Disconnect the power cord and remove the eight retaining screws from the rear panel.

2. Place the rear panel face down.

NOTE

Do not disconnect the plugs connected to the rear panel.

3. Locate the top cover mounting screws approximately halfway up on the left and right sides of the instrument, and remove with a Phillips screwdriver.

4. Disconnect the printer cable connected to the Computer PWB.

5. Gently pull the cover to the rear of the instrument approximately one inch while simultaneously lifting the cover.

B. Installation

1. Ensure that all I/O PWB connectors are plugged in.

2. Position the cover on the instrument, and slide it into place.

3. Connect the printer cable to the Computer PWB.

4. Attach the two mounting screws on the left and right-rear of the cover.

5. Attach the rear cover, using the eight mounting screws.

4-23 Volumetric Arm Assembly

A. Removal

1. Perform the DAILY SHUTDOWN as described in the Operator's Manual.

2. Air purge the system after the DAILY SHUTDOWN is completed and turn the power off.

3. Remove the front and top covers as described in paragraphs 4-20A and 4-22A, respectively.

4. Remove three mounting screws located at the bottom of the volumetric plate below the snorkel.

5. Remove one mounting screw located on the top middle of the volumetric plate (a ground strap terminal).

6. Unscrew the coaxial connector below the snorkel.

7. Pull the bottom of the volumetric arm assembly out approximately 1.5 inches.

8. Remove the waste tubing connected to the ground fitting assembly.

9. Remove the vacuum regulator tubing connected to the T-fitting.

10. Remove the wiring harness running from the volumetric arm assembly to the I/O PWB connected to J2 and J20.

11. Disconnect the HGB cell coaxial cable.

12. Remove the volumetric arm as-assembly.

B. Installation

1. Position the volumetric arm assembly in place.

2. Attach the vacuum regulator tubing to the 1/8" I.D. T-fitting connected to the pump.

3. Connect the ground fitting assembly to the adaptor fitting.

4. Align the volumetric plate with the screw holes on the bottom plate.

CAUTION

BE CAREFUL NOT TO TRAP THE SNORKEL TUBING OR THE CELL COAXIAL CABLE BEHIND THE VOLUMETRIC PLATE.

5. Install the mounting screw on the top of the volumetric arm plate behind the HGB cell assembly.
6. Install the three mounting screws on the bottom of the volumetric plate.
7. Guide the wire harness assembly from the volumetric arm through the appropriate wire clips and down to the I/O PWB and HGB harness cable.
8. Connect the HGB cell coaxial cable; also connect cabling to the I/O PWB.
9. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

4-24 Snorkel Assembly

A. Removal

1. Remove the front cover as described in paragraph 4-20A.
2. Loosen the snorkel set screw located on the snorkel mounting block, using a 0.050" Allen wrench.
3. Remove the snorkel tubing fitting that is screwed into the left side of the cell assembly.
4. Remove the snorkel assembly from the instrument.

B. Installation

1. Position the metal snorkel in the mounting bracket and tighten the Allen screw.

CAUTION

TAKE CARE NOT TO OVERTIGHTEN THE SCREW SINCE THIS INHIBITS THE MOVEMENT OF THE SNORKEL.

2. Attach the snorkel tubing to the inlet on the left side of the cell assembly, firmly tightening that fitting.
3. Apply a drop of Locktite® to the Allen set screw holding the snorkel in place.

4-25 Volumetric Tube

A. Removal

1. Remove the front cover as described in paragraph 4-20A.
2. Remove the top cover as described in paragraph 4-22A.
3. Remove the Tygon® tubing connected to the elbow fitting on the top of the volumetric tube. (See note in general tubing instructions in paragraph 4-39.)
4. Loosen the volumetric tube set screw located in the middle of the second photodetector assembly.
5. With one hand, grasp the volumetric tube between the first and second photodetector assemblies, and with the other hand positioned above the second photodetector assembly, push up and out in an even, smooth motion.

B. Installation

1. Insert the new volumetric tube assembly through the two photodetector assemblies into the cell assembly O-rings.
2. Attach the Tygon® tubing leading from the count valve to the elbow fitting on top of the volumetric tube.
3. If the glue holding the elbow fitting in the volumetric tube has been broken, clean off all the old glue and apply fresh adhesive.
4. Check photodetector alignment as described in paragraph 4-56, Adjustments and Corrective Action before tightening the set screw.

Locktite® is a registered trademark of Locktite Corporation, Newington, Ct.
Tygon® is a registered trademark of NORTON Plastics and Synthetics Div., Akron, OH.

CAUTION
BE CAREFUL NOT TO OVERTIGHTEN, AS THE GLASS TUBE MAY FRACTURE.

5. Once alignment is set, tighten the Allen set screw.

6. Install the top and front covers as described in paragraphs 4-22B and 4-20B.

4-26 Cell Assembly

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Remove the volumetric tube as described in paragraph 4-25A.

4. Remove the Tygon® tubing connected to the top of the cell assembly.

5. Remove the snorkel fitting connected to the left side of the cell.

6. Disconnect the cell coaxial connector.

7. Loosen the cell by removing the two mounting screws on the lower left and right side of the cell assembly.

8. Guide the cell assembly away with a left, down, and outward motion.

9. Remove the cell coaxial cable from the wire clips.

B. Installation

1. Position the new cell assembly below the first photodetector and set it in place with the two mounting screws.

2. Carefully install the volumetric tube into place as described in paragraph 4-25B.

3. Screw the snorkel tube fitting into the left side of the cell assembly.

4. Attach the Tygon® tubing leading from the rear of the HGB cell to the barbed fitting on top of the cell assembly.

5. Guide the cell coaxial cable through the wire clips and connect with the female coaxial connector.

6. Check the alignment of the vent solenoid as described in Adjustments and Corrective Action, paragraph 4-59.

7. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

NOTE

The prime cell configuration is designed to be bubble free at the aperture. As illustrated in Figure 4-17, the port connected between the prime chamber and count chamber is beveled at a 45-degree angle so any bubbles at the aperture float up either the prime chamber or the count chamber.

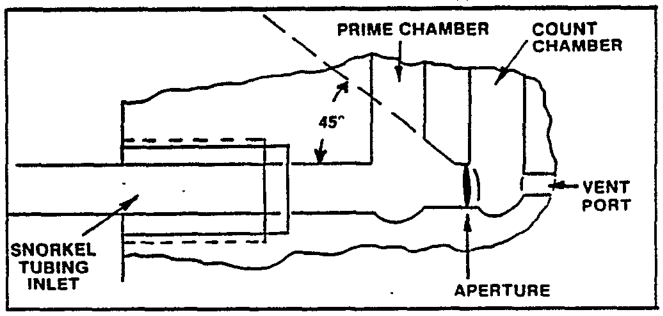

Figure 4-17. Cell Assembly Configuration

4-27 Cell Assembly O-Ring

A. Removal

1. Remove the cell assembly as described in paragraph 4-26A.

2. Using a needle, pierce the O-ring and gently remove it from its cavity.

CAUTION
DO NOT PIERCE THE CELL BODY WITH THE NEEDLE.

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3. Use a hooked probe or thin hemostats to remove the O-ring.

B. Installation

1. Position the O-ring near the cavity where it is to be installed.

2. Using stick applicators, work the O-ring into the cavity.

3. Install the cell assembly as described in paragraph 4-26B.

4-28. Phototransistor

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Loosen the set screws (located on the right side of the photodetector assembly) that retain the detector socket.

3. Once the set screw has been loosened, remove the detector socket from the assembly and replace the phototransistor.

B. Installation

1. Insert the new phototransistor in the detector socket; then, insert the detector socket into the assembly and tighten the set screw, being careful not to overtighten.

2. Once the phototransistor is installed, refer to photodetector alignment in Adjustments and Corrective Action, paragraph 4-56, for further instructions.

3. Install the front cover as described in paragraph 4-20B.

4-29 Photo LED

A. Replacement

1. Remove the front cover as described in paragraph 4-20A.

2. Loosen the set screw located on the left side of the photodetector assembly and remove the LED socket from the assembly.

B. Installation

1. Insert the new LED into the LED socket, aligning the polarized pin of the LED with the polarized portion of the socket.

2. Insert the LED socket into the assembly and tighten the set screw, being careful not to overtighten.

3. Once the LED is installed, refer to photodetector alignment in Adjustments and Corrective Action, paragraph 4-56, for further instructions.

4. Install the front cover as described in paragraph 4-20B.

4-30 Count/Prime Valve

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Remove the appropriate valve from the valve clip.(Figure 5-2.)

4. Remove the tubing connected to the valve and disconnect the plug, P3A for the prime valve or P3B for the count valve.

B. Installation

1. Position the valve in the valve clip, with the common ports of the valve facing toward the waste outlet tubing.

2. Connect the appropriate tubing to the valve, referring to the fluid schematic, Figure 5-3.

3. Electrically connect the valve.

4. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

4-31 Vent Solenoid

A. Removal

1. Turn the power off for at least two minutes before going on to the next step.

2. Remove the front cover as described in paragraph 4-20A.

3. Remove the two mounting screws holding the vent solenoid in place; see Figure 5-4, items 29 and 30.

4. Remove the vent solenoid.

B. Installation

1. Position the new vent solenoid underneath its mounting bracket.

2. Install the mounting screws through the bracket and into the vent solenoid. Do not tighten.

3. Refer to vent solenoid alignment in Adjustments and Corrective Action, paragraph 4-59.

4. Install the front cover as described in paragraph 4-20B.

4-32 Vent Pad

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the vent solenoid as described in paragraph 4-31A.

3. Remove the vent pad located on the tip of the solenoid arm by prying the pad out of the head cavity.

4. Scrape away any remaining glue that is still attached inside the head cavity.

5. Clean the head cavity with an alcohol swab and let it dry.

6. Place a small drop of adhesive in the cavity and install a new vent pad evenly on top of the adhesive.

7. Wipe any excess glue that seeps out the side, immediately.

8. Let the adhesive dry for the recommended time.

9. Install the vent solenoid as described in paragraph 4-31B.

4-33 HGB Lamp

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Loosen the HGB cell assembly by removing the two mounting screws located directly on top of the HGB block.

4. Rotate the HGB cell assembly approximately 90 degrees counterclockwise so the lamp terminals face the front of the instrument.

5. Loosen the lamp wire terminals. Remove the red lamp wires.

6. Loosen the Allen set screw using a 0.050" wrench and remove the HGB lamp.

B. Installation

1. Insert the new lamp into the cell assembly with the lamp filament in the vertical position.

2. Tighten, but do not overtighten, the set screw, or the lamp may be ruptured.

3. Attach the lamp wires to the power terminal located on the side of the HGB cell assembly.

4. Mount the HGB cell assembly on the volumetric plate.

5. Once the HGB cell assembly is in place, refer to the HGB cell voltage adjustment, paragraph 4-57, in Adjustments and Corrective Action, for further instructions.

6. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

4-34 HGB Cell

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Loosen the four block screws located on the front of the HGB cell assembly, providing access to the HGB cell.

4. Remove the HGB cell from the block and carefully remove the tubing connected to the top of the HGB cell.

B. Installation

1. Guide the HGB cell, with the arrow facing down (↓) and the cell facing the rear, into the block between two pieces of foam padding; see Figure 5-5.

2. Gently tighten the four mounting screws on the front of the block.

3. Attach the tubing leading from the cell assembly to the fitting on the HGB cell with the arrow facing down (↓).

4. Connect the other end to the piece of tubing connected to the prime valve.

5. Once the HGB cell assembly is assembled and in place, refer to the HGB cell voltage adjustment, paragraph 4-57, in Adjustments and Corrective Action, for further instructions.

6. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

4-35 HGB Filter

A. Removal

1. Remove the front cover as described in paragraph 4-20.

2. Remove the top cover as described in paragraph 4-22A.

3. Loosen the four front mounting screws on the HGB cell assembly block.

4. Remove the HGB cell as described in paragraph 4-34A.

5. Remove the piece of foam padding in front of the photodetector containing the HGB filter; see Figure 5-5.

6. Remove the HGB filter.

B. Installation

1. Position the new filter with the shiny side facing toward the photodetector.

2. Insert the piece of foam tape over the filter, sticky side towards the filter.

3. Carefully assembly the HGB cell as described in paragraph 4-34B.

4-36 HGB Detector

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Remove the front cover as decribed in paragraph 4-20A.

3. Unscrew the HGB detector from the front of the HGB cell assembly; see Figure 5-5.

CAUTION

- WHEN UNSOLDERING THE EXISTING DETECTOR, BE CAREFUL NOT TO OVERHEAT ANY OF THE COMPONENTS HOLDING THE DETECTOR IN PLACE.
- OBSERVE POLARITY (RED DOT) WHEN REMOVING THE DETECTOR.

B. Installation

1. Install the new HGB detector onto the harness assembly.

2. Clean all contacts thoroughly after soldering.

3. Clean the lens of the HGB detector with lens paper.

4. Install the HGB detector nut and lock it tight in place.

5. Once the HGB detector is in place, refer to the HGB cell voltage adjustment, paragraph 4-58, in Adjustments and Corrective Action, for further instructions.

6. Install the top and front covers as described in paragraphs 4-22B and 4-20B, respectively.

4-37 Vacuum Regulator

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Locate the vacuum regulator and remove the nut.

4. Remove the lock washer below the nut.

5. Loosen the mounting nut and slide the regulator out.

6. Remove the tubing connected to the port.

B. Installation

1. Loosen the mounting nut on the new vacuum regulator and slide the assembly into place with the lock washer below and the top mounting nut on top of the mounting plate.

2. Position the regulator before tightening, with the barbed fitting facing toward the left side of the instrument.

3. Tighten the mounting nut.

4. Install the lock washer and adjustment screw.

5. Connect the tubing running from the T-fitting from the vacuum pump to the barbed fitting on the vacuum regulator.

6. See Adjustments and Corrective Action, paragraph 4-60, for proper setting of this regulator.

4-38 Pump

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Remove the front cover as described in paragraph 4-20A.

3. Remove the volumetric arm assembly as described in paragraph 4-23A.

4. Disconnect the tubing connected to the pump.

5. Disconnect P9A, the electrical connector to the pump.

6. Remove the pump from the bottom of the instrument by removing the mounting screws from each corner of the assembly.

B. Installation

1. Position the new pump in place with the pressure port facing toward the rear of the instrument; then, tighten the mounting screws.

2. Electrically connect P9A, the plug connector, and attach any tubing connected to the pump ports (refer to the fluid schematic, Figure 5-3).

3. Install the volumetric arm assembly as described in paragraph 4-23B.

4. Proceed with the vacuum regulator adjustment, paragraph 4-60, in Adjustments and Corrective Action.

4-39 Tubing - General Notes

A. Replacement

1. When replacing any tubing in the system, refer to the fluid schematic for the proper type of tubing, inner diameter (I.D.), outer diameter (O.D.), and length.

2. When removing Tygon® tubing from a barbed fitting, gently cut the tubing from the fitting, taking care not to nick the barbed fitting.

2. When cutting a new piece of tubing, use a razor blade and cut at a 90-degree angle to the length axis of the tubing.

3. Once the tubing is cut, roll the end of the tubing between your fingers so that the inner diameter conforms to its original shape.

4-40 Computer PWB

A. Removal

1. Record calibration factors.

2. Remove the top cover as described in paragraph 4-22A.

3. Disconnect the waste socket wires from J16 of the I/O PWB.

4. Disconnect the HGB harness running from the Analog PWB (the bottom board) to the HGB cell assembly.

5. Remove the Computer PWB.

B. Installation

1. Inspect the new Computer PWB for the appropriate version of the PROMS.

2. Inspect the Computer PWB contacts for dirt and clean them, if necessary.

3. Slide the Computer PWB into the middle slot and snap it into the motherboard socket.

4. Connect the waste socket wires to J16 of the I/O PWB.

5. Connect the HGB harness assembly running from the Analog PWB to the HGB cell assembly.

6. Enter calibration factors; allow batteries to charge for 48 hours.

4-41 I/O PWB

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Remove connectors from J2, J16, J20, and J30 at the rear of the I/O PWB.

3. Disconnect the HGB harness running from the Analog PWB (the bottom board) to the HGB cell assembly.

4. Remove the I/O PWB.

B. Installation

1. Inspect the new I/O PWB contacts for dirt and clean them, if necessary.

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2. Slide the I/O PWB into the top slot through the card guides into the motherboard socket and snap it into place.

3. Install connectors at J16 from the waste outlet, J2 from the volumetric arm assembly; J20, also from the volumetric arm assembly, and J30 from the Relay PWB, at the rear of the I/O PWB.

4. Connect the HGB harness connector running from the Analog PWB (the bottom board) to the HGB cell assembly.

4-42 Analog PWB

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Disconnect the waste socket wires at J16 of the I/O PWB.

3. Disconnect the HGB harness running from the Analog PWB to the HGB cell assembly.

4. Disconnect the coaxial cable from the Analog PWB.

5. Remove the Analog PWB.

B. Installation

1. Inspect the new Analog PWB for the appropriate version as it applies to the model of the instrument.

2. Inspect the Analog PWB contacts for dirt and clean them, if necessary.

3. Guide the new Analog PWB into the bottom slot, snapping it into the motherboard socket.

4. Connect the HGB harness assembly running from the left side of the Analog PWB to the HGB cell assembly.

5. Connect the coaxial cable.

6. Connect the waste socket connector to J16 of the I/O PWB.

7. It may be necessary to adjust the thresholds and HGB cell voltage. See Adjustments and Calibration.

4-43 Motherboard

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Remove the I/O PWB as described in paragraph 4-41A.

3. Remove the Computer PWB as described in paragraph 4-40A.

4. Remove the Analog PWB as described in paragraph 4-42A.

5. Disconnect P5 running from the Power Supply PWB to the motherboard.

6. Remove the motherboard wire harness from the wire retaining clips.

7. Remove the two mounting screws retaining the display assembly.

8. Remove the four motherboard mounting screws (two on the left side and two on the right side).

9. Remove the keyboard ribbon cable connected to the motherboard.

10. Gently remove the motherboard.

B. Installation

1. Align the motherboard into position and mount the display assembly.

2. Mount the motherboard on the card cage, inserting the four mounting screws.

3. Attach the keyboard ribbon cable to the motherboard.

4. Guide the motherboard wire harness through the wire clips and connect to P5, running to the Power Supply PWB.

5. Install the Analog PWB as described in paragraph 4-42B.

6. Install the Computer PWB as described in paragraph 4-41B.

7. Install the I/O PWB as described in paragraph 4-40B.

4-44 Power Supply Assembly

A. Removal

1. Remove the rear cover as described in paragraph 4-21A.

2. Remove the top cover as described in paragraph 4-22A.

3. Remove the Relay PWB as described in paragraph 4-46A.

4. Disconnect P5 from the Power Supply PWB and P6 from the Corcom filter.

5. Remove two mounting screws located on each side of the gold-colored metal plate.

B. Installation

1. Position the power supply assembly in the instrument and install two mounting screws on the left side and two on the right side.

2. Install the Relay PWB as described in paragraph 4-29B.

3. Connect the line filter plug to connector P6 of the power supply assembly. Connect P5.

4. Install the top cover as described in paragraph 4-22B.

5. Install the rear cover as described in paragraph 4-21B.

4-45 Power Supply PWB

A. Removal

1. Remove the power supply assembly as described in paragraph 4-27A.

2. Remove the two mounting screws on the top and bottom, left side, and the corresponding two screws on top and bottom, right side.

3. Trace the two wire harnesses from the Power Supply PWB and disconnect it at P5 and P7.

4. Gently remove the Power Supply PWB from the power supply assembly.

B. Installation

1. Position the new Power Supply PWB in the power supply assembly.

2. Loosely attach two mounting screws to the right side, connected to the Power Supply PWB heat sink, top and bottom.

3. Prepare the mounting screw with a nylon washer insulator, to be installed on left-top of the power supply board; then, proceed to mount the screw.

4. Install another mounting screw on the left-bottom of the Power Supply PWB.

5. Tighten the screws facing in, on the right-hand side of the Power Supply PWB.

6. Connect P7 and P5.

4-46 Relay PWB

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Locate the Relay PWB mounted on the large capacitors in the power supply assembly.

3. Disconnect P9A and P9B, running to and from the pump assembly.

4. Disconnect J30 from the I/O PWB.

5. Remove the cover housing from the Relay PWB.

6. Remove the standoffs holding the Relay PWB on the mounting brackets.

7. Remove the Relay PWB.

B. Installation

1. Align the new Relay PWB over the mounting brackets and attach the ½" standoffs that hold the Relay PWB on the bracket mounts.

