



INSTRUCTION 77-9054
PDFM-808
Part Number 77-7070
Installation/Operation/Maintenance
Revision 5 - August, 2004

World Headquarters
621 Hunt Valley Circle, New Kensington, PA 15068
Ph: 724-334-5000 • Fax: 724-334-5001 • Toll Free: 800-736-4666
Website: www.bacharach-inc.com • E-mail: help@bacharach-inc.com

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SPECIFICATIONS

A. ELECTRICAL

Power Requirements:	4.0 Amps at 115 VAC, 60 Hz. 2.0 Amps at 220 VAC, 50 Hz.*
Operating Voltage:	115 VAC \pm 10%, 60/50 Hz., Single phase
RPM Input Signal:	60, 120, 150 or 300 pulses per revolution (magnetic or TTL). All Bacharach test stands** use a magnetic input of 120 pulses per revolution.
RPM Input Range:	50 to 5000 RPM
RPM Sensor (Magnetic):	0.6 VAC pp minimum 0.7 Vpp maximum frequency 25KHz
RPM Sensor (TTL):	0.5 to 4.5 VDC Range maximum frequency 25KHz
RPM Accuracy:	\pm 1 RPM over input range

B. HYDRAULIC

Inputs:	Eight 1/4 inch quick connect fittings; check valve type
Outlet:	One drain with 3/8" ID PVC Hose
Operating Pressure:	Approximately 75 psi

C. FLOWMETER

Operating Range:	3 to 225 mm ³ /stroke/outlet
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D. OPERATING TEMPERATURE: 60°F to 100°F (15°C to 38°C) (ambient)

E. SIZE (CRT & Console): See Page 2-1

F. WEIGHT (CRT & Console): 105 lbs. (47.6 kg.)

G. CRT: Model Dependent

H. PRINTER: 20 column, alphanumeric, thermal type

* Obtained by an external step-down transformer included with PDFM 808 (PN 77-7071)

**Current production

NOTES:

1 INTRODUCTION

1.1 GENERAL INFORMATION

The Bacharach PDFM 808 (Positive Displacement Flow Meter) Fluid Measurement System with monitor (CRT) Display measures the fluid delivery of diesel injection pumps. When used with an injection pump test stand, the PDFM 808:

- Measures the fluid delivery from a single injection pump outlet.
- Computes the average fluid delivery from up to eight pump outlets.
- Measures the delivery of each pump outlet, in sequence.

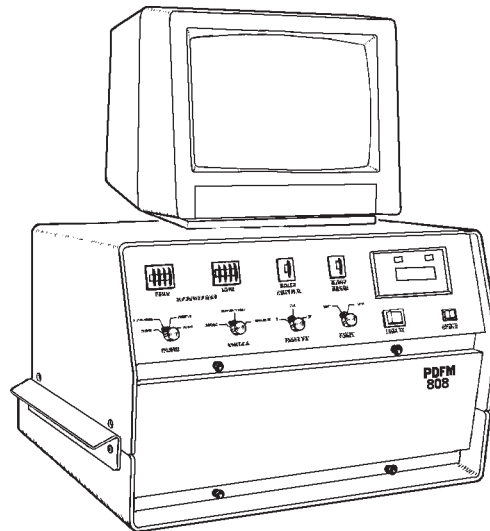
A CRT mounted on the PDFM console displays delivery flow values and related data. This includes error messages, to alert you to incorrect switch settings. At your option, a paper tape printer permanently records fluid delivery values.

This precision equipment has been fully tested at the Bacharach factory as follows:

- The accuracy of the PDFM 808's fluid delivery measurements.
- Operation of the unit's controls, switches, display and printer.

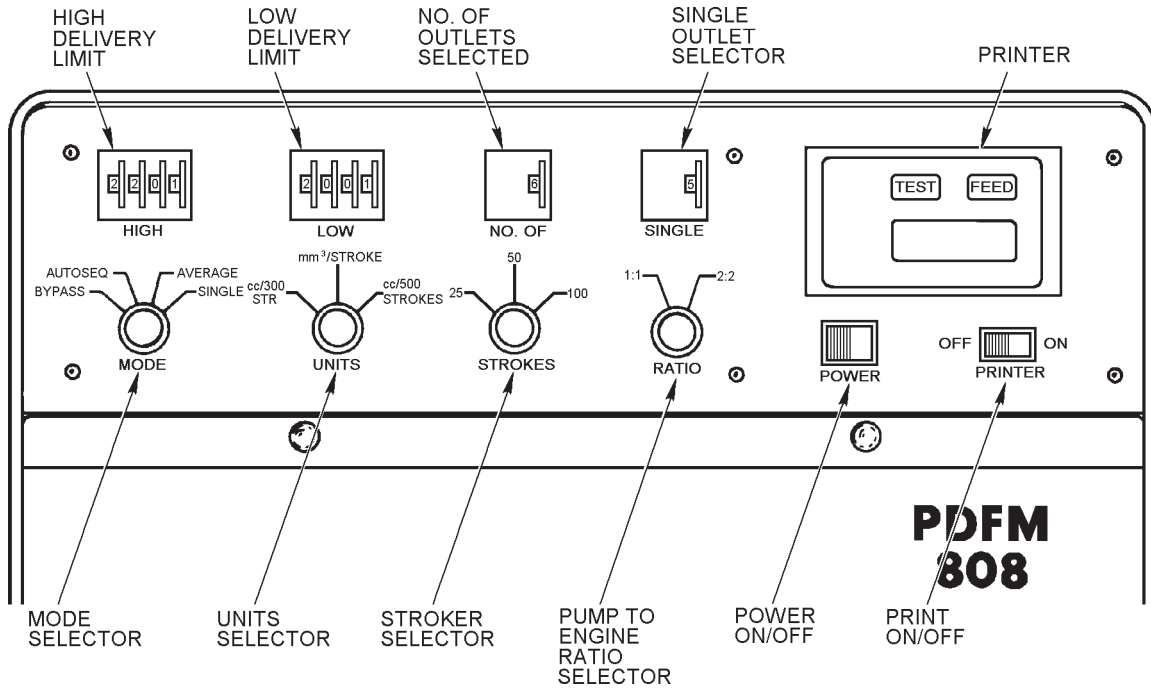
The PDFM 808 is easy to install, operate, maintain and repair. Should problems arise, consult Chapters 3 and 4 for help in interpreting error messages, finding and solving operation problems, and replacing parts. A list of accessories for installing the PDFM 808 on various Test Stands can be found in Section 2.6, and 5.2.

Figure 1-1. PDFM 808



1.2 PDFM CONSOLE FEATURES & OPERATION

Figure 1-2. PDFM Console Features

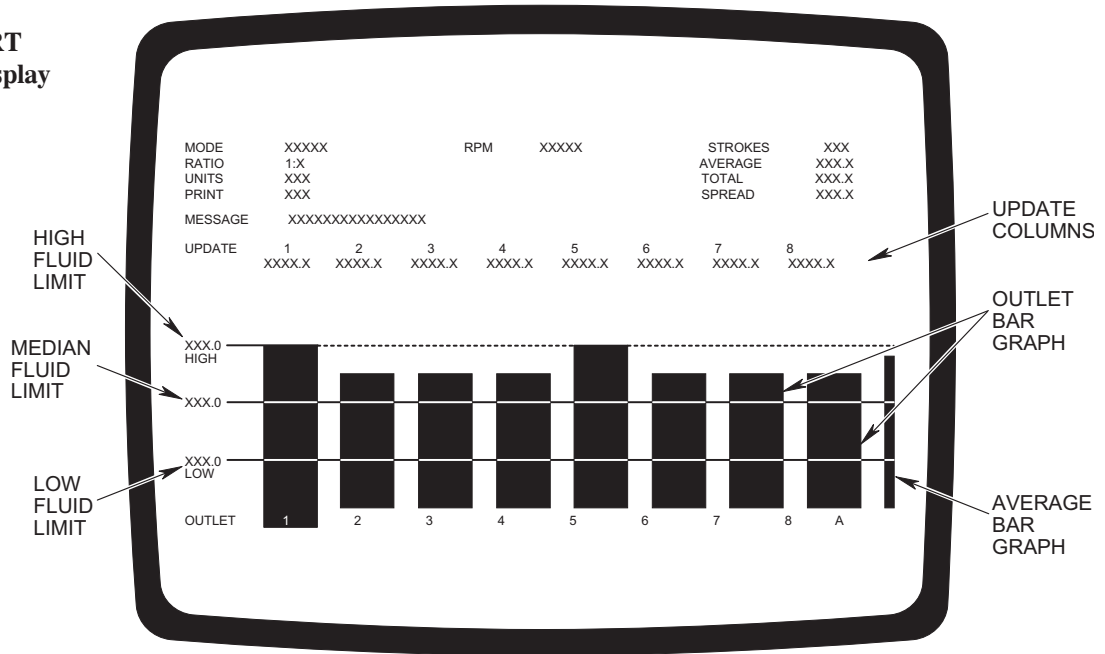


Feature	Operation
HIGH and LOW Delivery Limit switches	Set upper and lower limits for the injection pump's fluid delivery. Limits can be set to any number between 000.0 and 999.9. Consult the pump manufacturer's specifications when setting these limits.
NO. OF OUTLETS switch	Selects the number of injection pump outlets to be tested (up to eight).
SINGLE OUTLET	Selects a single injection pump outlet to measure its fuel delivery.

Feature	Operation
Printer FEED & TEST switches	Operates when the PRINT ON/OFF switch is ON. Press the FEED button to feed paper tape. Press self TEST to check printer operation.
PRINT ON/OFF switch	Enables or disables the printing of flow test results.
POWER ON/OFF switch (Red)	When lit, indicates that 115 VAC \pm 10% input power is available to run the PDFM.
RATIO switch	Selects the pump shaft to engine crankshaft drive ratio. May be set to 1:1 or 1:2.
STROKES switch	Selects the number of injection pump strokes required to measure an outlet's fluid delivery. May be set to 25, 50 or 100 strokes.
UNITS switch	Selects the unit of measure for fluid delivery. May be set to cc per 300 strokes, mm ³ per stroke, or cc per 500 strokes.
MODE switch	<p>Selects one of four operating modes:</p> <ul style="list-style-type: none"> (1) BYPASS Fluid from the injection pump bypasses the transducer. (2) AUTOSEQUENCE Measures the fluid delivery of each injection pump outlet, in sequence. (3) AVERAGE Measures the fluid delivery of all injection pump outlets. Computes the average fluid delivery. (4) SINGLE Measures the fluid delivery from a single (user selected) pump outlet.

1.3 CRT DISPLAY

Figure 1-3. CRT Display



Feature	Operation
MODE	Displays the current mode of PDFM operation (BYPASS, AUTOSEQUENCE, AVERAGE, or SINGLE).
RATIO	Displays the selected drive ratio of injection pump to engine.
UNITS	Displays the selected unit of measurement for fluid delivery.
PRINT	Displays print status (ON or OFF).
RPM	Displays the current injection pump (test stand) revolutions per minute.
STROKES	Displays the selected number of strokes for measuring an injection pump outlet's delivery.
AVERAGE	Displays the average fluid flow from all injection pump outlets.
TOTAL	Displays the total flow of all the displayed injection pump outlets.
SPREAD	Displays the maximum difference between the highest and lowest delivery values.

Feature	Operation
MESSAGE	Displays error messages (normally blank).
COLUMNS & BAR GRAPHS	Display fluid delivery values for each pump outlet. Column numbers correspond to the numbers on the solenoid valves at the back of the PDFM. The far right hand Bar Graph (A) indicates the average outlet delivery.
OUTLET	Lists pump outlet numbers. Highlights the number of the outlet column being updated.
HIGH Fluid Limit	Displays the user selected upper fluid delivery limit.
Median Fluid Limit	Displays a fluid delivery value halfway between the upper and lower fluid flow limits. The PDFM 808 automatically calculates and displays this value.
LOW Fluid Limit	Displays the user selected lower fluid delivery limit.

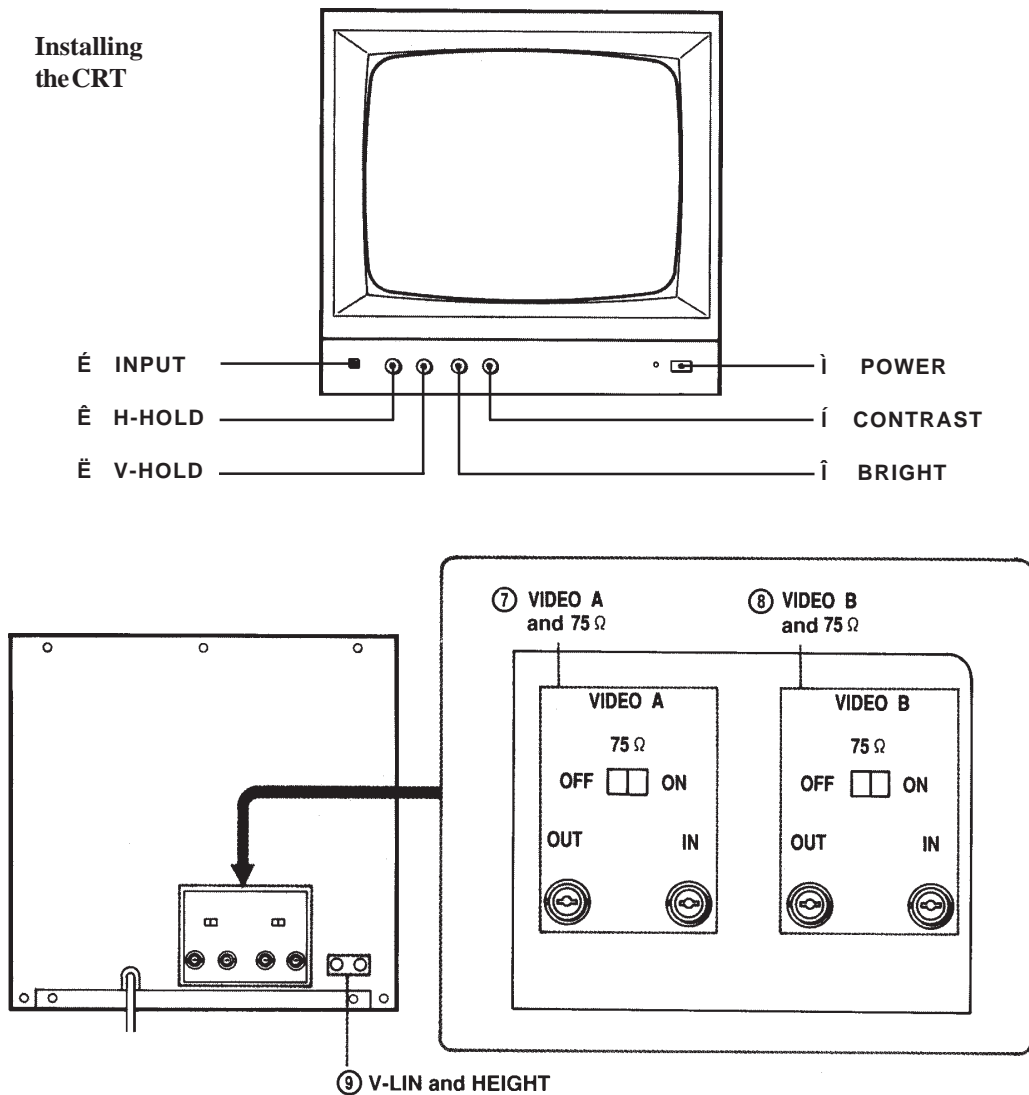
NOTES

2.3 INSTALLING THE CRT

NOTE: Due to availability, there may be one of several different CRT's supplied with the PDFM 808.

1. Unpack the CRT and place it on the base (attached to the top of the PDFM 808).
2. Plug in the power cord into the receptical on the rear of the PDFM 808.
3. Unpack the BNC to RCA adapter and connect it to the IN terminal of the VIDEO A panel on the CRT (see Figure 2-2).
4. Unpack the video cable and connect one end into the adapter installed in the previous step.
5. Connect the other end of the cable assembly to the PDFM 808 (see Figure 4-10).
6. Make sure both 75 W switches (for both VIDEO A & B) on the back of the CRT are set to ON.
7. Make sure that the INPUT select switch on front of the CRT is set to the released (out) position (VIDEO A).

Figure 2-2. Installing the CRT



INPUT select switch - Changes to VIDEO A with (A) released, and VIDEO B with the (B) depressed.

H-HOLD (horizontal hold) control - Helps eliminate slanting horizontal bars.

V-HOLD (vertical hold) control - Helps eliminate picture roll.

POWER switch - Depress to turn on CRT (ON) and Release to turn off CRT (OFF).

CONTRAST control - Turn clockwise to increase contrast, and counterclockwise to decrease contrast.

2.4 SELECTING RPM INPUT

The PDFM 808 accepts a magnetic or digital (TTL) RPM input signal. It can also accept input of 60, 120, 150 or 300 pulses per revolution. The unit is factory set up for **magnetic input at 120 pulses per revolution** (setting used by all current production Bacharach test stands). If a setting change is necessary the, use the following:

Tools needed:

- 1/8 or 1/4 inch blade screwdriver
- 5/16 inch Allen wrench or hex head screwdriver

To change the setting(s):

1. Lift the CRT off the PDFM console and set it aside.
2. Remove the four screws that fasten the PDFM console cover, just above the handles. Set the screws aside.
3. Loosen the hex head screws that fasten the console handles.
4. Lift the cover up and off the console.
5. At the back of the console, locate the PDFM interface circuit board (largest of the boards in the card cage). Disconnect the ribbon cable and withdraw the board. Refer to Fig. 2-4 and locate jumpers and pins at W1, W2, and W3.

***NOTE:** At the factory, a jumper was installed between pins 2 and 3 of W3 to select magnetic RPM input.*

6. To change to digital (TTL) input, move jumper to pins 1 and 2 of W3.
7. To adjust the number of pulses per revolution, reset jumpers as follows:

BRIGHT (brightness) control - Turn clockwise for a brighter picture, and counterclockwise for a darker picture.

VIDEO A & VIDEO B

IN connector - Video signal input.

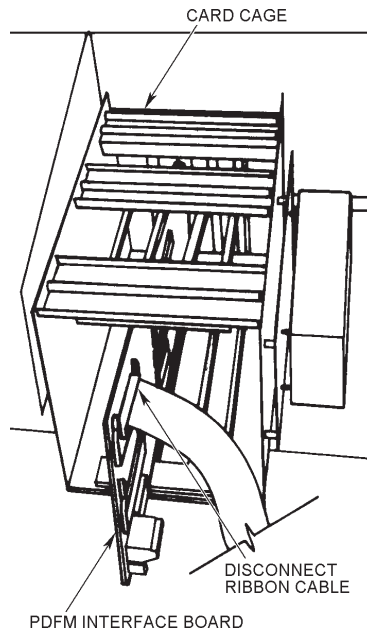
OUT connector - To connect the video to another device (such as a second CRT).

75 Ω termination switch - Switch ON when only the IN connector is used, and OFF when both the IN and OUT (loop-through) connectors are used.

V-LIN (vertical linearity) & HEIGHT controls

For special adjustments by qualified personnel.

Figure 2-3. Removing Circuit Board



Pulses/ Rev.	Set W1 Jumpers At	Set W2 Jumpers At
60	pins 1 & 2	pins 2 & 3
120	pins 1 & 2	pins 1 & 2 (factory set)
150	pins 2 & 3	pins 1 & 2
300	pins 2 & 3	pins 2 & 3

NOTE: The jumpers at W1 and W2 are factory set to accept 120 pulses per revolution (see Fig. 2-4).

8. Reinstall the interface board. Slide it forward until it seats into the front of the card cage. Reconnect ribbon cable.
9. Reconnect the PDFM to input power. Turn the console and the CRT on.
10. If necessary, adjust potentiometer R21 on the interface board until the CRT displays the actual RPM (± 1 RPM).

***IMPORTANT:** The RPM input signal (magnetic or digital) on the PDFM must always match the test stand in use. Otherwise, the CRT will show zero fluid delivery. If operating the PDFM with different test stands, check settings of W1, W2 and W3 each time you change test stands. Reset the jumper(s) if necessary.*

11. Reassemble console cover and reinstall CRT in reverse order of removal.

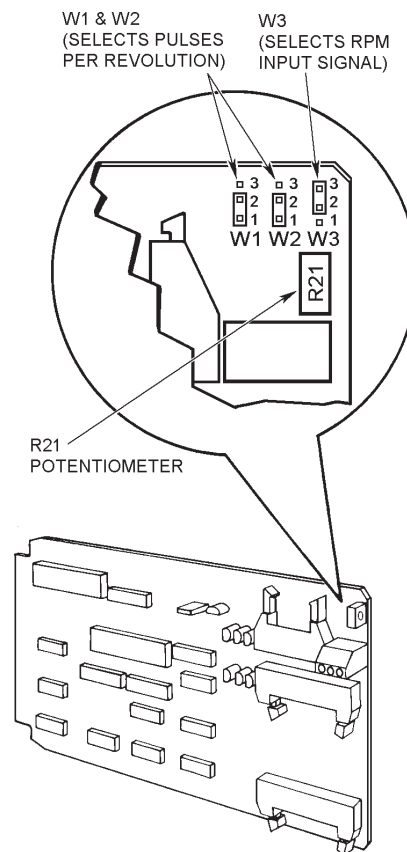
2.5 FILLING THE TRANSDUCER OIL CAVITY

Before operating the PDFM 808, always check the oil level in the transducer oil cavity. The oil should be between 1/4" to 3/8" from the bottom of the cavity.

WARNING

Operating the PDFM-808 with low oil in the transducer oil cavity will damage the piston and oil seals. The cavity must always contain about 28 cc (1 oz) of SAE 30W lube oil. FAILURE TO FILL OR MAINTAIN A PROPER LEVEL OF FLUID IN THE CAVITY WILL VOID THE WARRANTY.

Figure 2-4. PDFM Interface Board



The transducer oil cavity is drained before shipping and will need to be filled before operating the PDFM 808:

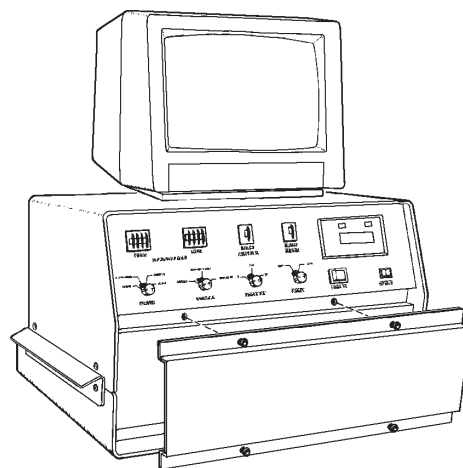
1. The PDFM console should be turned off and unplugged from its power source.

WARNING

For safety reasons, never open the front panel when input power is on at the PDFM console.

2. Loosen the four push/pull fasteners, and Remove the lower front cover.
3. Push the encoder arm to the left until the plastic dust cover clears the oil cavity by about 1/4 inch. This requires moderate force.

Figure 2-5. PDFM Front Cover Removal



NOTE: Use caution when moving the piston to prevent engagement of the microswitch operator level. This will cause the PDFM 808 to be inoperative, until the piston is returned (manually) to the mid-position. The PDFM must be OFF before the piston can be moved.

4. Fill the plastic bottle provided with 30W lube oil (see Figure 2-7).

IMPORTANT: Don't overfill the oil cavity. If the oil level exceeds 3/8" the excess oil will leak out onto the transducer.

5. Squeeze the contents of the bottle into the piston block cavity.
6. Push the piston encoder arm until the plastic oil splash guard is centered.
7. Reinstall the lower front panel.

