SWTPC PR-40 Alphanumeric Printer Assembly Instructions

The SWTPC PR-40 Printer kit is a 5 X 7 dot matrix impact printer similar in operation to the well known Centronics printers. It prints the 64 character upper case ASCII set with 40 characters/line at a rate of 75 lines/minute on standard 3 7/8" wide rolls of adding machine paper. One complete line is printed at a time from an internal forty character line buffer memory. Printing takes place either on receipt of a carriage return or automatically whenever the line buffer memory is filled.

The printer can accept character data as fast as one character per microsecond or as slow as you wish to send it. The printer's seven parallel data lines are TTL compatible and may be enabled by a single "data ready" control line or by separate "data ready" and "data accepted" handshake control lines. This universal approach makes the printer compatible with all computer and terminal systems having an eight bit parallel interface; including of course the MITS 8800 and SWTPC 6800 computer systems just to mention a few.

The printer mechanism is attached to a black anodized aluminum chassis with front trim panel which houses the unit's circuitry including its own 120/240 VAC 50 to 60 Hz power supply. This makes the printer's overall dimensions 9 5/8" wide X 10 1/2" deep X 8 3/4" high.

Each unit is shipped with one ribbon and one roll of paper. Extra ribbons are available from us while the standard adding machine paper may be purchased in office supply stores.

Caution

When handling the print mechanism itself you must make absolutely sure not to try to rotate the large plastic cylinder that moves the head. If this cylinder is rotated so the top is turned toward the front of the printer, it may bend the arm on the roller cam microswitch on the right hand side of the mechanism which will not only damage the switch but will prevent the printer from operating.

Note

The print mechanism you receive may not have the paper roll holder installed. If so, it along with the mounting hardware will probably be contained within a separate bag. The paper roll holder is secured to the back of the print mechanism with four screws.

Assembling the Unit

The electronics for the printer are constructed on two printed circuit boards. The larger of the two is the PR-40A and contains all of the logic necessary to drive the print mechanism. The smaller board is the PR-40B and contains mostly power supply circuitry. When assembling the printer it is best to first assemble the PR-40A board, then the PR-40B board, then complete the unit by installing the chassis components and completing the wiring. The assembly instructions have been written in this sequence.

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PR-40A PC Board Assembly

NOTE: Since all of the holes on the PR-40A PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board, unless otherwise noted. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use a low wattage iron (not a gun) with a small tip. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated-thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the PR-40A circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.

( ) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder. You should have one 1M ohm resistor left over.

( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Solder.

( ) Install integrated circuits IC3 thru IC17 on the circuit board. The integrated circuits must be turned to match the outlines shown on the component layout drawing. Solder.

( ) Install fuses F1 thru F7 on the circuit board. Solder.

( ) Install the diodes and transistors on the circuit board. Transistors Q1 thru Q7 must be mounted vertically with the bottoms of the transistors about 3/16" above the top of the board. These components must be turned to match the outlines shown on the component layout drawing. Solder.

( ) Insert the twelve male PC mount pins into the 12 pin Molex female connector shell. The pins are inserted from the back or numbered side of the connector. Orient the shell as shown in the component layout drawing and mount it in the J1 connector position. Solder.

( ) Insert female receptacle J2 into the PC board making sure to orient it as shown in the component layout drawing. The small notches on the inside of the connector must point toward the edge of the board as shown in the component layout drawing. Solder.

( ) Insert Molex receptacle J3 into the PC board making sure to orient it as shown in the component layout drawing. The notches on the connector must point toward the edge of the PC board as shown in the component layout drawing. Solder.

( ) Insert Molex receptacle J4 into the PC board making sure to orient it as shown in the component layout drawing. The notches on the connector must point toward the edge of the PC board as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptible to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits ICI and IC2 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Working from the "TOP" side of the circuit board, fill in all of the feedthru's with molten solder. The feed-thru's are those unused holes on the board whose internal plating connects the "TOP" and "BOTTOM" circuit connections. Filling these feed-thru's with molten solder guarantees the integrity of the connections and increases the current handling capability.

( ) Now that all of the components have been installed on the board, double check to make sure all have been installed correctly in their proper location.

( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really cause some hard to find problems later during check out. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly of the PR-40A circuit board.

PR-40B PC Board Assembly

( ) Attach all of the resistors to the board excluding resistor R6. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.

( ) Install all of the capacitors on the board excluding electrolytic capacitor C4. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Note the two set of holes for C3 to accommodate two different size capacitors - use the correct set depending on your capacitor. Solder.

( ) Install transistor Q1 on the PC board. The transistor must be turned to match the outline on the component layout drawing. Solder.

( ) Install transistor Q2 on the PC board. The transistor must be oriented so that its flat side is against the circuit board and should be secured with a #4-40 X 1/4" screw.

( ) Install all of the diodes on the PC board making sure to orient each as shown in the component layout drawing. Solder.

( ) Install all of the male PC type pins in female connector shells J1 and J2 from the numbered side of the connector. Then install each connector in its proper location oriented as shown in the component layout drawing. Solder.

( ) Now that all of the components have been installed on the board, double check to make sure all have been installed correctly in their proper location.

( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really cause some hard to find problems later during checkout. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly of the PR-40B circuit board.

Chassis Assembly

( ) Some of the print mechanisms we are supplying have two mounting holes on the bottom while others have three. Install the appropriate number of mounting screws thru the proper holes on the chassis by running a number 6 - 32 X 1/2" screw thru the chassis from the inside followed by a lockwasher and #6 - 32 nut. The printer mechanism itself will be attached to these screws at a later time.

( ) Snap the large plastic bushing into the chassis from the outside of the chassis.

( ) Attach fuseholder F1 to the chassis using a #6 - 32 X 3/8" screw, lockwasher and nut. Orient the fuseholder as shown in the wiring diagrams.

( ) Scrape away the anodizing around the mounting hole for TS-1 on the inside of the PR-40 chassis. Scraping away the anodizing insures electrical contact between the terminal strip and the chassis. Attach lug strip TS-1 to the chassis using a #6 - 32 X 1/4" screw, lockwashers and nut. Sandwich one lockwasher between the terminal strip and the chassis. Orient the lug strip as shown in the wiring diagram.

( ) Attach transformer T1 to the chassis using four #8-32 X 3/8" screws, flatwashers and nuts. Run the screws thru the outside of the chassis, place a flatwasher between the inside of the chassis and the transformer leg, place another flatwasher on the top of the leg and secure with a #8-32 nut and lockwasher. Orient the transformer so the side with the green secondary leads is toward the inside of the chassis.

( ) Snap the eight PC board standoffs into their respective holes from the inside of the chassis.

( ) Attach the two large capacitor clamps to the chassis using #6-32 X 1/4" finishing screws, lockwashers and nuts. Orient the clamps as shown in the wiring diagrams.

( ) Snap PR40B's electrolytic capacitor C4 into place in the two capacitor clamps on the front of the chassis. Be sure to orient the capacitor as shown in the wiring diagrams. The negative terminal of the capacitor must be nearer the bottom of the chassis.

( ) Attach toggle switch S1 to the chassis using the supplied finishing washer and nut. Orient the switch as shown in the wiring diagram.

( ) Crimp the strain relief onto the line cord at a point about six inches from the end of the cord using a pair of pliers. While compressing the strain relief insert the short end of the line cord and the strain relief into the hole provided on the back of the chassis and release.

Attaching Connectors to the Print Mechanism

The print mechanism is supplied with two connectors installed, one for the print head and one for the printer motor. The connector for the print head is a fifteen pin AMP connector and will mate to a connector located on the PR-40A board. The connector for the printer motor is a nine pin AMP connector and must be cut off right at the connector so that another connector may be installed in its place.

( ) Cut off the nine pin motor connector for the print mechanism right at the connector.

( ) You should note that the print mechanism motor is divided into two distinctive halves. The inner half has one black and one white wire coming out of it and the outer half also has one black and one white wire coming out of it. Attach and solder a female connector pin to the end of each of the four wires. Insert the wires into the respective pins of a six pin Molex male connector as listed below:

MOTOR WIRE	CONNECTOR PIN #
inside white	1
outside white	3
outside black	4
inside black	6

The word inside refers to being nearest the body of the printer while outside is farthest away. The wires are each electrically dependent and must be connected exactly as listed in the preceding table for the printer motor to run correctly.