2. Install the cover housing on the standoffs.

3. Connect P9A and P9B, running to the pump assembly and to the mother harness assembly, respectively.

4. Connect J30 from the Relay PWB to P30 on the I/O PWB.

CAUTION

TO AVOID DAMAGE TO THE I/O PWB, OBSERVE POLARITY IN THIS CONNECTION.

5. Install the top cover as described in paragraph 4-22B.

6. Install the rear cover as described in paragraph 4-21B.

4-47 Keyboard

A. Removal

1. Remove the front cover as described in paragraph 4-20A.

2. Remove the top cover as described in paragraph 4-22A.

3. Locate the keyboard ribbon cable connected to the motherboard above the I/O PWB and disconnect it.

4. Gently peel off the keyboard from the front cover.

B. Installation

1. Clean any existing glue from the base assembly with an adhesive remover.

2. Peel the back from the new keyboard, and before installing it on the front cover, guide the keyboard ribbon cable through the slot provided. Simultaneously, gently roll the new keyboard onto the cover, lining up the window of the keyboard with the window of the display.

3. Attach the keyboard ribbon cable to the motherboard connector.

4-48 Printer

A. Removal

1. Remove the printer paper from the printer well.

2. Remove the top cover as described in paragraph 4-22A.

3. Place the top cover on its back and remove the four 5/16" nuts that hold the printer to the cover.

CAUTION

THE PRINTER ASSEMBLY IS ELECTROSTATIC SENSITIVE. PRECAUTIONARY MEASURES ARE REQUIRED.

B. Installation

1. Align the new printer on the top cover standoffs so that the ribbon cable faces toward the printer paper well.

CAUTION
WHEN HANDLING THE PRINTER, OBSERVE ELECTROSTATIC PRECAUTIONS.

2. Once the printer is in place, insert the black insulator onto the screw, followed by a 5/16" nut for each of the four mounting posts.

3. Ensure that the paper-release lever insulator is transferred from the old printer to the new printer.

4. Install paper in the printer well.

4-49 Corcom Filter

A. Removal

1. Disconnect the power cord.

2. Remove the rear cover as described in paragraph 4-21A.

3. Remove the Corcom™ filter by collapsing the retaining clips on the Corcom filter from the inside of the cover.

4. Remove the wires (connector P6) from the Corcom filter.

NOTE
It may be helpful to mark the wires to correspond with the pin arrangement on the Corcom filter.

B. Installation

1. Insert the Corcom filter, right side up, through the rear cover, pushing it in until it snaps into place.

2. Attach the wires leading from connector P6 (reference AC/DC Distribution Wire List).

3. Use heat-shrink tubing to insulate the wiring.

4. Install the rear cover as described in paragraph 4-21B.

5. Insert the power cord.

4-50 Power Switch

A. Removal

1. Disconnect the power cord.

2. Remove the top cover as described in paragraph 4-22A.

3. Locate P8, connected from the power switch, and remove it.

NOTE
It may be helpful to mark the wires connected to the power switch prior to disassembly.

4. Collapse the self-retaining clips holding the power switch to the panel and gently slide the switch through the front plate.

B. Installation

1. Connect the wires from P8 to the new power switch.

2. Guide the assembly through the mounting hole, snap it into place, and connect P8.

3. Ensure that the power switch is off. Attach the power cord.

4-51 Adjustments and Corrective Action

4-52 Clean System

1. Place a beaker of Haema-Clean™ PM under the snorkel and perform three STANDBY/FLUSH routines. Allow solution to stand for two minutes after third flush before proceeding.

2. Place a beaker of Haema-Clean™ 100 under the snorkel and perform three STANDBY/FLUSH routines. Allow solution to stand for one minute after third flush before proceeding.

3. Place a beaker of distilled water under the snorkel and perform three STANDBY/FLUSH routines.

Corcom™ is a trademark of Corcom Corporation, Chicago, Il.
Haema-Clean™ is a trademark of Baker Instruments Corporation, Allentown, Pa.

4. Mix 10mL of diluent (Haema-Line® 2) and three drops of Haema-Lyse™ and perform one STANDBY/FLUSH routine.

NOTE

Do not allow the snorkel to run dry, nor allow the system to stand idle more than the recommended time.

4-53 Pressure Cleaning

A. Back Pressure

1. Place Haema-Standby™ under the snorkel and perform two STANDBY/FLUSH routines.

2. Perform the STANDBY/FLUSH routine two times with just air under the snorkel.

3. With the instrument in STANDBY, attach the syringe and tubing to the metal snorkel.

NOTE

The syringe plunger must be fully depressed before attaching the syringe to the snorkel.

4. Vigorously pull the plunger all the way out of the syringe until it pops. Reinsert the plunger after removing the tubing from the metal snorkel. Perform this two-step procedure ten times.

5. Clean the system as described in paragraph 4-52.

B. Forward Pressure

1. Place Haema-Standby under the snorkel and perform two STANDBY/FLUSH routines.

2. Perform the STANDBY/FLUSH routine twice with just air under the snorkel.

3. Remove the front cover; refer to paragraph 4-20.

4. Clamp shut the tubing between the cell assembly and the HGB cell.

5. With the instrument in STANDBY, attach the syringe and tubing to the metal snorkel.

NOTE

The syringe plunger must be removed before attaching the syringe to the metal snorkel.

6. Insert and fully depress the plunger in the syringe. Remove the plunger after removing the tubing from the metal snorkel. Perform this two-step procedure ten times.

7. Remove the clamp and replace the front cover to make the instrument operational.

4-54 Elbow - Volumetric Tube

1. Turn the system power off and remove the top cover as described in paragraph 4-22A.

2. Remove the front cover as described in paragraph 4-20A.

3. Locate the elbow fitting on top of the volumetric tube and clean off all excess glue from both the fitting and the volumetric tube. If necessary, replace the elbow fitting.

4. Clean the surface areas thoroughly with alcohol and allow 3 minutes drying time.

5. Insert the elbow fitting into the volumetric tube and apply a very small amount of adhesive. Be careful not to permit the glue to run down the volumetric tube and adhere to the photo-block. Allow the glue to dry before using the system.

NOTE

The recommended glue is cyanoacrylate CA-5™.

Haema-Line® is a registered trademark of Baker Instruments Corporation, Allentown, Pa.
Haema-Standby™ is a trademark of Baker Instruments Corporation, Allentown, Pa.
CA-5™ is a trademark of 3M Corporation, St. Paul, Mn.

4-55 Valve Rebuild/Clean

1. Turn system power off and remove power cord.
2. Remove the front cover as described in paragraph 4-20A.
3. Remove the top cover as described in paragraph 4-22A.
4. Locate the valve and remove it from its bracket.
5. Disassemble the valve by removing the two assembly screws located on the base of the valve; see Figure 5-4.
6. Remove the base from the valve and the armature, spring, and O-ring from inside the valve.
7. Inspect the valve seats for any debris clinging to them. Clean thoroughly with Haema-Clean™100. Also, inspect the porting on the base assembly for debris and clean, if necessary.
8. If the valve seats appear to be swollen or scarred, replace the valve armature.
9. Reassemble the valve by inserting the spring first, then the armature O-ring, and finally the base.

4-56 Photodetector Adjustment

1. Check the photodetector voltages as described in paragraph 4-9. Photodetector voltages can be adjusted for optimum performance during the off state.
2. Working with one photodetector assembly at a time, loosen both the LED and photodetector set screws with the DMM attached to the appropriate resistor on the I/O PWB, rotate the LED and transistor sockets to obtain the maximum off, no fluid, reading. Once this is achieved, tighten the set screws.
3. Next, loosen the volumetric tube set screw and gently rotate the tube for optimum performance.

CAUTION

BE CAREFUL NOT TO RUPTURE THE GLUE HOLDING THE ELBOW FITTING AT THE TOP OF THE VOLUMETRIC TUBE IN PLACE.

4. Once optimum performance is obtained, tighten the volumetric tube set screw.

4-57 HGB Cell Voltage Adjustment

Before adjusting the HGB cell voltage, the system must be cleaned as described in paragraph 4-52. At the end of the cleaning procedure, remove the rear cover as described in paragraph 4-21A. Locate the lamp potentiometer, R13, as shown in Figure 5-18. On some instruments the potentiometer must be approached from the front. Remove the front cover, as described in paragraph 4-20A. The potentiometer is found near the HGB cell assembly.

NOTE

Adjusting the lamp voltage causes the HGB cell voltage to change.

1. Press the SCAN key until the non-flashing HGB sign appears.
2. Turn the lamp potentiometer until the cell voltage is in the required range between 4.4 and 4.9 volts with a recommended value of 4.65 volts.
3. Upon completion of this adjustment, replace either the front or rear cover as described in paragraph 4-20B or 4-21B.

4-58 RBC/WBC Threshold Adjustment

1. With power off, remove the eight screws from the rear cover, but do not disconnect the power cord or the waste detector sensor.
2. Allow the rear cover to rest face down.
3. Locate the threshold adjustment potentiometer on the Analog PWB. To adjust WBC threshold, adjust potentiometer R46; as you view the rear of the instrument, the potentiometer is located on the left.
4. Turn the instrument's power on; SCAN and hold on the WBC value.
5. Adjust the potentiometer for 0.90 ± 0.01 (human).

Haema-Clean™ is a trademark of Baker Instruments Corporation, Allentown, Pa.

6. To adjust the RBC threshold, adjust potentiometer R47, the potentiometer on the right, and SCAN and hold on the RBC value displayed.

7. Adjust the potentiometer for a reading of 0.65 ± 0.01 (human).

8. Once the threshold adjustments are completed, turn the power off and install the rear cover.

4-59 Vent Solenoid Alignment

1. Turn the power off and remove the front cover as described in paragraph 4-20A.

2. Locate the vent solenoid and loosen the two mounting nuts holding it.

3. While holding the vent solenoid arm back, use the white cap on the right end of the vent solenoid arm, and slide the vent solenoid assembly so that the vent pad on the end is parallel with the right side of the cell assembly. (This is the open position of the vent solenoid aligning the proper throw length; see Figure 4-18.)

4. Next, ensure that the vent solenoid is at a 90-degree angle against the vent port cell assembly for maximum sealing.

5. Once it is aligned, tighten the mounting screws and install the front cover.

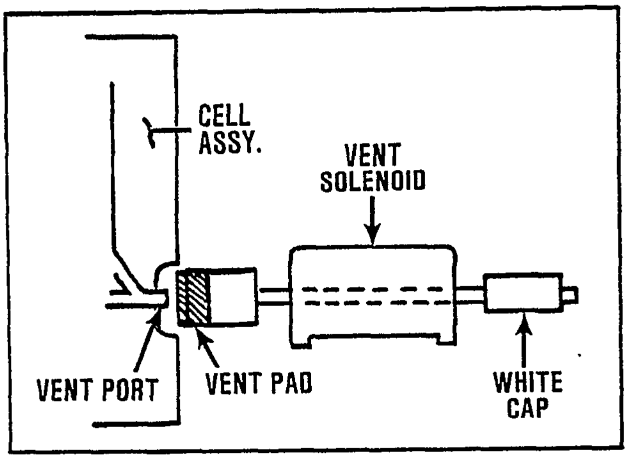


Figure 4-18. Vent Solenoid Alignment

4-60 Vacuum Regulator Adjustment

1. Attach pressure gauge to (vacuum) port of pump. Press STANDBY/FLUSH key; verify pressure is minimum of - 6 PSI.

2. Attach the pressure gauge to the top port (vacuum) on the rear of the instrument.

3. Press the STANDBY/FLUSH key; the gauge should read -2.40 ± 0.01 PSI; if not, proceed to step 3; otherwise, proceed to step 6.

4. If an adjustment is necessary, remove the front cover as described in paragraph 4-20A.

5. Locate the vacuum regulator and spin the lock washer down away from the knurled nut.

NOTE

Adjusting the knurled nut one-quarter turn clockwise increases vacuum; adjusting it counterclockwise decreases vacuum.

6. Once the pressure reading is obtained, tighten the lock washer against the knurled nut, holding the nut in place, so the lock washer does not upset the adjustment.

7. Attach the waste bottle vaccum line (blue) to the pressure gauge.

NOTE

The short (blue) tubing on the waste detector is attached to the top port (vacuum) on the rear of the instrument.

8. Press the STANDBY/FLUSH key and read the gauge, comparing it to the pressure reading in step 2. There should be no drop in pressure. If there is a pressure drop, isolate the source of the leak at the waste detector assembly.

4-61 Pump Rebuilding

A. Removal

1. Remove the top cover as described in paragraph 4-22A.

2. Remove the front cover as described in paragraph 4-20A.

3. Remove the pump as described in paragraph 4-38A.

4. Remove the spring-leaf arm from the pump by removing both the center mounting screw and the three outer mounting screws; see Figure 4-19.

5. Remove the diaphragm assembly by removing the four mounting screws holding it together.

6. Lift the upper metal and plastic portions of the diaphragm assembly and then slide out the plastic middle block of the diaphragm assembly; see Figure 4-19.

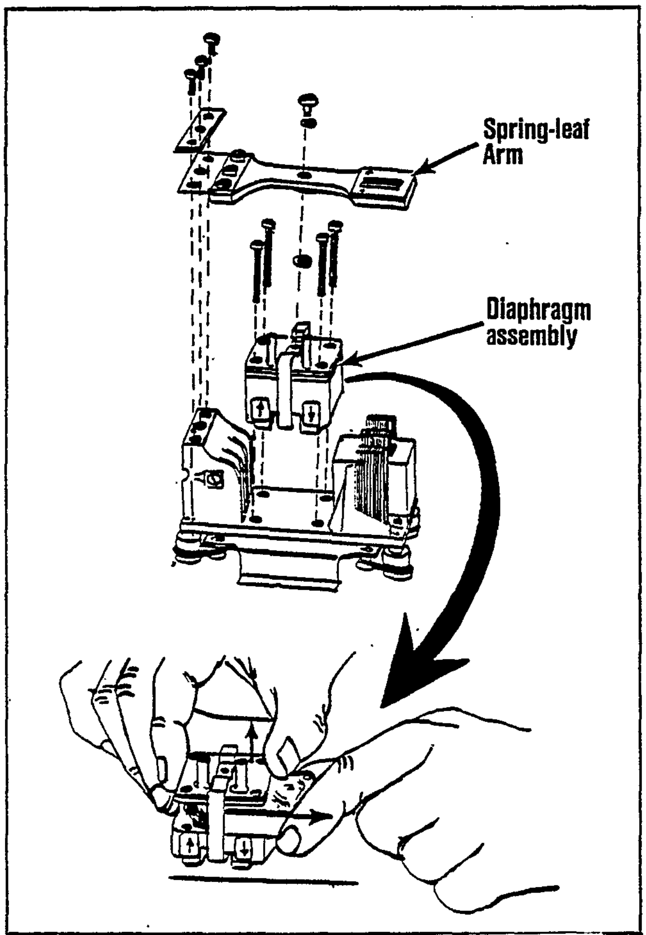


Figure 4-19. Pump, Exploded View

7. Remove the head gasket located between the top and middle blocks of the diaphragm assembly; see Figure 5-6.

8. Remove the flapper gaskets located on the top and bottom of the middle block by removing the retaining clips; see Figure 5-6.

9. Disassemble the bottom diaphragm block by removing the bottom nut; see Figure 5-6.

10. Remove the mounting screw and top and bottom washer from the pump diaphragm.

11. Pushing from the bottom, pop out the diaphragm.

12. Discard the flapper gaskets, diaphragm and retainer clips. Wash all other parts in warm, mild soap solution. Rinse thoroughly with distilled water and dry with lint-free tissue.

B. Installation

NOTE

All parts must be completely dry before assembling.

1. Install the new pump diaphragm in the bottom block and attach the hardware.

2. Install the new flapper gaskets and retainer clips under the top block and position the block into place first, before inserting the middle block.

3. Place the top block into position, then slide in the middle block.

4. Align the diaphragm blocks and install them in the main housing.

5. Install the spring-leaf arm by attaching the three mounting screws and a center mounting screw.

6. Install the pump assembly as described in paragraph 4-38B.

7. Verify pump pressure is minimum 6 PSI.

4-62 Printer Adjustments

Four adjustments are required on the printer:

1. With the head release lever in the forward or PRINT position, wing "A" of the lever should not touch the Thermal Head group. There must be visible clearance at "B" so that the Thermal Head group may rest on the platen; see Figure 4-20.

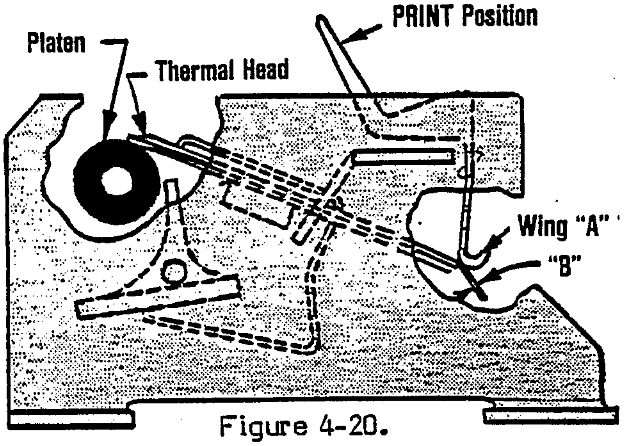


Figure 4-20.
Printer - Clearance Adjustment; Wing "A"/Thermal Head Group

2. When the head release lever is in the activated or RELEASE position, the Thermal Head group must be held away from the platen. Minimum clearance is 0.8mm, as shown. To obtain both these conditions, form wing "A" as necessary; see Figure 4-21.

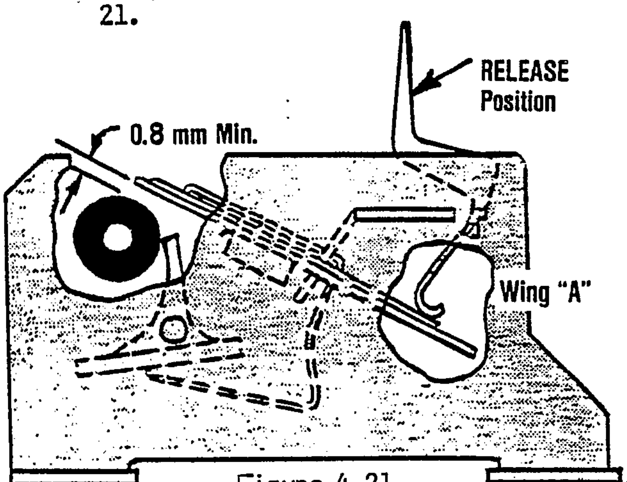


Figure 4-21.
Printer - Clearance Adjustment; Platen/Thermal Head Group

3. Motor gear mesh is adjusted by loosening the top and bottom motor mounting screws, and re-positioning the motor as necessary. The mesh between the motor and the large transmission gear must be as deep as possible without binding. When this condition is obtained, tighten the motor mounting screws; see Figure 4-22.

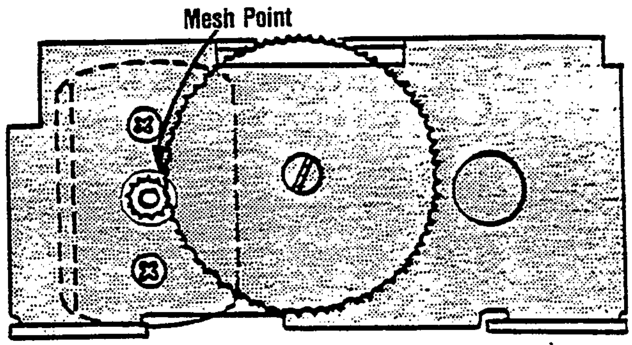


Figure 4-22.
Motor Gear Mesh Adjustment

4. To adjust vertical alignments, print a series of eights and ones, as shown in Figure 4-23. Rotate the strobe cap until all vertical dots are in line. Tighten.