Figure 2-6. Transducer

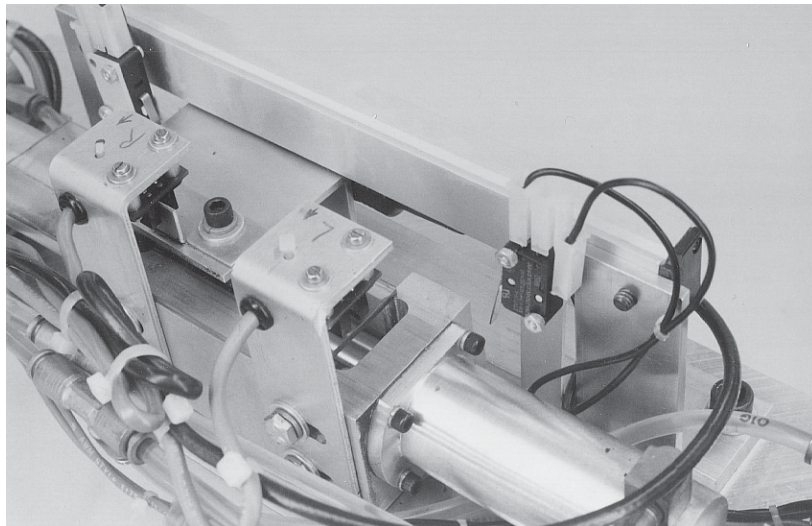


Figure 2-7. Plastic Bottle Filled & Transducer Cavity

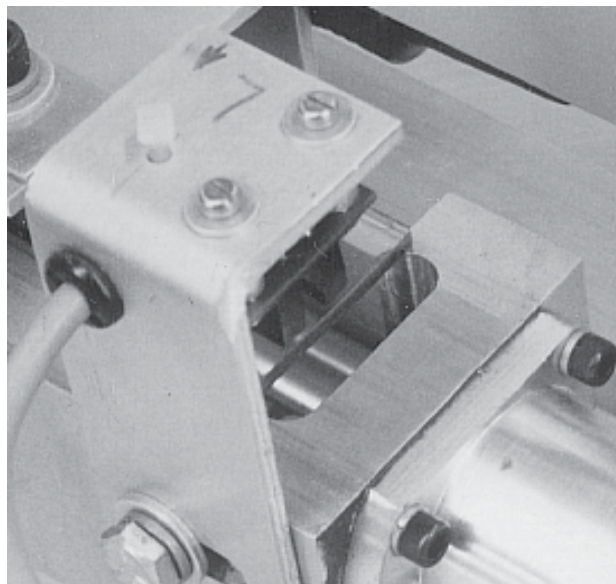
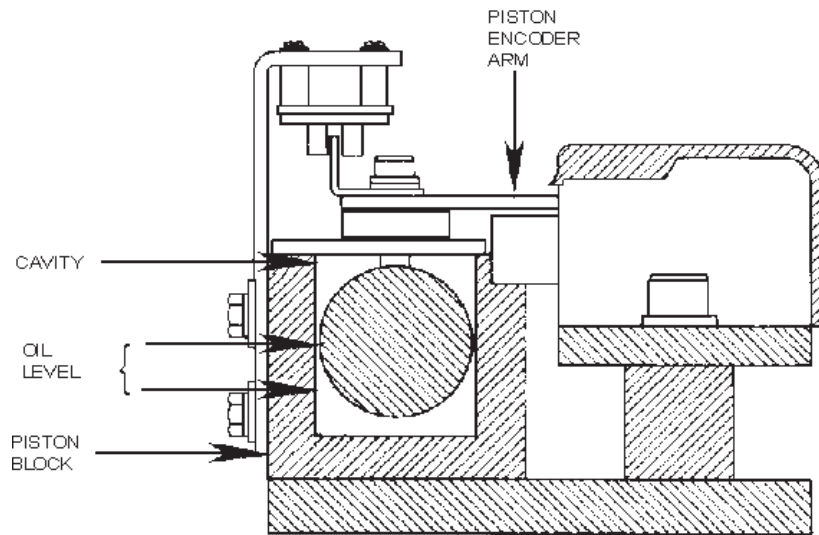


Figure 2-8. Transducer Cross Section



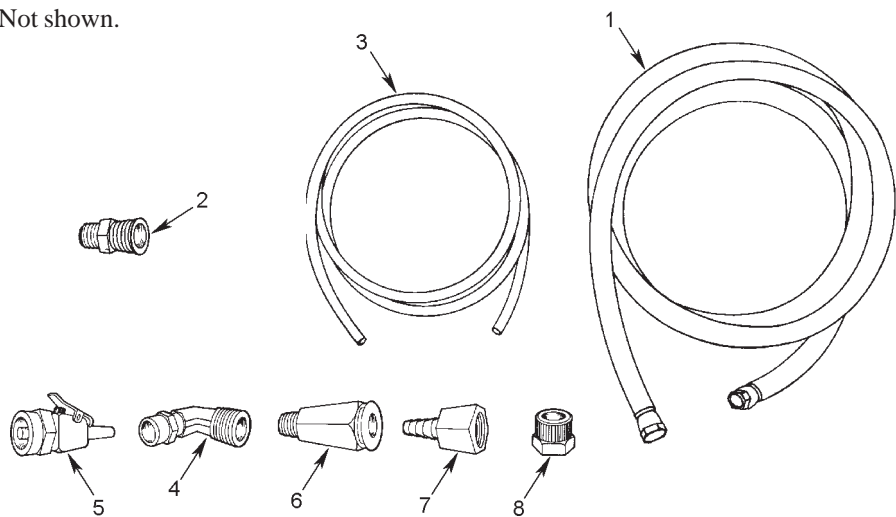
2.6 HYDRAULIC CONNECTIONS

Plumbing connections between the PDFM and the test stand require the PDFM Plumbing Accessory Kit, which contains:

Item	Part No.	Description	Qty.
2	03-1542	Male Connector, 1/4 NPT, 3/8 T	1
3	03-2912	Nylon Tubing, 1/4 OD	100 ft.
4	303-3010	Male Elbow for 1/4 Tubing, 1/8 NPT	8
5	103-5391	Male Quick Connect Plug for 1/4 tubing	8
7	67-6660	Female Quick Connect Coupling to 1/8 NPT	8
8	03-5262	Female Barbed Adapter, 1/8 NPT to 1/4 hose	8
9	03-2962	Nut with Brass Ferrule (spares)	4
10 to 17	104-7301* through 104-7308*	Identification Markers numbered "1" through "8" for tygon tubing	16 (2 of each #)
20 to 27	104-7311* through 104-7318*	Identification Markers numbered "1" through "8" for nylon tubing	16 (2 of each #)
28	03-6013	PVC Tubing 3/8 ID	5'
29	03-5120*	Swivel Fitting 5/8-18 x 3/8 Tube	1

* Not shown.

Figure 2-9. PDFM Plumbing Accessory Kit (67-6800 Rev. 10)



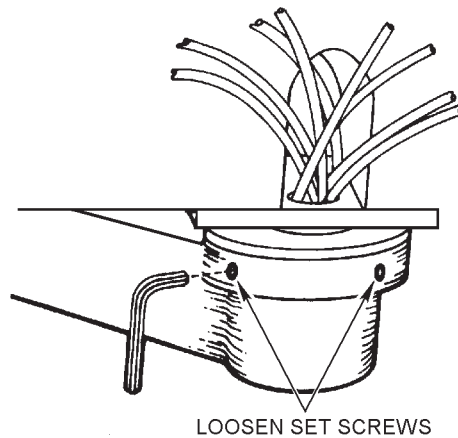
Items 7 and 8 from the Kit allow re-routing fluid delivery to the graduates on the test stand. (You can only do this with Bacharach stands). Section 2.7 describes this procedure.

Some of the early Bacharach Specialist and Technician fuel pump test stands don't have single block accumulators. If using one of these stands with the PDFM 808, you'll need to install one of the following Accumulator Retrofit Kits:

- Kit 67-8512 for Professional test stands
- Kit 67-8514 for Specialist test stands
- Kit 67-8516 for Technician test stands

Use the directions below to connect plumbing between the PDFM and a Bacharach test stand using the PDFM Plumbing Accessory Kit. If connecting the PDFM to other test stands, consult both these procedures and the test stand manufacturer's instructions.

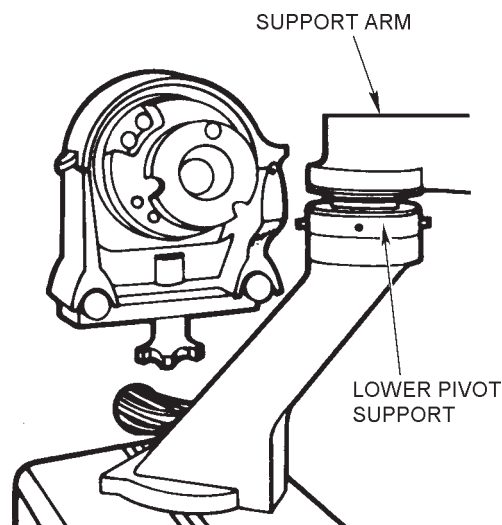
Figure 2-10. Accumulator Support Arm



2.6.1 Accumulator Plumbing Connections

1. Locate the pivots for the accumulator support arm. With a 1/8 inch Allen key, loosen the set screws at each end of the support arm (7 total).
2. Lift out the nozzle block assembly and set it aside. Remove the support arm from the lower pivot support.

Figure 2-11. Lower Pivot Support

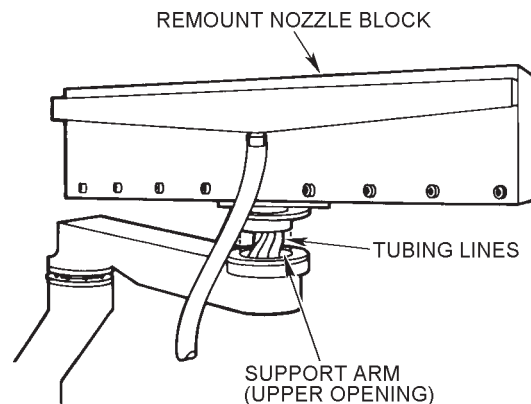


3. Cut the 100 feet of Nylon tubing from Kit 67-6800 into eight lengths (10 ft. maximum). All pieces should be the same length. Make cuts square and clean for proper connection to the male quick connect fittings.
4. Insert the tubing pieces into and through the support arm. Leave about four feet for connection to the PDFM's solenoid valves.
5. Install the support arm over the lower pivot support.
6. Carefully feed the tubing through the opening in the lower support arm. Use the Allen key to retighten the four set screws.

NOTE: If Tygon tubing was previously connected to the accumulator, disconnect the tubing and the male elbows. Remove tubing from the arm. Mark the tubing with the tags, item 10 to 17 in Section 2.6 Replace tubing and hardware with the items from the Accessory Kit (PDFM Plumbing).

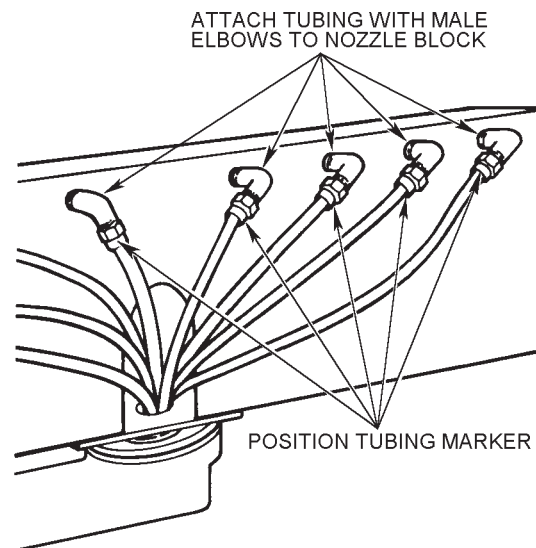
7. Bundle the upper end of the tubing. Attach a "fish" line to help feed the accumulator tubing through the nozzle block.
8. Remount the nozzle block. Feed the Nylon lines through the upper opening in the support arm. Retighten the three set screws.

Figure 2-12. Nozzle Block



9. Install the male elbows (from the Accessory Kit) on the nozzle block.
10. Number each of the Nylon tubing lines as follows:
 - a. Select one of the tubing lines. Tag it with the identification marker numbered "1".
 - b. Apply shop air to the line. At the accumulator, find the line with the air flow and tag it with the second marker numbered "1."
 - c. Repeat Steps (a) and (b) until all lines are identified and tagged.
11. At the accumulator, remove the nuts from the male elbows. Slide these nuts over the tubing lines.
12. Connect each line, in numeric order, to the accumulator nozzle block. The number on the fluid line must match the number of the cylinder (attach the #1 cylinder to the #1 fluid line, etc.).

Figure 2-13. Tubing Attached

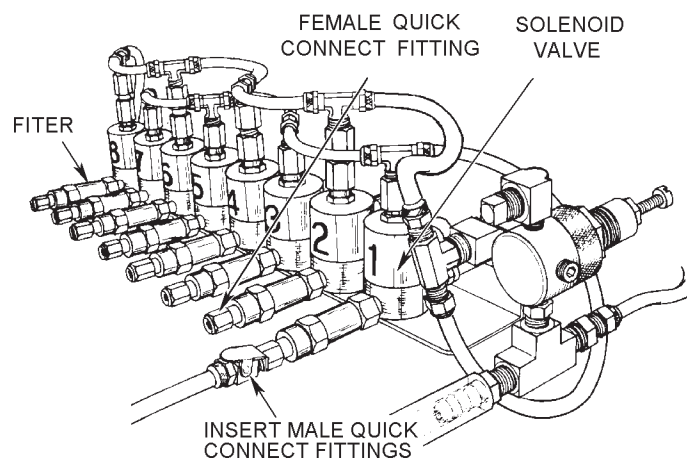


2.6.2 PDFM Plumbing Connections

IMPORTANT: When testing an injection pump with fewer than eight outlets, don't connect unused fluid lines to the input filters on the solenoid valves. Otherwise, the fluid may overflow and spill from the unused accumulator ports.

1. Remove the nut with ferrule from each of the eight male quick connect fittings (from the Accessory Kit).
2. Slide the nuts over the free ends of the tubing lines.
3. Insert the male quick connect fittings into the female fittings on the solenoid filters.

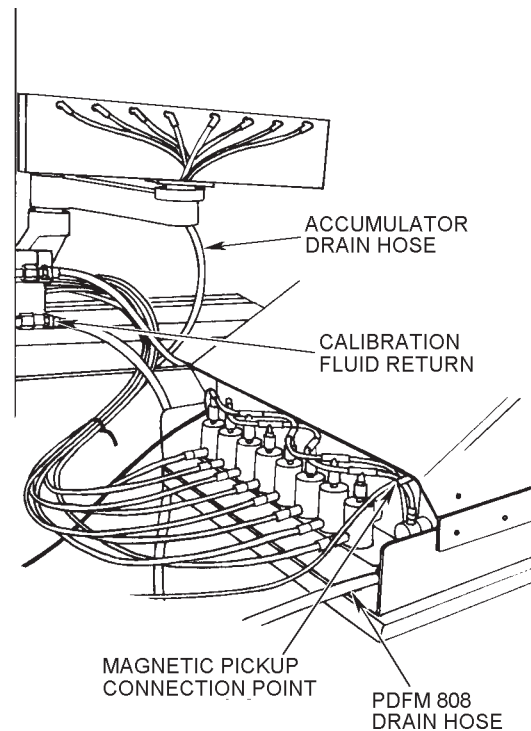
Figure 2-14. Valve Fittings



4. Insert the tubing lines as far as they will go into the quick connect fittings. The numbers of the injection pump cylinder, the fluid line and the solenoid valve must match. Tighten each nut.
5. Cut the PVC tubing (from the Accessory Kit) to a suitable length and connect it to the PDFM barbed fitting.
6. Connect the other end to the "Calibration Fluid Return" fitting on the test stand.
7. Check all connections for leaks.

To prevent the input fluid lines from tangling, or to create more room between the PDFM and the test stand, you may want to bundle the lines in plastic sheathing.

Figure 2-15. Plumbing Connections



2.7 RE-ROUTING FLUID DELIVERY TO THE TEST STAND

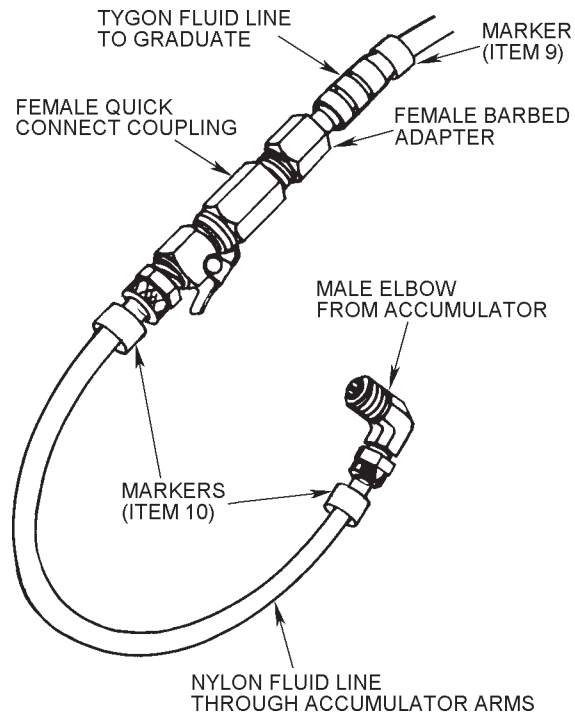
If you are using a Bacharach test stand, and would like to re-route fluid delivery from the PDFM to the graduates (on the test stand), it will require two items from Plumbing Accessory Kit (67-6800):

- The eight female quick connect couplings, and
- The eight female barbed adapters

To re-route fluid delivery:

1. Disconnect the fluid lines with the male quick connect fittings from the PDFM's solenoid filters.
2. Thread the female quick connect couplings into the female barbed adapters.
3. At the test stand, insert the barbed adapters into the Tygon tubing that runs from the graduates. Connect this tubing to the barbed graduate fittings on the test stand's lower front panel.
4. Then connect the male quick connect fittings from the PDFM fluid lines to the female quick connect couplings. Check all connections for leaks.

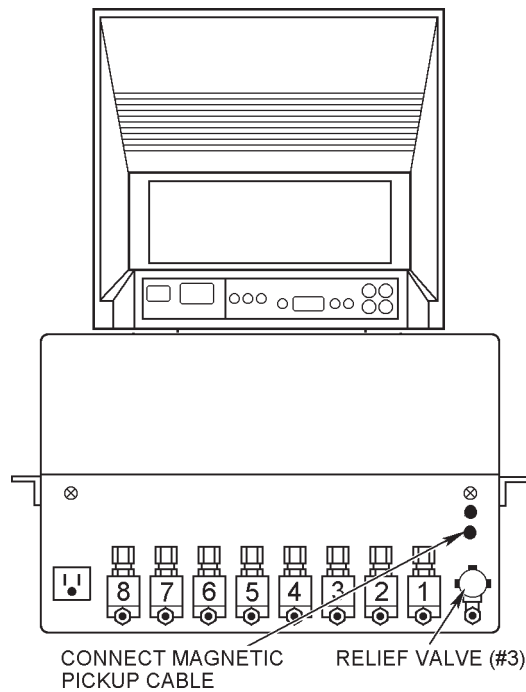
Figure 2-16. Re-Routing Fluid Delivery



2.8 CONNECTING THE RPM PICK-UP CABLE

For this connection, use only the cable assembly furnished with the PDFM Accessory Kit. Connect the cable to the test stand as per the instructions shipped with the kit. Plug the other cable end into the back of the PDFM.

Figure 2-17. RPM Pick-up Cable

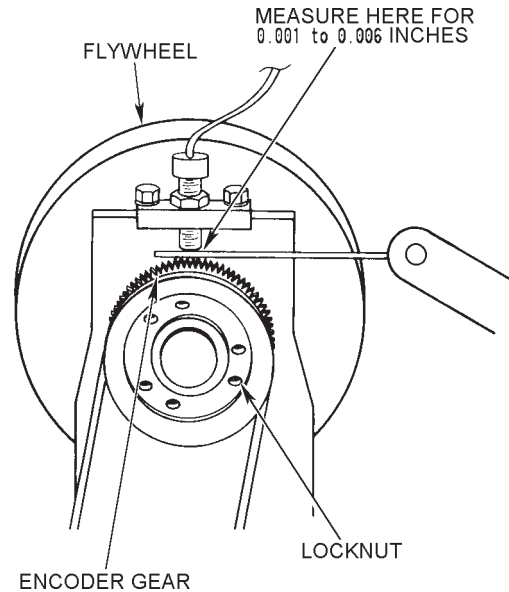


2.9 CHECKING THE MAGNETIC PICKUP SETTING

For the PDFM 808 to display correct RPM and fluid delivery:

- The gap between the magnetic pickup and the encoder gear on the test stand must be 0.001 to 0.006 inches, and
- The encoder gear must be concentric within .0025 inches T.I.R.

Figure 2-18. Magnetic Pickup Gap Setting



Before operating the PDFM 808, check the magnetic pickup gap at the test stand. To do this, run the test stand and the PDFM and compare RPM indications.

If the gap is incorrect, the RPM display at either the test stand tachometer or the PDFM's CRT will be erratic. Erratic RPM indications are most noticeable at very low speeds. At higher speeds, however, the magnetic pickup may generate enough voltage to operate the PDFM properly.

For measurement and adjustment of the gap:

1. Disconnect input power to the test stand.

WARNING

***SHOCK HAZARD.** Lethal voltages exist at various points in the test stand. To avoid injury, death, or damage to the pickup, never adjust the gap spacing while the stand is running. Disconnect input power before making adjustments.*

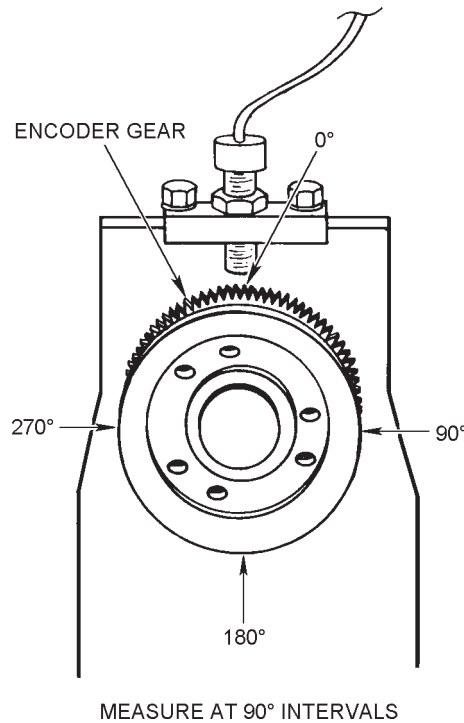
2. Remove the test stand's access panel.
3. Measure the space between the magnetic pickup and the encoder gear. Measure at four places around the gear, approximately 90° apart. If the gap is 0.001 to 0.006 inches, skip to Step 5. If not, loosen the locknut on the magnetic pickup. Use a plastic feeler gauge to adjust the gap then retighten the locknut.
4. Manually turn the flywheel one full turn and make sure that all gear teeth should clear the pickup.

5. With a dial indicator, check the concentricity of the encoder gear.

IMPORTANT: If the encoder gear isn't concentric to within .0025 inches T.I.R., RPM and fluid delivery readings at the PDFM may fluctuate or be incorrect.

6. Reinstall the access panel.

Figure 2-19. Checking Concentricity

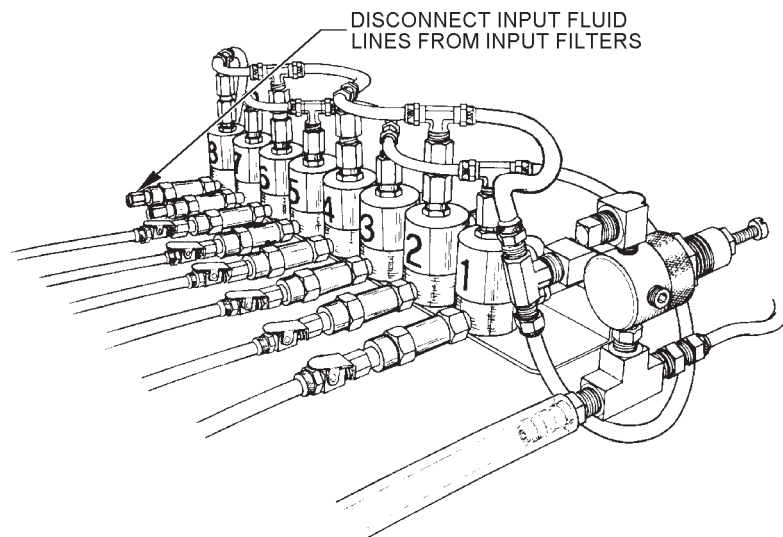


2.10 PREPARING FOR START-UP

Before operating the PDFM 808:

- Flush entrapped air, dust and dirt out of the fluid lines and the test stand accumulator.
- Test the printer.
- Complete the checklist in Subsection 2.10.5.

Figure 2-20. Disconnecting Fluid Lines

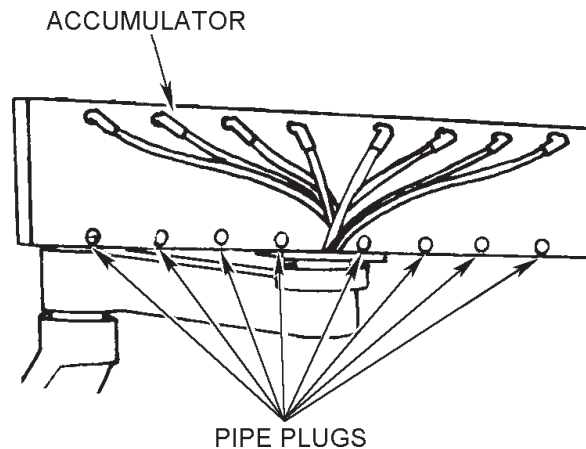


2.10.1 Flushing the Fluid Lines and Accumulator

For accurate fluid delivery measurements, the fluid lines between the test pump and the PDFM 808 must be free of dust and dirt. Filters on the PDFM's input solenoid valves prevent most foreign particles from entering the PDFM. To make sure that the fluid lines are clean, however, you should flush the lines (1) before you operate the PDFM and (2) each time you replace test injectors. Use the following steps:

1. Disconnect the fluid lines from the PDFM solenoid input filters, at the quick connect fittings.
2. Turn the test stand on. Run the injection pump at about 500 RPM for several minutes and let fluid drain from the lines into a clean container or waste can.
3. To flush the accumulator, remove the eight 1/8 inch pipe plugs at the base of the accumulator chamber and catch the fluid being pumped out.
4. Turn the test stand off. Reinstall the pipe plugs.
5. At the PDFM, reconnect the fluid lines.

Figure 2-21. Locating Pipe Plugs



IMPORTANT: When testing an injection pump with fewer than eight outlets, don't connect unused fluid lines to the input filters on the solenoid valves. Otherwise, the fluid may overflow and spill from the unused accumulator ports.

2.10.2 Checking Printer Operation

During a flow test, the PDFM 808's printer can print out fluid delivery values for each injection pump outlet.

With the PDFM turned on, press "FEED" to check printer operation. The printer should feed paper until you release the switch.

2.10.3 Installing or Changing Printer Paper

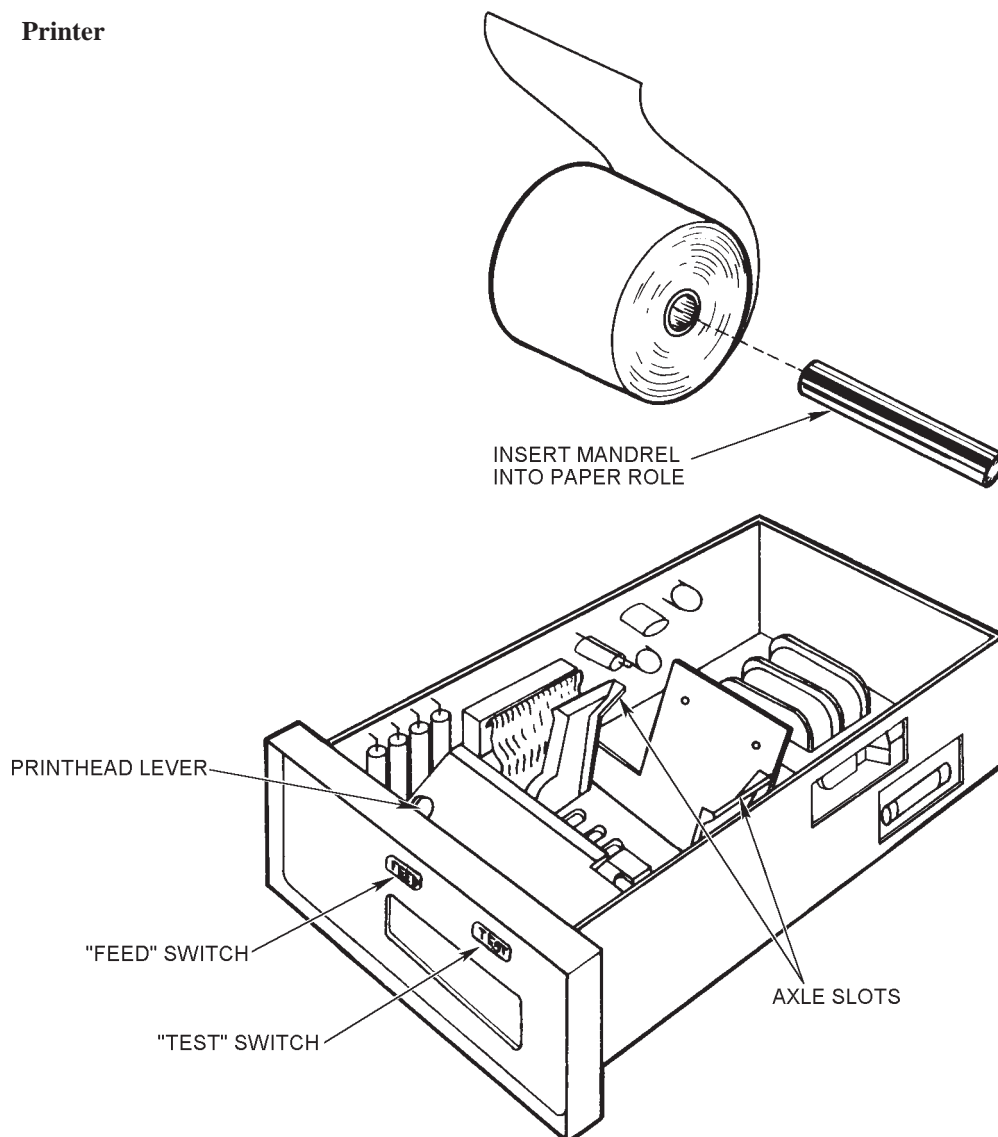
To prevent printer problems, such as paper sticking to the printhead, use only Gulton Industries Thermal Paper D20M-black image or equivalent (Bacharach part number 74-1234). You need not remove the printer from the PDFM console to install or change the paper.