( ) Attach and solder three 16" pieces of #24 (light) gauge hookup to each of the three switch-terminals on the roller cam microswitch located on the right hand side of the printer mechanism. On the opposite end of the upper lug's wire, attach a male pin. Attach a female pin to the unconnected end of, the remaining two lug wires. Solder.

( ) Insert each of the pins into the specified pin location of a six pin Molex male plug using the table below. The pins must be installed from the back or numbered side of the connector:

ROLLER CAM SWITCH LUG	CONNECTOR PIN #
upper	3
middle	1
lower	2

( ) Complete wiring steps 1 thru 4 of the wiring table if you will be operating the printer on 120 VAC. For 240 VAC, 50 Hz operation, skip wiring steps 2 and 3 and instead connect together and insulate transformer T1's brown and black-red wires. Then connect T1's remaining black and brown-white wires just as described in the wiring table steps 1 and 4.

( ) Complete wiring steps 5 thru 10 of the wiring table and then snap fuse Fl into place.

( ) Complete wiring steps 11 thru 34 of the wiring table. A female connector pin will be attached to one end of each of the wires. Make absolutely sure each pin is installed correctly into the specified hole of the correct connector block, since the pins cannot be removed after installation. The pins must be installed from the back or numbered side of the connector. Take note that J1 on the PR40B board is a 15 pin male connector block while J1 on the PR40A board is a 12 pin male connector block.

( ) Check to make sure that all electrical connections have been soldered. Cut off any extra length of the tabs on C4 if necessary.

( ) Snap the two PC boards into the chassis. The larger PR40A board should be oriented so the upright transistors are adjacent the power transformer, while the smaller PR40B board should be oriented so the 15 pin connector is near the power transformer.

( ) Plug each of the J1 connectors onto their respective mates.

( ) Set the printer chassis upside down (components exposed) and set the print mechanism itself right next to it. Connect the connector from the print mechanism's motor wires to the PR40B's J2 connector block.

( ) Attach the connector from the print mechanism's roller cam microswitch wires to the PR40A's J3 connector block.

Installing the Ribbon and Paper Roll

The paper roll is installed by pressing the plastic roll holder thru the center of the paper and placing the spool on the printer so the paper pulls from the inside back of the printer. This allows the paper to contact the paper guides at all times thus centering the paper for printing. Feed the paper thru the guides adjacent the paper roll and advance the platten.

The ribbon is installed by first orienting the spools so the ribbon is fed and spooled from the outside of the spools and then snapping the spools into

place so the ribbon is routed inside the tensioner and looped around the guides on both sides of the platten. The ribbon is self-reversing so it doesn't matter which spool is placed where. After installing the ribbon, be sure that each ribbon spool will turn freely on its respective shaft. If a spool is excessively tight on a shaft sanding the shaft slightly with sandpaper should help. If the binding is being caused by the two springs on the spindle that hold the spool in place a small washer can be placed between the bottom of the spindle and the mechanism that it is attached to. This will allow the spool to ride lower on the spindle.

You are now in a position to test and set the line length and print intensity adjustments on the printer. By having everything exposed as you do now, adjustments and troubleshooting will be considerably easier. Once the unit has been calibrated and thoroughly tested, as described later in the instructions, the print mechanism can be disconnected and reinstalled and secured on the top of the printer chassis using #6-32 nuts and lockwashers. All of the wires for the print mechanism are then run thru the large bushing on the top of the printer chassis. The I/0 cable feeding the printer is also run out of this large bushing so that the bottom of the printer may be closed with the perforated cover supplied with the kit. The cover is secured with #6-32 screws and tinnerman nuts which are also supplied with the kit. The four rubber feet should be attached to the outside of the cover about 1" in from each corner.

Wiring the Printer's Input Data Connector

The actual ASCII data fed to the printer is input thru connector J4 on the PR-40A board. In order to test and set the calibration controls on the printer, it will be necessary to load a diagnostic program into your computer system to feed data to the printer. The program should feed the printer continual, printable ASCII data. This will force the printer to print full 40 character lines which are necessary to set the line length trimmer resistor, R17 for symmetrical margins. Trimmer resistor R25 sets the print intensity and may be adjusted when printing any line length.