81 81 81 81 81 81

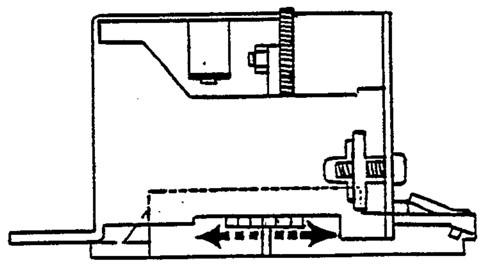


Figure 4-23.
Printer - Vertical Alignment

Data Worksheet

1. Control Data

Control Supplier:______________/Lot #:______________/Expiration Date:______________

	Normal			Abnormal - Hi			Abnormal - Lo	
	Mean	Range		Mean	Range		Mean	Range
RBC			RBC			RBC		
HCT			HCT			HCT		
MCV			MCV			MCV		
WBC			WBC			WBC		
HGB			HGB			HGB		

2. Dilution Check

a)

	Manual	Dilutor	Δ%
RBC			
HCT			
WBC			
HGB			

b)

	Manual	Dilutor	Δ%
RBC			
HCT			
WBC			
HGB			

3. Calibration Check

a) Calibration

	Normal Control (1)	(2)	(3)	Mean	Δ%
RBC					
HCT					
MCV					
WBC					
HGB					

b) After Calibration

	Normal Control (1)	(2)	(3)	Abnormal Control Lo	Hi
RBC					
HCT					
MCV					
WBC					
HGB					

13. Precision Check

a) First Trial

	RBC	HCT	MCV	WBC	HGB
1)					
2)					
3)					
4)					
5)					
6)					
7)					
8)					
9)					
10)					
11)					
12)					
13)					
14)					
15)					
%C.V.					

b) Second Trial

	RBC	HCT	MCV	WBC	HGB
1)					
2)					
3)					
4)					
5)					
6)					
7)					
8)					
9)					
10)					
11)					
12)					
13)					
14)					
15)					
%C.V.					

5-1 INTRODUCTION

This section contains an illustrated parts list and block diagrams, schematic diagrams, interconnecting diagrams, and wire lists for the 100 Series Cell Counters. An overall system functional block diagram is shown in Figure 5-1.

The system parts list in Table 5-1 lists the major assemblies and their part numbers. Figure 5-2 locates these assemblies. Where applicable, exploded views, PWB layouts, block diagrams, schematic and interconnecting diagrams, and wire lists are included with their associated parts list.

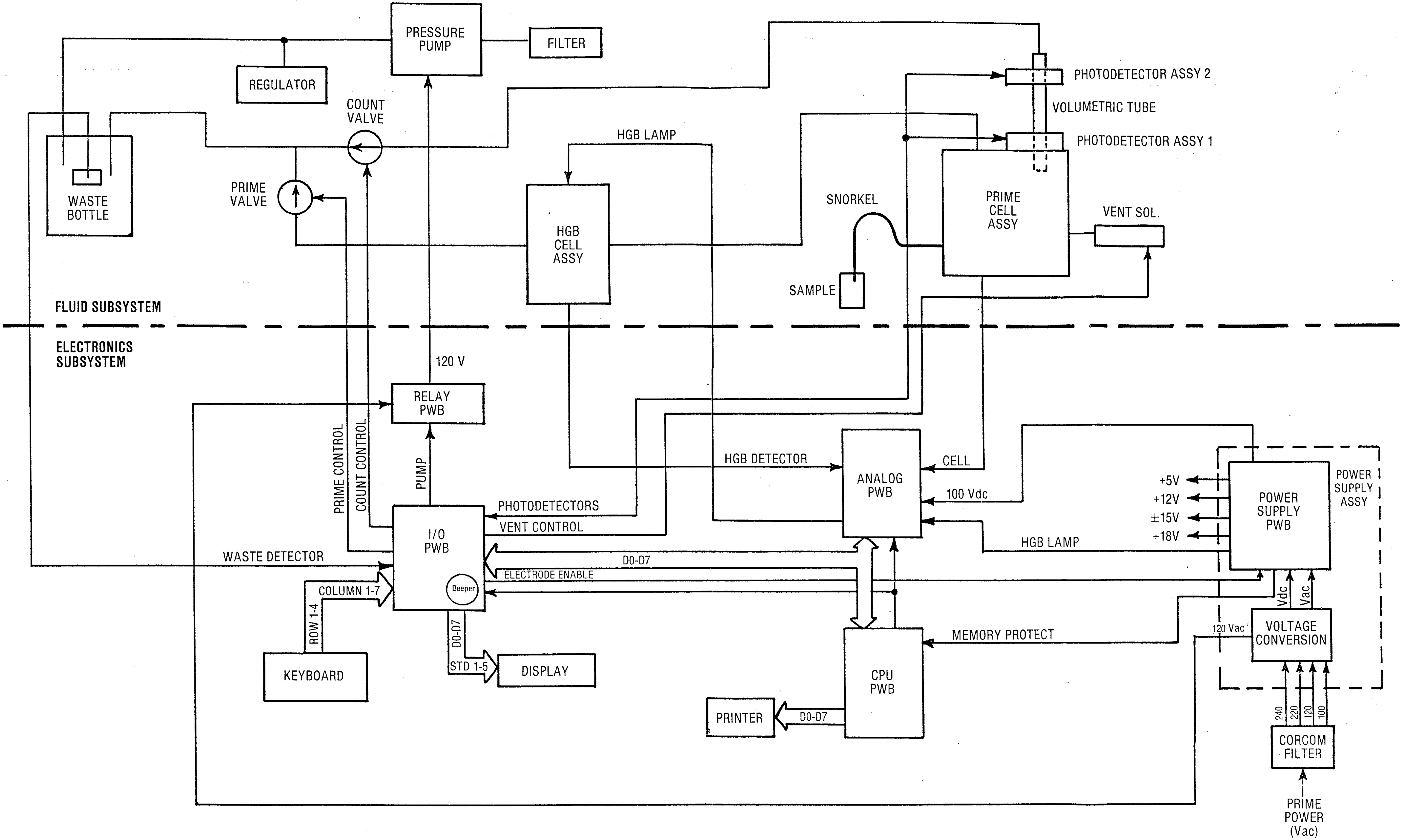


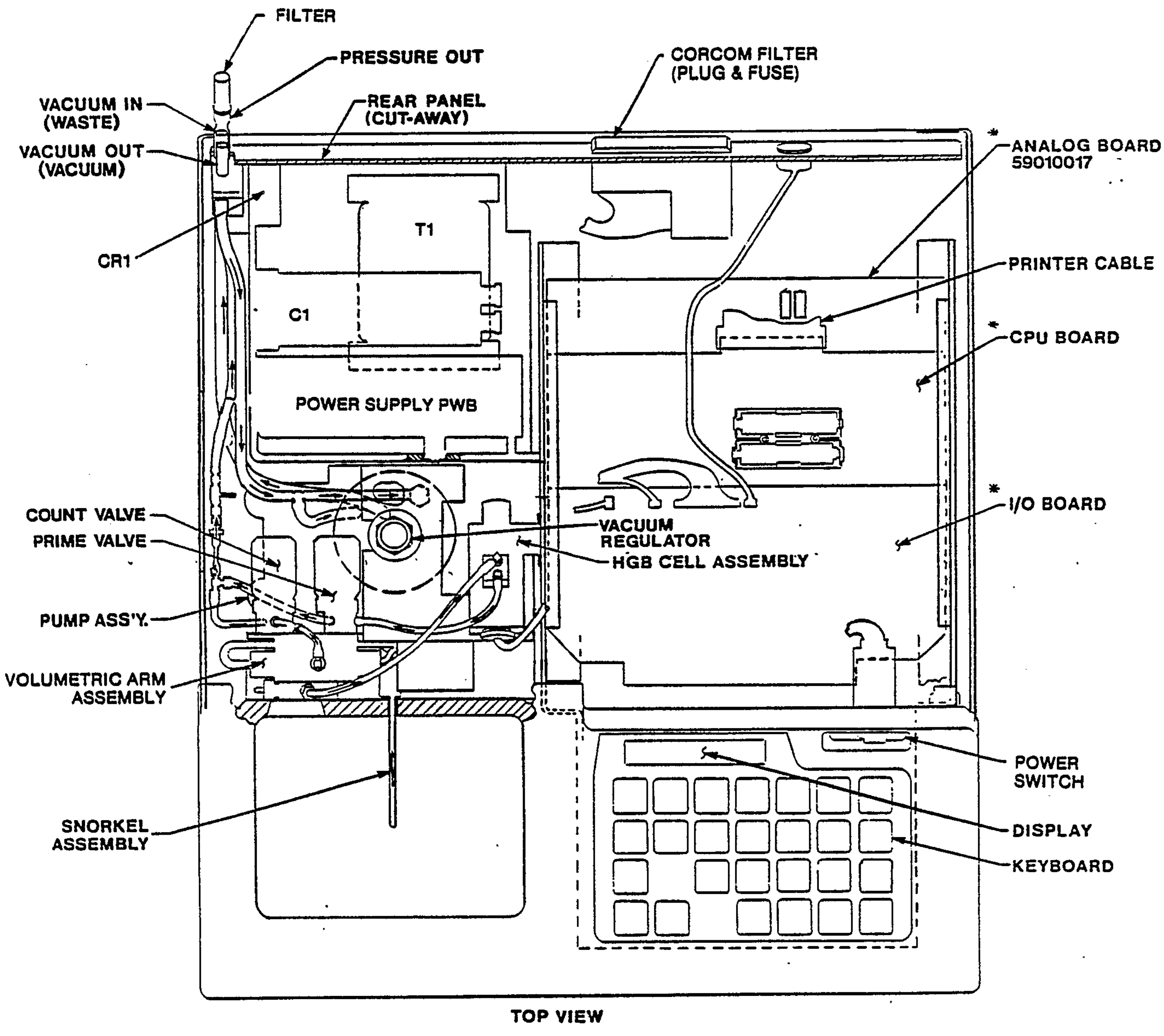
Figure 5-1. System Block Diagram

Table 5-1. Assembly Parts List

DESCRIPTION	REFERENCE	PART NUMBER
	FLUID SUBSYSTEM	
Volumetric Arm assembly	Table 5-3	51 000 138-000
Snorkel assembly	"	51 000 146-000
Valve assembly	"	51 000 386-000
Waste assembly	"	51 000 130-000
HGB Cell assembly	Table 5-4	51 000 391-000
Pump	Table 5-5	51 000 137-000
Vacuum Regulator		11 202 217-000
	ELECTRONICS SUBSYSTEM	
Motherboard	Table 5-6	59 010 020-000
Display	"	55 000 586-000
Computer PWB	Table 5-8	
130, 130 Vet		59 010 018-001
150, 150 Vet		59 010 018-002
170, 170 Vet		59 010 086-003
130 SI		59 010 018-004
150 SI		59 010 018-005
170 SI		59 010 086-006
121, 121 Vet		59 010 018-007
131, 131 Vet		59 010 018-008
I/O PWB	Table 5-10	59 010 019-000
Keyboards		
130		55 000 252-000
150, 170		55 000 253-000
121		55 000 254-000
131		55 000 255-000

Table 5-1. Assembly Parts List (Continued)

DESCRIPTION	REFERENCE	PART NUMBER
Relay PWB	Table 5-12	59 010 085-000
Analog PWB	Table 5-13	
130, 131, 130 SI; 150, 151, 151 SI; 170, 170 SI		59 010 017-001
121		59 010 017-002
130 Vet, 131 Vet		59 010 017-003
150 Vet, 170 Vet		"
121 Vet		59 010 017-004
Power Supply assembly	Table 5-14	51 000 288-000
Power Supply PWB		59 010 016-000
Capacitor, C1		17 000 500-003
Transformer, T1		55 000 544-000
Rectifier, C R1		00 300 009-003
Corcom Filter		15 000 241-000
Fuse (100/120V)		20 500 135-005
Fuse (220/240V)		20 500 135-003
Power switch		05 600 026-000
Printer		15 000 242-000
Dilutor		
106, 115V		06 300 107-001
106, 220V		06 300 107-002
105, 115V		50 000 048-001
105, 220V		50 000 048-002



* NOTE: FOR CLARITY, THE CONFIGURATION OF THE ANALOG, I/O, AND CPU BOARDS HAS BEEN ALTERED.

Figure 5-2. Assembly Locator

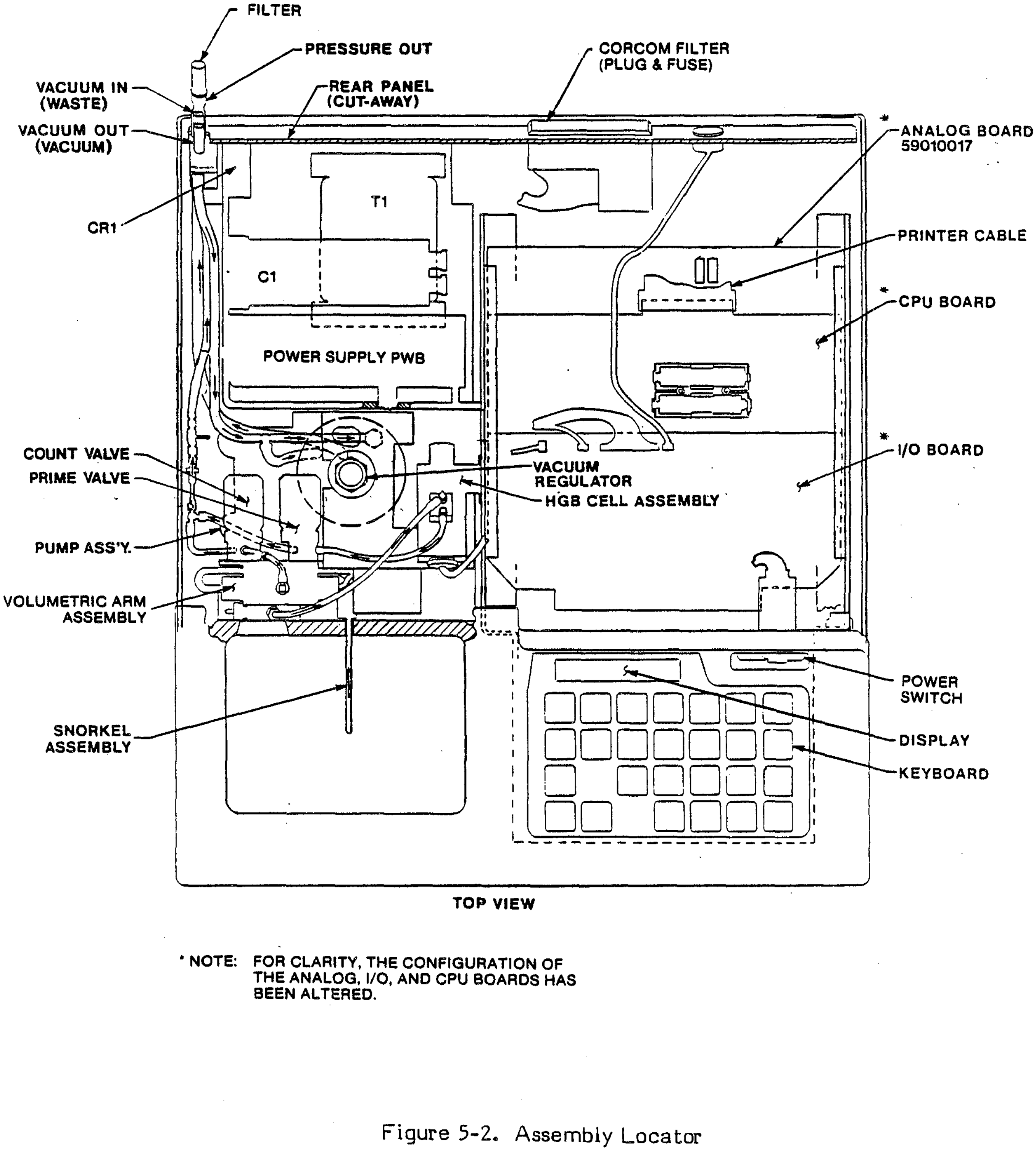


Figure 5-2. Assembly Locator

Table 5-2. Fluid Subsystem Parts List

ITEM NO.	DESCRIPTION	PART NUMBER
1	Tubing, Tygon®[1], 1/8" ID x 1/4" OD	13 220 026-003
1A	Tubing, Tygon®[1], 1/16" ID x 1/8" OD	13 219 987-001
2	Tubing assembly, cell, 0.030 ID	51 000 388-000
3	Tubing, silicone, 1/8" ID	13 220 034-000
4	Tubing, Teflon®[2], 0.030" ID	13 219 898-001
5	Filter	11 202 229-000
6	Fitting, elbow	13 219 828-000
7	Fitting, tee, 1/16" ID	13 219 823-000
8	Connector, tubing union, 1/8"	13 219 824-000
8A	Connector, tubing union, 1/8" to 1/16"	13 219 808-000
9	Ground assembly	51 000 140-000
10	Snorkel assembly	51 000 146-000
11	Vent Solenoid assembly	51 000 145-000
12	Prime Cell assembly	51 000 401-000
13	Photodetector assembly #1	51 000 389-000
14	Photodetector assembly #2	51 000 390-000
15	Volumetric tube assembly	51 000 385-000
16	Valve assembly	51 000 386-000
17	Hemoglobin cell assembly	51 000 391-000
18	Pump	51 000 137-000
19	Vacuum regulator	11 202 217-000
20	Waste assembly	51 000 130-000
21	Detector	55 000 114-000
22	Detector extension	55 000 245-000
23	Bottle stopper	55 000 244-000
24	Waste Bottle	11 202 330-000

Tygon®[1] is a registered trademark of Norton Plastics and Synthetics Div., Akron, OH.
Teflon®[2] is a registered trademark of E.I. duPont deNemours and Co., Inc., Wilmington, DE.

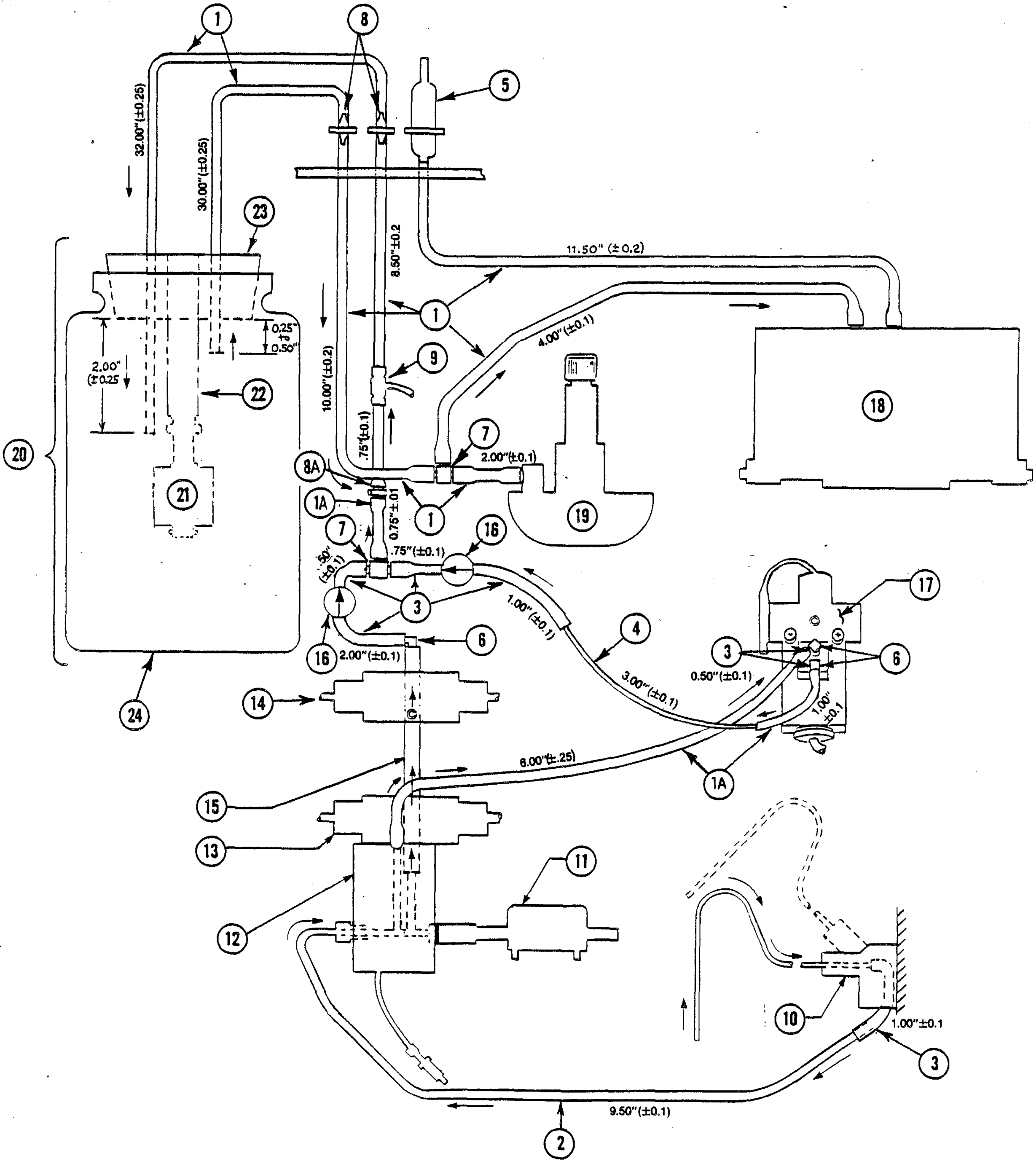


Figure 5-3. Fluid Subsystem

Table 5-3. Volumetric Arm Assembly Parts List

ITEM NO.	DESCRIPTION	PART NUMBER
1	Support Bracket	55 000 256-000
2	Cell assembly	51 000 401-000
3	Cloth, wire	55 000 262-000
4	O-ring, red	12 512 740-007
5	Fitting, Barbed	13 219 830-000
6	Screw, 6-32 x 1.37" LG	11 202 222-015
7	Tubing assembly, cell	51 000 388-000
8	Snorkel assembly (includes Item #7)	51 000 146-000
9	Set Screw, Nylon tip	12 616 221-001
10	Snorkel Mount	55 000 488-000
11	Lockwasher #6	12 512 252-000
12	Screw, 6-32 x 0.87" LG	11 202 222-011
13	Screw, 4-40 x 0.375" LG	11 202 210-005
14	Light Block assembly F	51 000 389-000
15	Screw, 2-56 x 0.19" LG	12 615 203-000
16	LED	00 300 008-000
17	Photo Transistor	00 200 000-000
18	Volumetric Arm Harness	51 000 147-000
19	Screw, 6-32 x 1.12" LG	12 310 592-013
20	Light Block assembly B	51 000 390-000
21	Volumetric Tube assembly	51 000 554-000
22	Fitting, elbow	13 219 828-000
23	Valve assembly	51 000 386-000
24	Armature	11 202 458-000
25	Clip	11 202 285-000