To change the paper roll:

1. Slide the printer completely out (to the stop) of the control panel.
2. Release the printhead lever so that it no longer touches the drive roller.
3. If necessary, pull the remaining paper out from under the printhead.
4. Grasp the mandrel or empty paper roll. Pull it straight up along the axle slots and out of the printer assembly. You may have to spread the axle slots slightly.

Note: Don't discard the mandrel.

Figure 2-22. Printer



5. Discard the empty paper roll and insert the mandrel into a new paper roll.
6. Insert the mandrel with the paper roll into the mandrel slots.
7. Thread the paper from the rear and over the paper roll. Only the outside surface of the paper is treated for printing.
8. Seat the mandrel in the bottom of the slots.
9. Fold the end of the paper so it inserts easily.
10. Insert the paper into the slot formed by the front guide in the printhead, until the paper appears at the control panel opening.
11. Pull some paper through the slot.
12. Push the printhead lever back against the drive roller.
13. If necessary, press "FEED" to advance the paper.

Figure 2-23. Sample "Test" Printout

2.10.4 Testing the Printer

Press "TEST" to check the quality of your printouts. When you press "TEST", the printer should automatically print a set of characters shown to the right.

If no printing occurs:

The paper was installed with the wrong side of the paper against the printhead. Remove paper and reinsert it with the correct side against printhead.

SAMPLE "TEST" PRINTOUT

If light streaks appear on the paper:

The printhead is probably dirty. Clean the head as per Section 4.3.

If paper sticks:

Check that the paper is Bacharach part number 74-1234 or equivalent.



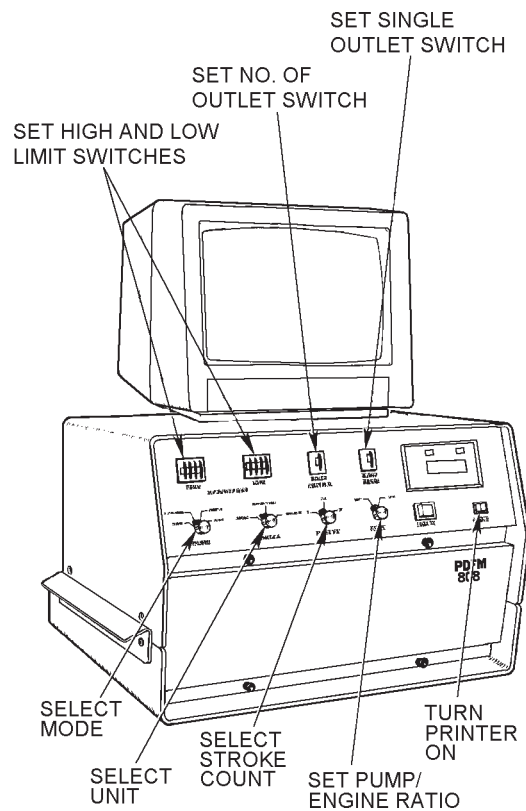
2.10.5 Pre-Operation Checklist

Before operating the PDFM 808, complete the following checklist.
Don't proceed until all responses on the checklist are "Yes".

IS THIS TRUE?	YES	NO
1. The PDFM power cord is connected to a three-prong, grounded plug in a 115 VAC ±10%, 60/50 Hz outlet.	_____	_____
2. Ambient temperature around the PDFM is 60° to 100°F (15° to 38°C).	_____	_____
3. The CRT is installed on the PDFM console, with the video cable connected to both phone jacks.	_____	_____
4. The RPM input signal is set to the proper number of pulses per revolution as per Subsection 2.4.	_____	_____
5. The level of 30W motor oil in the transducer oil cavity is 1/4" to 3/8" from the bottom of the cavity.	_____	_____
6. Fluid input lines between the test stand accumulator and the PDFM solenoid valves are connected and flushed.	_____	_____
7. The RPM pickup cable is connected between the test stand and the PDFM.	_____	_____
8. The gap between the encoder gear and the magnetic pickup on the test stand is 0.001 to 0.006 inches.	_____	_____
9. The encoder gear is concentric within 0.0025 inches T.I.R.	_____	_____
10. Paper is installed correctly on the printer.	_____	_____
11. The "TEST" printout has no errors.	_____	_____

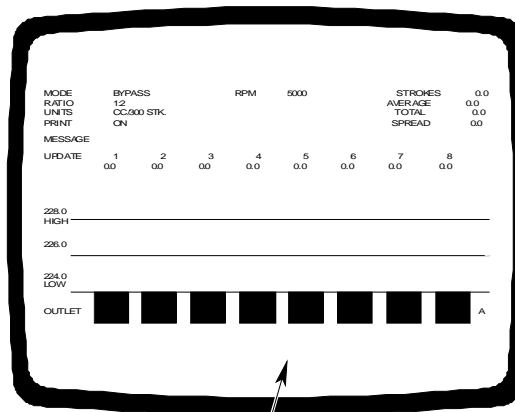
6. Set the required injection pump/engine ratio.
7. Set the HIGH and LOW LIMIT switches to the proper delivery values. The higher limit must always be a value greater than the lower limit. Consult the pump manufacturer's specifications.
8. Select the number of injection pump outlets to be tested, from 1 to 8 (0 or 9 will produce an error message.)
9. If you wish to check delivery of a single outlet, select the number, from 1 to 8 (0 or 9 will produce an error message.)

Figure 3-2. Setting PDFM Controls



10. At power-up the CRT will display:
 - Values of 0.0 for AVERAGE, TOTAL, SPREAD and bar graphs.
 - Bars between the LOW and OUTLET headings.
 - BYPASS mode. (Fluid flow from the injection pump bypasses the transducer.)
 - After two seconds, the PDFM enters the mode selected and begins to report fluid delivery values.
11. If the values aren't within the high and low delivery limits you set, adjust the pump output as needed to bring the flow within limits.

Figure 3-3. Power-up Display



POWER-UP CRT DISPLAY

CAUTION

*To prevent needless transducer wear, select **BYPASS** mode when not testing a pump.*

After completing a flow test, you can:

- Repeat the test just performed.
- Switch to another mode and retest as desired.
- Install another pump on the test stand and test its fluid delivery as per Steps 1 through 11.
- If no further testing will be done — turn power off at the PDFM console and the CRT. Remove the pump from the test stand.

3.2 READING THE CRT DISPLAY

3.2.1 Bar Graphs

Bar graphs displayed on the CRT indicate fluid delivery. The eight wide bars depict the flow from injection pump outlets. The narrow bar at the far right shows the average value of the displayed bars (See Figure 3-10). Bar graphs appear on the screen in all PDFM operating modes except **BYPASS** mode, which doesn't measure fluid flow.

In **SINGLE** mode:

Figure 3-4. Bar Graph SINGLE

The wide bars depict the flow from the outlet selected by the **SINGLE OUTLET** switch.

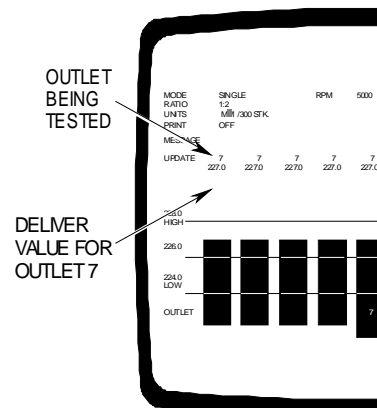


Figure 3-5. Bar Graph AVERAGE

In AVERAGE mode:

The wide bars show the average delivery of all active pump outlets.

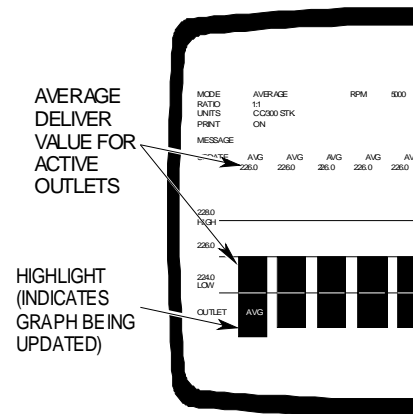
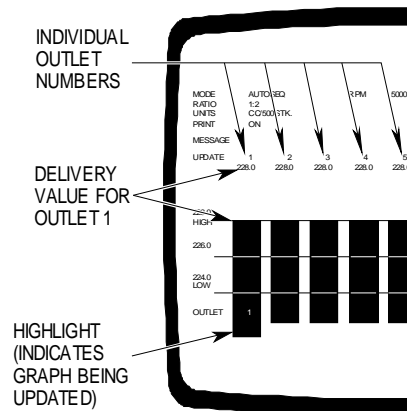


Figure 3-6. Bar Graph AUTO-SEQUENCE

In AUTOSEQUENCE mode:

The wide bar depicts the delivery of a different outlet. If you're testing fewer than eight outlets, the wide bars show only the delivery from active outlets.



When measurement starts (by switching into SINGLE or AVERAGE) the display will show delivery accumulated from stroke 1 to stroke 25, 50 or 100. After the 25th, 50th or 100th stroke is completed, delivery is displayed as the first graphical bar and the value above it. The next reading (bar graph and value above) will appear one second thereafter and each succeeding second until the eighth bar is presented. The update will repeat on the first and each succeeding bar until a different mode is selected or an operating parameter is changed or the main drive is shut down. The readings updated each second represent the average delivery over the preceding 25, 50 or 100 strokes, in the units selected (mm^3/stk , cc/500 stk, cc/300 stk).

A bar will extend above the LOW LIMIT horizontal line only if the fuel delivered is greater than the value set on the LOW LIMIT thumbwheel switch.

The thin bar at the monitor's far right represents the average of all the bars displayed. This bar's numerical value is displayed at the top of the monitor.

When the MODE switch is set to AUTOSEQUENCE, fuel delivery measurement starts with the #1 outlet for the preset stroke count of 25, 50 or 100. The unit then automatically cycles through all outlets and repeats until switched to another mode or an operating parameter is changed or the main drive is shut down. A time delay is introduced when the unit switches from one pump outlet to the next. A delay is also introduced when switching between any of the modes. These delays may vary with speed and delivery and are always in multiples of one pump revolution.

While the fuel delivery is being measured, the rising bar graph and the digital display above it may stop for several seconds and then continue. This is normal and occurs when, during the measurement cycle, the piston in the transducer reaches the end of its travel and changes direction. During that time, the measurement process is interrupted for several strokes. However, the fuel delivery readings are always averages of the preceding 25, 50 or 100 strokes (injections) whether it appears to be continuous or interrupted.

Prolonged running of the pump with the mode switch in one position may produce a drift in readings. This could be the result of pump internal temperature changes with time and/or speed, or that the system temperature has not completely stabilized, or a combination of the above.

When switching from one mode to another, the first reading(s) may vary slightly from the next series of readings. Therefore, it may be necessary to wait several seconds for the reading to stabilize. The time required for the reading to stabilize will depend on speed and fuel delivery.

Remember that readings displayed are samples of 25, 50 or 100 strokes. The smaller the sample, the more sample-to-sample variations may be expected from the pump and injectors. Such variations are accentuated because of the display's 0.1 resolution and the sensitivity of the measuring mechanism.

3.2.2 BYPASS Mode Display

When the PDFM 808 is in BYPASS mode, the unit's solenoid valves route test fluid from the pump bypassing the transducer and return the fluid to the test stand.

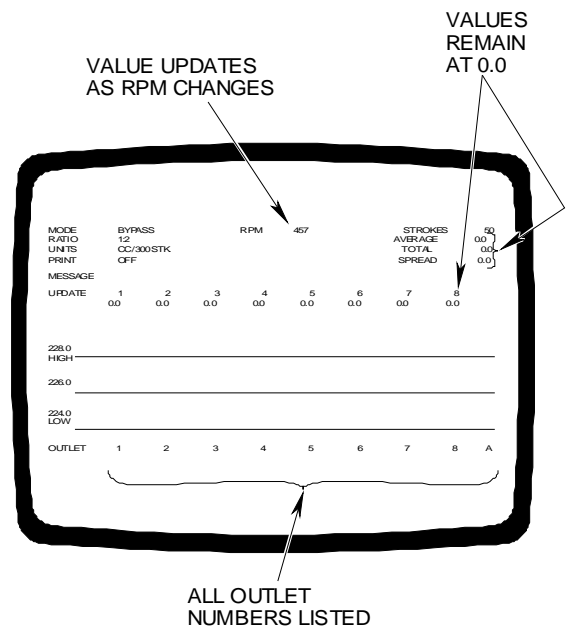
In BYPASS mode, the CRT displays:

Figure 3-7. Bypass Mode Display

Nothing in the bar graph area since fluid flow is not measured in this mode.

The current settings for MODE (BYPASS), pump/engine RATIO, UNITS, PRINT status (ON or OFF), RPM (pump revolutions per minute) and STROKES.

Values of 0.0 for AVERAGE outlet delivery, TOTAL outlet delivery and SPREAD. Fluid delivery values displayed for each outlet are also 0.0 in BYPASS mode.



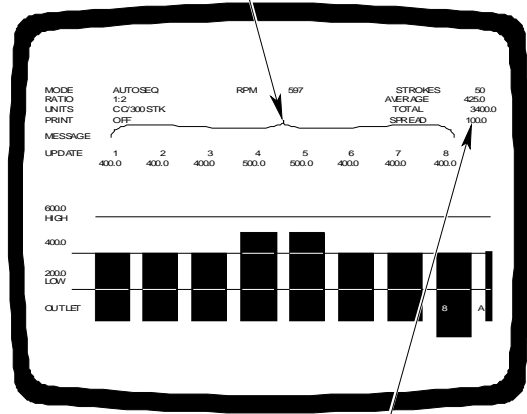
3.2.3 AUTO-SEQUENCE Mode Display

Displays above bar graph - These displays represent the delivery of each pump outlet.

AVERAGE:

This display will show the average delivery of all outlets after the first set of values were obtained from all outlets. The value in AVERAGE will then update to represent the average of all preceding readings.

EACH COULMN DISPLAYS DELIVERY OF DIFFERENT OUTLETS



DIFFERENCE BETWEEN LARGEST AND SMALLEST DELIVERY VALUE

Figure 3-8. AUTO-SEQUENCE Mode Display

SPREAD:

This display will update by showing first the maximum difference between either the #1 or #2 outlet (which-ever is greater) and 0 (i.e., until #3 outlet delivery measurement starts). It will then continuously update showing maximum spread existing between all successive outlet readings as they are completed.

TOTAL:

This display will continuously increase from “0” when the #1 outlet starts recording delivery until the last outlet’s delivery was recorded. At that point, the displayed value indicates the sum of all outlet deliveries and may fluctuate as each outlet completes its successive measurement.

3.2.4 AVERAGE Mode Display

Display above bar graphs - This display represents the delivery of all delivered fluid divided by the number of outlets as selected in “NUMBER OF OUTLETS”.

AVERAGE:

This display follows the same pattern as the SINGLE mode. The value displayed is always derived by dividing the total fuel delivery (being actually measured) by the “NUMBER OF OUTLETS” preselected.

AVERAGE = TOTAL DELIVERY OF ALL ACTIVE OUTPUTS DIVIDED BY NUMBER OF OUTPUTS

ALL COULMNS DISPLAY AVERAGE DISPLAY VALUE

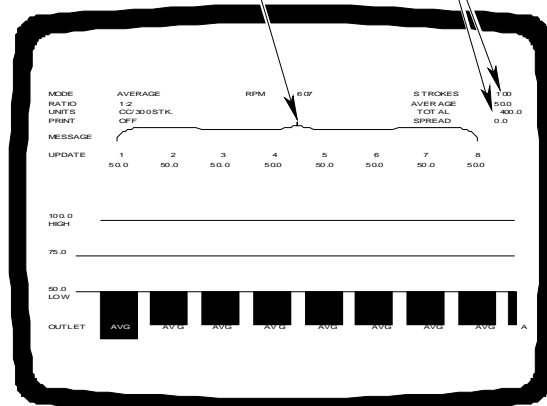


Figure 3-9. AVERAGE Mode Display

SPREAD:

As the first bar and/or reading is increasing, so does the SPREAD display. When the first reading is reached, this display is now showing the maximum difference between the final reading of the first or succeeding readings and “0” until the eighth reading is taken.

TOTAL:

This display sums all values from start of measurement until the eighth bar graph reaches its maximum reading. From this point on, the TOTAL display updates and continuously indicating the sum of current values on all preceding eight bar graphs.

NOTE: The values displayed on the monitor under AVERAGE, SPREAD and TOTAL when in the AVERAGE mode have limited use.

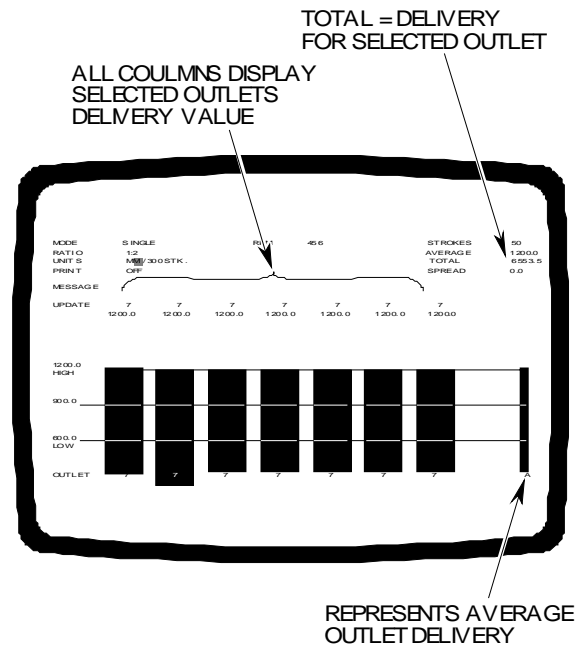
3.2.5 SINGLE Mode Display

Displays above bar graphs - These displays represent delivery of selected “OUTLET NUMBER”. First graph and delivery display, after switching to SINGLE mode, shows progressive increase until final reading is displayed. All subsequent displays are in one second intervals.

AVERAGE:

Figure 3-10. SINGLE Mode Display

This display progressively duplicates the display above the first bar graph. After first bar graph reaches its maximum value, the AVERAGE display starts to indicate progressively the arithmetic average of all completed measurements and the one in progress until the twelfth reading is completed. This display then shows the average of all eight readings, momentarily however. From here on the display continues to show the average of all preceding displays above the bar graphs.



SPREAD:

As the first bar and/or reading is increasing, so does the SPREAD display. When the first reading is reached, this display is now showing the maximum difference between the final reading of the first or succeeding readings and “0” until the eighth reading is taken.

TOTAL:

This display sums all values from start of measurement until the eighth bar graph reaches its maximum reading. From this point on, the TOTAL display updates and continuously indicates the sum of current values on all preceding eight bar graphs.

NOTE: *The values displayed on the monitor under AVERAGE, SPREAD and TOTAL when in the SINGLE mode have limited use.*

3.3 READING THE PRINTOUT

When printing is enabled, the printer prints about two lines per second. Fluid delivery values print out as they appear on the CRT display.

The printer prints data “backwards” to let you read fluid delivery values as they are measured. That is, column headings print out first, followed by the delivery values.

NOTE: *Press “FEED” for a few seconds before tearing off the paper tape.*

The printer prints flow test data in this order:

1. Low and high delivery limits.
2. Pump/engine ratio.
3. Number of outlets tested.
4. Unit of flow measurement.
5. Stroke count.
6. Currently selected mode.
7. Delivery values by outlet (or average outlet delivery, in AVERAGE mode).
8. Column headings.
9. Spread.
10. Average delivery per outlet.

Figure 3-11. Printout : Single

SINGLE MODE PRINTOUT

```

5      500    176.2
5      500    176.8
5      500    176.8
5      500    176.8

OUTLET SPEED  FLOW
SINGLE

STROKES= 25
FLOW UNIT=   MM3/STK
OUTLETS= 8
RATIO=1:2
LIMITS=100.0 - 200.0

```

Figure 3-12. Printout : Average

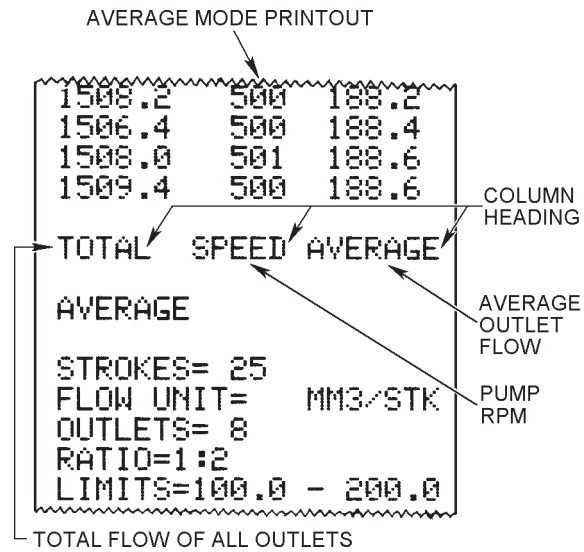
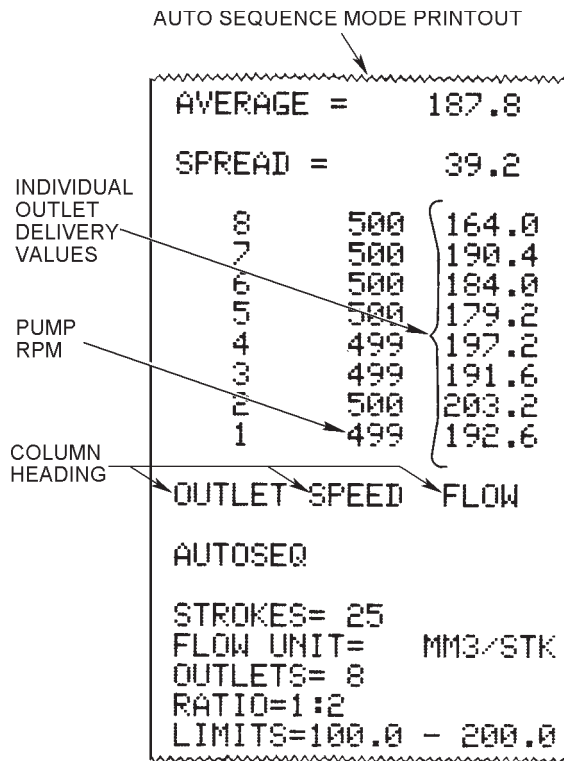


Figure 3-13. Printout: Auto-sequence



3.4 RESETTING CONTROL PANEL SWITCHES

Changes in pump RPM or in console switch settings while the PDFM is operating alter the CRT display and printer output. If you reset a switch, the printout displays new fluid delivery data that reflects the revised switch settings.

Change	Effect on CRT Display
RPM decreases to zero.	Bar graphs disappear (after a few seconds). Delivery, AVERAGE, TOTAL and SPREAD values go to 0.0.
RPM increases from zero.	After a few seconds, bar graphs reappear. Fluid delivery values begin to accumulate again.
Operator changes unit of measurement.	After a few seconds, the PDFM automatically converts delivery values to new unit of measurement.
Operator changes mode.	After a few seconds, the display resets. Measurement begins in new mode.
Operator changes stroke count.	After a few seconds, all delivery values go to 0.0. Measurement resumes from the beginning.
Operator changes pump/engine ratio.	Bar graphs disappear. All delivery values go to 0.0. Measurement resumes from the beginning.
Operator resets NO. OF OUTLETS switch, SINGLE OUTLET switch or both switches.	Bar graphs disappear. All delivery values go to 0.0. Measurement resumes from the beginning.
Operator changes high or low delivery limit.	The CRT rescales bar graphs. At the end of the stroke count period, CRT displays adjusted delivery values.
Operator turns printer on or off.	CRT display blinks. After a few seconds, measurement resumes where it left off.
POWER switch (or input power to PDFM) turned off, then back on.	CRT display clears. After a few seconds, measurement resumes

3.5 ERROR MESSAGES

Normally, the MESSAGE line on the CRT display is blank. If an error message appears, a control switch is set incorrectly or the CPU circuit board is having trouble "reading" the switch setting. Error messages should disappear when you reset the switch. If not, the problem may be a faulty switch or loose connector.

Only the following error messages should appear on the CRT screen. If any other messages appear, change modes or reset the PDFM by turning power off, then on. Should this not delete the message, call a Bacharach Service Center.