If you are using the PR-40 printer with the SWTPC 6800 Computer System you should use the PRNTST-1 diagnostic contained within this instruction set, otherwise you will need to write a program for your own specific computer system which performs similar functions. You may even feed the printer directly from an ASCII keyboard if you can live with not being able to read the line until a carriage return is entered. The keyboard must output a negative going "keypressed" strobe for direct compatibility with the PR-40 Printer.

The data connections to J4 on the PR-40A board should be made as follows:

J4 Pin #	Data Connection
1	ground
2	"data accepted" output - from printer
3	"data ready" from computer
4	ground
5	ASCII bit 5
6	ASCII bit 6
7	no connection
8	ASCII bit 3
9	ASCII bit 4

10	ASCII BIT 0
11	ASCII bit 1
12	ASCII bit 2

If you will be using the PR-40 Printer with the SWTPC 6800 Computer System, you will need to drive it with the output half of an MP-L option on the SWTPC 6800 Computer System. Connections should be made between the two as shown in the PR-40/SWTPC 6800 Interconnection drawing. When writing programs to drive the PR-40 printer with the SWTPC 6800 Computer System, it will be necessary to first configure the 6820 peripheral interface adaptor integrated circuit on the MP-L option of the SWTPC 6800 as in the diagnostic and then use an output character routine similar to that used in the PRNTST-1 diagnostic.

Checkout and Adjustment

For the initial testing of your PR-40 disconnect the printer solenoids by pulling loose J2 on the PR40A board if you have the solenoids connected. In order to checkout the printer you should use an analog type DC voltmeter having a 0-10V scale. (Most digital meters give false readings for this particular application). Connect the negative (-) end of your meter to the PR40's chassis or PC board ground and hook a 4.7K ohm 1/2 watt resistor (supplied) between the + and - terminals of your meter. Turn on the power and connect the positive meter probe (with the 4.7K resistor attached) to the collector of Q1 on the PR-40A board (the metal part of the case with the mounting hole in it). The voltage should read very low and go up as you initiate your PRNTST diagnostic program. Also note that the print motor should start up and move the head although no printing will occur. If the voltage does not rise recheck your program. The voltage should rise to anywhere between 1 and 6 volts depending on the setting of the density control. Check each of the seven transistors for this voltage. If the voltage goes beyond about 6 volts recheck your circuit board for mistakes - DO NOT HOOK UP THE SOLENOIDS UNTIL THE PROBLEM IS CORRECTED.

After you have verified that all voltages look OK switch the printer off and connect J2. Re-load your diagnostic and switch the printer on. Running your diagnostic should activate the printing mechanism and printing should start. You can now adjust the line length and print density. Adjust R25 for the print intensity most desirable. The line width can then be adjusted by R17. Note that if the width is extended too far the characters on the right edge will be much narrower than normal. After the line width has been adjusted the paper can be centered by moving the two white plastic guides on the round bar underneath the platen at the rear of the mechanism. If necessary, the entire paper carrier can be moved slightly by loosening the four screws holding it to the main mechanism and sliding it to one side or the other as necessary.

The Printer Mechanics

The entire design is based on a remarkably simple and reliable print mechanism. The printed characters are formed by moving the print head horizontally across the paper while selectively energizing solenoid driven print wires on the head which strike an inked ribbon and imprint dots on standard adding machine paper. All seven of these solenoid driven print wires converge at the tip of the print head in a vertical line which is perpendicular to the horizontal direction of movement of the print head. By selectively firing the print wires, 5 dot wide X 7 dot high characters are printed as the print head moves across the paper. A one dot time spacing is left for separation between the printed characters.