Table 5-3 - Volumetric Arm Assembly Parts List (Continued)

ITEM NO.	DESCRIPTION	PART NUMBER
26	Nut #4	11 202 210-001
27	Solenoid assembly	51 000 145-000
28	Pad, vent	11 202 403-000
29	Screw, 4-40 x 0.25" LG	11 202 210-003
30	Lockwasher #4	12 512 251-000
	HGB assembly (not shown, see Figure 5-5)	51 000 391-000

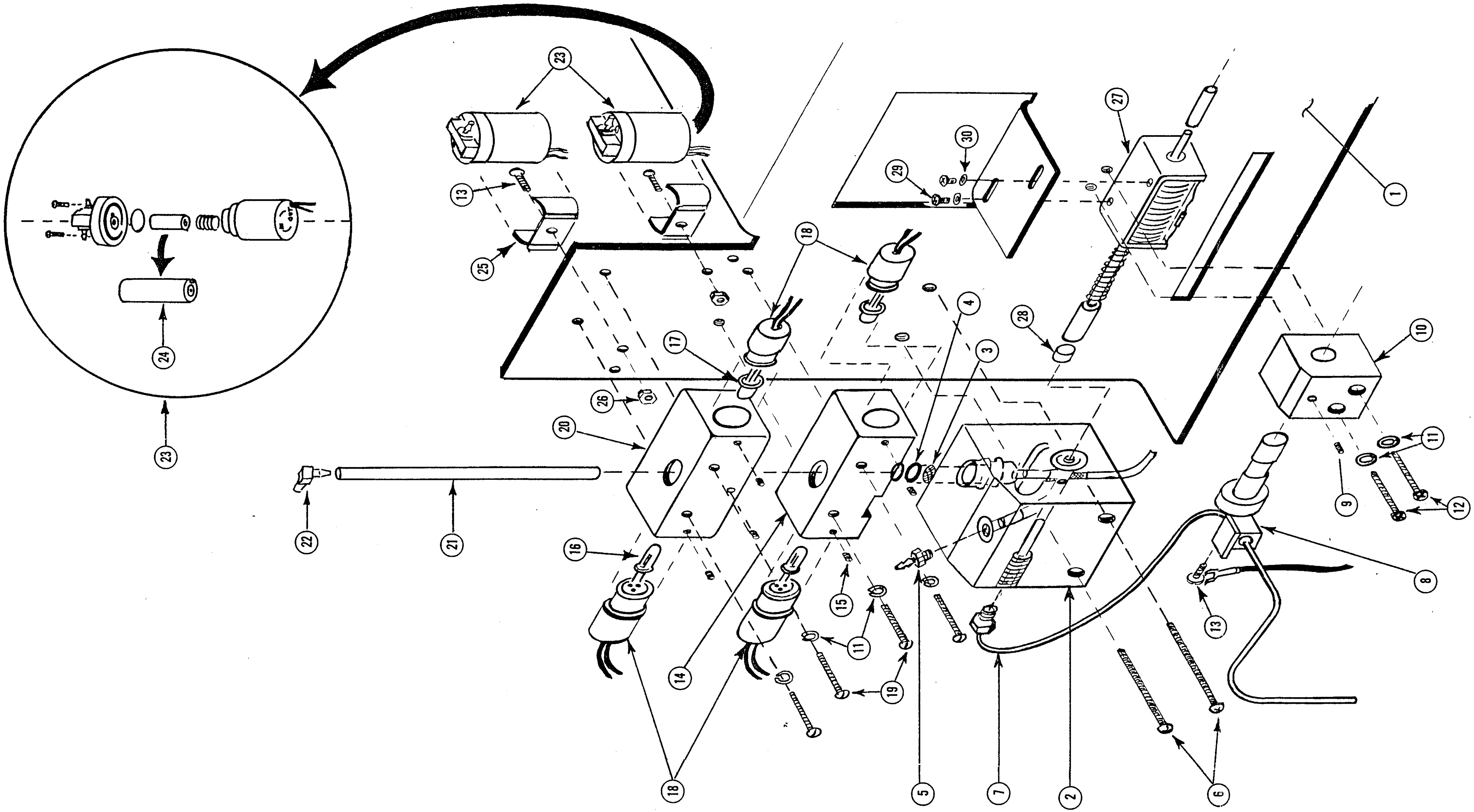


Figure 5-4. Volumetric Arm Assembly, Exploded View

Table 5-4. Hemoglobin Cell Assembly Parts List

ITEM NO.	DESCRIPTION	PART NUMBER
1	HGB Cell	55 000 136-001
2	Cell body, detector	55 000 778-000
3	HGB filter, 540nm	55 000 783-000
4	Gasket	55 000 782-000
5	Cable assembly	51 000 087-000
6	Photodetector	15 000 246-000
7	Transipad	02 200 002-003
8	PWB, HGB Cell	59 000 038-000
9	End Cap	55 000 146-000
10	Screw, 4-40 x 1.25" LG	11 202 210-013
11	Lockwasher, star #4	12 512 355-002
12	Cell body, lamp	55 000 779-000
13	Lamp	08 000 019-000
14	Set screw, 4-40 x 0.31" LG	12 615 225-000
15	Terminal Strip	22 500 024-002
16	Screw, 4-40 x 0.38" LG	12 310 591-005
17	Screw, 2-56 x 3/16" LG	12 310 590-002
18	Screw, 4-40 x 1.38" LG	12 310 586-015
19	Lockwasher, split #4	12 512 251-000
	Fitting, elbow (not shown)	13 219 828-000
	Tubing, silicone (not shown)	13 220 034-000

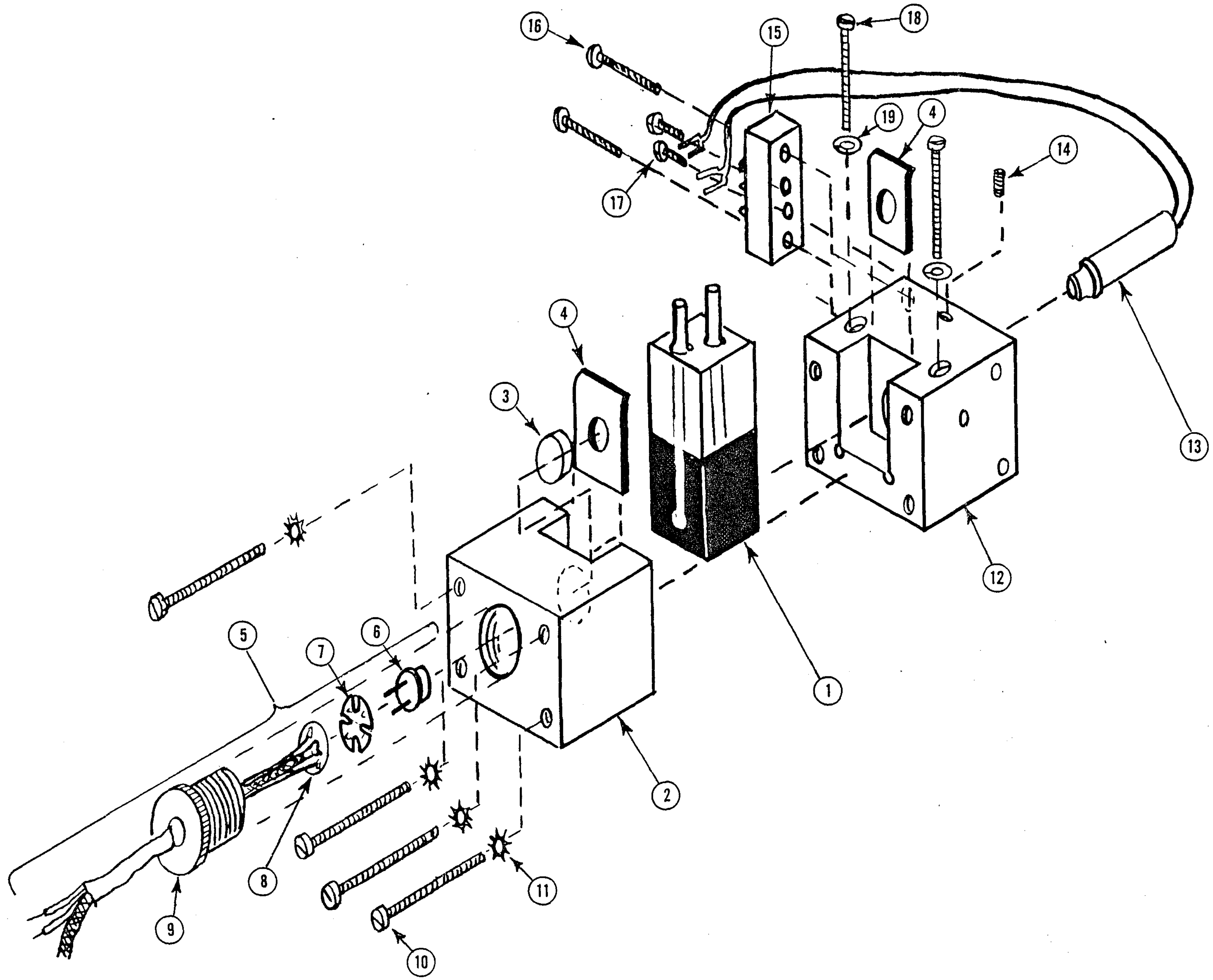


Figure 5-5. Hemoglobin Cell Assembly, Exploded View

Table 5-5. - Pump Assembly (51 000 137-000) Parts List

REF DES	DESCRIPTION	PART NUMBER
1	O-ring, mount	12 512 741-005
	Repair Kit (includes 2 through 5):	08 000 058-000
2	Pump diaphram	---
3	Head gasket	---
4	Flapper gaskets (2)	---
5	Retainer clips (2)	---
6	Metal bracket	---

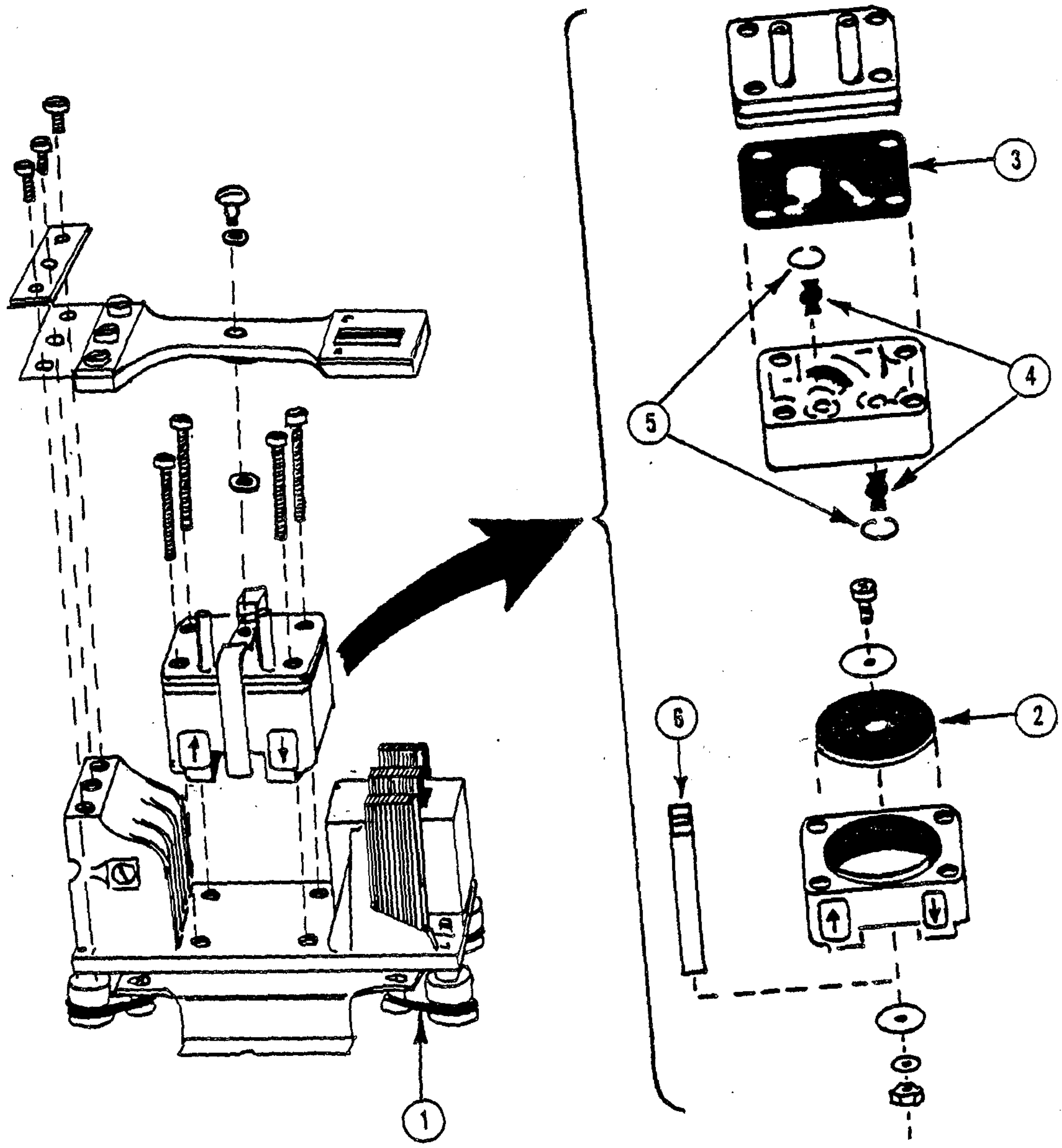


Figure 5-6. Pump, Exploded View

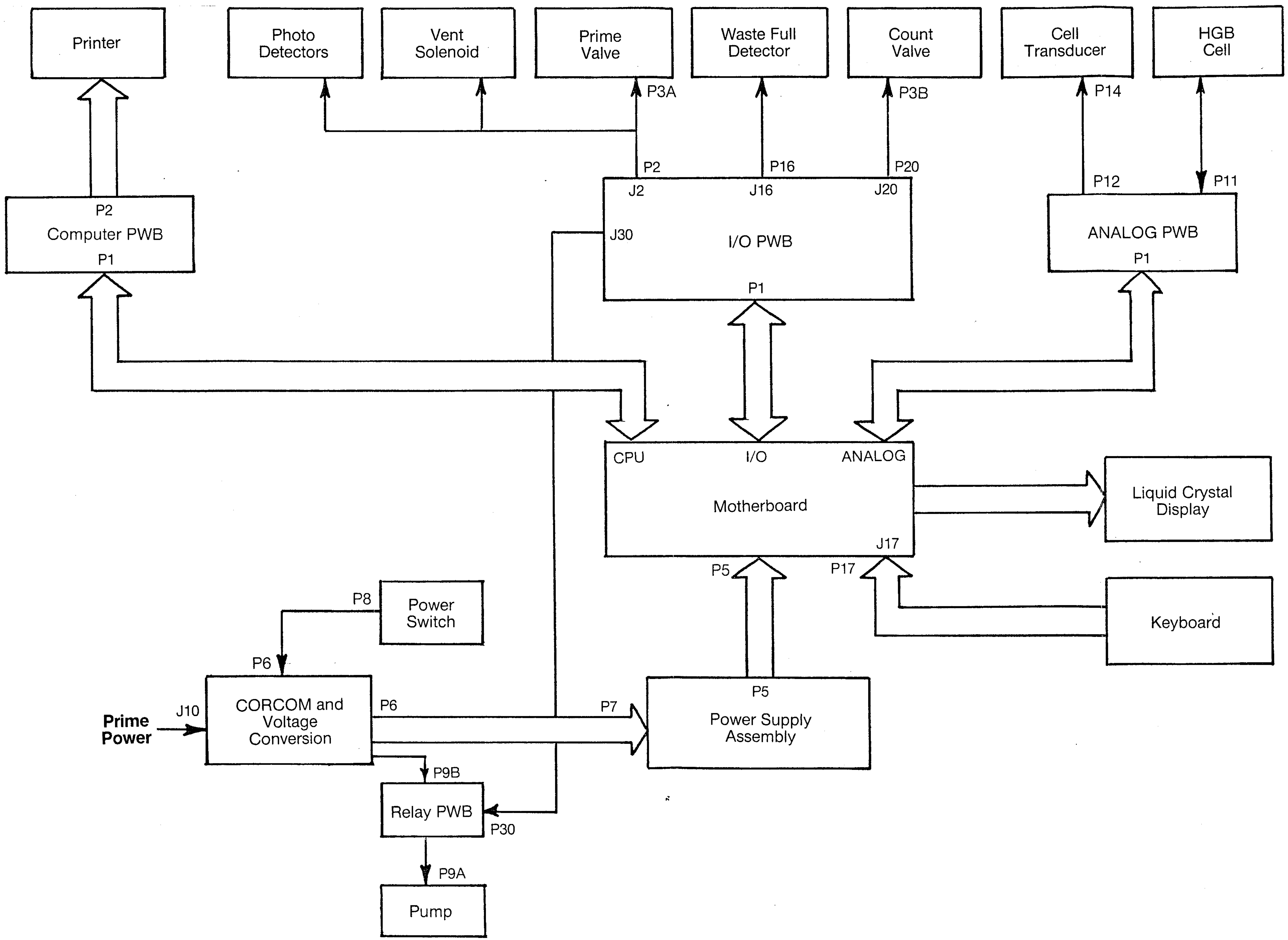
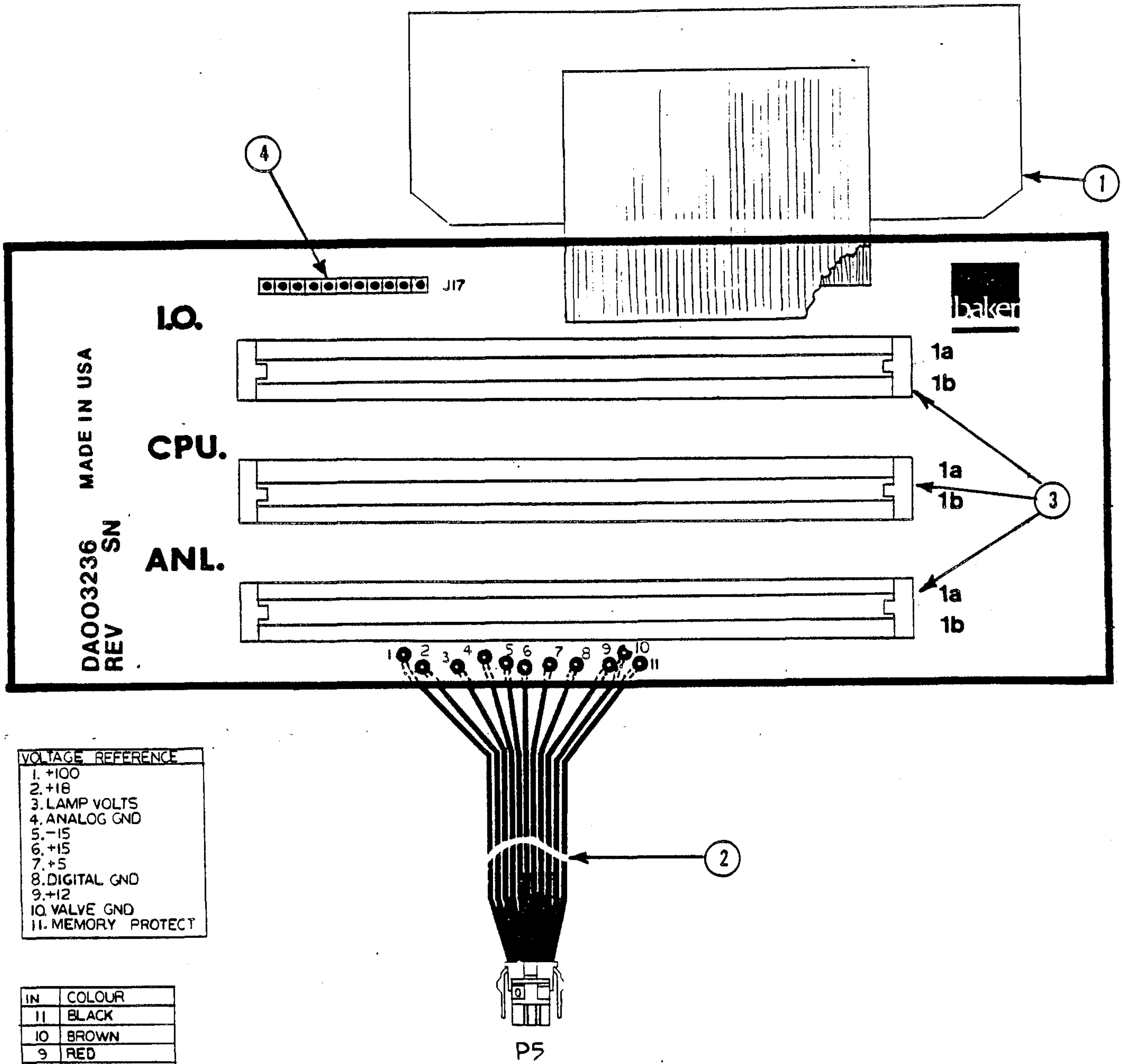