Message	Meaning
HIGH LIMIT SWITCH < LOW LIMIT SWITCH	High or low limit switches are incorrectly set. Or High limit switch is at 0, or at a lower value than the Low limit switch. Reset the switches to the proper values.
INVALID LOW DELIVERY LIMIT SWITCH	Switch may be "stuck" between two digits, or defective. Reset or replace each thumbwheel.
INVALID HIGH DELIVERY LIMIT SWITCH	Switch may be "stuck" between two digits. Reset each thumbwheel.
INVALID SINGLE OUTLET SWITCH	NO. OF OUTLETS switch or SINGLE OUTLET switch set at zero. Reset the switch to the desired value.
SINGLE OUTLET SWITCH > NO. OF OUTLETS SWITCH	NO. OF OUTLETS switch set at zero or a number lower than the SINGLE OUTLET switch. Reset the incorrect switches.
INVALID NUMBER OF OUTLETS SWITCH	NO. OF OUTLETS switch or both outlet switches set at 9. Reset the switch(es) to 8 or below.
INVALID STROKE SWITCH	Switch is "stuck" between positions or defective. Reset or replace the switch.
INVALID RATIO SWITCH	Switch is "stuck" between positions or defective. Reset or replace the switch.
INVALID PRINT SWITCH	Switch is "stuck" between positions or defective. Reset or replace the switch.
INVALID UNITS SWITCH	Switch is "stuck" between positions or defective. Reset or replace the switch.
INVALID MODE SWITCH	Switch is "stuck" between positions or defective. Reset or replace the switch.

3.6 HOW THE PDFM OPERATES

3.6.1 Hydraulic System

The PDFM 808's hydraulic system carries fluid delivered from injection pump outlets through:

1. Eight input solenoid valves
2. The manifold
3. The flowmeter transducer assembly, which contains:
4. Relief valve #1
5. Two flow control solenoid valves
6. Two fluid chambers
7. Two optical pickups
8. Relief valve #2
9. Relief valve #3

Fluid delivered from the pump outlets travels through the test stand accumulator to input solenoid valves (1). If the PDFM is turned off or in BYPASS mode, the fluid passes through the valves and a common line (shown as a dashed line) returning to the test stand through relief valve #3 (9).

If the PDFM is in SINGLE, AVERAGE or AUTO-SEQUENCE mode, some or all of the fluid passes through the manifold (2) and into the flowmeter transducer assembly. The measured inputs flow through the manifold to the transducer, unmeasured inputs flow through the solenoid valves back to the reservoir.

At the transducer, the fluid:

1. Enters relief valve #1 (4), which dampens fluid pulsations due to the fuel injection.
2. Passes through a tee, which directs the fluid to one of the flow control solenoid valves (5) at either end of the transducer.
3. Flows through the solenoid valve and into one of two chambers (6). As fluid enters the chamber it displaces the piston toward the opposite solenoid valve and forces fluid out of the other fluid chamber.
4. Flows into relief valve #2 (8), which provides back pressure for the return fluid.

As the piston travels in one direction, it interrupts one of two optical pick-ups (7). The optical pickup signals the flow control solenoid valves (5) to reverse the fluid flow. This forces the piston to travel in the opposite direction. When the piston interrupts the second optical pickup, the direction of piston travel reverses again. During piston reversal (“turnaround”) the PDFM stops measuring fluid flow for several revolutions of the drive shaft to prevent transient measurement errors.

Figure 3-14. Hydraulic System

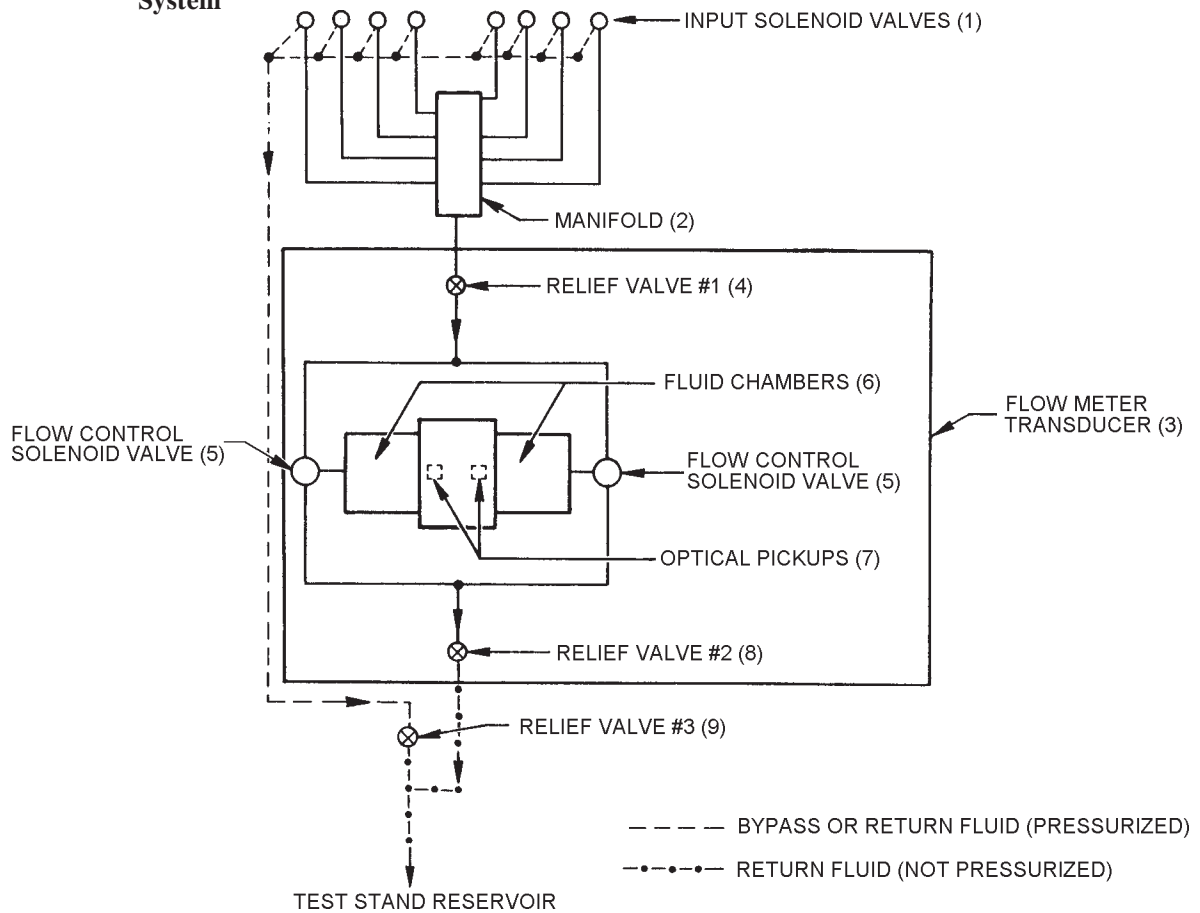
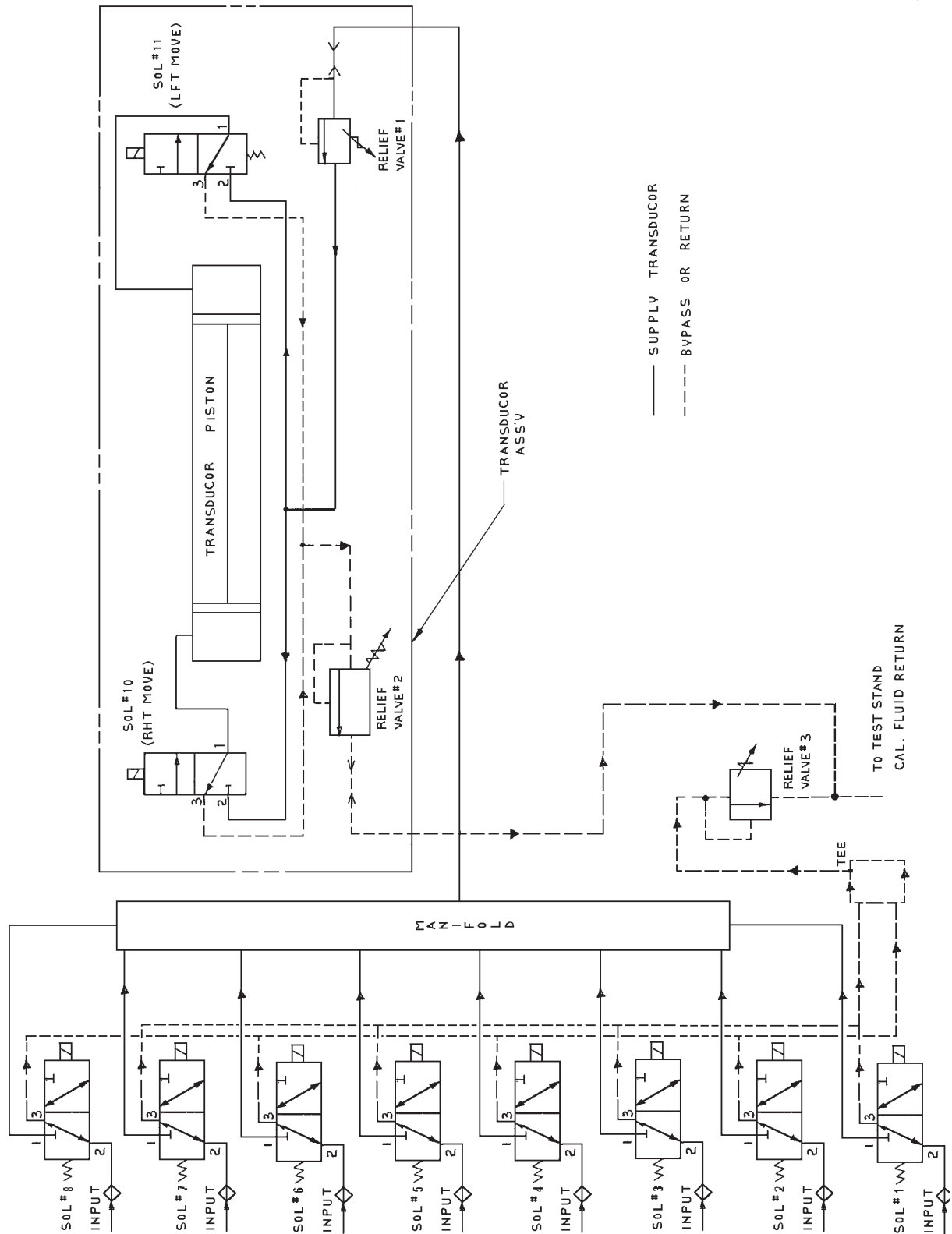


Figure 3-15. PDFM 808
HYDRAU-
LIC
SYSTEM



(Derived from 77-7070DS6R28)

3.6.2 Electronic Circuit

As fluid moves through the PDFM's hydraulic system, the unit's electronic circuitry generates a series of digital signals. A CPU circuit board reads these signals and translates them into fluid delivery, RPM and stroke count values. The PDFM 808 then displays these values on the CRT screen and prints them out if the printer is turned on.

To trace the path of these digital signals through the PDFM's electronic circuits, see the flowchart below and the following schematic drawing.

Figure 3-16. Electronic Circuit Diagram

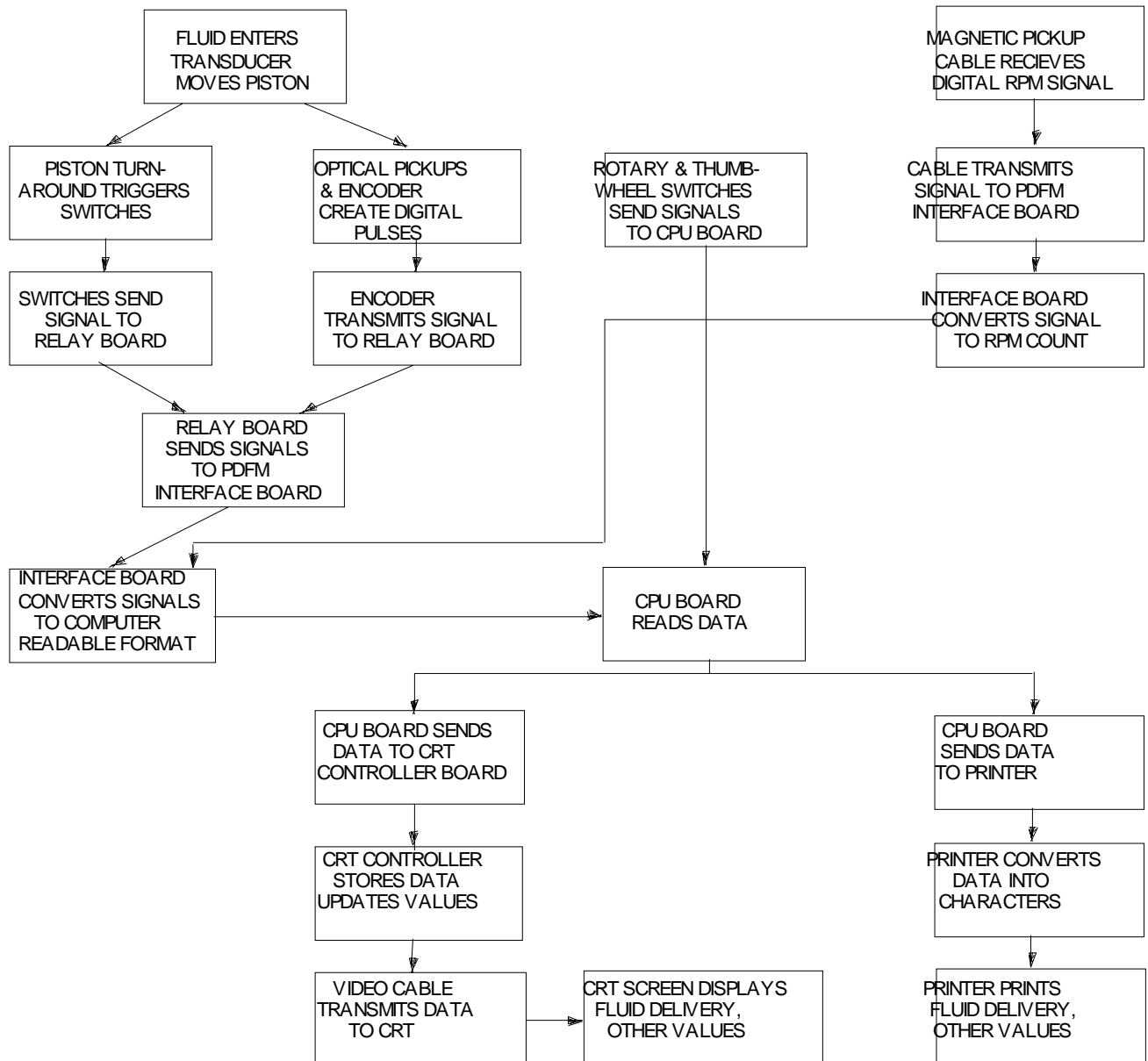
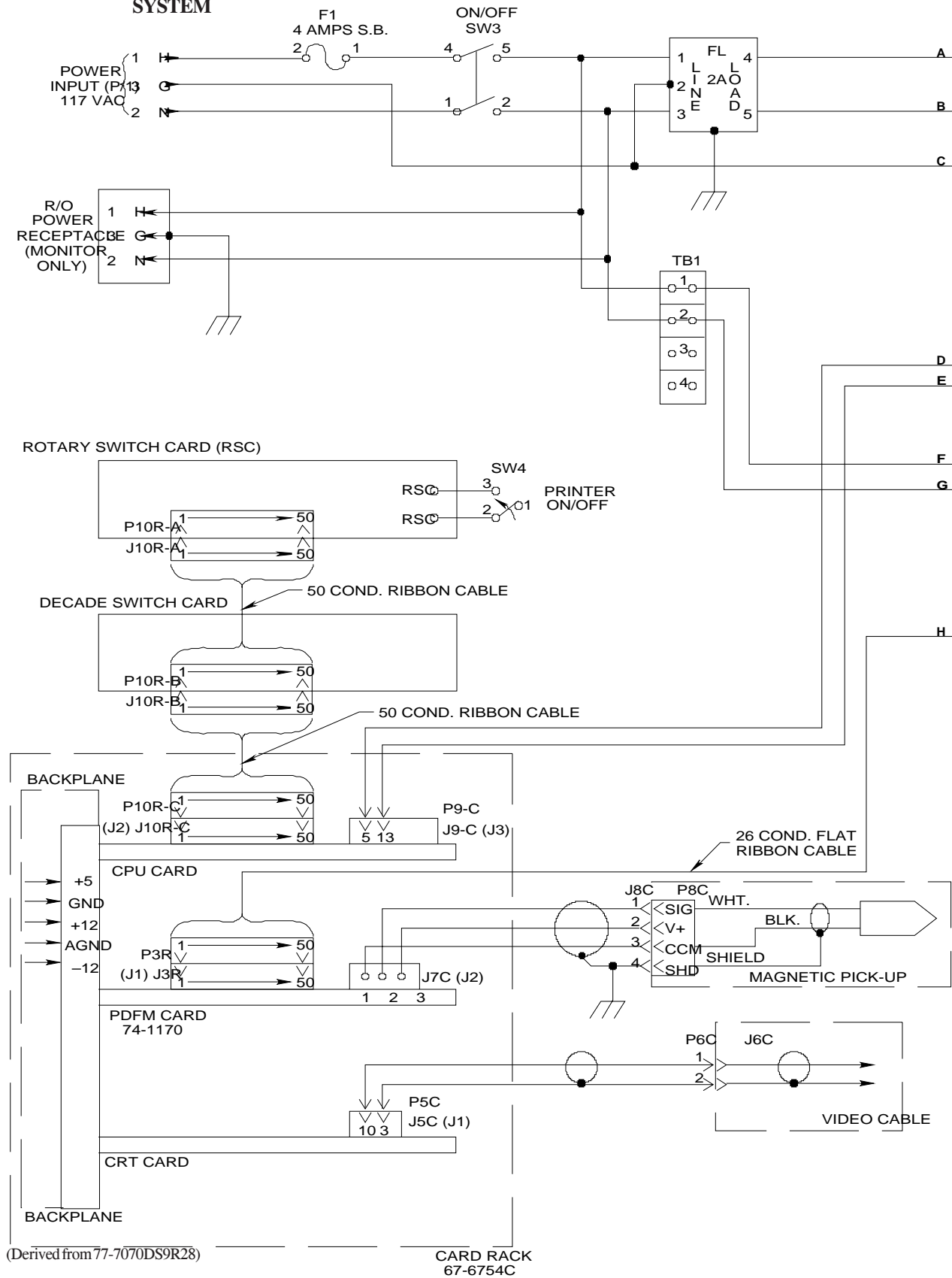
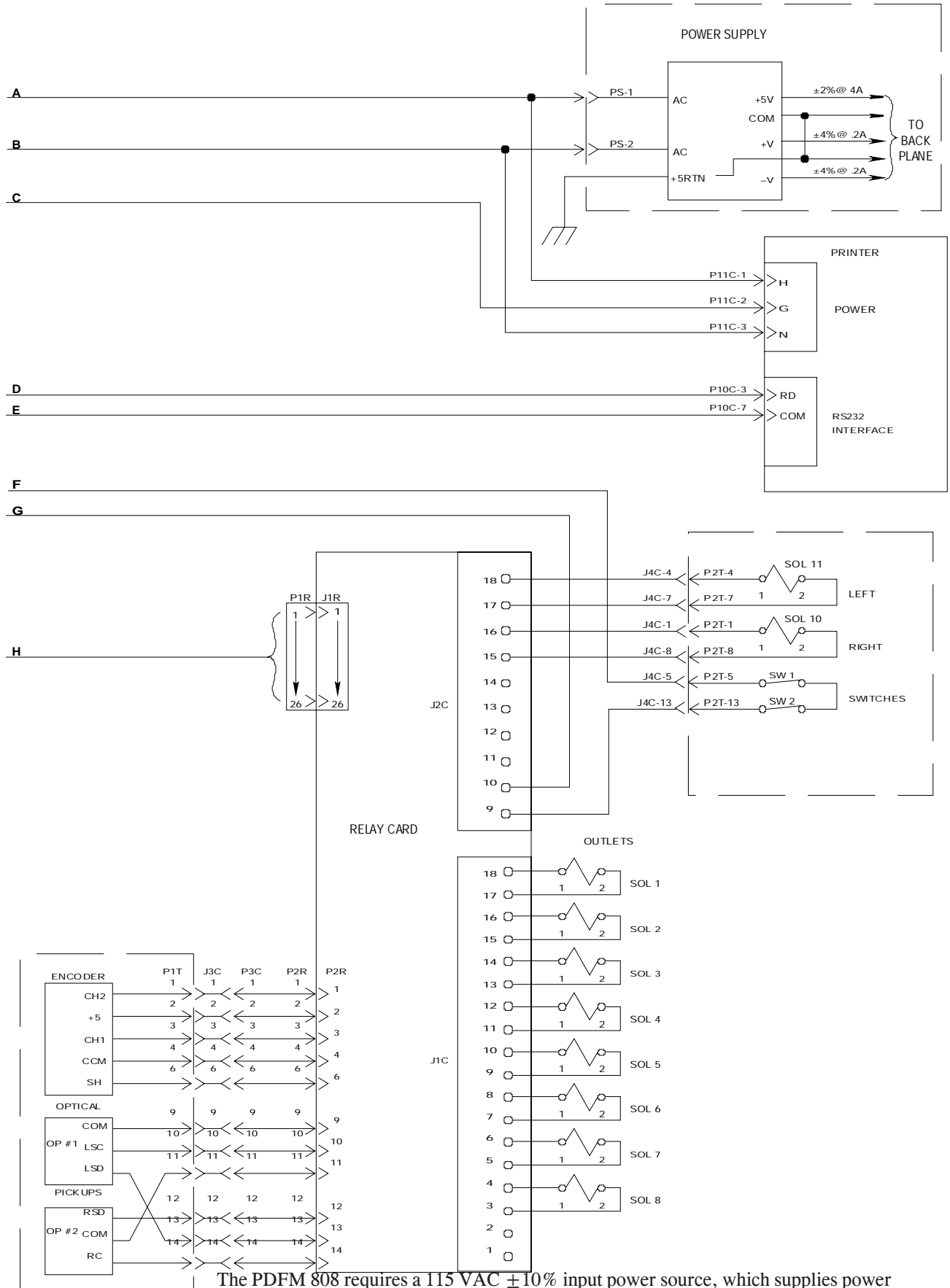


Figure 3-17. PDFM ELECTRICAL/ELECTRONIC SYSTEM



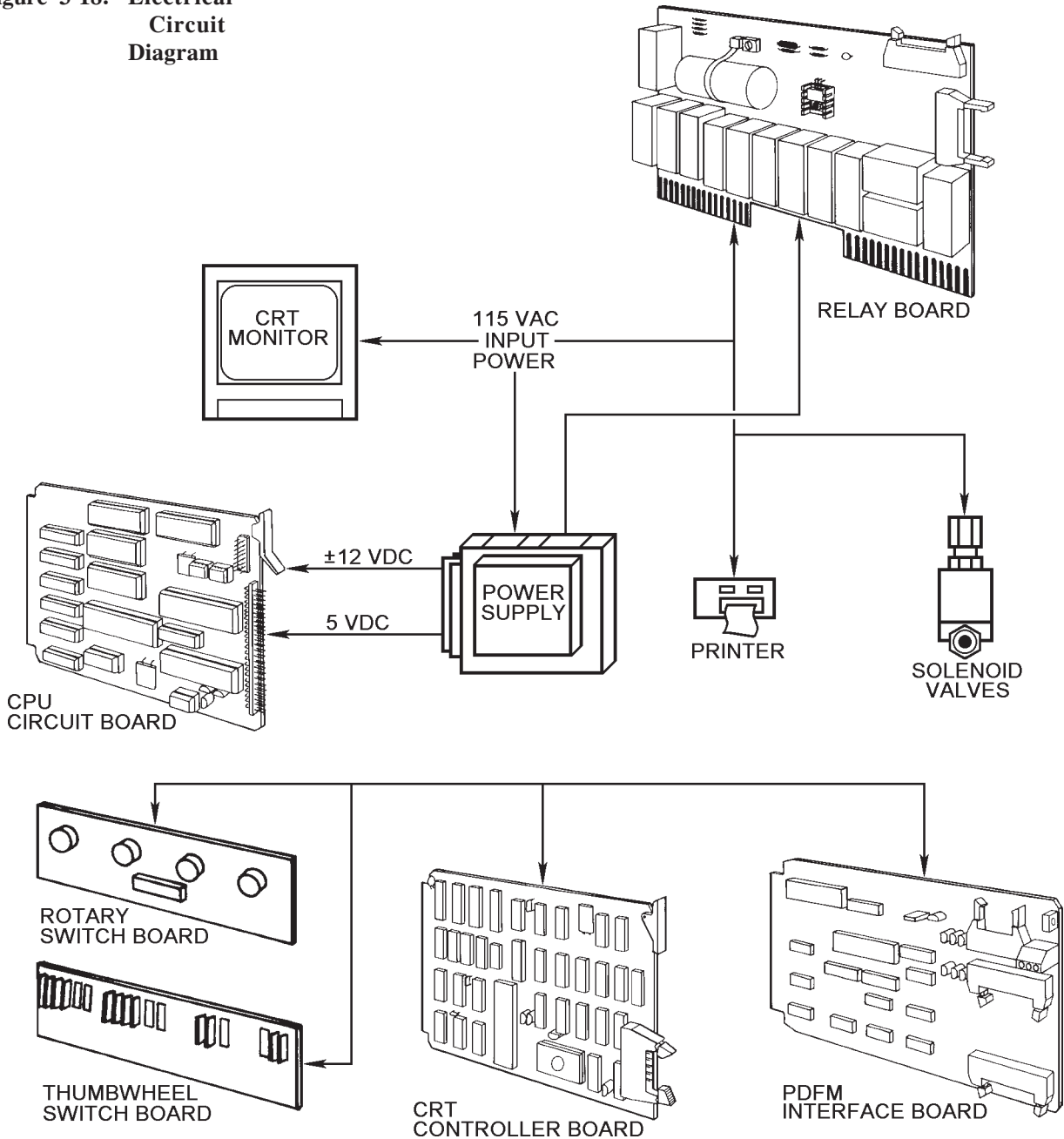


3.6.3 Electrical Circuit

directly to the CRT and the relay circuit board. The power supply mounted on the card cage converts the 115 VAC to 5 VAC or ± 12 VDC, the operating voltages for the other PDFM circuit boards. The solenoid valves, and printer all operate on 115 VAC $\pm 10\%$.

For details on the PDFM's electrical system, see the flowchart below and the schematic drawing in Subsection 3.6.2.