Figure 5-7. Electronics Block Diagram

Table 5-6 - Motherboard (59 010 020-000) Parts List

REF DES	DESCRIPTION	PART NUMBER
1	Display Assembly	59 010 021-000
2	Harness Assembly	51 000 279-000
3	Edge Card Socket	21 500 015-040
4	Connector	21 500 041-000



VOLTAGE REFERENCE
1. +100
2. +18
3. LAMP VOLTS
4. ANALOG GND
5. −15
6. +15
7. +5
8. DIGITAL GND
9. +12
10. VALVE GND
11. MEMORY PROTECT

IN	COLOUR
11	BLACK
10	BROWN
9	RED
8	ORANGE
7	YELLOW
6	GREEN
5	BLUE
4	VIOLET
3	GREY
2	WHITE
1	WHT/BLK

Figure 5-8. Motherboard, Parts Locator

Table 5-7 - Card Cage Wire List

SHEET 1 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA1-1A	LCD-1	LCD-21	LCD-40		DF	
XA1-2A	LCD-2				ID#	
XA1-3A	LCD-3				Ready	
XA1-4A	LCD-4				Date	
XA1-5A	LCD-5				100's E Segment	
XA1-6A	LCD-6				100's D Segment	
XA1-7A	LCD-7				100's C Segment	
XA1-8A	LCD-8				RBC D.P.	
XA1-9A	LCD-9				10's E Segment	
XA1-10A	LCD-10				10's D Segment	
XA1-11A	LCD-11				10's C Segment	
XA1-12A	LCD-12				WBC D.P.	
XA1-13A	LCD-13				1's E Segment	
XA1-14A	LCD-14				1's D Segment	
XA1-15A	LCD-15				1's C Segment	
XA1-16A	LCD-16				MCHC	
XA1-17A	LCD-17				MCV	
XA1-18A	LCD-18				MCH	
XA1-19A	LCD-19				PRP	
XA1-20A	LCD-20				HGB	
XA1-21A/B	P5-10				GND	
XA1-22A/B	P5-9				+12V	
XA1-23A/B	P5-8				GND	
XA1-24A/B	P5-7				+5V	
XA1-25A					NOT USED	
XA1-26A	XA2-20A				$\overline{\text{STD4}}$	
XA1-27A	XA2-27A				$\overline{\text{STD2}}$	
XA1-28A	XA2.28A				$\overline{\text{PSI}}$	
XA1- 29A	XA2-30A				SYS CLK	

SHEET 2 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA1-30A	J17-11				Row 1	
XA1-31A	J17-10				Row 2	
XA1-32A	J17-9				Column 1	
XA1-33A	J17-8				Column 2	
XA1-34A	J17-7				Column 3	
XA1-35A	J17-6				Row 4	
XA1-36A	J17-5				Column 4	
XA1-37A	J17-4				Column 5	
XA1-38A	J17-3				Column 6	
XA1-39A	J17-2				Column 7	
XA1-40A	J17-1				Row 3	
XA1-1B	XA3-1A				Count	
XA1-2B	LCD-39				Ready	
XA1-3B	LCD-38				Self Test	
XA1-4B	LCD-37				Minus Sign	
XA1-5B	LCD-36				100's G Segment	
XA1-6B	LCD-35				100's F Segment	
XA1-7B	LCD-34				100's A Segment	
XA1-8B	LCD-33				100's B Segment	
XA1-9B	LCD-32				10's G Segment	
XA1-10B	LCD-31				10's F Segment	
XA1-11B	LCD-30				10's A Segment	
XA1-12B	LCD-31				10's F Segment	
XA1-13B	LCD-28				1's G Segment	
XA1-14B	LCD-27				1's F Segment	
XA1-15B	LCD-26				1's A Segment	
XA1-16B	LCD-25				1's B Segment	
XA1-17B	LCD-24				RBC	

SHEET 3 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA1-18B	LCD-23				HCT	
XA1-19B	LCD-22				WBC	
XA1-20B	XA2-18A				A1	
XA1-21B	XA2-21A/B	XA3-21A/B	P5-10		Valve GND	
XA1-22B	XA2-22A/B	XA3-22A/B	P5-9		+12V	
XA1-23B	XA2-23A/B	XA3-23A/B	P5-8		DIG GND	
XA1-24B	XA2-24A/B	XA3-24A/B	P5-7		+5V	
XA1-25B	XA2-25A				RST 6.5	
XA1-26B	XA2-25B				$\overline{\text{STD5}}$	
XA1-27B	XA2-26B				$\overline{\text{STD3}}$	
XA1-28B	XA2-27B				$\overline{\text{STD1}}$	
XA1-29B	XA2-28B				$\overline{\text{PSO}}$	
XA1-30B	XA2-31B				SYS RESET	
XA1-31B	XA2-31A				$\overline{\text{WR}}$	
XA1-32B	XA2-32A				$\overline{\text{RD}}$	
XA1-33B	XA2-33B	XA3-33B			D7	
XA1-34B	XA2-34B	XA3-34B			D6	
XA1-35B	XA2-35B	XA3-35B			D5	
XA1-36B	XA2-36B	XA3-36B			D4	
XA1-37B	XA2-37B	XA3-37B			D3	
XA1-38B	XA2-38B	XA3-38B			D2	
XA1-39B	XA2-39B	XA3-39B			D1	
XA1-40B	XA2-40B	SA3-40B			D0	

SHEET 4 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA2-1A					NOT USED	
↓					NOT USED	
					NOT USED	
XA2-17A					NOT USED	
XA2-18A	XA1-20B				A1	
XA2-19A	XA1-25A				A0	
XA2-21A/B	XA1-21A/B	XA3-21A/B	P5-10		VALVE GND	
XA2-22A/B	XA1-22A/B	XA3-22A/B	P5-9		+12V	
XA2-23A/B	XA1-23A/B	XA3-23A/B	P5-8		DIG GND	
XA2-24A/B	XA1-24A/B	XA3-24A/B	P5-7		+5V	
XA2-25A	XA1-25B				RST 6.5	
XA2-26A	XA1-26A				$\overline{\text{STD4}}$	
XA2-27A	XA1-27A				$\overline{\text{STD2}}$	
XA2-28A	XA1-28A				$\overline{\text{PSI}}$	
XA2-29A/B			P5-1		+18V	
XA2-30A	XA1-29A				SYS CLK	
XA2-31A	XA1-31B				$\overline{\text{WR}}$	
XA2-32A	XA1-32B				$\overline{\text{RD}}$	
XA2-6B	XA3-5B				$\overline{\text{RD A/D LOW}}$	
XA2-7B	XA3-6B				$\overline{\text{RD A/D HIGH}}$	
XA2-8B	XA3-7B				$\overline{\text{ST ANALOG CONTROL}}$	
XA2-10B	XA3-10A				NOT USED	
↓					NOT USED	
XA2-16B	XA3-16A				NOT USED	
XA2-20B			P5-11		MEMORY PROTECT	
XA2-25B	XA1-26B				$\overline{\text{STD5}}$	
XA2-26B	XA1-27B				$\overline{\text{STD3}}$	
XA2-27B	XA1-28B				$\overline{\text{STD1}}$	
XA2-28B	XA1-29B				$\overline{\text{PSO}}$	

Table 5-7 - Card Cage Wire List (Continued)

SHEET 5 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA2-29B	P5-2				+18	
XA2-31B	XA1-30B				SYS RESET	
XA2-33B	XA1-33B	XA3-33B			D7	
XA2-34B	XA1-34B	XA3-34B			D6	
XA2-35B	XA1-35B	XA3-35B			D5	
XA2-36B	XA1-36B	XA3-36B			D4	
XA2-37B	XA1-37B	XA3-37B			D3	
XA2-38B	XA1-38B	XA3-38B			D2	
XA2-39B	XA1-39B	XA3-39B			D1	
XA2-40B	XA1-40B	XA3-40B			D0	

SHEET 6 OF 6

FROM	TO	TO	TO	TO	FUNCTION	NOTE
XA3-1A	XA1-1B				COUNT	
XA3-21A/B	XA1-21A/B	XA2-21A/B	P5-10		VALVE GND	
XA3-22A/B	XA1-22A/B	XA2-22A/B	P5-9		+12 V	
XA3-23A/B	XA1-23A/B	XA2-23A/B	P5-8		D16 GND	
XA3-24A/B	XA1-24A/B	XA2-24A/B	P5-7		+5 V	
XA3-25A/B			P5-6		RST 6.5	
XA3-26A/B			P5-5		-15 V	
XA3-27A/B			P5-4		ANALOG GND	
XA3-28A/B			P5-3		HGB LAMP	
XA3-29A/B			P5-1		+100V	
XA3-5B		XA2-6B			RD A/D LOW	
XA3-6B		XA2-7B			RD A/D HIGH	
XA3-7B		XA2-8B			ST ANALOG COUNTROL	
XA3-33B	XA1-33B	XA2-33B			D7	
XA3-34B	XA1-34B	XA2-34B			D6	
XA3-35B	XA1-35B	XA2-35B			D5	
XA3-36B	XA1-36B	XA2-36B			D4	
XA3-37B	XA1-37B	XA2-37B			D3	
XA3-38B	XA1-38B	XA2-38B			D2	
XA3-39B	XA1-39B	XA2-39B			D1	
XA3-40B	XA1-40B	XA2-40B			D0	

Table 5-8 - Computer PWB (59 010 086-000) Parts List

REF DES	DESCRIPTION	PART NUMBER
1	Tie Wrap	15 010 171-000
2	I.C. Socket, 22-Pin	02-200-001-006
3	I.C. Socket, 24-Pin	02-200-001-007
4	I.C. Socket, 40-Pin	02 200 001-009
5	Wire, #22 AWG STRND, Blue	15 400-654-007
6	Wire, #22, AWG STRND, Red	15 400 654-003
7	Wire, #22 AWG STRND, Black	15-400-654-001
8	Screw, Rd Hd, 4-40 x $\frac{1}{4}$	12 310 591-001
9	Washer	12 512 301-000
10	KEP, 4-40	11 202 223-001
11	Battery Holder	15 000 252-000
12	Battery, Nicad, AA, 1.2V	15 000 253-000
13	Wire, #22 AWG, Solid	15 400 659-004
C1, C4	Capacitor, 1 µF, 35V	17 000 503-002
C2, C3	Capacitor, 22 µF, 35V	17 000 503-010
C5	Capacitor, 4.7 µF, 35V	17 000 503-015
C6	Capacitor, 220 µF, 10V	17 000 503-011
C7	Capacitor, 27 pF	17 000 509-006
CX	Capacitor, 0.1 µF	17 000 509-004
CR1	ICTE 5 TransZorb	00 300 003-011
CR2, CR3	IN4148	00 300 000-005
Q1	Transistor, J177-18	00 200 006-000
R1	Resistor, 820 kΩ, 5%, $\frac{1}{4}$W	25 000 011-133
R2	Resistor, 1 kΩ, 5%, $\frac{1}{4}$W	25 000 011-063
R3	Resistor, 180 Ω, 5%, $\frac{1}{4}$W	25 000 011-045
U12	Integrated Circuit, HM6116 LP-4 CMOS RAM	00 100 709-000

Table 5-8 - COMPUTER PWB (59 010 086-000) Parts List (Continued)

REF DES	DESCRIPTION	PART NUMBER
R4	Resistor, 10 Ω, 5%, $\frac{1}{4}$W	25 000 011-087
R5	Resistor, 82 Ω, 5%, $\frac{1}{2}$W	25 000 012-037
R6	Resistor, 4.7 Ω, 5%, $\frac{1}{4}$W	25 000 011-079
RN1	Resistor Pack	25 001 306-000
S1	Switch	05 600 031-000
S2, S3	D.I.P. Switch, 8-position	05 600 042-000
U1	Integrated Circuit, 8085	00 100 037-000
U2	Integrated Circuit, 74LS373	00 100 022-000
U3	Integrated Circuit, 74LS500	00 100 452-000
U4, U5	Integrated Circuit, 5101 CMOS RAM	00 100 036-000
U6, U7, U8	Integrated Circuit, 74LS138	00 100 492-000
	PROGRAM OPTIONS	
U9, U10 U11	Chip Set, 131	00 105 335-001
U9, U10, U11	Chip Set, 121	00 105 336-001
U9, U10 U11	Chip Set, 170 S.I.U.	00 105 343-001
U9, U10, U11, U12	Chip Set, 150 S.I.U.	00 105 338-001
U9, U10 U11, U12	Chip Set, 130 S.I.U.	00 105 339-001
U9, U10 U11	Chip Set, 170 Standard	00 105 344-001
U9, U10, U11, U12	Chip Set, 150 Standard	00 105 341-001
U9, U10 U11, U12	Chip Set, 130 Standard	00 105 342-001
U13	Integrated Circuit, 74LS374	00 100 545-000
Y1	Crystal, 4.096 MHz	00 400 005-000

Table 5-9 - Computer PWB S2 and S3 Switch Settings

STANDARD MEMORY				EXPANDED MEMORY - Series 170™			
SWITCH 2	STATUS	SWITCH 3	STATUS	SWITCH 2	STATUS	SWITCH 3	STATUS
1	OFF	1	N.C.	1	ON	1	N.C.
2	ON	2	N.C.	2	OFF	2	N.C.
3	OFF	3	N.C.	3	ON	3	N.C.
4	ON	4	N.C.	4	OFF	4	N.C.
5	OFF	5	ON	5	ON	5	OFF
6	ON	6	OFF	6	OFF	6	ON
7	OFF	7	ON	7	ON	7	OFF
8	ON	8	OFF	8	OFF	8	ON

Series 170™ is a trademark of Baker Instruments Corporation, Allentown, PA.

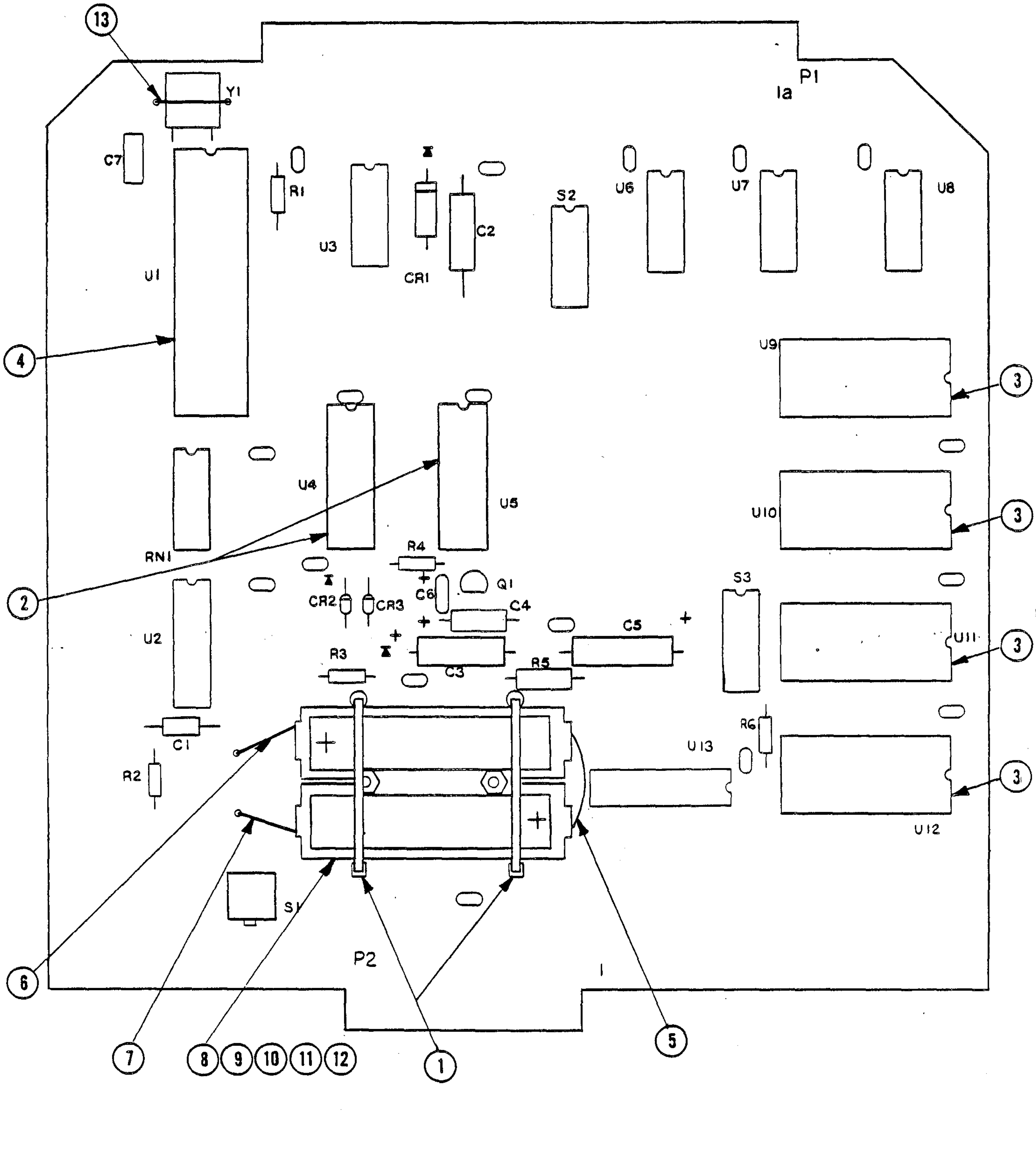


Figure 5-9. Computer PWB, Parts Locator

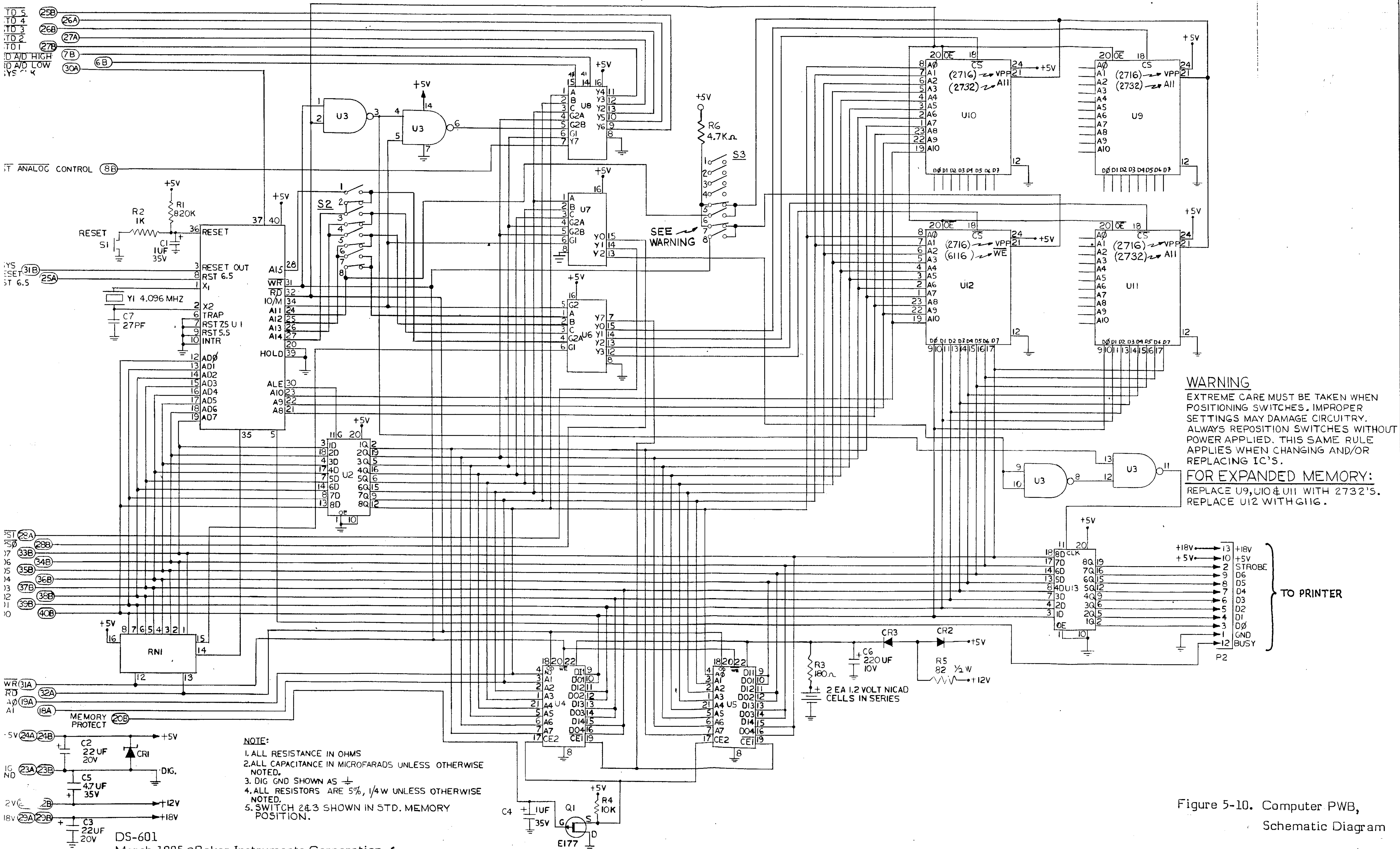


Figure 5-10. Computer PWB, Schematic Diagram

DS-601
March 1985 ©Baker Instruments Corporation

Table 5-10 - I/O PWB (59 010 019-000) Parts List

REF DES	DESCRIPTION	PART NUMBER
C1	Capacitor, 0.22 μF	17-000-502-009
C2, C4	Capacitor, 0.01 μF	17 000 502-002
C3, C5	Capacitor, 0.001 μF	17 000 509-003
C6	Capacitor, 22 μF 20V	17 000 503-009
C7	Capacitor, 4.7 μF 35V	17 000 503-015
CX	Capacitor, 0.1 μF	17 000 509-004
CR1, CR2, CR3	Diode	00 300 000-003
CR4	TransZorb	00 300 003-011
J2	Connector, 12-Pin	21 500 026-012
J16, J20	Connector, 2-Pin	21 500 026-002
J30	Pin, Terminal	21 500 085-009
L1	Sound Transducer	15 000 247-000
R1	Resistor, 2.2 kΩ, 5%, ¼W	25 000 011-071
R2	Resistor, 180 kΩ, 5%, ¼W	25 000-011-117
R3	Resistor, 82 kΩ, 5%, ¼W	25 000 011-109
R4, R5	Resistor, 330 kΩ, 5%, ¼W	25 000 011-123
R6, R7, R13, R14	Resistor, 10 kΩ, 5%, ¼W	25 000 011-087
R8	Resistor, 680 Ω, 5%, ¼W	25 000-011-059
R9, R10	Resistor, 22 kΩ, 5%, ¼W	25 000-011-095
R11, R12	Resistor, 180 Ω, 5%, ¼W	25 000-011-045
RN1	Resistor Pack 4.7 k Ω	25 001 306-000
U1	Integrated Circuit, P8255A	00 100 477-000
U2, U17	Integrated Circuit, Peripheral Driver, 75401	00 100 008-000
U3	Integrated Circuit, Quad or Gate, 74LS32	00 100 007-000

Table 5-10 - I/O PWB (59 010 019-000) Parts List (Continued)

REF DES	DESCRIPTION	PART NUMBER
U4	Integrated Circuit, Timer, SN556	00 100 006-000
U5	Integrated Circuit, Quad Comparator, LM339	00 100 005-000
U6	Integrated Circuit, Timer, 8253	00 100 004-000
U7	Integrated Circuit, Hex Inverter, 74LS04	00 100 432-000
U8	Integrated Circuit, Dual D Flip Flop, 74LS74	00 100 003-000
U9	Integrated Circuit, 4-Bit Counter, 74LS93	00 100 002-000
U10-U13	Integrated Circuit, Display Driver, 4054	00 100 001-000
U14-U16	Integrated Circuit, Display Driver, 4056	00 100 010-000

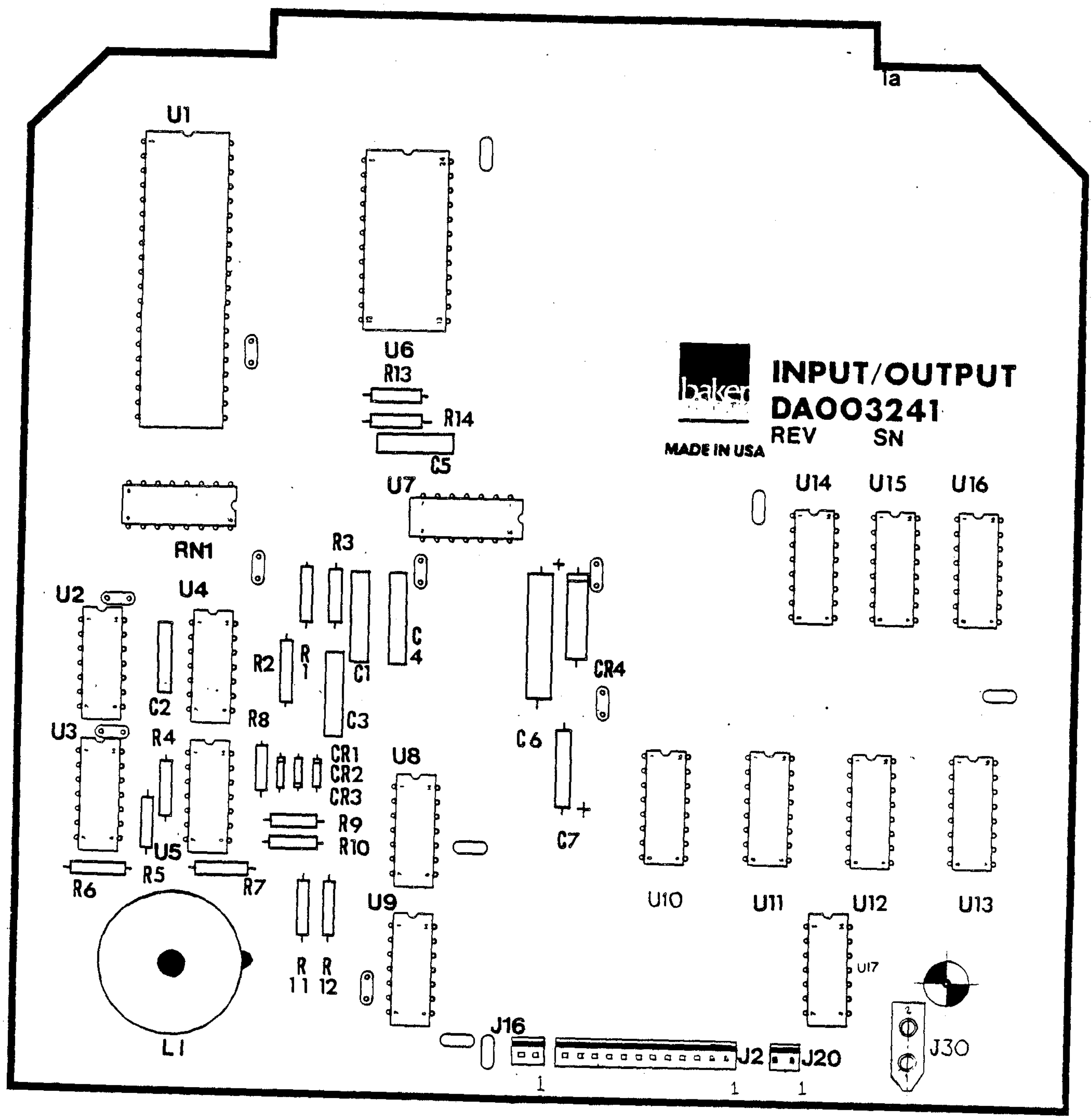


Figure 5-11. I/O PWB, Parts Locator

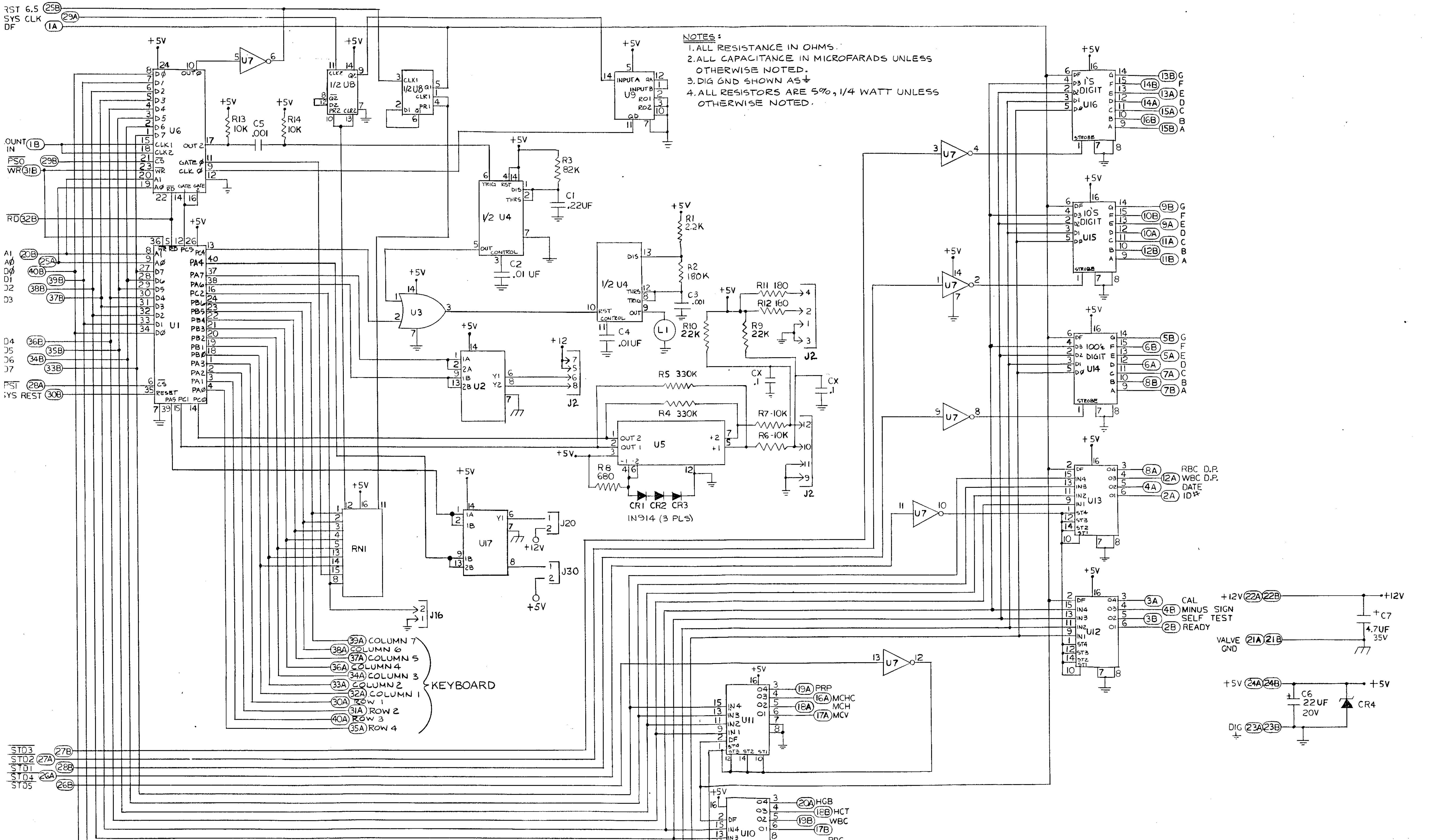


Figure 5-12. I/O PWB, Schematic Diagram

Table 5-11 - Relay PWB (59 010 084-000) Parts List

REF DES	DESCRIPTION	PART NUMBER
K1	Relay, Solid State	05 500 148-000
R1	Resistor, CBN, 200 Ω, 5%, $\frac{1}{4}$W	25 000 011-046
R3	Resistor, CBN, 220 kΩ, 5%, $\frac{1}{4}$W	25 000 011-119
XK1	Socket, 8-Pin, Low Profile	02 200 006 001
1	Cable Tie	15 010 170-000
2	Cable Assembly, Relay	51 000 400-000
3	Cable Assembly, Relay	51 000 399-000
4	Cable Assembly, Relay	51 000 398-000

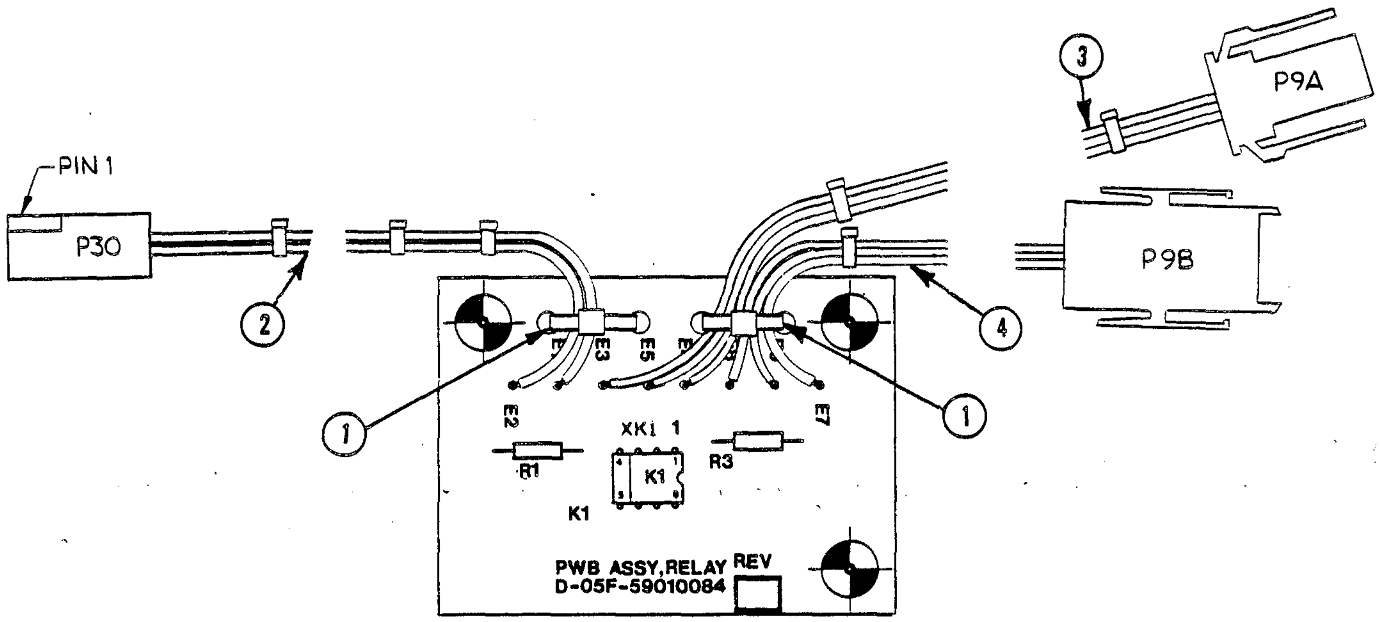


Figure 5-13. Relay PWB, Parts Locator

Table 5-12 - Relay PWB Wire Run List

ITEM NO.	WIRE COLOR	AWG	FROM	TO
2	White	24	E1	P30-1
2	Green	24	E2	P30-2
3	White/Blue	20	E3	P9A-1
3	White/Orange	20	E4	P9A-2
3	White/Gray	20	E5	P9A-3
10	Gray	20	E6	P9B-3
10	Blue	20	E7	P9B-1
10	Orange	20	E8	P9B-2