Figure 3-18. Electrical Circuit Diagram



4 MAINTENANCE & TROUBLE- SHOOTING

4.1 SCHEDULE

Perform these tasks as indicated:

Task:	Do This:
Check oil level in transducer	Weekly. Add oil if level is below 1/4" from the bottom of the cavity.
Empty and refill transducer oil cavity	Every three months or after 120 operating hours.
Test printer output	Weekly. Clean the printhead when characters print faintly or not at all.
Clean solenoid valve filters	After flow testing 40 to 45 injection pumps, or if fluid lines appear contaminated.
Check for contaminants in the PDFM manifold	When test stand calibration fluid is changed.
Clean test stand's accumulator block	Each time engine nozzles are installed.
Clean CRT screen and PDFM control panel	As required.

This schedule is only a guideline. Maintenance will depend on the working environment and the cleanliness of the pump and injection nozzles.

For best results, an AUDIT by Bacharach service personnel should be performed periodically. It has been our experience that for best equipment accuracy, an AUDIT should be done every six months.

4.2 CHECKING OR CHANGING TRANSDUCER LUBE OIL

Weekly, check that the level of SAE 30W motor oil in the transducer oil cavity is at least 1/4" from the bottom of the cavity.

Drain and refill the transducer oil cavity after three months, or 120 hours of PDFM operation, or if the oil becomes contaminated.

Tools needed:

- 1/4 inch hex wrench
- Drain pan for waste fluid

1. Prop up the PDFM console. Slide a drain pan under the plug at the bottom front of the console (underneath the transducer).
2. Use the hex wrench to open the plug. Let the old oil drain out.

3. Reinstall the drain plug.
4. Fill the transducer oil cavity as per Section 2.5.

Figure 4-1. Drain Pan

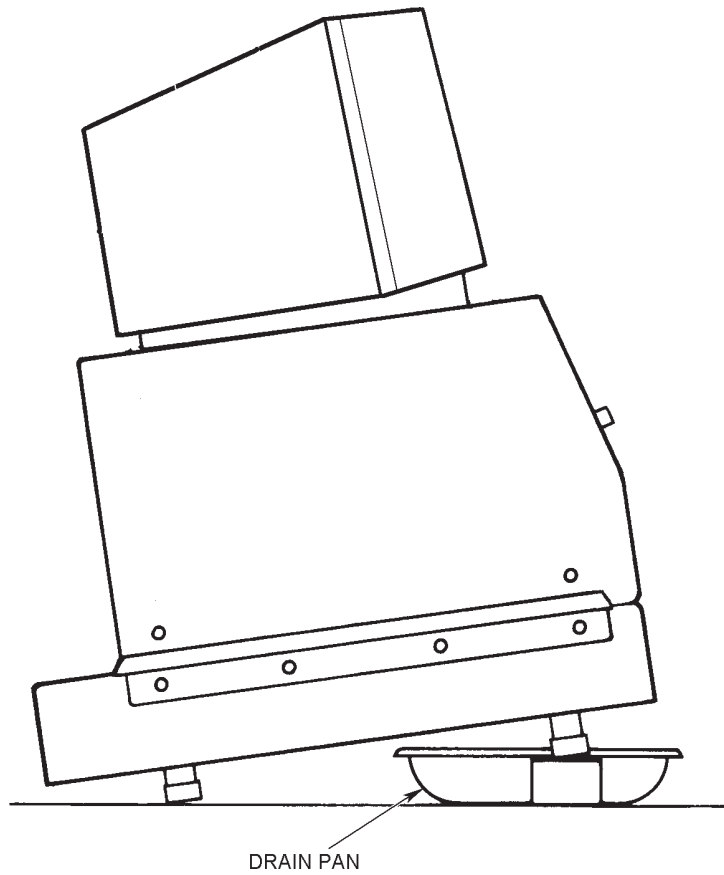
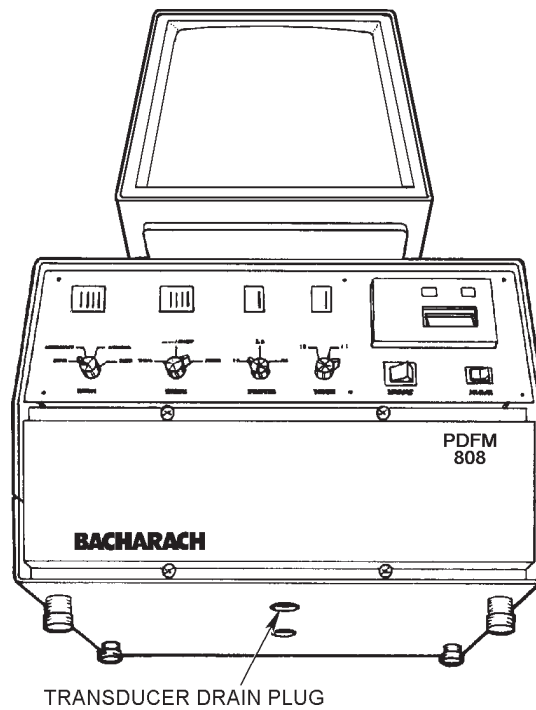


Figure 4-2. Drain Plug

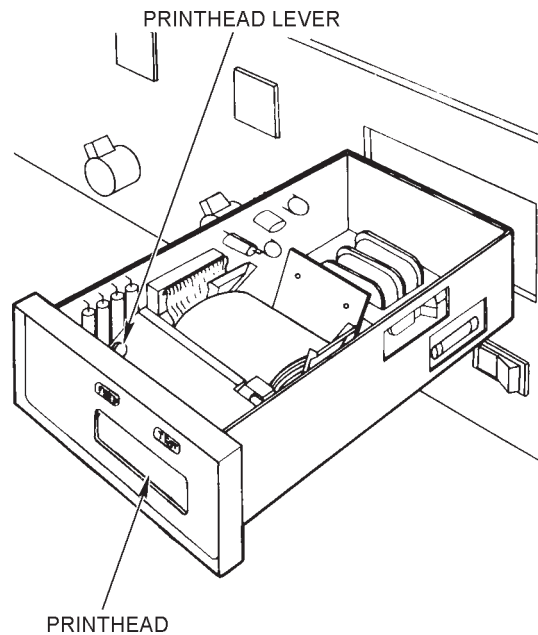


4.3 CLEANING THE PRINTHEAD

To clean the printhead, you need not remove it from its holder or remove the printer from the control panel.

1. Pull the printer out to the stop.
2. Release the printhead lever so that it no longer touches the drive roller.
3. Remove the paper roll.
4. Clean the printhead with a small cotton swab dipped in alcohol. Remove all paper residue.
5. Reinsert the paper roll.
6. Push the printhead lever back against the drive roller.
7. Push the printer back into the control panel.
8. Press TEST to check printer operation.

Figure 4-3. Cleaning Printhead



4.4 CLEANING OR CHANGING A SOLENOID VALVE FILTER

Inspect the fluid lines from the test stand often for entrapped dirt. Clean the filters on the PDFM solenoid valves when dirt appears in the fluid lines, or after testing approximately 100 injection pumps.

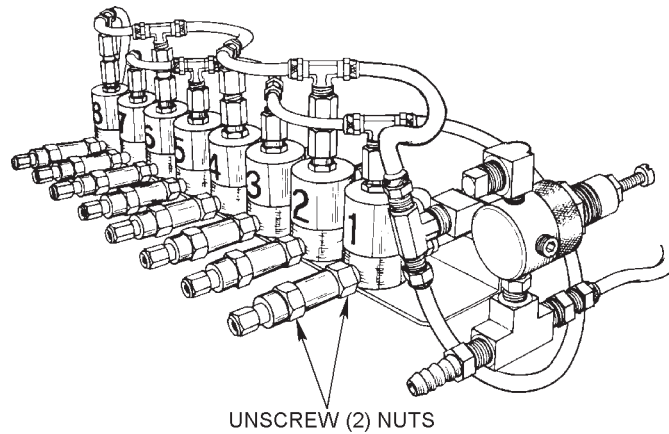
Tools needed:

- 13/16 inch open end wrench
- 7/8 inch open end wrench
- Alcohol and shop air (if cleaning the filters)

1. Disconnect the accumulator fluid line. Place a drain pan under the line and the solenoid valve to catch waste fluid.

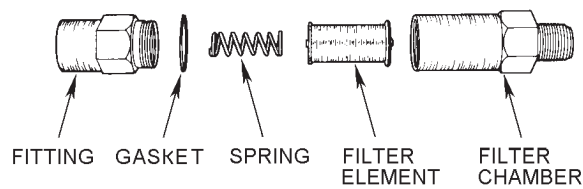
2. With the 7/8 inch wrench, hold down the nut on the filter chamber (next to the solenoid valve). With the other wrench, remove the nut at the end of the fitting.

Figure 4-4. Unscrew Filter Chamber



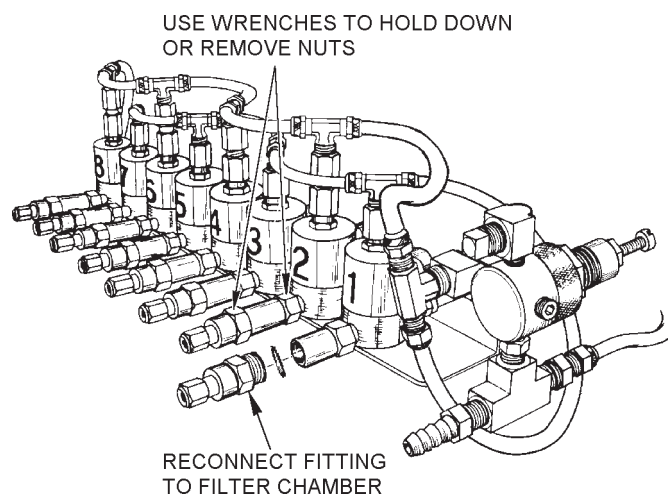
3. Remove the filter.

Figure 4-5. Solenoid Filter



4. Remove the fitting. Blow out the element with shop air and clean its surface with alcohol.
5. Reinsert the filter and reinstall the fitting to the filter chamber.
6. Reconnect the fluid line.

Figure 4-6. Reconnecting Filter Chamber



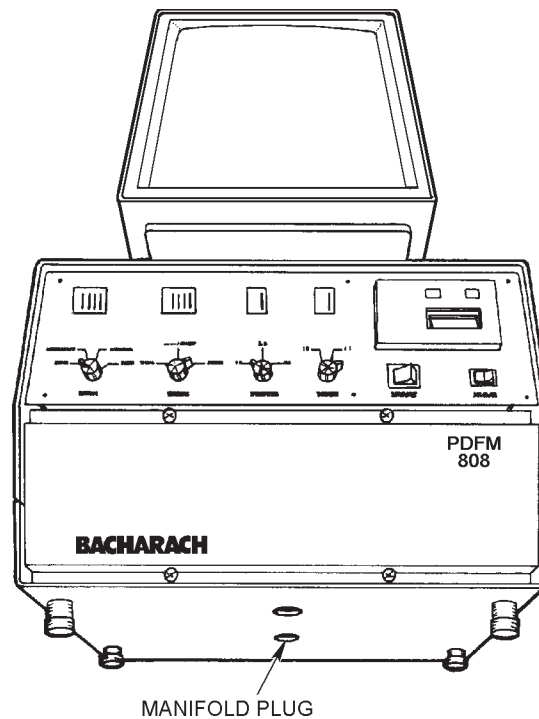
4.5 CHECKING THE MANIFOLD FOR CONTAMINANTS

A magnetic pipe plug at the base of the PDFM manifold traps metal chips that may collect before they can contaminate the transducer. Remove and clean the manifold plug each time you change calibration fluid in the test stand.

Tools needed: 1/4 inch Allen wrench

1. Remove the CRT from its stand.
2. Lift up the PDFM console or tilt it backward.
3. The manifold plug is at the bottom center of the console housing. Use the Allen wrench to remove the plug.

Figure 4-7. Checking Manifold



4. Inspect the plug and remove any metal chips.
5. Reinstall the plug.

4.6 CLEANING THE TEST STAND ACCUMULATOR BLOCK AND NOZZLES

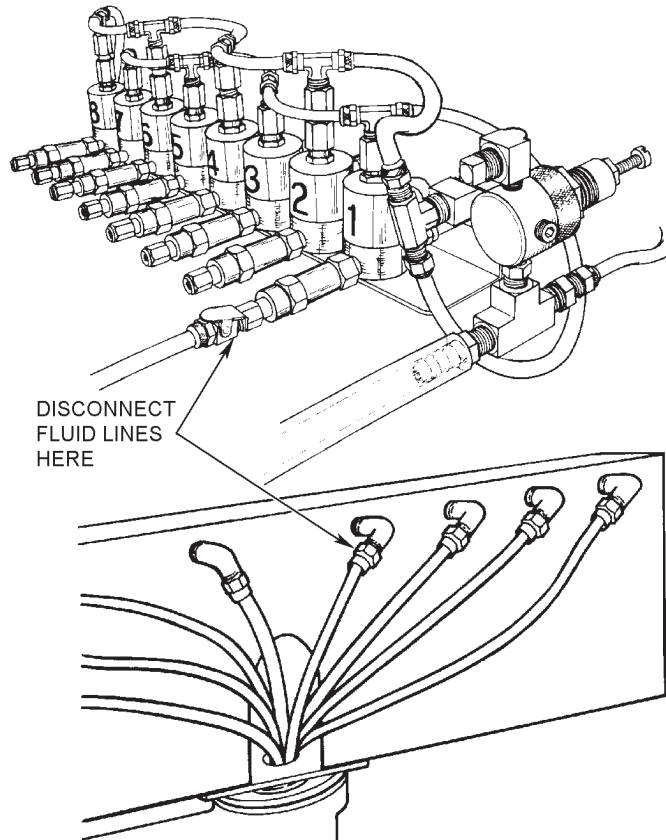
Never let contaminants accumulate in the fluid lines between the accumulator and the PDFM solenoid valves. Small particles can block or restrict the fluid flow and the lines may rupture. Inspect the fluid lines often for contaminants. Clean the accumulator block each time you install new test nozzles.

1. Disconnect the fluid lines from the accumulator and the solenoid valves.
2. Remove pipe plugs at bottom of each bore in the accumulator*.
3. Clean the accumulator thoroughly with degreasing solvent. Dry it with shop air.

*Early production accumulator blocks do not have these plugs.

4. Blow out the fluid lines and accumulator block with shop air.
5. Reconnect the fluid lines. Reinstall plugs.

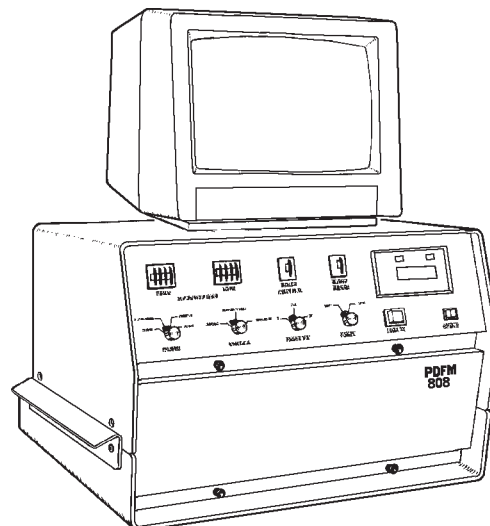
Figure 4-8. Cleaning Accumulator Block & Nozzles



4.7 CLEANING THE CRT AND PDFM CONSOLE

The PDFM 808 will remain in good working condition with just ordinary cleaning procedures. Daily or as required, wipe the CRT screen and the PDFM control panel with a good cleaning agent to remove dirt and oil splashes. Keep the front panel closed while operating the PDFM to avoid contaminating the transducer.

Figure 4-9. Cleaning the CRT & Console



4.8 TROUBLE-SHOOTING

Fault	Possible Cause and Remedy
Blank CRT display	<ol style="list-style-type: none"> 1. The CRT may not be turned on. Turn the CRT on. 2. The CRT's brightness control may be turn too far counterclockwise. Adjust the brightness control. 3. Check that the video cable is connected to the phone jacks at the rear of the CRT and the PDFM console. Also check the cable for continuity. 4. Input power may have been disrupted. Check that 115 VAC input power is connected to the PDFM. 5. The power supply on the card cage may be faulty. See Subsection 4.9.5. 6. CRT not set up correctly, see Section 2.3.
Bar graphs aren't displayed while delivery is being measured	<ol style="list-style-type: none"> 1. Pump delivery is probably below the lower delivery limit. Reset the delivery limit switches to lower values. 2. One of the transducer limit switches may be engaged. Disengage the switch by turning off the unit, then pushing the encoder arm back to the center of its travel. 3. Check for loose cable connections at the PDFM interface board and the relay board.
CRT doesn't update RPM values	<ol style="list-style-type: none"> 1. One of the transducer limit switches may be engaged. Disengage the switch by turning off the unit, then pushing the encoder arm back to the center of its travel. 2. Check for loose or broken wires at the PDFM interface board. 3. The magnetic pickup may be faulty. Contact a Bacharach Service Center.

Fault	Possible Cause and Remedy
<p>CRT displays “snow” in place of column headings and delivery values</p>	<ol style="list-style-type: none"> 1. Check for loose or broken wires at the CRT controller board.
<p>CRT doesn’t update fluid delivery values</p>	<ol style="list-style-type: none"> 1. One of the transducer limit switches may be engaged. Disengage the switch by turning off the unit, then pushing the encoder arm back to the center of its travel. 1. Check for loose or broken wires at the PDFM interface board.
<p>CRT won’t respond to changes in fluid delivery</p>	<ol style="list-style-type: none"> 1. The pump outlet under test may not be connected to the proper PDFM solenoid valve. <ol style="list-style-type: none"> a. Check that plumbing is installed between the outlet and the solenoid. See Subsections 2.6.1 and 2.6.2. b. Make sure that all fittings and fluid lines are tight.
<p>CRT won’t respond to changes in pump RPM</p>	<ol style="list-style-type: none"> 1. The magnetic pickup cable may be loose. Make sure that cable connections at the test stand and at the back of the PDFM are tight.
<p>Switch status reported on the CRT doesn’t match actual switch settings</p>	<ol style="list-style-type: none"> 1. On rare occasions, this may happen when you first turn the PDFM on. Turn the unit off, then back on.
<p>Zero fluid delivery indicated</p>	<ol style="list-style-type: none"> 1. The outlet being tested may not be connected to a PDFM solenoid valve. <ol style="list-style-type: none"> a. Check that plumbing is installed properly between the outlet and solenoid. See Subsections 2.6.1 and 2.6.2. b. Make sure that all fittings and hoses are tight. 2. One of the transducer limit switches may be engaged. Disengage switch by turning unit off, then pushing encoder arm back to the center of its travel.

Fault	Possible Cause and Remedy
	<ol style="list-style-type: none"> 3. The optical pickup on the transducer may be blocked. This prevents the piston from traveling a full stroke. If necessary: <ol style="list-style-type: none"> a. Turn the PDFM off. b. Remove the front panel. c. Move the piston by hand until it is centered between the transducer limit switches. d. Clean the optical pickups with a cotton swab dipped in a degreasing agent. e. Switch the PDFM on and watch the piston. The piston should travel easily in both directions.
Solenoid valves won't switch on or off; PDFM won't switch from one valve to another	<ol style="list-style-type: none"> 1. Check for loose or broken wires at the relay circuit board. 2. The relay circuit board may be faulty. See Subsection 4.9.3.
POWER switch is on and lit but no other switches operate	<ol style="list-style-type: none"> 1. On rare occasions, this may happen when you first turn the PDFM on. Turn unit off, then back on to reset circuits.
PDFM won't operate with 115 VAC input power connected	<ol style="list-style-type: none"> 1. If the POWER switch is not lit, the fuse at the back of the console may be burned out. Check the fuse and replace it if necessary. 2. One of the transducer limit switches may be engaged. Disengage the switch by turning off the unit, then pushing the encoder arm back to the center of its travel. 3. Check that the cables connected to the CPU circuit board aren't loose. 4. Input power may be less than 115 VAC $\pm 10\%$. Check the input power source. 5. An electrical connection within the PDFM may be faulty. Consult the electrical schematic drawing in Section 3, and trace the continuity of the circuit.

Fault	Possible Cause and Remedy
Fluid delivery at one or more outlets not within recommended limits	<ol style="list-style-type: none"> 1. Plumbing lines with out-of-limit fluid delivery may be blocked by dust or dirt. Inspect the lines and flush them if necessary. 2. Check that fluid lines from all outlets are of equal length and diameter. 3. Determine whether the problem is at the pump or at the PDFM, as follows: <ol style="list-style-type: none"> a. Turn the PDFM off. b. At the solenoid valves, disconnect the fluid line(s) from the outlet(s) with out-of-range fluid flow. c. Connect these fluid lines to solenoids that delivered normal fluid flow. Restart the PDFM. d. If fluid delivery from the reconnected outlets is now within limits, the problem is at the PDFM. If the delivery is still out of limits, the problem is at the pump. 4. The solenoid valve(s) connected to the outlet(s) flowing above or below limits may be faulty. Replace a faulty valve as per Subsection 4.9.9.
Printer won't print	<ol style="list-style-type: none"> 1. The PRINT switch may not be on. Turn the switch on. 2. The printer may need paper. Install a new paper roll as per Subsection 2.10.3. 3. The printer may have a loose electrical connection. Check the power and DB25 connections at the back of the printer housing. 4. Press the printer's TEST switch. If the switch works and Steps 1 through 3 have been performed, replace the CPU circuit board as per Subsection 4.9.4.

Fault	Possible Cause and Remedy
Paper tape sticks	1. The wrong type of paper may be installed. See Subsection 2.10.4.
Printouts contain light streaks, or characters that don't print	1. The printhead may be dirty. See Section 4.3. 2. The printer may be faulty. If necessary, install a new printer as per Subsection 4.9.8.

4.9 REPLACING PARTS

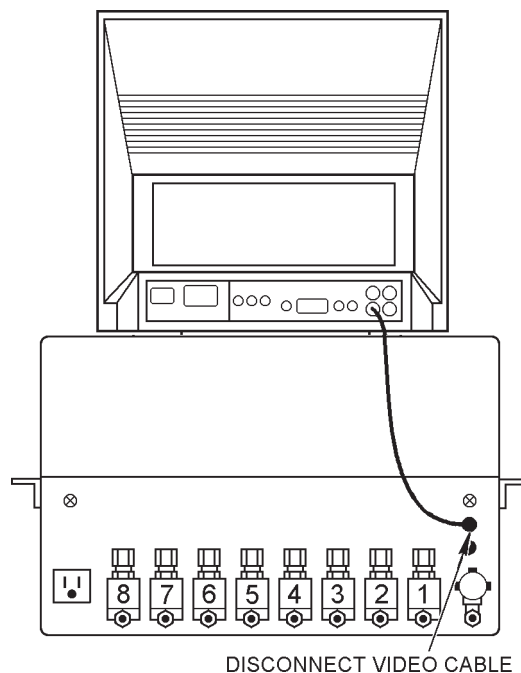
4.9.1 Removing the PDFM Console Cover

Tools needed:

- 1/8 or 1/4 inch blade screwdriver
- 5/32 Allen wrench or hex head screwdriver

1. Disconnect power cord, and video cable at the PDFM.

Figure 4-10. Removing Console Cover



2. Lift the CRT off the PDFM console. Set the CRT aside. Remove the four screws which fasten the console cover, just above the handles. Set the screws aside.
3. Loosen the button head screws in the PDFM handles.
4. Lift the cover up and off the console

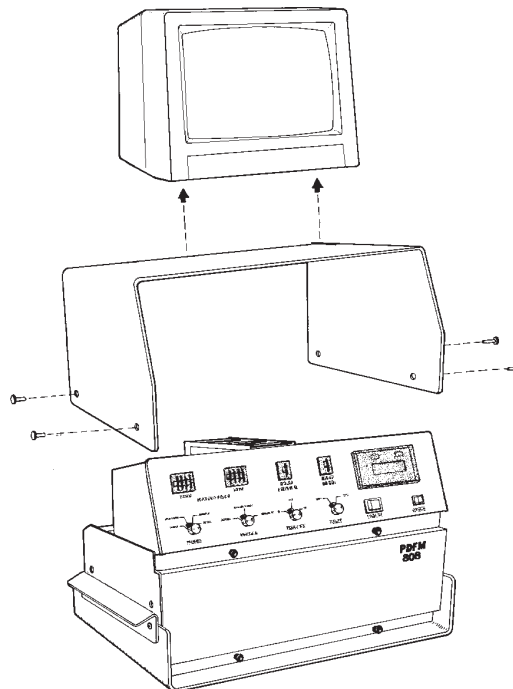
4.9.2 Reinstalling the PDFM Console Cover

Tools needed:

- 1/8 or 1/4 inch blade screwdriver
- 5/32 Allen wrench or hex head screwdriver

1. Place the cover on the console. Align the screw holes in the cover with the console screw holes.
2. Reinstall and tighten the console screws. Retighten the handle screws.
3. Reinstall the CRT monitor.
4. Reconnect the power cord and video cable.

Figure 4-11. Reinstalling Console Cover



4.9.3 Replacing the Relay Circuit Board

Tools needed:

- 3/8 inch blade screwdriver

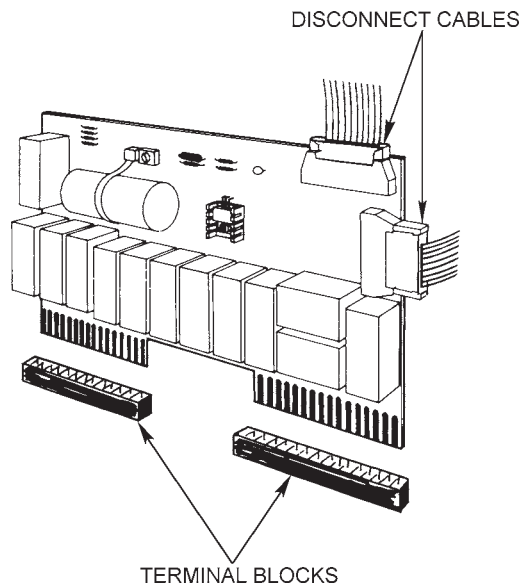
1. Turn the PDFM 808 off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

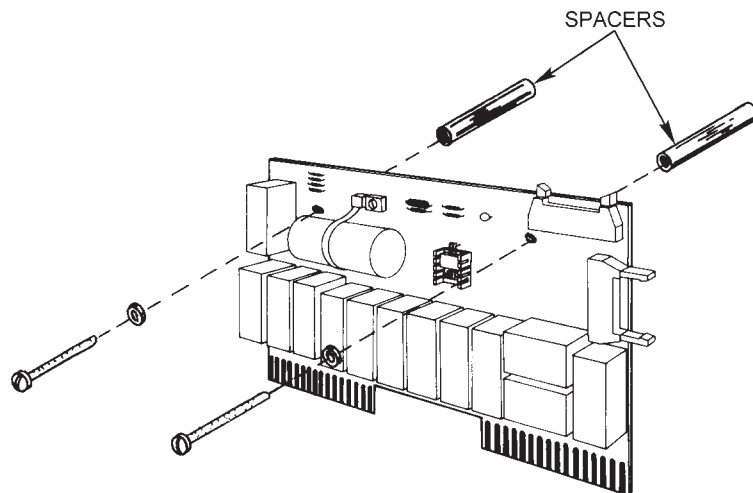
3. Remove the console cover. See Subsection 4.9.1.
4. Disconnect the ribbon cable and stranded wire cable from the solid state relay board.