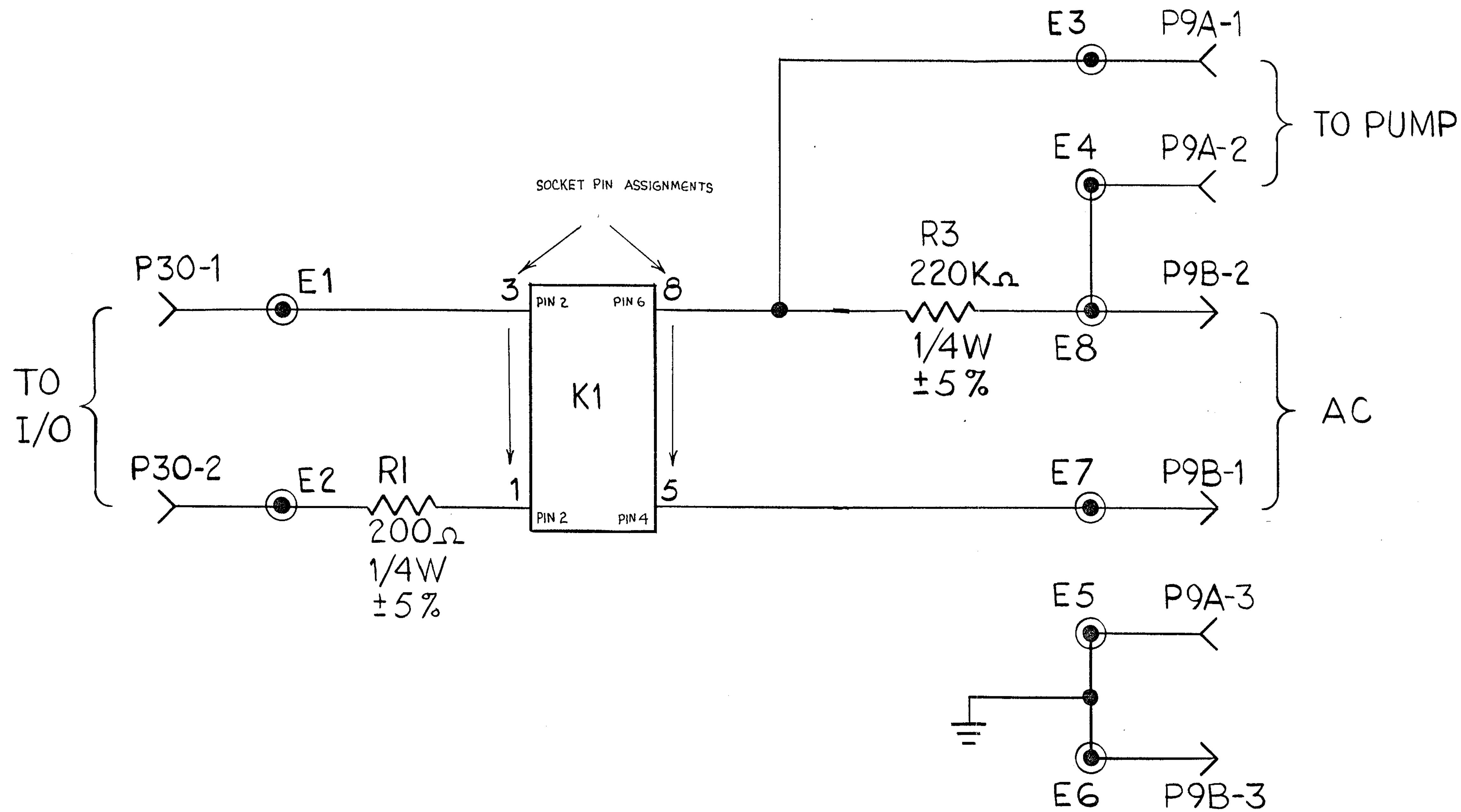


Figure 5-14. Relay PWB,
Schematic Diagram

Table 5-13 - Analog PWB (59 010 017-003) Parts List

REF DES	DESCRIPTION	Part Number
1	Shield Assembly	51 000 315-000
2	Harness Assembly (Analog Board and POT)	51 000 341-000
3	Tie Wrap	15 010 171-000
4	Harness Assembly (Analog Board and HGB)	51 000 316-000
5	Harness Assembly	51 000 239-000
6	Threaded Standoff	11 202 210-003
7	SEM #4 - 40 x $\frac{1}{4}$	51 000 316-000
C1	Capacitor, 3 μF, 200V	17 000 508-015
C2, C3	Capacitor, 1 μF, 35V	17 000 503-020
C4	Capacitor, 10 pF	17 000 506-001
C5	Capacitor, 0.022 μF	17 000 507-003
C6, C14	Capacitor, 4.7 pF	17 000 509-009
C7, C16, C17, C19, C20	Capacitor, 4.7 μF 35V	17 000 503-015
C9, C10	Capacitor, 120 μF 20V	17 000 503-004
C11, C13	Capacitor, 2.2 μF ± 10%, 50V	17 000 503-021
C12, C15, C23, CX	Capacitor, 0.1 μF 100V	17 000 509-004
C18	Capacitor, 82 pF	17 000-509-013
C21, C22	Capacitor, 0.01 μF	17 000 506-002
CR1, CR2, CR7-CR9, CR13, CR14	Diode, IN914	00 300 000-003
CR3	TransZorb, ICTE 5	00-300-003-011
CR4, CR5	TransZorb, ICTE 15	00 300 003-012
CR6	Diode, IN935A	00 300 003-013
CR10, CR11	Diode, IN270	00 300 000 002

Table 5-13 - Analog PWB (59 010 017-003) Parts List (Continued)

REF DES	DESCRIPTION	Part Number
CR12	Diode, FD333	00 300 000-004
Q1	Transistor, 2N5416	00 200 004-000
Q2	Transistor, 2N2905	00 200 131-000
R1	Resistor, 220 Ω, 5%, ¼W	25 000 011-047
R2	Resistor, 6.81 kΩ, 1%, 1/8W	25 001 305-485
R3	Resistor, 15 kΩ, 1%, 1/8W	25 001 305-108
R4	Resistor, 47.5 kΩ, 1%, 1/8W	25 001 305-396
R5, R8, R11, R15, R20, R21, R42	Resistor, 100 kΩ, 1%, 1/8W	25 001 305-006
R6	Resistor, 475 kΩ, 1%, 1/8W	25 001 305-397
R7, R12, R25, R26, R43	Resistor, 10 kΩ, 1%, 1/8W	25 001 305-005
R9, R10	Resistor, 9.09 kΩ, 1%, 1/8W	25 001 305-557
R13, R44, R45	Resistor, 100 Ω, 5%, 1/4W	25 000 011-039
R14	Resistor, 237 kΩ, 1%, 1/8W	25 001 304-000
R16	Resistor, 121 kΩ, 1%, 1/8W	25 001 305-052
R17	Resistor, 12.7 k Ω,1%, 1/8W	25 001 305-066
R18	Resistor, 2.21 kΩ, 1%, 1/8W	25 001 305-203
R19, R30, R39	Resistor, 4.7 kΩ, 5%, ¼W	25 000 011-079
R22, R23	Resistor, 196 kΩ, 1%, 1/8W	25 001 305-175
R24	Resistor, 39.2 k Ω,1%, 1/8W	25 001 305-348
R27	Resistor, 1 kΩ, 1%, 1/8W	25 001 305-001
R28, R32, R33, R36, R48	Resistor, 10 kΩ, 5%, ¼W	25 000 011-087

Table 5-13 - Analog PWB (59 010 017-003) Parts List (Continued)

REF DES	DESCRIPTION	Part Number
R31	Resistor, 680 Ω, 5%, ¼W	25 000 011-059
R34	Resistor, 40.2 kΩ, 1%, 1/8W	25 001 305-354
R35	Resistor, 2.21 kΩ, 1%, 1/8W	25 001 305-203
R37	Resistor, 1 kΩ, 5%, ¼W	25 000 011-063
R38	Resistor, 100 kΩ, 5%, ¼W	25 000 011-111
R40	Resistor, 12 kΩ, 5% ¼W	25 000 011-089
R41	Resistor, 1.2 kΩ, 5%, ¼W	25 000 011-065
U1	Integrated Circuit, TIL-111, Opto Coupler	00 100 021-000
U2	Integrated Circuit, TL084ACN, Op Amp	00 100 029-000
U3, U6 U15	Integrated Circuit, LM210H, Op Amp	00 100 031-000
U4	Integrated Circuit, LM311H, Comparator	00 100 135-000
U5	Integrated Circuit, SN7416N, Buffer	00 100 183-000
U7	Integrated Circuit, LH0022H, Op Amp	00 100 035-000
U8	Integrated Circuit, LM201AH, Op Amp	00 100 030-000
U9	Integrated Circuit, DG200, Analog Switch	00 100 034-000
U10, U11	Integrated Circuit, MM74C74N, Flip Flop	00 100 025-000
U12	Integrated Circuit, MM74C00N, Nand gate	00 100 023-000
U13	Integrated Circuit, SN74121, One shot	00 100 127-000
U14	Integrated Circuit, DG508AC, Multiplexer	00 100 033-000
U16	Integrated Circuit, ADC80AG-10, A/D Converter	00 100 027-000
U17, U18	Integrated Circuit, SN74LS368, Buffer	00 100 026-000
U19	Integrated Circuit, 74LS374, Octal latch	00 100 545-000
U20	Integrated Circuit, MM74C14N, Schmitt trigger	00 100 024-000

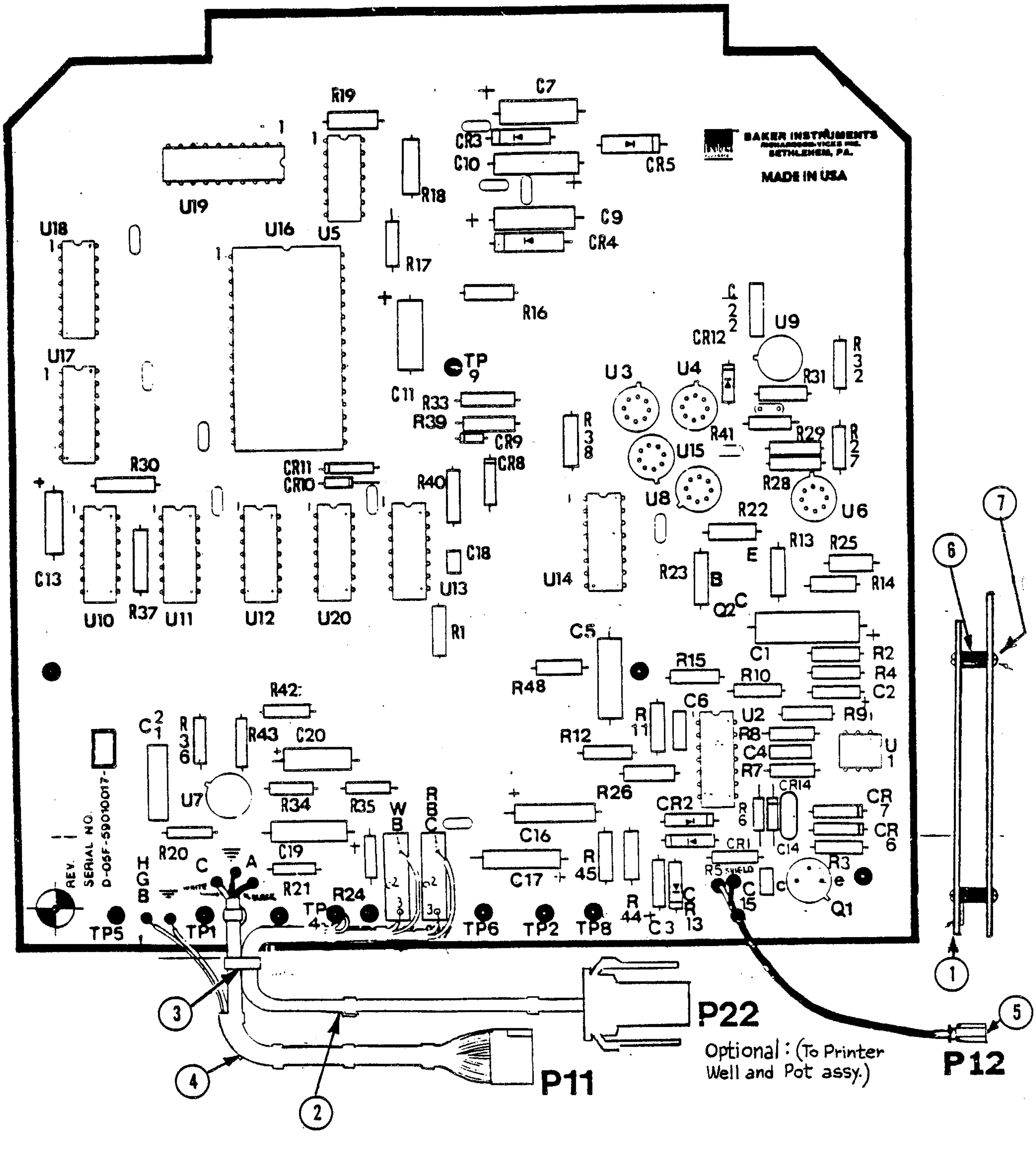


Figure 5-15. Analog PWB, Parts Locator

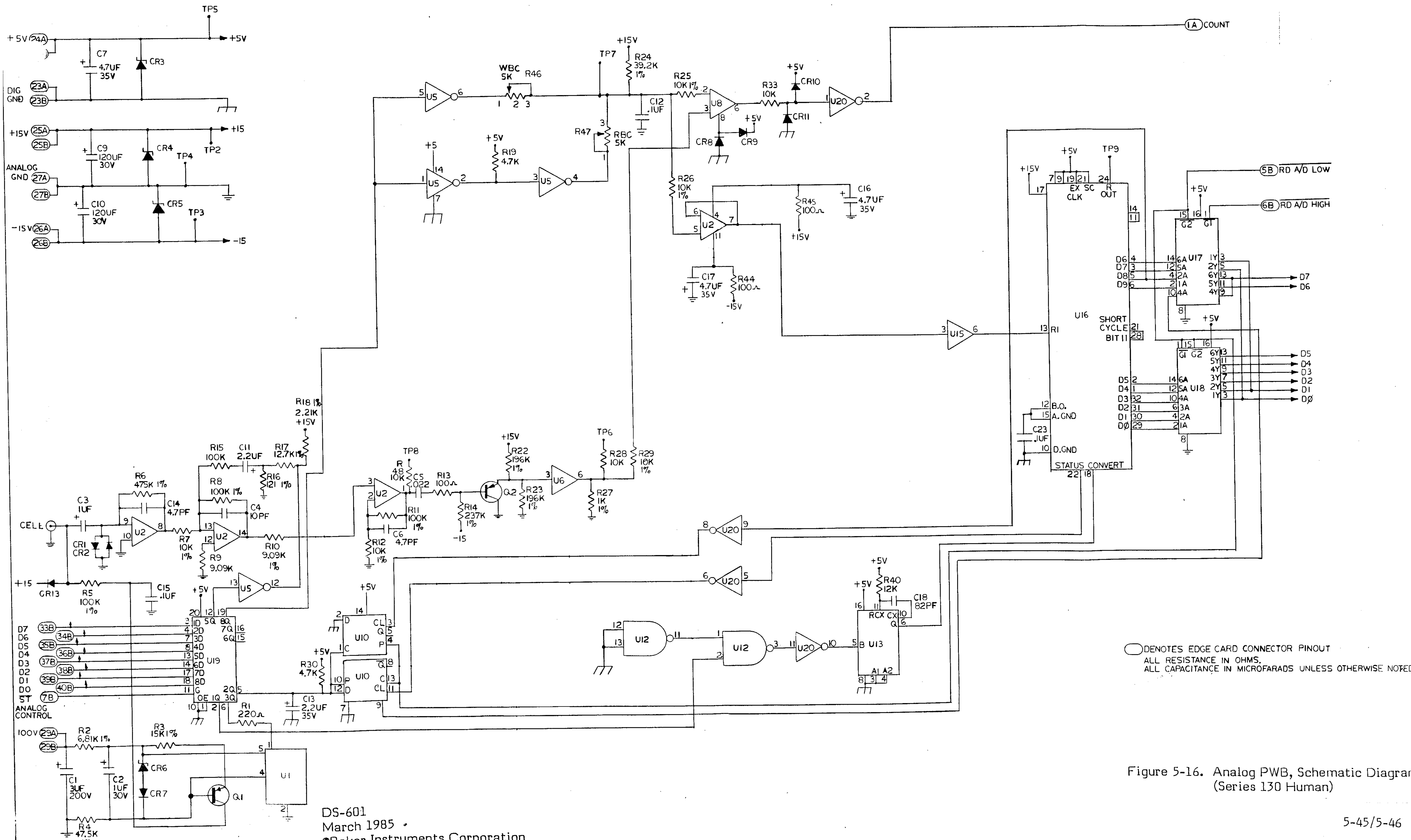


Figure 5-16. Analog PWB, Schematic Diagram (Series 130 Human)

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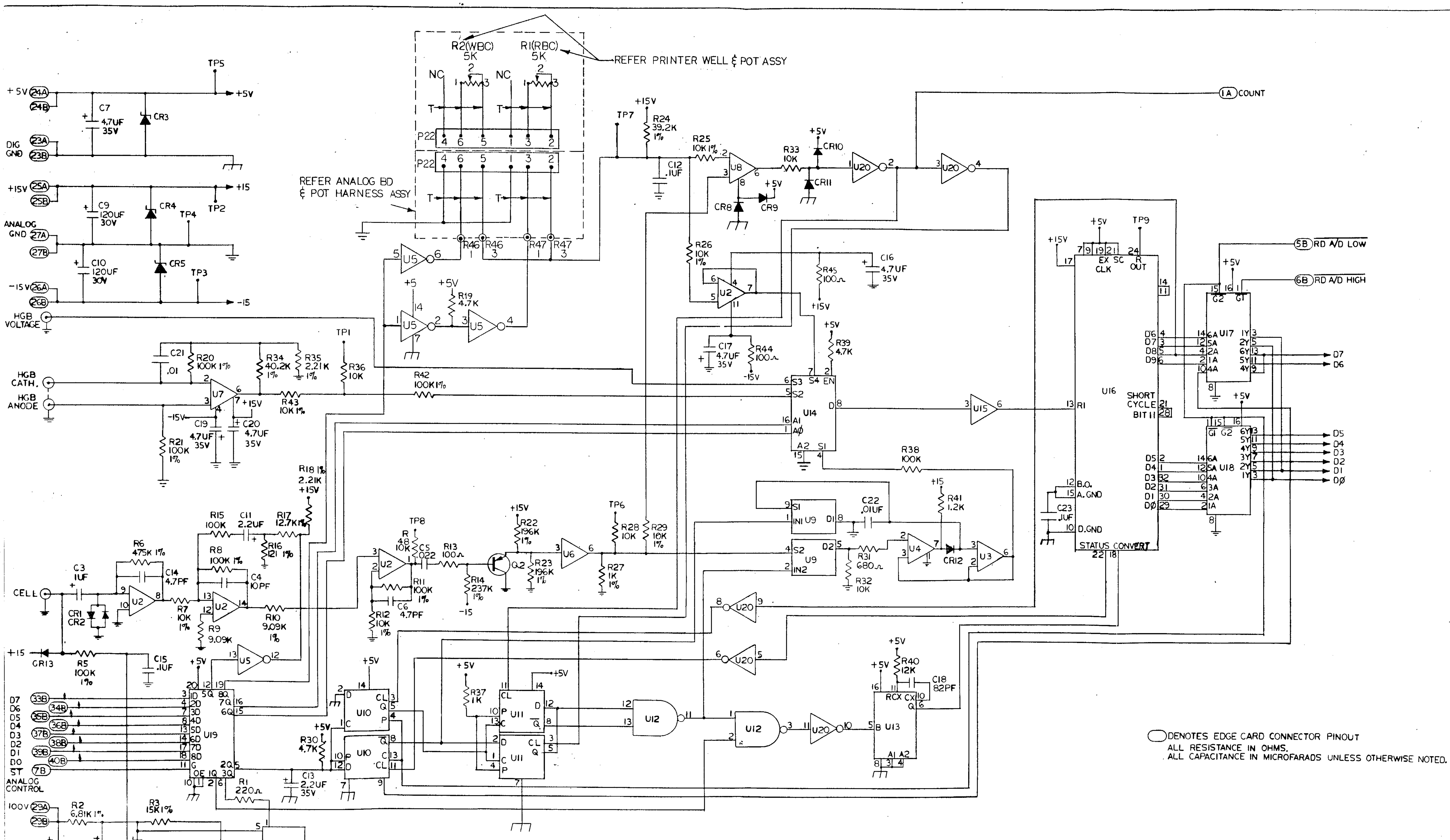

Figure 5-17. Analog PWB, Schematic Diagram (Series 150, 170, Veterinary)

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Table 5-14 - Power Supply PWB (59 010 016-000) Parts List

REF DES	DESCRIPTION	Part Number
1	Heatsink	55 000 550-000
2	Insulator	15 000 248-003
3	Thermal Compound	11 202 291-000
4	Insulator	15 000 248-001
5	Screw, #6-32, 3/8", Steel	12 310 592-007
6	Screw, #6-32, 3/8", Nylon	11 202 231-005
7	#6-32 KEPS	11 202 223-002
8	Input Harness	51 000 232-000
9	Output Harness	51 000 258-000
C1-C3	Capacitor, 2200 µF, 35V	17 000 508-010
C4	Capacitor, 30 µF, 200V	17 000 508-017
C5	Capacitor, 0.01 µF, 200V	17 000 502-002
C6	Capacitor, 1000 µF, 35V	17 000 508-006
C7, C19	Capacitor, 1 µF, 35V	17 000 503-020
C8, C14-C18	Capacitor, 0.1 µF, 100V	17 000 509-004
C9-C11, C13	Capacitor, 4.7 µF, 35V	17 000 503-017
C12	Capacitor, 3 µF, 200V	17 000 508-015
CR1-CR4	Diode, IN4004	00 300 001-003
CR5, CR6	Diode, IN4148	00 300 000-005
CR7, CR8	Diode, IN4758	00 300 003-007
CR9	Diode, IN4743	00 300 003-006
CR10	Diode, IN4005	00 300 001-004
Q1	Transistor, MJE1100	00 200 003-000
Q2	Transistor, 2N5814	00 200 002-000

Table 5-14 - Power Supply PWB (59 010 016-000) Parts List (Continued)