Figure 4-12. Disconnect Cables



5. Remove the two screws, washers and spacers. Set the hardware aside.

Figure 4-13. Remove Hardware



6. Pull the relay board out. Insert a new relay board and push down to seat it in the two terminal blocks.
7. Place the spacers behind the board. Insert and tighten the screws and washers.
8. Connect the cables to the new relay board.
9. Reinstall the console cover. See Subsection 4.9.2.
10. Turn the PDFM back on.

4.9.4 Replacing the Circuit Boards in the Card Cage

The card cage behind the front panel contains the following circuit boards:

- Microprocessor or CPU — performs all logic and arithmetic functions
- CRT controller — controls the display of data on the CRT screen
- PDFM interface — processes signals from the PDFM relay board and the test stand's magnetic pickup

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

Figure 4-14. CPU Circuit Board

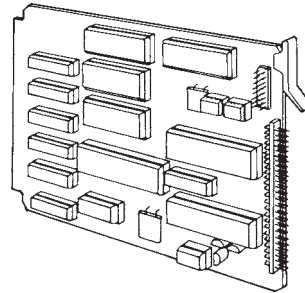


Figure 4-15. CRT Controller Board

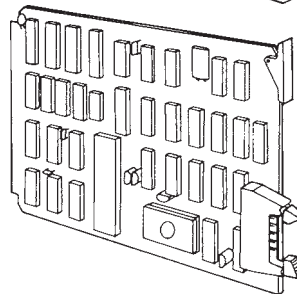
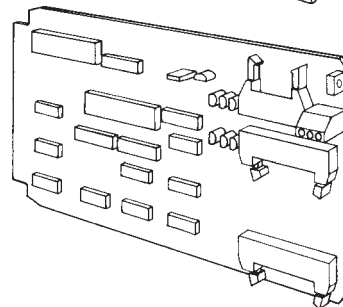


Figure 4-16. PDFM Interface Board



1. Turn the PDFM off.
2. Disconnect input power at its source.
3. Remove the console cover. See Subsection 4.9.1.
4. Locate the board you want to replace.
5. Detach the cable(s) by pulling them straight out or by opening the connectors.
6. Pull the board straight out.

7. Replace the old board with a new one.
8. Push the new board into the card cage until it is seated in the front of the cage.
9. Reconnect the cable(s).
10. Reinstall the console cover. See Subsection 4.9.2.
11. Reconnect input power.
12. Turn the PDFM back on.

4.9.5 Replacing the Card Cage/Power Supply Assembly

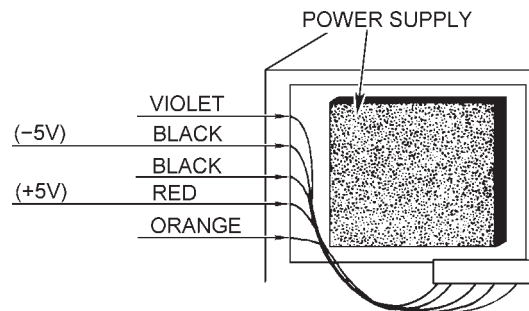
A. Testing the Power Supply

If the power supply isn't working properly, it won't provide output of 5 VDC and ± 12 VDC. These voltages are required to operate the PDFM circuit boards. To test power supply output, obtain a voltmeter with pointed probes and:

1. Remove the console cover. See Subsection 4.9.1.
2. Locate the wiring connections just left of the power supply. Place the (+) voltmeter lead on the red wire connection and the (-) voltmeter lead on one of the black wire connections. The voltage should be 5.0 ± 0.5 VDC.

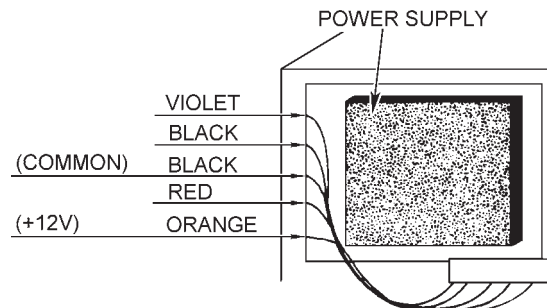
IMPORTANT: When measuring output voltages, make sure that the CPU circuit board is fully seated in the front of the card cage. Otherwise, the voltage indications may be incorrect.

Figure 4-17. Checking for 5VDC



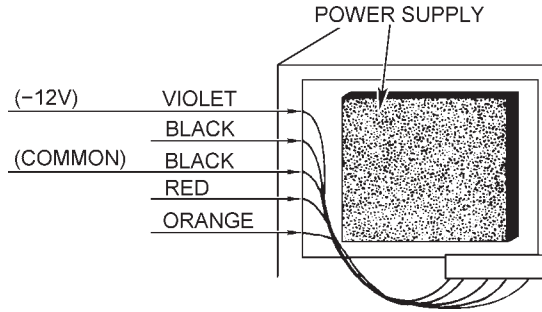
3. Measure the voltage at the connections for the orange and black wires. The voltage should be $+12 \pm 0.5$ VDC.

Figure 4-18. Checking for +12VDC



4. Measure the voltage at the connections for the violet and black wires. The voltage should be -12 ± 0.5 VDC.

Figure 4-19. Checking for -12VDC



5. If any of the voltage indications aren't within the limits given, the power supply is faulty and must be replaced.

B. Card Cage/Power Supply Replacement

Tools needed:

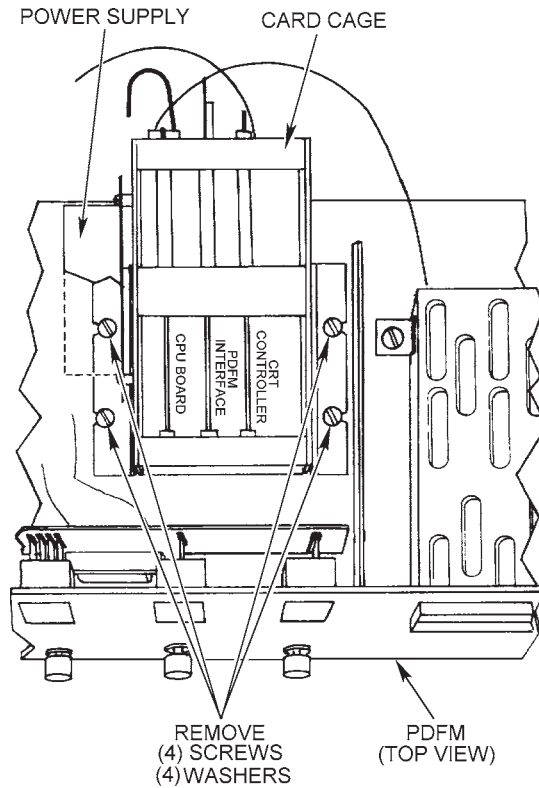
- 3/8 inch blade screwdriver

1. Turn the PDFM off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

Figure 4-20. Card Cage/Power Supply



3. Remove the circuit boards from the card cage. You may have to disconnect the cables from the boards.
4. Remove the four screws and washers from the base of the card cage/power supply assembly.
5. Lift the assembly out of the console.
6. Install a new card cage/power supply. Insert and tighten the screws and washers.
7. Insert the circuit boards into the new card cage. Reconnect cables if necessary.
8. Reinstall the console cover. See Subsection 4.9.2.
9. Reconnect input power and turn the PDFM back on.

4.9.6 Replacing the Thumbwheel Switches and Circuit Board

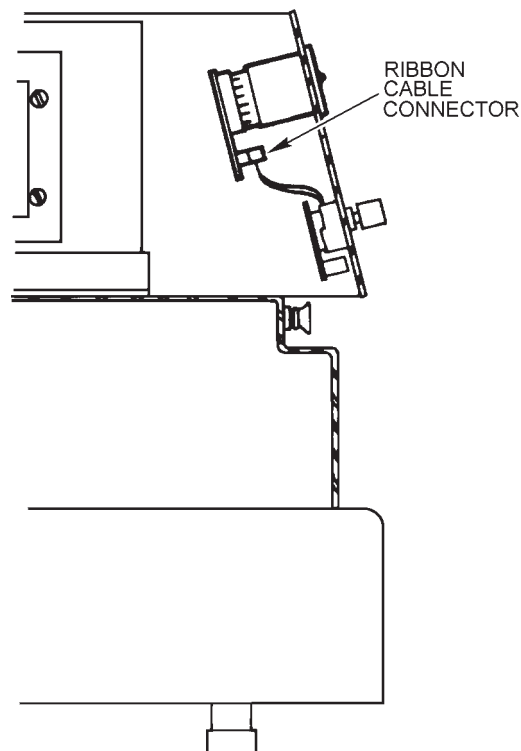
1. Turn the PDFM off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

3. Remove the console cover. See Subsection 4.9.1.

Figure 4-21. Thumbwheel Switches & PCB



4. If replacing a single thumbwheel switch:
 - a. Hold the circuit board and pull the old thumbwheel switch out of the control panel.
 - b. Insert the new thumbwheel switch into the control panel.
 - c. Connect the new thumbwheel switch to the circuit board.
 - d. Skip to step 5d.

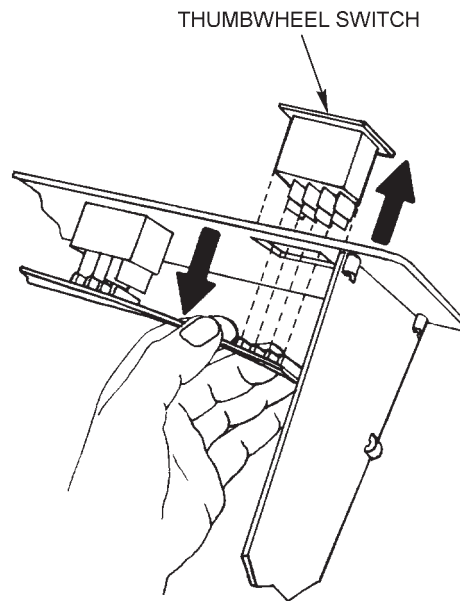
5. If replacing the thumbwheel switch circuit board:
 - a. Disconnect the ribbon cable from the circuit board.
 - b. Gently pull the four connectors on the circuit board away from the switches.

CAUTION

Take care not to crack the circuit board when pulling it out. If the board is damaged, the switches won't operate properly.

- c. Plug the connectors on the new board into the pins on the back of the switches.
- d. Reinstall the console cover. See Subsection 4.9.2.
- e. Reconnect input power. Turn the PDFM back on.

Figure 4-22. Replacing Switch & PCB



4.9.7 Replacing the Rotary Switches and Circuit Board

Tools needed:

- 1/16 Allen key
- Soldering iron or gun
- 60/40 rosin core solder

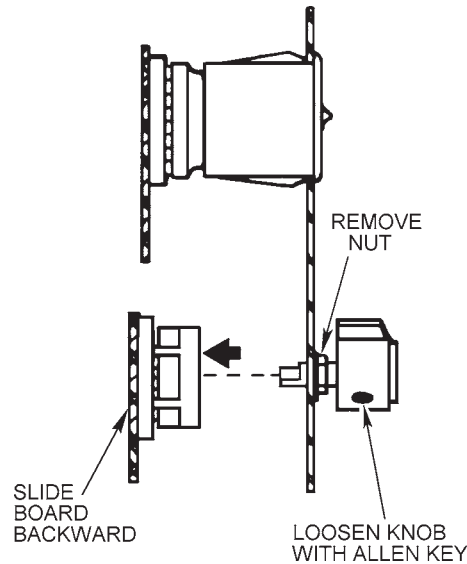
1. Turn the PDFM off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

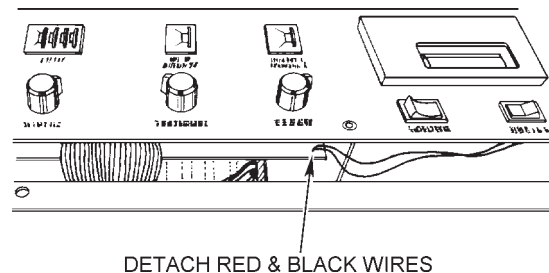
3. Remove the console cover. See Subsection 4.9.1.
4. Loosen the knobs with the Allen key. Remove the knobs and nuts.

Figure 4-23. Replacing Rotary Switch & PCB



5. Slide the circuit board backward. Disconnect the ribbon cable from the rotary switch circuit board.
6. Unsolder the red and black wires from the lower right edge of the circuit board. These wires are the power leads to the PRINT switch.

Figure 4-24. Unsolder Red & Black Wires



7. Remove the old circuit board and install a new one. Solder the PRINT switch power leads to the new board.
8. Connect the ribbon cable to the circuit boards.
9. Align the switches with the holes in the control panel. Reinstall the nuts and knobs. If necessary, replace the knob(s).
10. Reinstall the console cover. See Subsection 4.9.2.
11. Reconnect input power and turn the PDFM back on.

4.9.8 Replacing the Printer

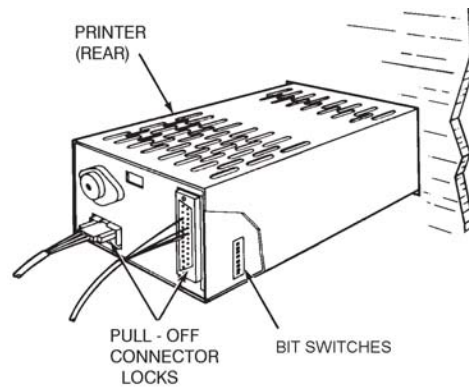
1. Turn the PDFM off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

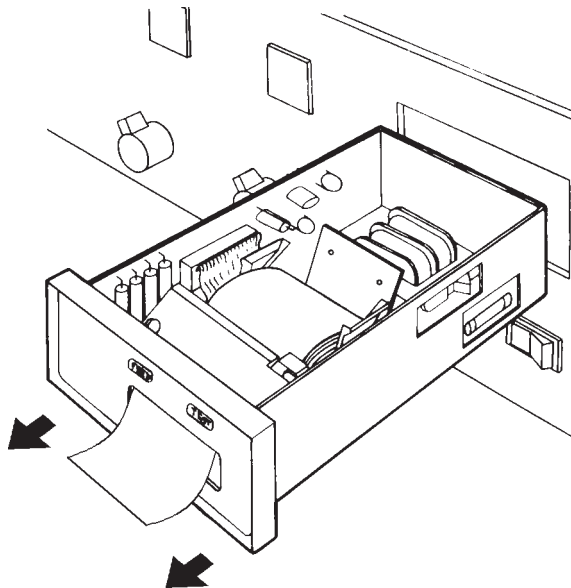
3. Remove the console cover. See Subsection 4.9.1.
4. Detach the power and DB25 connectors.

Figure 4-25. Disconnect Power & Connector



5. Release the safety latch at the right side of the printer, above the fuse. Pull the printer out of the control panel.

Figure 4-26. Pull Printer Forward



6. Set new printers bit switches to look like the ones on the old printer.
7. Install the new printer and attach both connectors.
8. Reinstall the console cover. See Subsection 4.9.2.
9. Reconnect input power and turn the PDFM back on.

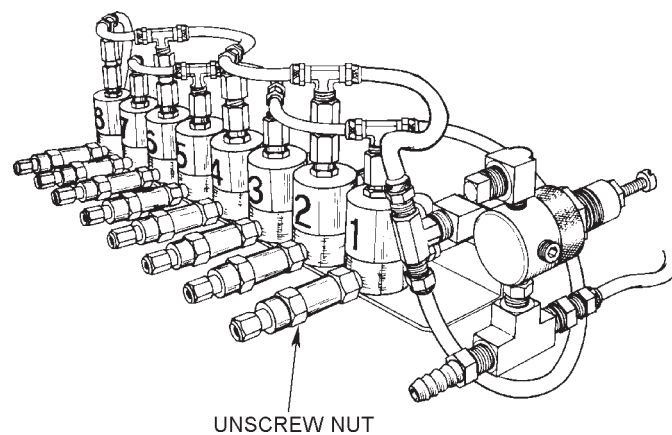
4.9.9 Replacing a Solenoid Valve

Tools needed:

- 1/8 inch blade screwdriver
- 13/16 inch open end wrench
- 1 inch crescent wrench
- Drain pan for waste fluid
- Wire cutters
- Hydraulic sealant
- Cable ties

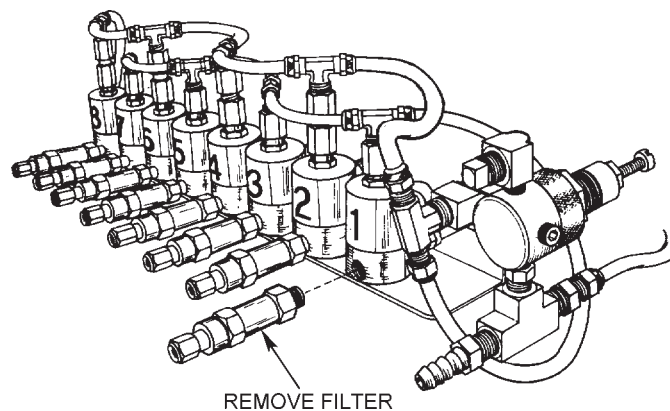
1. Turn the PDFM off.
2. Place a drain pan under the solenoid to be replaced.
3. Disconnect the fluid lines at the filter and the rear of the solenoid.

Figure 4-27. Unscrew Filter Chamber



4. With the 13/16 inch wrench, remove the filter.

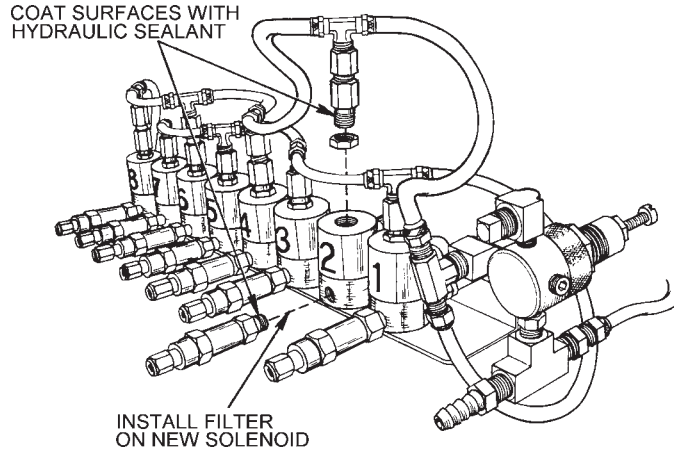
Figure 4-28. Removing Filter



5. Hold the solenoid and remove the two screws from the bottom.
6. Remove the PDFM console cover. See Subsection 4.9.1.
7. Find the terminal block with the black wires, at the bottom right of the relay board. Clip the cable ties.
8. Each solenoid valve connects to two black wires at the terminal block. Find and disconnect the two wires from the solenoid being replaced.

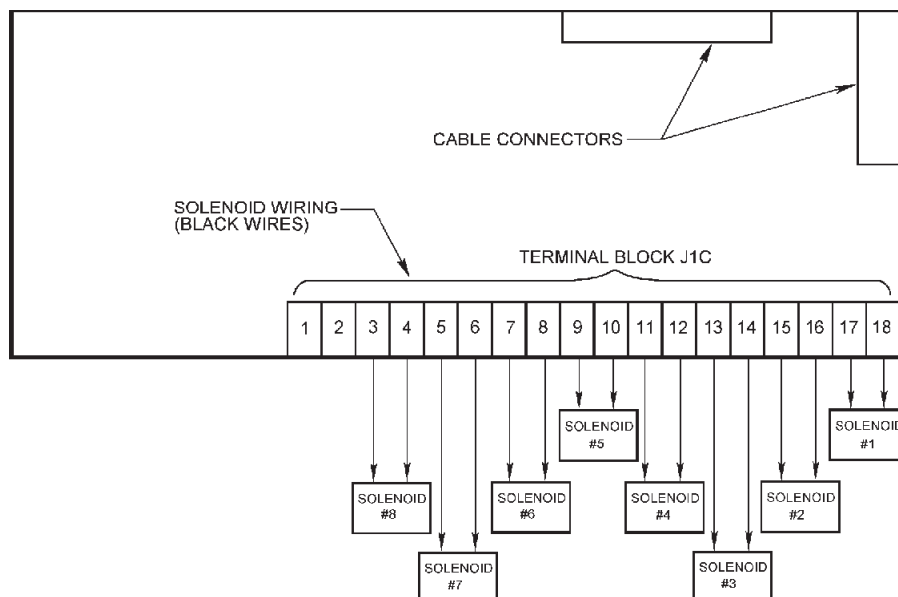
9. Remove the tee outlet and fittings from the solenoid's top.

Figure 4-29. Remove Tee Outlet



10. Coat the threads of the filter chamber, tee outlet and the fittings from the top of the solenoid with hydraulic sealant. Screw the fitting onto the new solenoid. Make sure to transfer the number from the old solenoid.
11. Align the holes in the bottom of the solenoid with the holes in the base plate. Insert and tighten the screws.
12. Connect the new solenoid wires to the terminal block. Use cable ties to bundle the wires.
13. Reinstall the console cover. See Subsection 4.9.2.
14. Install the filter chamber and fitting on the new solenoid.
15. Connect the fluid lines to the fittings.
16. With an injection pump mounted on the calibration stand, run the PDFM to test the new solenoid.

Figure 4-30. Disconnect Wires from Relay Board



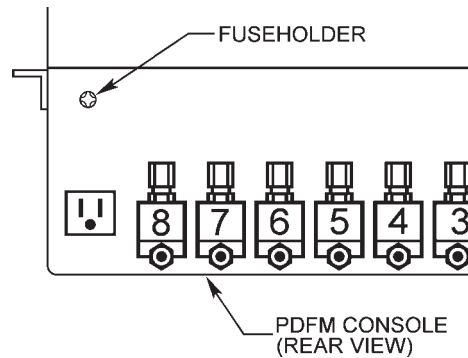
4.9.10 Replacing Fuses

The PDFM has two replaceable fuses, one on the printer and one at the console. The console fuseholder is at the left rear of the PDFM.

A. To replace the console fuse:

1. Turn the PDFM off.
2. Unscrew the fuseholder top. Pull out the spent fuse.

Figure 4-31. Replacing Console Fuse



3. Insert a new 4 Amp, 3AG Slo-Blo fuse. Reinstall the fuseholder top.

B. To replace the printer fuse:

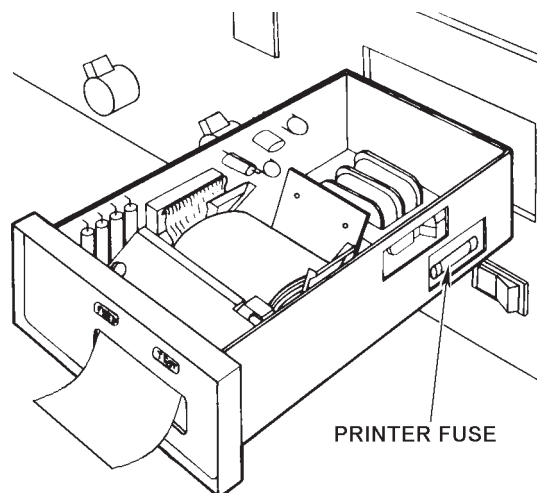
1. Turn the PDFM off.
2. Disconnect input power at its source.

WARNING

LETHAL VOLTAGE. Disconnect input power at its source before beginning this procedure.

3. Slide the printer out of the control panel.
4. The fuse is at the right rear corner, on the side plate. Remove the fuse and install a new 1 Amp Slo-Blo, 250 volt fuse.

Figure 4-32. Replacing Printer Fuse



5. Slide the printer back into the control panel.

NOTES

5 PARTS LIST AND DIAGRAMS

5.1 REPLACEMENT PARTS FOR PDFM 808

NOTE: *This list contains customer replaceable parts. Because of the critical calibration of such items as relief valves and individual parts inside the Transducer Assembly, these parts are not replaceable. Replacement or repair of these individual parts must be performed by an authorized Bacharach representative, capable of calibrating them to the individual assembly, or subassembly.*

Part #	Description	Qty./Unit	Item No. (Fig. 5-2)
03-2912	Flexible Nylon Tubing 1/4 OD	14.59 ft	91*
03-4174	Relief Valve	1	92*
03-4230	Solenoid Valves, 3 way	8	93
03-6013	PVC Tubing 3/8 ID	5 ft.	96*
04-2547	Line Filter	1	105
04-2655	Fuse, 1A Slo-Blo (3AG), Printer	1	300
04-2665	Fuse, 4A Slo-Blo (3AG), Primary Pwr.	1	107
05-3616	Gasket for Solenoid Valve	8	.*
05-5145	O-Ring	8	117
06-5498	Bottle (1 oz)	1	121*
07-1629	Filter for Solenoid Valve	8	123
07-9701	Tubing, Teflon	.06 ft.	124*
67-6758	Relay Circuit Board Assembly	1	7
67-7650	Transducer Assembly	1	17
77-0539	CPU Circuit Board	1	37
74-1170	PDFM Interface Board	1	25
74-1233	Printer	1	26
74-1234	Printer Paper	1 roll	27
77-0507	Rotary Switch Circuit Board	1	31
77-0509	Thumbwheel Switch Circuit Board	1	32
77-0510	CRT Controller Board	1	33
77-0528	Card Cage/Power Supply Ass'y.	1	36
77-0536	CRT Monitor	1	42*
77-9055	PDFM Set-Up Instruction	1	44*
104-0623	Power On-Off Switch	1	143
104-0627	Printer On-Off Switch	1	144
104-0654	Thumbwheel Switch, 4 position	2	145
104-0655	Thumbwheel Switch, 1 position	2	146
104-3459	Power Cord	1	166
104-3473	Video Cable (6 ft.)	1	167*
104-4029	BNC to RCA Adapter	1	.*
104-6530	Rotary Switch Knob	4	176

* Not indicated on drawing

5.2 PDFM 808 ACCESSORIES

The following Kits are required when a PDFM 808 has to be connected to a Bacharach early production test stand with individual accumulator can (also see Section 2-6).