REF DES	DESCRIPTION	Part Number
R1	Resistor, 680 Ω, 5%, ¼W	25 000 011-059
R2-R4	Resistor, 2.2 k Ω 5%, ¼W	25 000 011-071
R5	Resistor, 120 kΩ, 5%, ¼W	25 000 011-113
R6	Resistor, 100 kΩ, 5%, ¼W	25 000 011-111
R7	Resistor, 47 kΩ, 5%, ¼W	25 000 011-103
R8	Resistor, 10 kΩ, 5%, ¼W	25 000 011-087
R9, R10	Resistor, 5.6 k Ω,5%, ¼W	25 000 011-081
R11	Resistor, 470 Ω, 5%, ¼W	25 000 011-055
R12	Resistor, 220 Ω, 5%, ¼W	25 000 011-047
R13	Potentiometer, 200 Ω	25 005 039-000
R15	Resistor, 270 kΩ, 5%, ¼W	25 000 011-121
U1, U2	Rectifier, MDA970-2	00 300 009-002
U3	Voltage Regulator, LM323K	00 100 017-000
U4	Voltage Regulator, 7815	00 100 020-000
U5	Voltage Regulator, 7915	00 100 019-000
U6	Voltage Regulator, 7818	00 100 018-000
U7	Timer, LM2905	00 100 554-000
U8	Voltage Regulator, LM317T	00 100 016-000

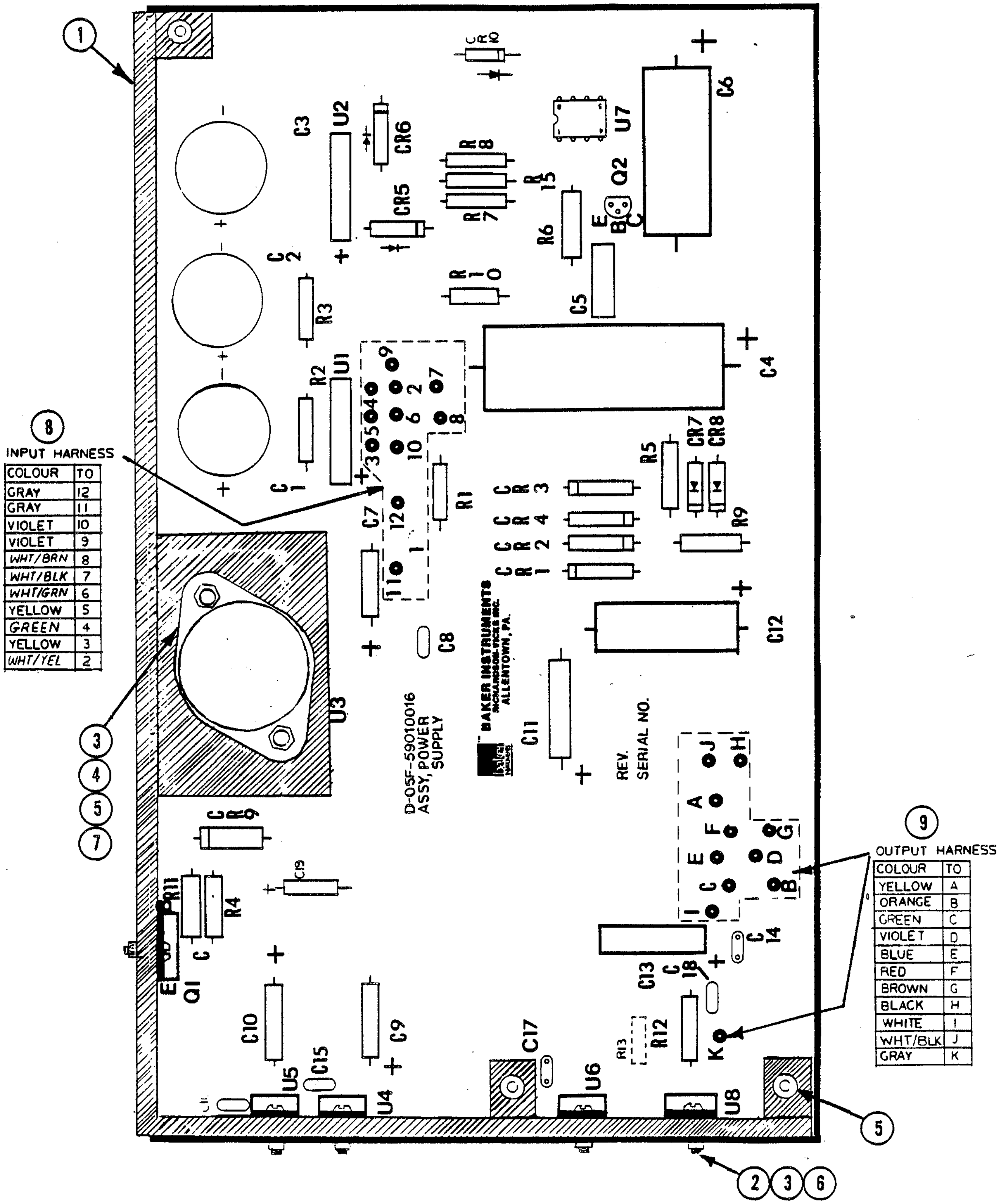

Figure 5-18. Power Supply PWB, Parts Locator

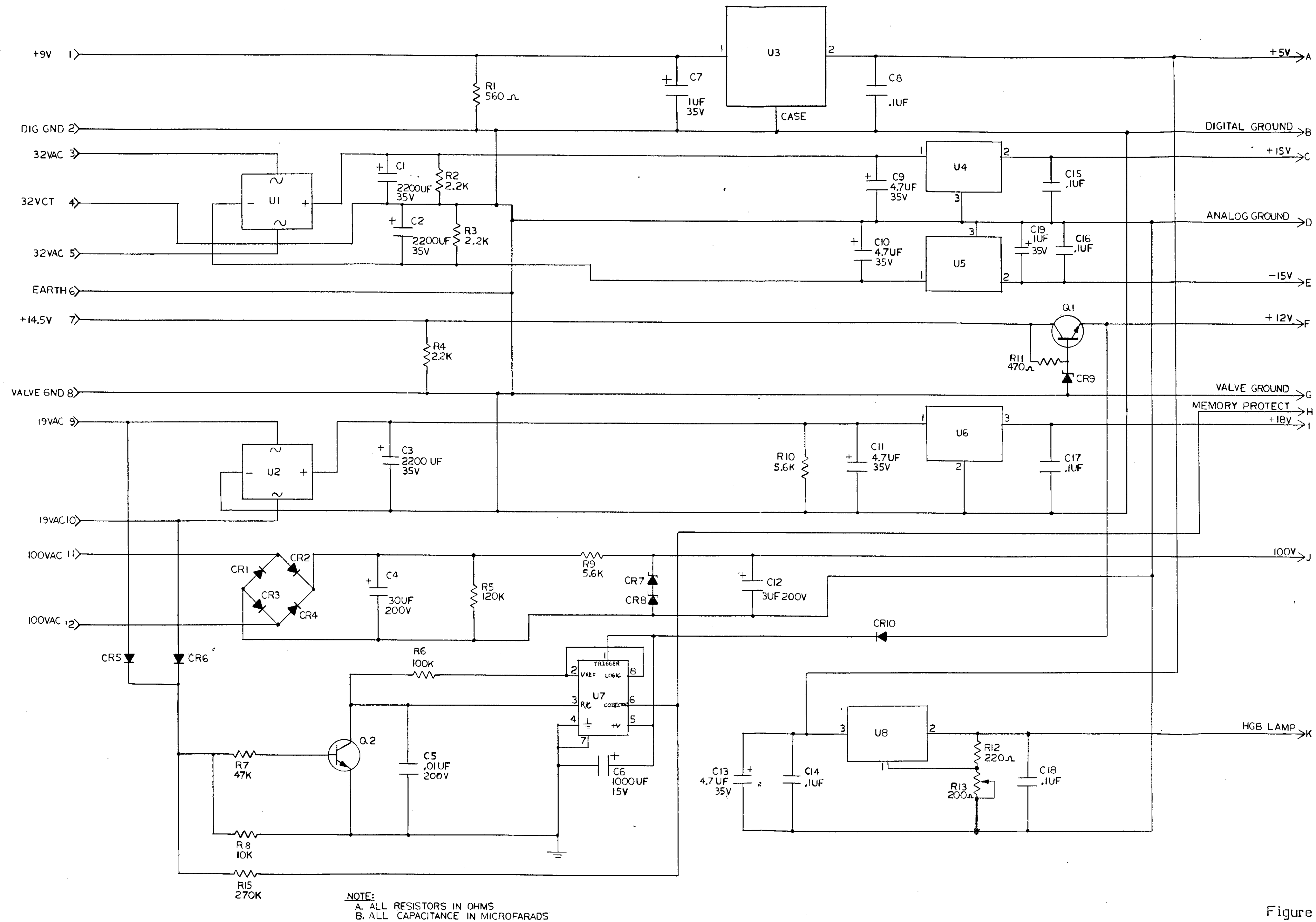

Figure 5-19. Power Supply PWB, Schematic Diagram

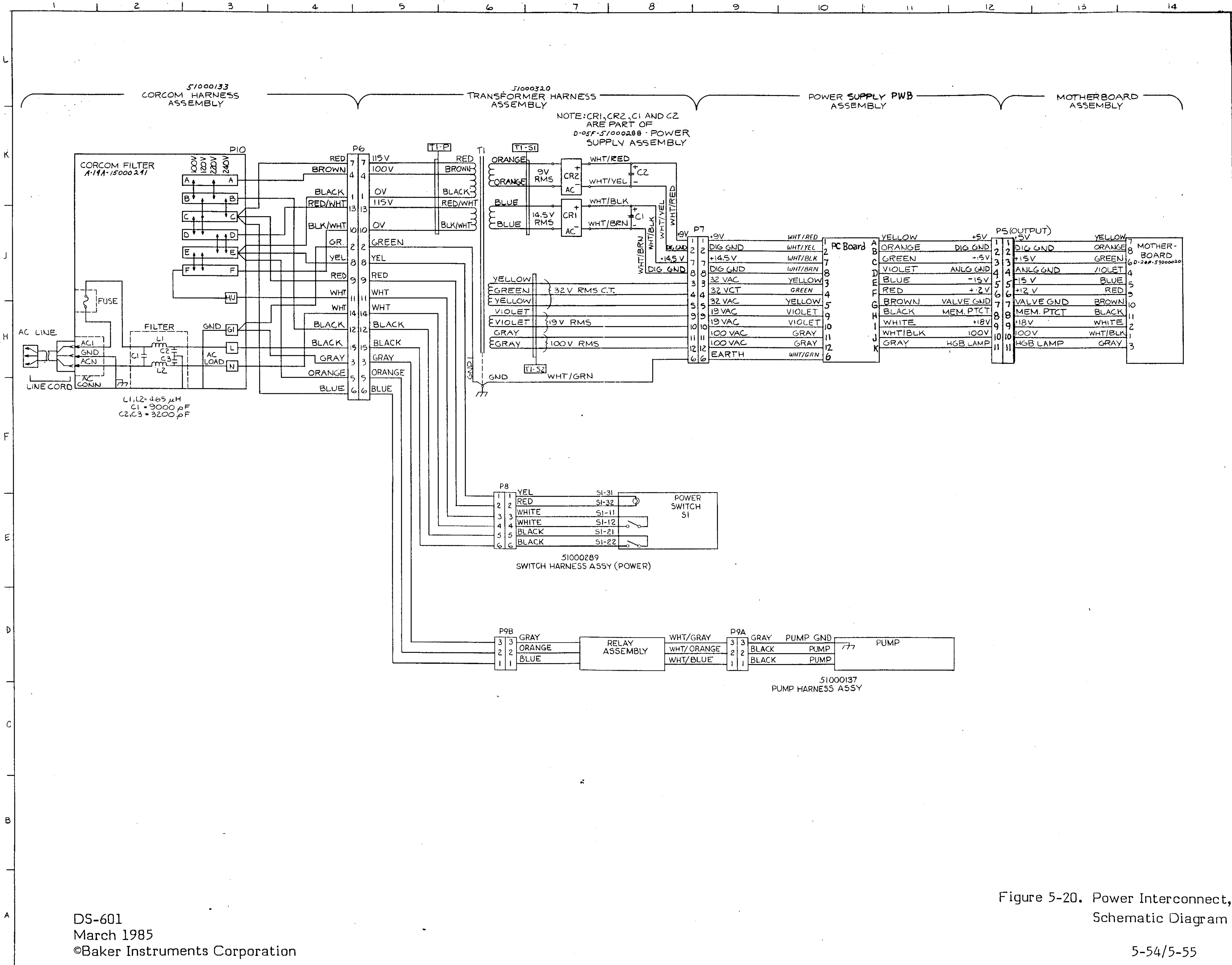

Figure 5-20. Power Interconnect, Schematic Diagram

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Table 5-15 - Power Supply Wire List

SUB-SYSTEM P2- I/O PWB DRWG.
APP'D. FOR RELEASE DATE SHEET 1 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P2-1	LED2-1				GND	
P2-2	LED2-2				+5Vdc	
P2-3	LED1-1				GND	
P2-4	LED1-2				+5Vdc	
P2-5	P4-1	Vent Sol.			+12Vdc	
P2-6	TS13-1	P3A-1	Prime Valve		GND	
P2-7	TS13-2	P3A-2	Prime Valve		+12Vdc	
P2-8	P4-2	Vent Sol.			GND	
P2-9	PC2-1				GND	
P2-10	PC2-2				Photo 2 Output	
P2-11	PC1-1				GND	
P2-12	PC1-2				Photo 2 Output	

SUB-SYSTEM P3 Volumetric Arm Assembly DRWG.
APP'D. FOR RELEASE DATE SHEET 2 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P3A-1	TS13-1	Prime Valve			GND	
P3A-2	TS13-2	Prime Valve			+12Vdc	
P3B-1	TS13-3	Count Valve			GND	
P3B-2	TS13-4	Count Valve			+12Vdc	

SUB-SYSTEM P4-Vent Solenoid DRWG.
APP'D. FOR RELEASE DATE SHEET 3 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P4-1	P2-5	Vent Sol.			+12Vdc	
P4-2	P2-8	Vent Sol.			GND	

SUB-SYSTEM P5 Power Supply PWB DRWG.
APP'D. FOR RELEASE DATE SHEET 4 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P5-1	P.S.-A	M.B.-7			+5Vdc	1, 2
P5-2	P.S.-B	M.B.-8			Dig GND	1, 2
P5-3	P.S.-C	M.B.-6			+15Vdc	1, 2
P5-4	P.S.-D	M.B.-4			Anlg GND	1, 2
P5-5	P.S.-E	M.B.-5			-15Vdc	1, 2
P5-6	P.S.-F	M.B.-9			+12Vdc	1, 2
P5-7	P.S.-G	M.B.-10			Valve GND	1, 2
P5-8	P.S.-H	M.B.-11			Memory Protect	1, 2
P5-9	P.S.-I	M.B.-2			+18Vdc	1, 2
P5-10	P.S.-J	M.B.-1			100V	1, 2
P5-11	P.S.-K	M.B.-3			HCB Lamp	1, 2

Table 5-15 - Power Supply Wire List (Continued)

SUB-SYSTEM P6 AC Power DRWG.
APP'D. FOR RELEASE ____ DATE ____ SHEET 5 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P6-1	P10-E	T1-P (black)			AC LO	3
P6-2	P10-GI	Chassis			GND	
P6-3	P10-GI	P9B-3			GND	
P6-4	P10-A	T1-P (brown)			100V	3
P6-5	P10-E	P9B-2			AC LO	
P6-6	P10-C	P9B-1			115Vac	
P6-7	P10-C	T1-P (red)			115Vac	3
P6-8	P10-E	P8-1	S1-31		AC LO	5
P6-9	P10-C	P8-2	S1-32		115Vac	5
P6-10	P10-F	T1-P (blk/whc)			AC LO	3
P6-11	P10-H/J	P8-3	S1-11		Switch return	5
					(neutral)	
P6-12	P10-B	P8-5	S1-21		Switch return	5
					(hot)	
P6-13	P10-D	T1-P (red/whc)			115Vac	3
P6-14	P10-N	P8-4	S1-12		AC LO	5
P6-15	P10-L	P8-6	S1-22		AC HI	5

SUB-SYSTEM P7 Power Supply Assembly DRWG.
APP'D. FOR RELEASE ____ DATE ____ SHEET 6 OF 12

FROM	TO	TO	TO	TO.	FUNCTION	NOTE
P7-1	P.S.-1	C2+	CR2+-		+9Vdc	1
P7-2	P.S -2	C2-	CR2-		Dig GND	1
P7-3	P.S.-3	T1-S2 (yellow)			32Vac	1, 4
P7-4	P.S.-4	T1-S2 (green)			32Vct	1, 4
P7-5	P.S.-5	T1-S2 (yellow)			32Vac	1, 4
P7-6	P.S.-6				Chassis	1
P7-7	P.S.-7	C1+	CR1+		+14.5Vdc	1
P7-8	P.S.-8	C1-	CR1-		Dig GND	1
P7-9	P.S.-9	T1-S2 (violet)			19Vac	1, 4
P7-10	P.S.-10	T1-S2 (violet)			19Vac	1, 4
P7-11	P.S.-11	T1-S2 (gray)			100Vac	1, 4
P7-12	P.S.-12	T1-S2 (gray)			100Vac	1, 4

SUB-SYSTEM P8 Power Switch DRWG.
APP'D. FOR RELEASE ____ DATE ____ SHEET 7 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P8-1	S1-31	P6-8	P10-E		AC LO	5
P8-2	S1-32	P6-9	P10-C		115Vac	5
P8-3	S1-11	P6-11	P10-H/J		Switch return	5
					(neutral)	
P8-4	S1-12	P6-14	P10-N		AC LO	5
P8-5	S1-21	P6-12	P10-B		Switch return	5
					(hot)	
P8-6	S1-22	P6-15	P10-L		AC HI	5

SUB-SYSTEM P9 Relay PWB DRWG.
APP'D. FOR RELEASE ____ DATE ____ SHEET 8 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P9A-1	Pump (black)	Relay (whc/blue)			115Vac	
P9A-2	Pump (black)	Relay (whc/orange)			AC LO	
P9A-3	Pump (gray)	Relay (whc/gray)			GND	
P9B-1	Relay (blue)		P6-6	P10-C	115Vac	
P9B-2	Relay (orange)		P6-5	P10-E	AC LO	
P9B-3	Relay (gray)		P6-3	P10-G/I	Gnd	

Table 5-15 - Power Supply Wire List (Continued)

SUB-SYSTEM P10 Corcom Filter DRWG.
APP'D. FOR RELEASE ______ DATE ______ SHEET 9 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P10-A	P6-4	T1-P (brown)			100Vac	3
P10-B	P6-12	P8-5	S1-21		Switch return (hot)	5
P10-C	P6-7	T1-P (red)			115Vac	3
P10-C	P6-9	P8-2	S1-32		115Vac	5
P10-C	P6-6	P9B-1			115Vac	
P10-D	P6-13	T1-P (red/wht)			115Vac	3
P10-E	P6-1	T1-P (black)			AC LO	3
P10-E	P6-8	P8-1	S1-31		AC LO	5
P10-E	P6-5	P9B-2			AC LO	
P10-F	P6-10	T1-P (blk/wht)			AC LO	3
P10-GI	P6-2	Chassis			GND	
P10-GI	P6-3	P9B-3			GND	
P10-H/J	P6-11	P8-3	S1-11		Switch return (neutral)	5
P10-L	P6-15	P8-6	S1-22		AC HI	5
P10-M	P6-14	P8-4	S1-12		AC LO	5

SUB-SYSTEM P11 HGB Cell Assembly DRWG.
APP'D. FOR RELEASE ______ DATE ______ SHEET 10 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P11-1					HGB GND	
P11-2					HGB Cathode	
P11-3					HGB Anode	
P11-4	TB1-1				HGB Lamp	
P11-5	TB1-2				GND	

SUB-SYSTEM P12/P14 Analog PWB DRWG.
APP'D. FOR RELEASE ______ DATE ______ SHEET 11 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P12-1	P14-1	Electrode (hot)			Cell	
P12-2	P14-2	Electrode (cold)			GND	

SUB-SYSTEM P20 I/O PWB DRWG.
APP'D. FOR RELEASE ______ DATE ______ SHEET 12 OF 12

FROM	TO	TO	TO	TO	FUNCTION	NOTE
P20-1	P3B-1	TS13-3	Count Valve		GND	
P20-2	P3B-2	TS13-4	Count Valve		+12Vdc	

NOTES

1. P.S. is Power Supply PWB
2. M.B. is Mother board in card cage
3. T1-P is primary side of transformer in Power Supply Assembly
4. T1-S is secondary side of transformer in Power Supply Assembly
5. S1 is the POWER switch on front of instrument