67-6800	PDFM Plumbing Accessory Kit
67-8512	Accessories for use with Bacharach Professional test stands
67-8514	Accessories for use with Bacharach Specialist test stands
67-8516	Accessories for use with Bacharach Technician test stand

Installing PDFM 808 on a Bacharach Test Stand requires one of four kits:

Test Stand	Kit No.	Contains	Part No.
1. Professional Model 15, 20	77-8025	PDFM 808 Plumbing Accessories Kit Cable Assembly (magnetic pickup) Instruction Sheet	77-7070 67-6800 67-6857 67-9389
2. Specialist 8010, 8010, 8015 & Technician test stands	77-8026	PDFM 808 Plumbing Accessories Kit Cable Assembly (magnetic pickup) Instruction Sheet	77-7070 67-6800 67-6802 67-9355
3. Specialist 10 test stands with optical pickup	77-8027	PDFM 808 Plumbing Accessories Kit Magnetic Pickup Accessory Kit Instruction Sheet	77-7070 67-6800 67-6796 67-9353

Installing the PDFM 808 (77-7070, purchased separately) on another manufacturer's Test Stand requires one of the following kits:

Test Stand	Kit No.	Contains
1. Robert Bosch Models EFEP 375, 385, 390, & 410	67-8524	Accumulator Assembly, Connector & Cable Assy., Sender ISSPRO No. 2732
2. Robert Bosch Models EFEP 500, 515, & 615A	67-8529	Accumulator Assembly, Plumbing Accessories, Magnetic Pickup Assy.
3. Hartridge 1100 Series with Digital Tach	67-8526	Accumulator Connectors, Plumbing Accessories, Cable Assembly
4. Hartridge 2500 Series	67-8528	Accumulator Connections, Plumbing Accessories, Cable Assembly

5.3 SERVICE CENTERS

Bacharach S/S Center
621 Hunt Valley Circle
New Kensington, PA 15068
(724) 334-5051
FAX (724) 334-5723

Bacharach S/S Center
7281 Garden Grove Blvd., Suite H
Garden Grove, CA 92641
(714) 895-0050
FAX (714) 895-7950

Bacharach S/S Center
7300 Industrial Park
Route 130, Bldg. 22
Pennsauken, NJ 08110
(609) 665-6176
FAX (609) 665-6661

Bacharach S/S Center
8618 Louisiana Place
Merrillville, IN. 46410
(219) 736-6178
FAX (219) 736-6269

Bacharach of Canada
250 Shields Court, Unit #3
Markham, Ontario L3R 9W7
(905) 470-8985
FAX (905) 470-8963

5.4 SCHEMATIC DIAGRAMS

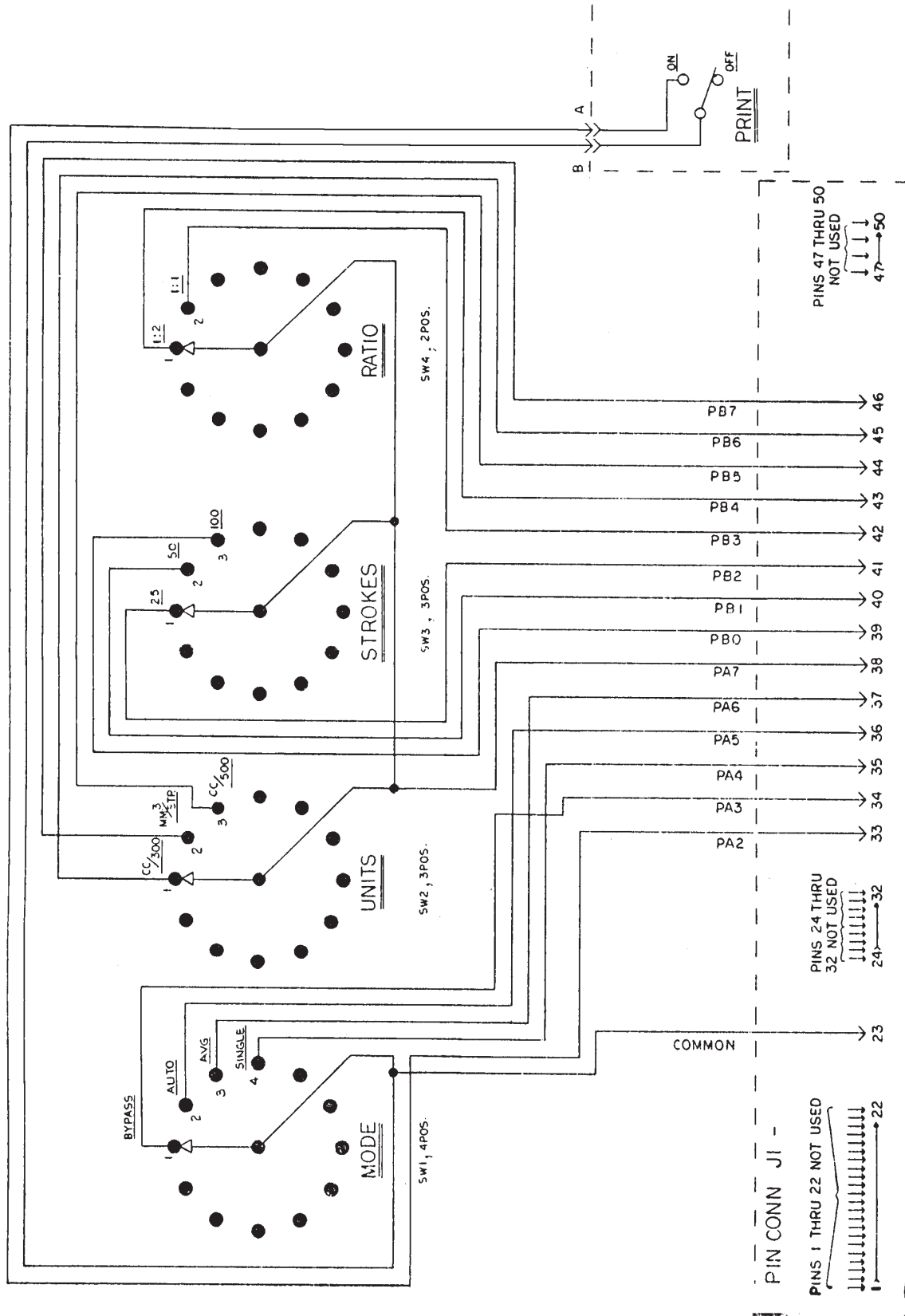


Figure 5-1. Rotary Switch Circuit Board Schematic

(Derived from 77-0507D-S2R2)

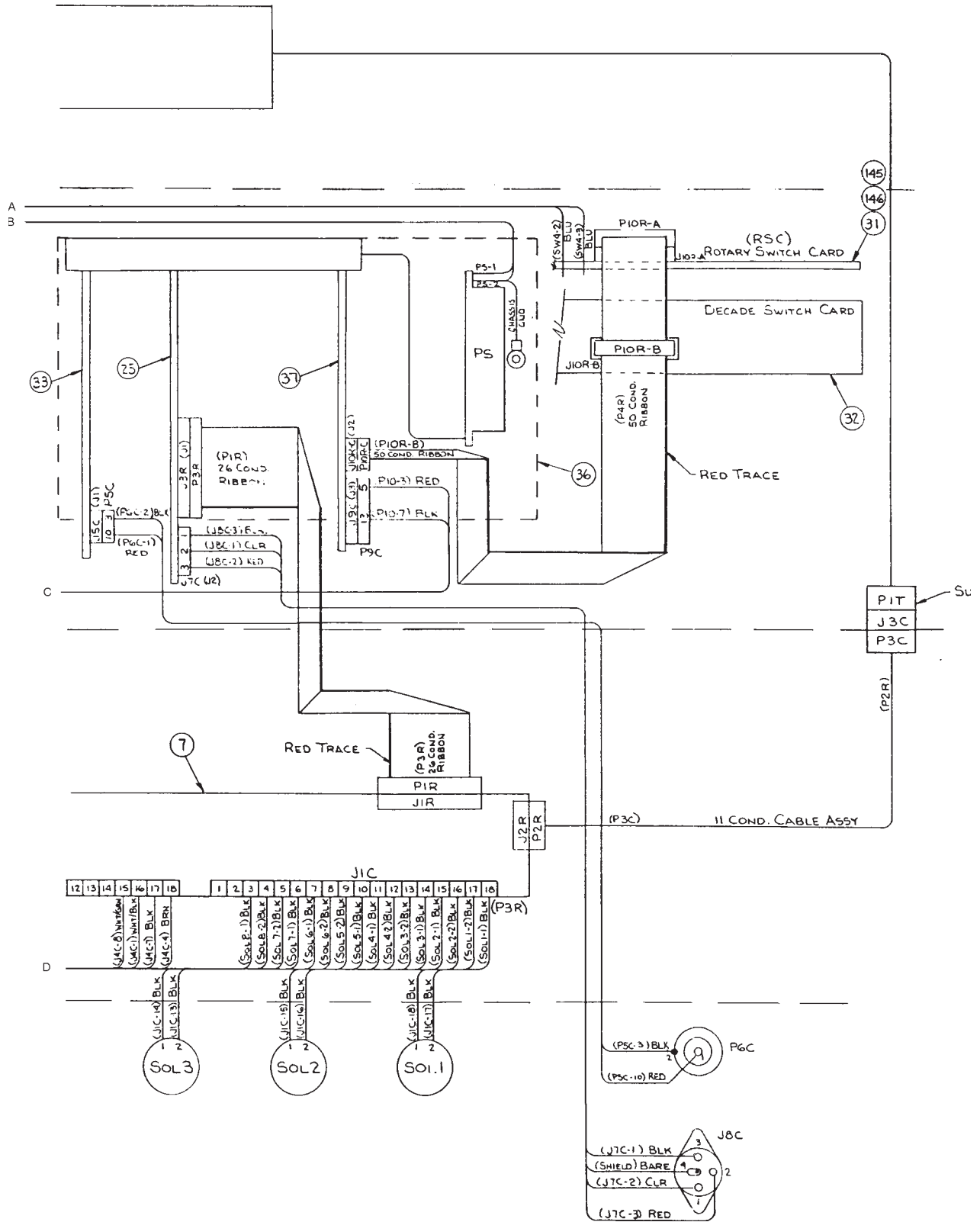


Figure 5-2B. PDFM 808 Wiring Diagram

(Derived from 77-7070D-S8R28)

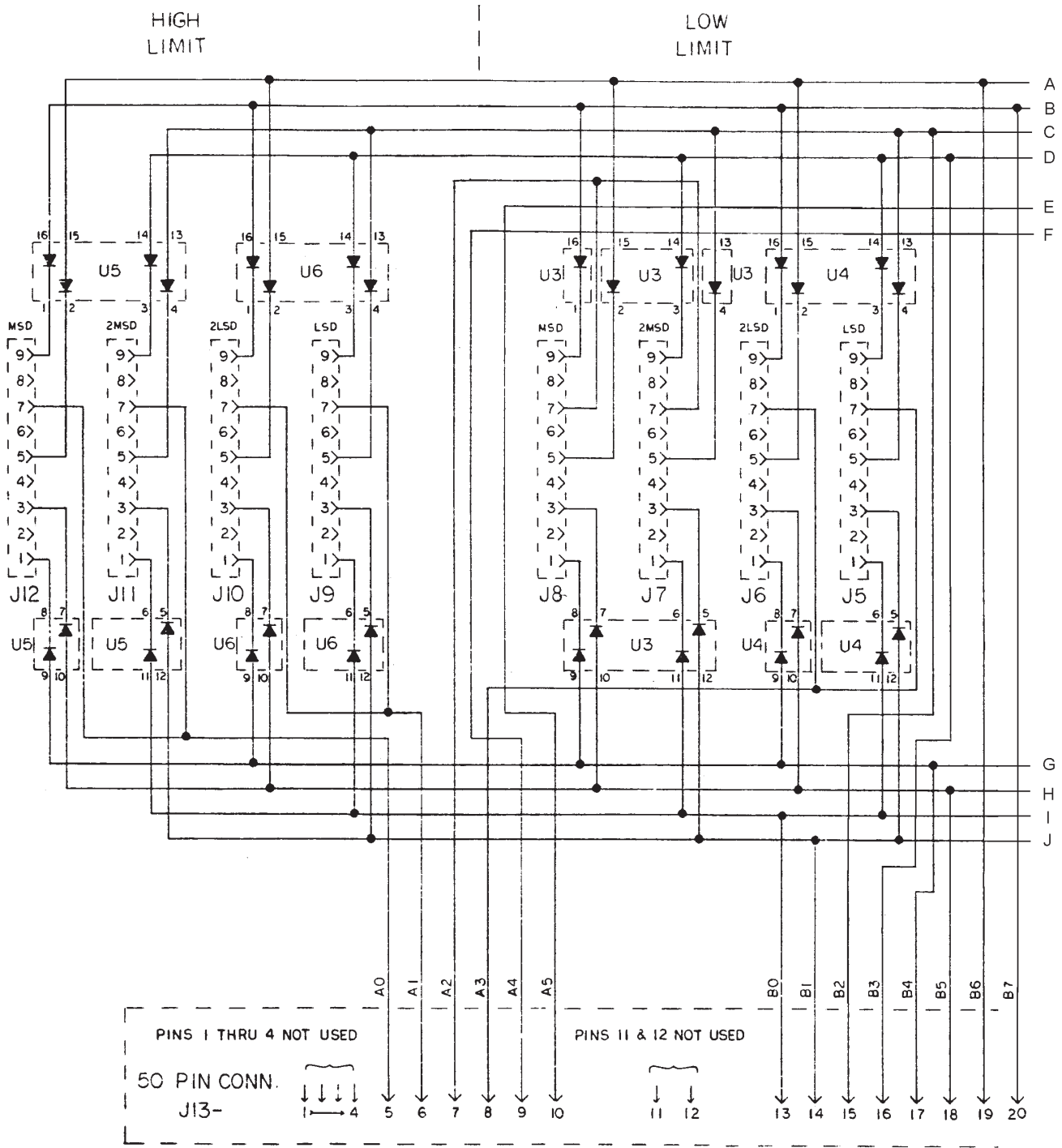


Figure 5-3A. Thumbwheel Switch Circuit Board Schematic

(Derived from 77-0509D-S2R1)

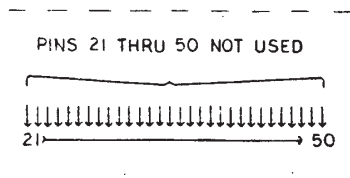
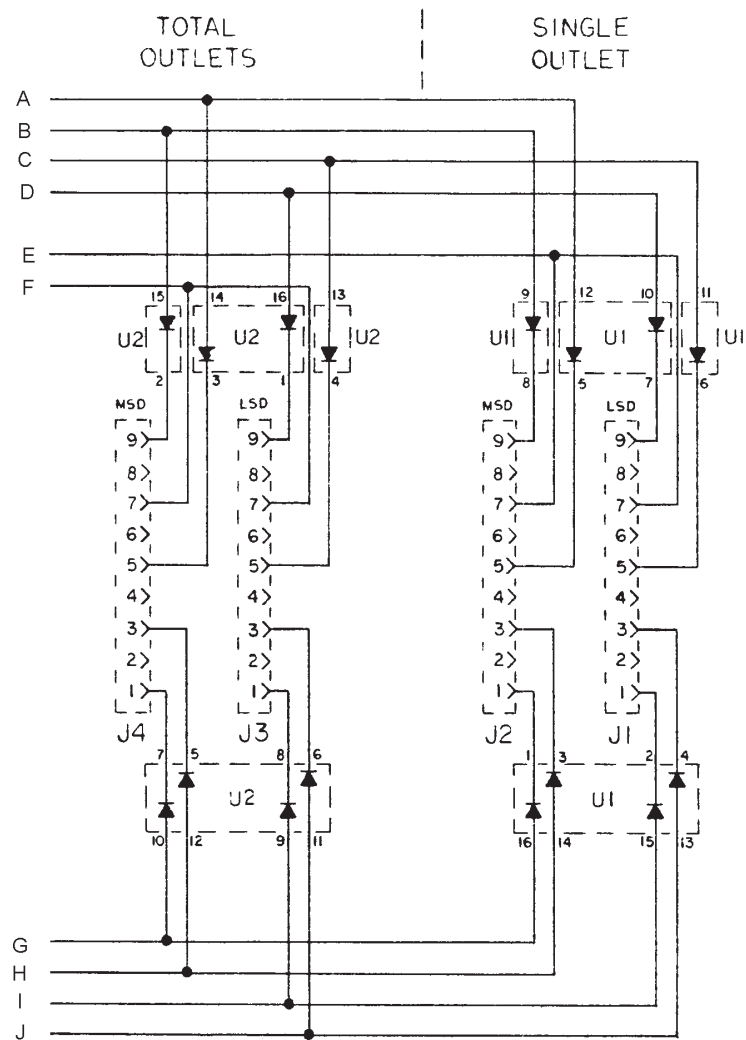


Figure 5-3B. Thumbwheel Switch Circuit Board Schematic

(Derived from 77-0509D-S2R1)

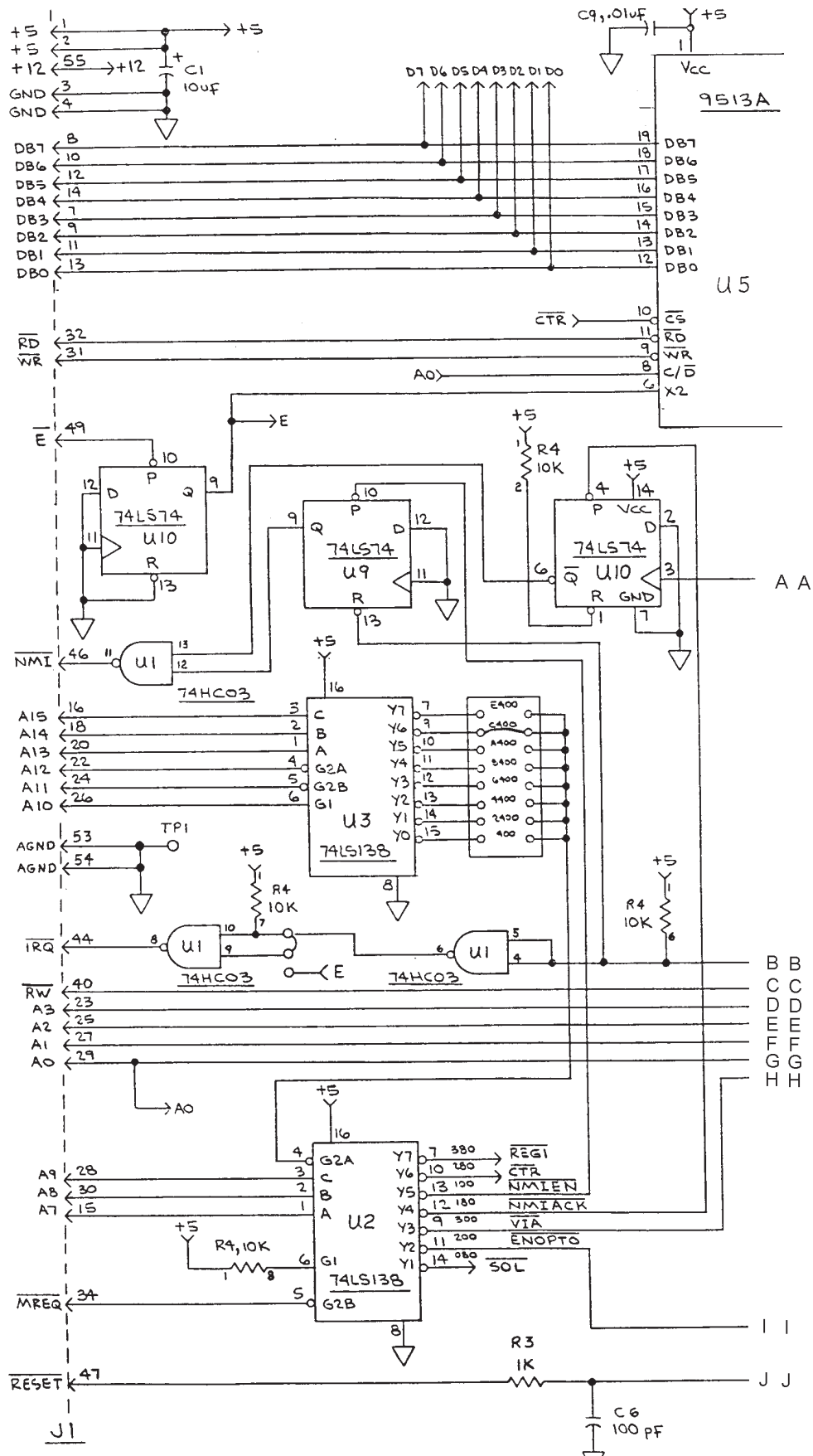


Figure 5-4A. PDFM Interface Circuit Board Schematic

(Derived from 74-1170D-S2R10)

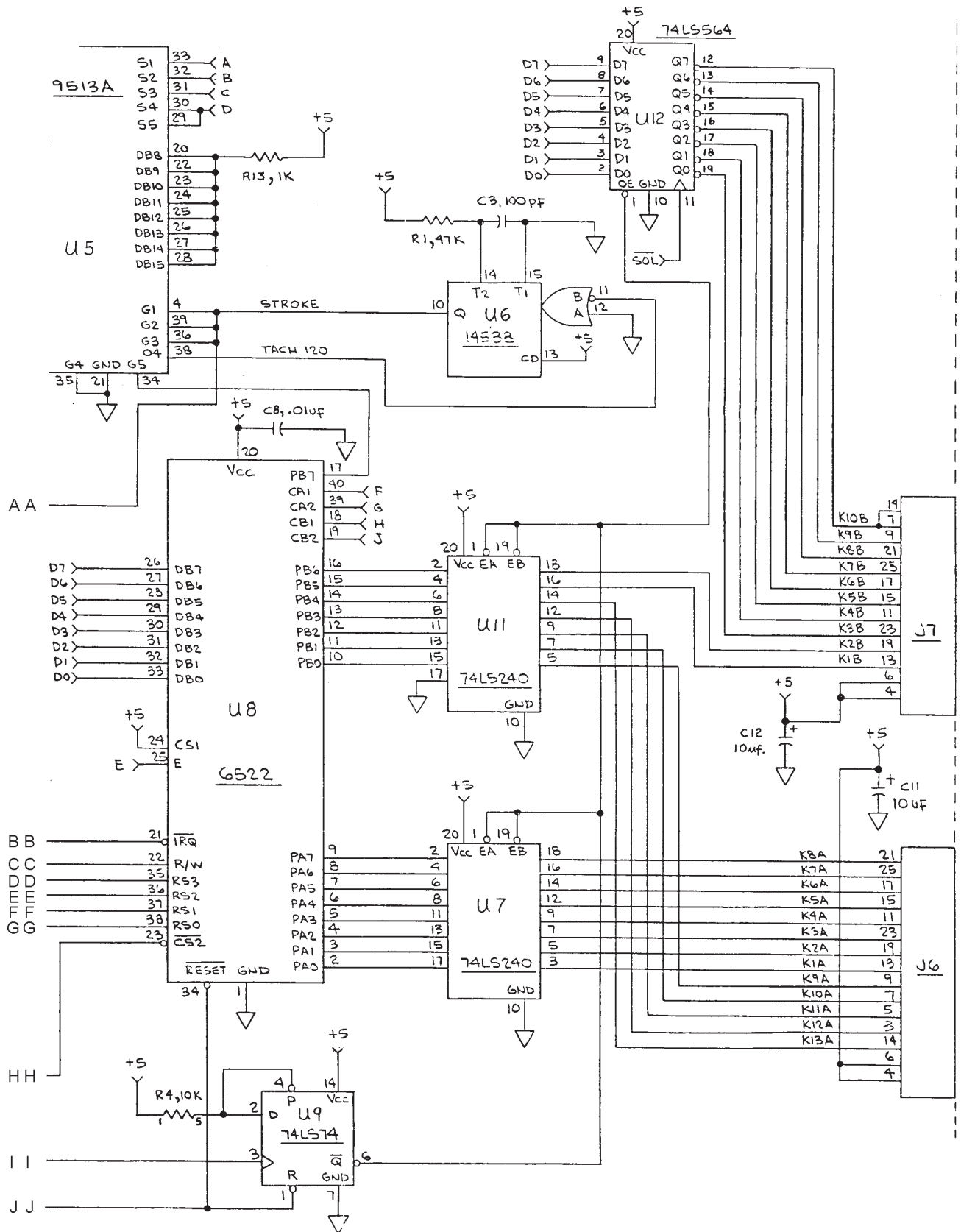


Figure 5-4B. PDFM Interface Circuit Board Schematic

(Derived from 74-1170D-S2R10)

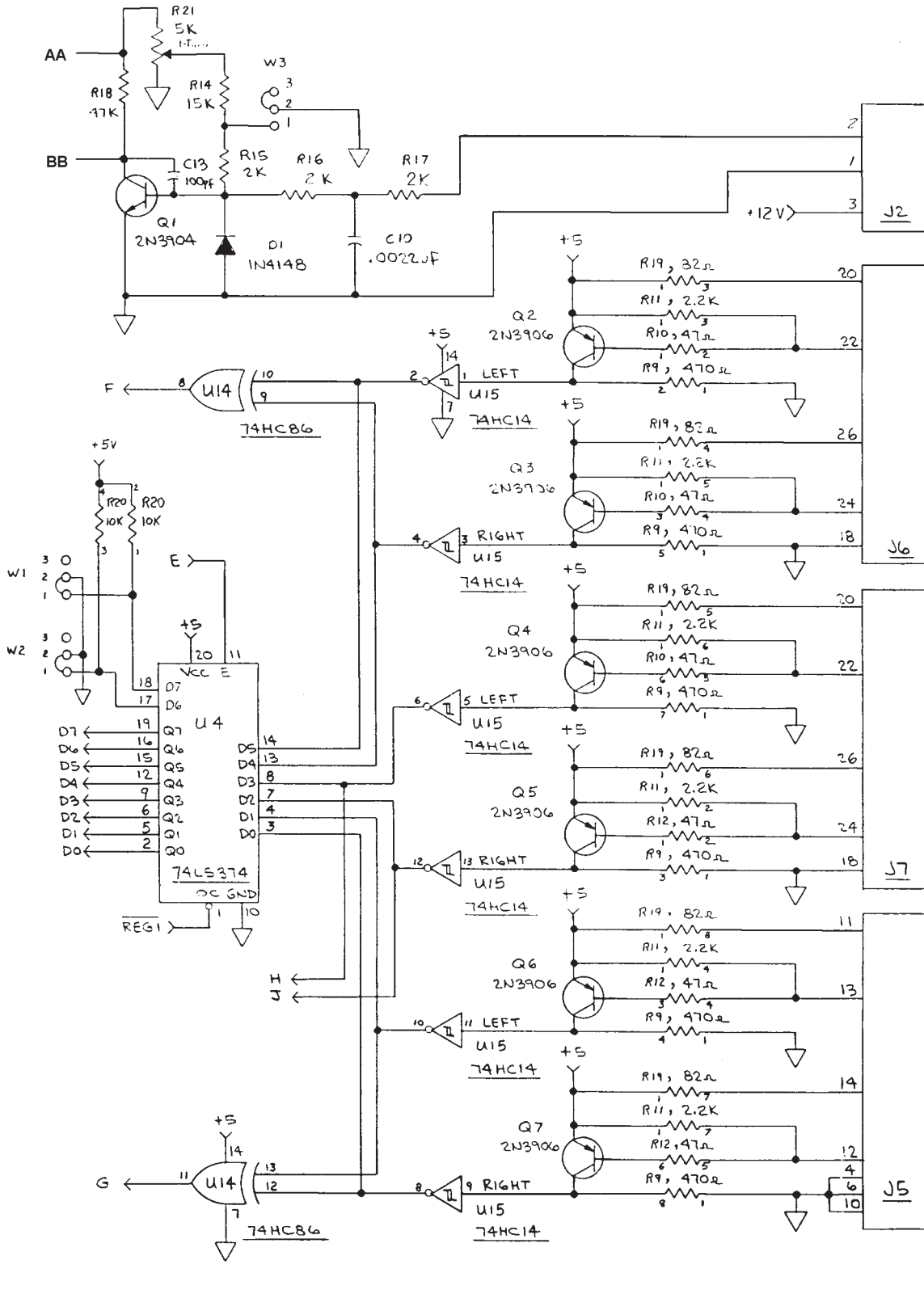


Figure 5-4D. PDFM Interface Circuit Board Schematic

(Derived from 74-1170D-S3R10)

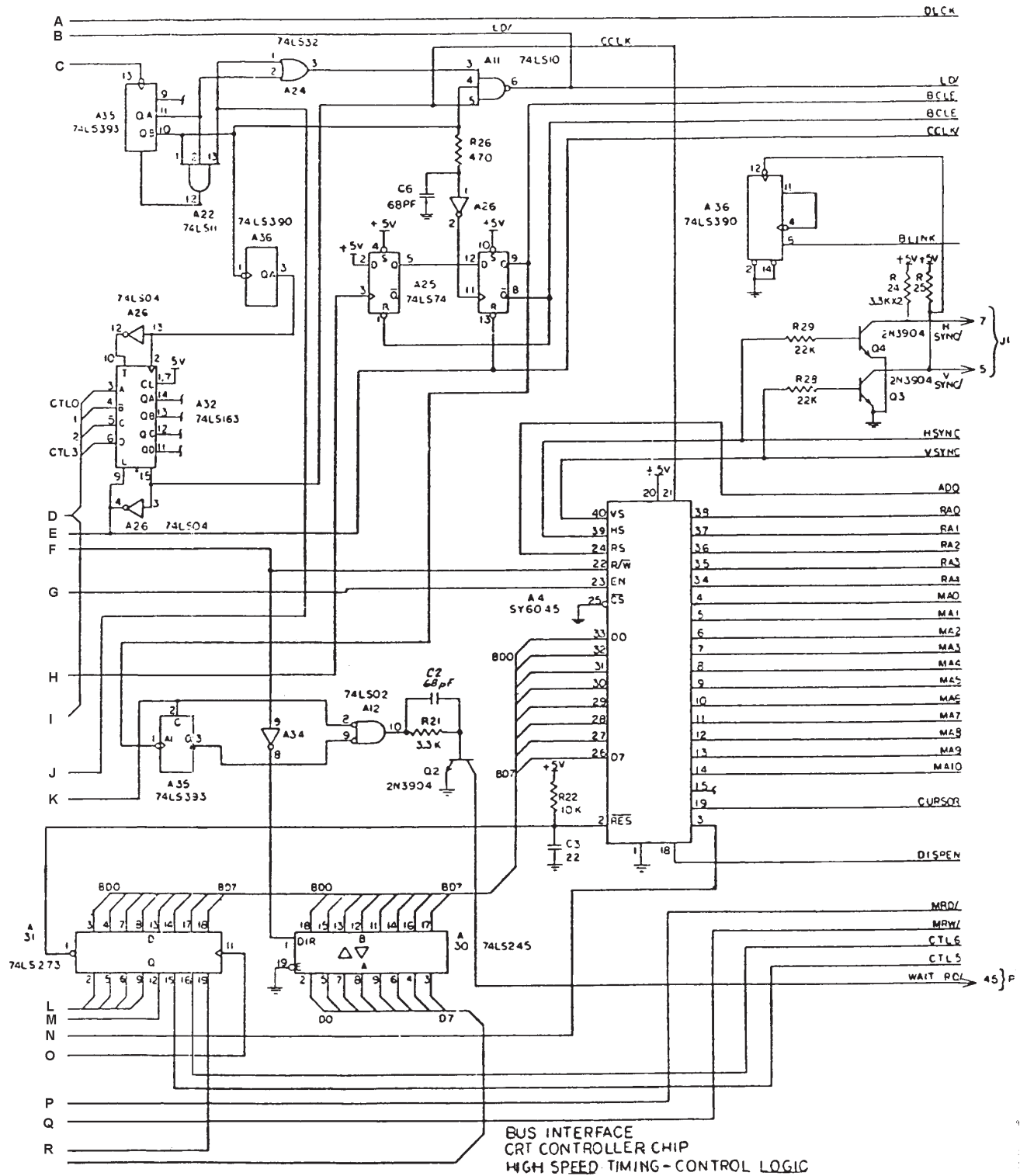


Figure 5-5B. CRT Controller Circuit Board Schematic

(Derived from 77-0510D-S2R2)

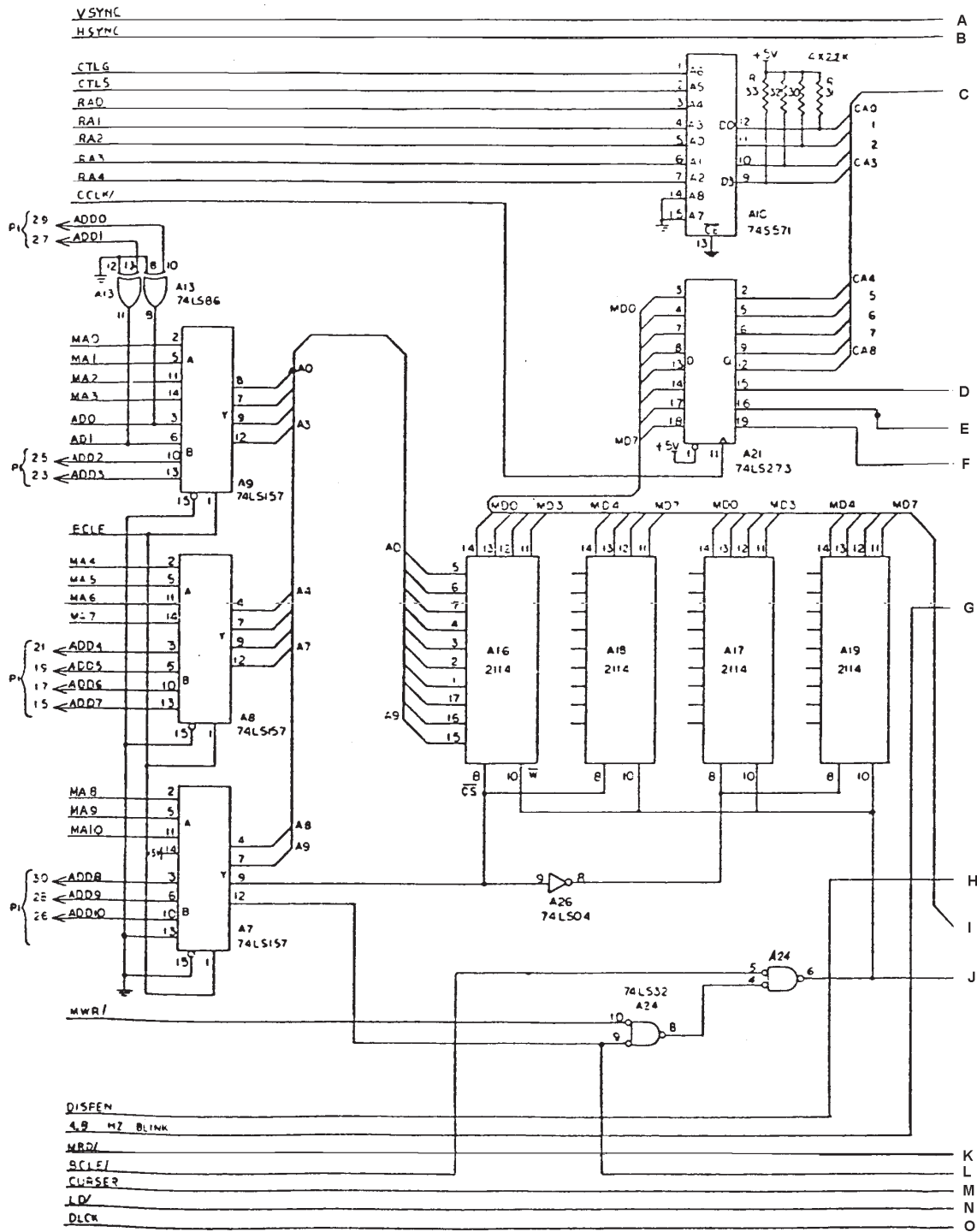


Figure 5-5C. CRT Controller Circuit Board Schematic

(Derived from 77-0510D-S3R2)

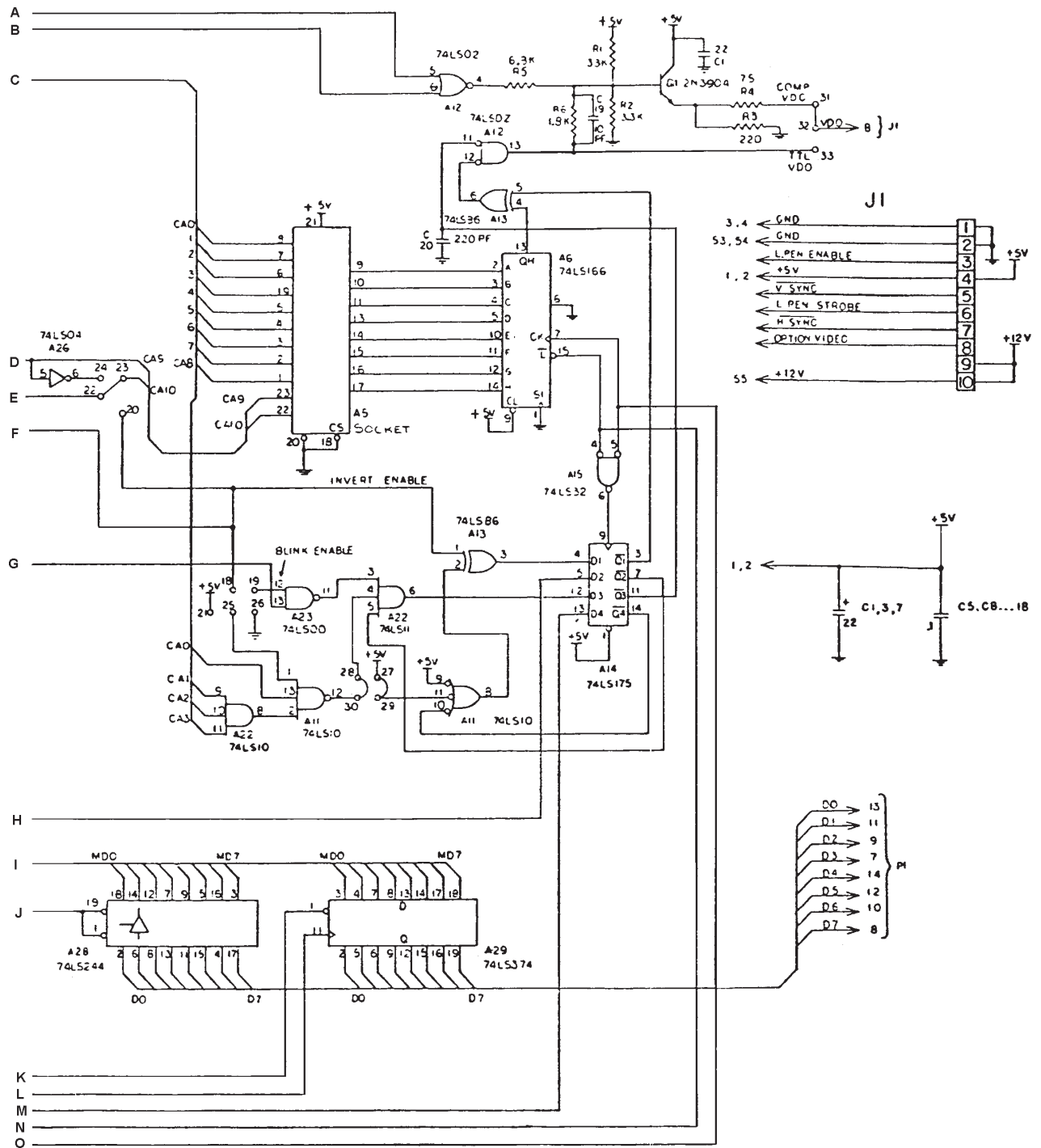


Figure 5-5D. CRT Controller Circuit Board Schematic

(Derived from 77-0510D-S3R2)

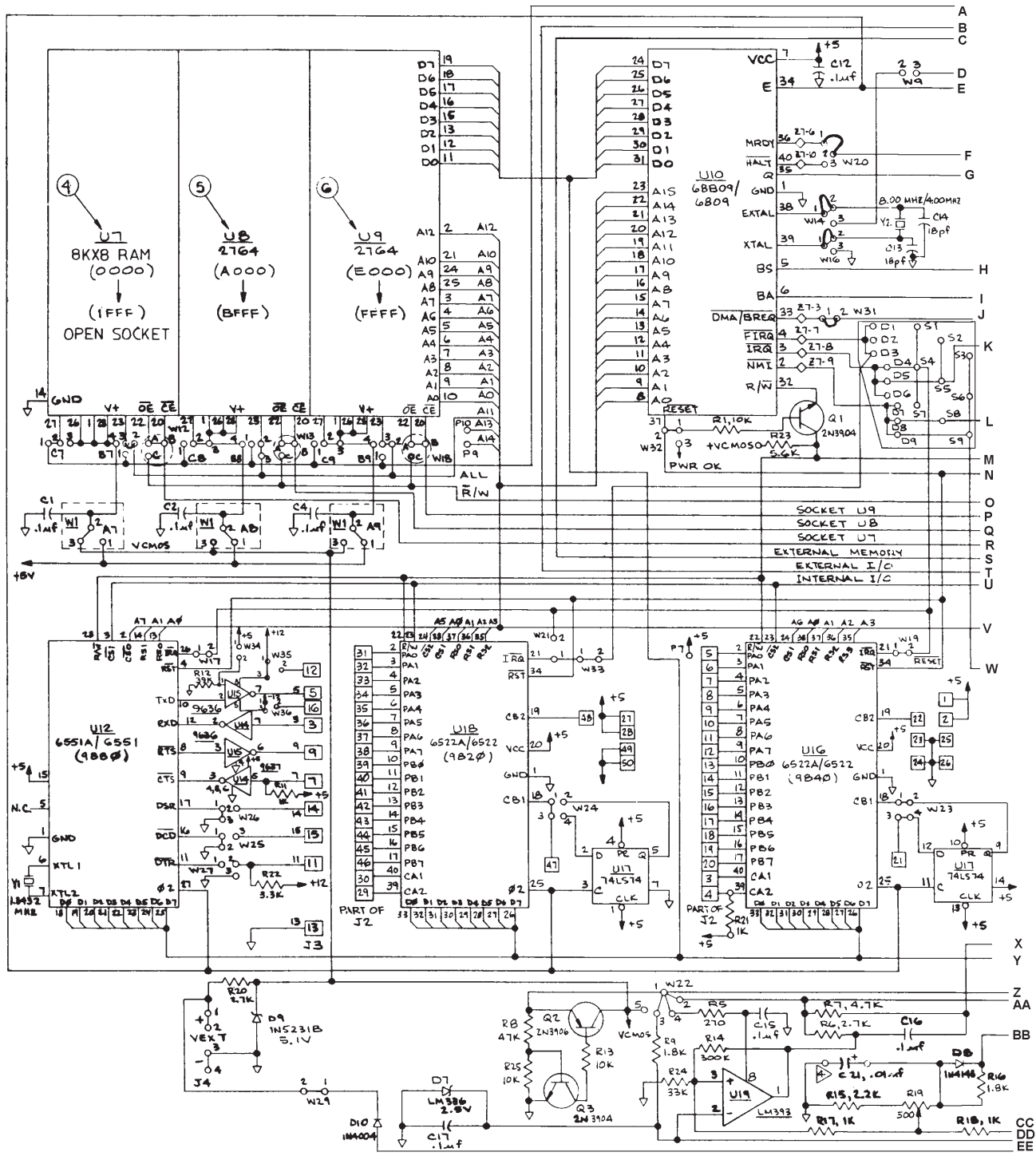


Figure 5-6A. Microprocessor (CPU) Circuit Board Schematic

(Derived from 77-0539D-S2R7)

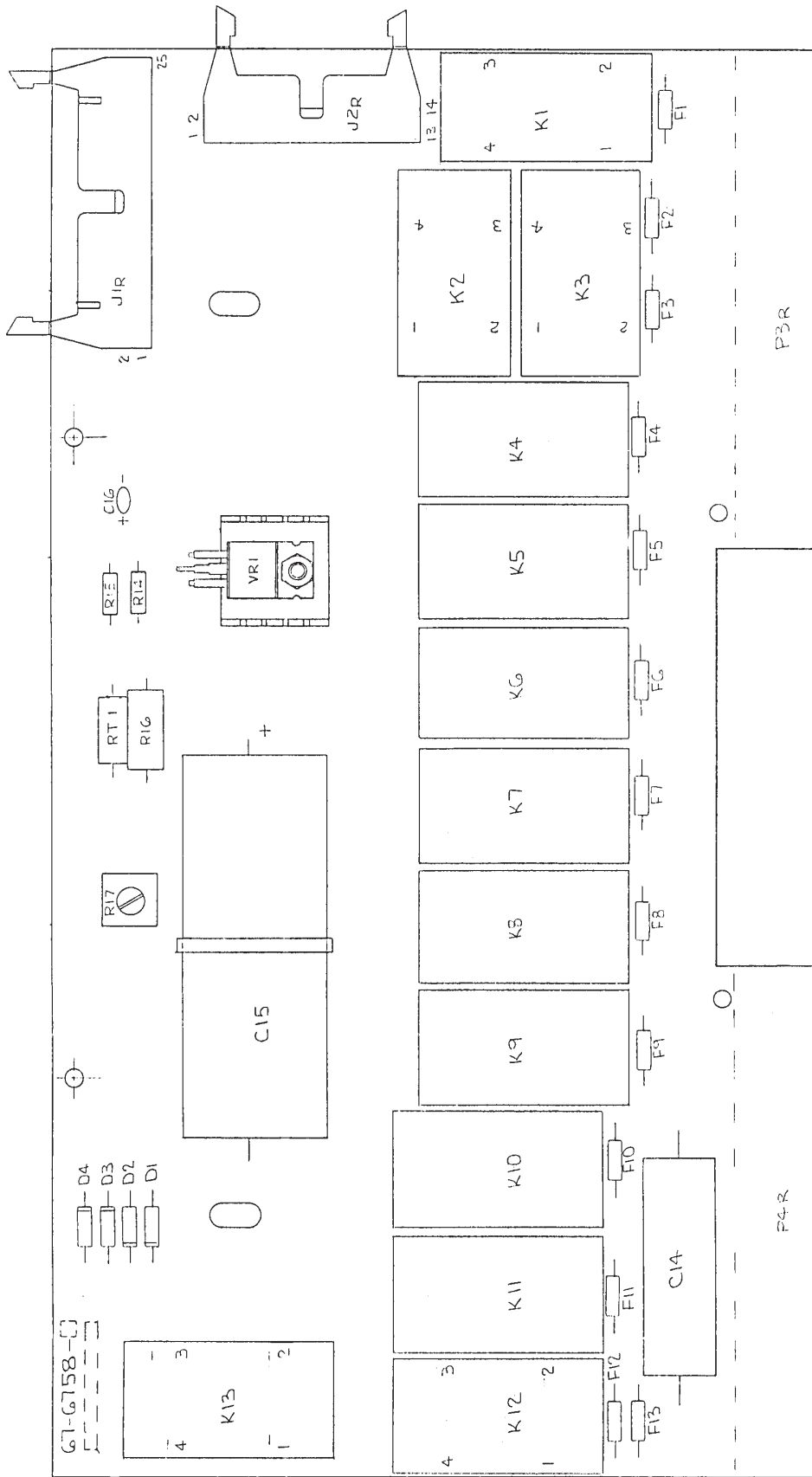


Figure 5-7. Solid State Relay Board

(Derived from 67-6758D-S1R5)

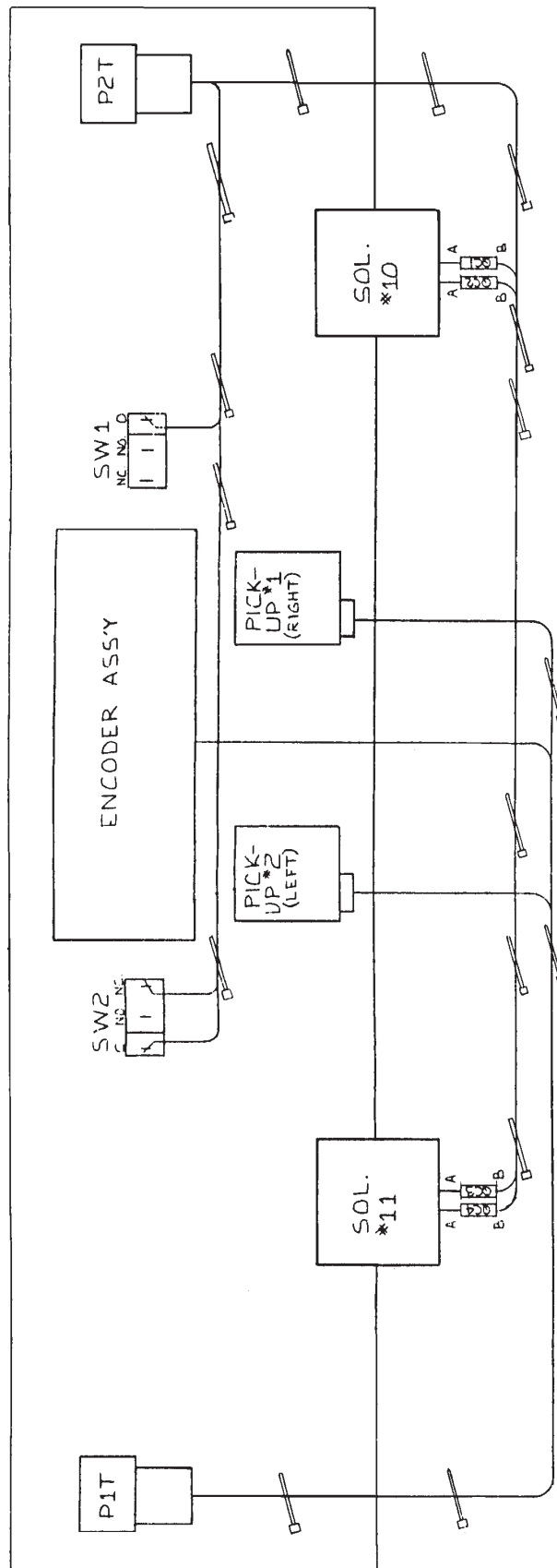
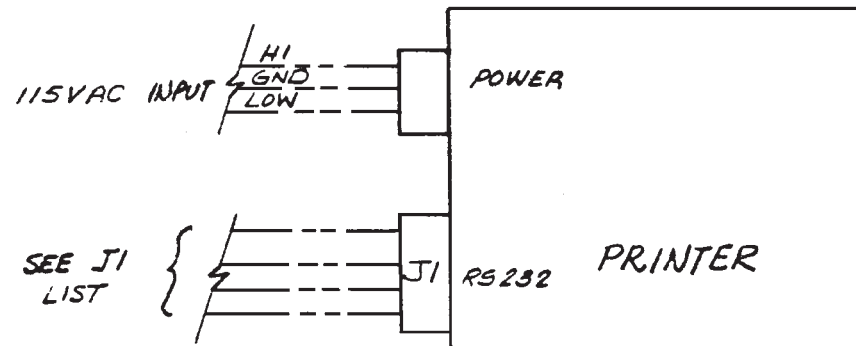


Figure 5-8. Transducer Schematic

(Derived from 67-7650D-S3R30)



**J1 LIST
I/O CONNECTIONS**

- | | |
|----------------------|------------------------|
| 1. GND (FRAME) | 14. TIMED INTERRUPT |
| 2. \overline{DAV} | 15. PAPER FEED |
| 3. REC. DATA | 16. \overline{RESET} |
| 4. N.C. | 17. I LOOP + |
| 5. BUSY | 18. I LOOP - |
| 6. \overline{BUSY} | 19. 5V PULLUP |
| 7. GND (COM) | 20. DTR |
| 8. DAC | 21. OUT 0V PAPER |
| 9. \overline{DAC} | 22. LOAD DATA |
| 10. D0 | 23. D6 |
| 11. D1 | 24. D5 |
| 12. D3 | 25. D4 |
| 13. D3 | |

Figure 5-9. Printer Schematic

(Derived from 74-1233D-S1R5)

NOTES