This method of printing characters is not new but the method of moving this wire impact print head is unique. Rather than using dual motors, clutches timing bars and the other hardware usually associated with this type of print head, this printer rotates a long cylinder just beneath the print head. The length of the cylinder itself is a little longer than the head's printing width on the paper. The cylinder has a uniform single cyclic zig-zag track formed on its outer circumference, running from the left side of the cylinder to the right side then back to the left again. A small projection on the bottom of the print head rides in this track so that as the cylinder rotates the print head moves back and forth from left to right. This technique moves the print head across the paper at a constant velocity except for the extreme ends, where nothing is printed anyway. This approach greatly simplifies the electronics needed to drive the printer since no head positioning circuitry is necessary. The cylinder itself is turned by an AC motor on the lower right hand side of the print mechanism. A small ribbed nylon belt interconnecting the two rides on gear teeth of both the motor and cylinder. Also attached to the right side of the cylinder is a cam that actuates a roller arm micro-switch riding on the cam. This is how the printer's electronic circuitry senses the "start of line" position of the print head. On the left side of the cylinder is an eccentric driven pawl arm that advances the paper one line for each revolution of the cylinder which is the same as one cycle of the print head.

Let's go thru a cyclic operation of a printed line where we will first assume the head is in rest position just left of center. When a line print command is initiated by the control circuitry, the motor starts and the head begins to move from the center position toward the far left side of the printer where the head reverses direction. This non-print dead zone gives the motor, cylinder, and print head time to attain full speed. As the head begins its movement from left to right, the cam actuated micro-switch opens telling the electronic circuitry to start outputting character forming solenoid driving pulses. Somewhere before the print head reaches the far right hand edge of the paper the solenoid pulses will cease while the head continues to move. When the head reaches the right end of its travel, it will reverse direction and begin to move back toward the center of the printer. During this return movement, the pawl arm will rotate the platen one line for the line feed. The motor is then turned off just to the left of center where it started originally. Character data is not accepted by the printer's circuitry during an actual print cycle, however feeding continual print data from a computer to the printer may take place so fast that the print motor may never appear to stop between repeatedly printed lines although it actually does.

The operation of printing ribbon used on the unit is also amazingly simple. A ratchet technique not only advances the ribbon incrementally for each cycle of the print head but automatically reverses it when it reaches the end of one of the two spools. This means you need only change the ribbon when the printing become too light for easy legibility.

The Electronics

The electronic circuitry driving the fore mentioned print mechanism can vary from nothing but motor and solenoid drivers constantly serviced by the microcomputer to a fully self-contained hardware control unit with memory needing only 7 bit parallel ASCII data and a "data ready" strobe control line from the computer. This printer system fits into the latter category. The printer has its own 40 character FIFO (first in - first out) memory allowing the computer to send character data at whatever speed it wishes. The entire line is printed upon receipt of a carriage return ($0D_{16}$) or automatically whenever the 40 character

line buffer has been filled. All control characters with the exception of a carriage return are ignored by the printer. They are not stored in the FIFO line memory since they cannot be printed anyway. Repeated line feeds are initiated by sending repeated carriage return control commands. Since the printer prints upper case ASCII characters only, all lower case characters sent to the printer are transposed to their upper case equivalent before printing. The printer's line buffer memory is automatically cleared by a hardware power-up reset circuit when printer power is first applied. The printer's motor is triac controlled and is powered by a 120 VAC secondary on the power supply's power transformer. This not only provides power line isolation but allows the entire unit to be run on either 120 VAC or European 240 VAC power systems since the power transformer has two primary windings which may be either parallel or series connected.

The seven ASCII parallel data input lines and "data ready" and "data accepted" control lines are all TTL compatible. The inputs represent a maximum of two standard TTL loads while the "data accepted" output will drive ten standard TTL loads. Data is presented to the printer by storing the selected ASCII data on the seven data input lines and strobing the normally high (logic 1) "data ready" input line low. This line should go low (logic 0) for at least 1 microsecond and when it does the normally high "data accepted" will also go low. The character is not actually loaded until the "data ready" input is returned to its normally high state. The "data accepted" line will then normally return high as well, indicating that the character has been loaded. However, when loading the 40th character on a print line or a carriage return command this "data accepted" line will not return high until the character data has been printed and the printer memory is ready for more data. The printer will ignore all data sent to it while the "data accepted" line is low. So you will usually want to make sure the "data accepted" output line is high before sending the printer data to be printed.

If you are careful not to output data faster than one character per microsecond and allow a minimum one second delay before sending data after sending a carriage return or the 40th character of each line then you may avoid using the "data accepted" line altogether. However, using the "data accepted" line will give your system the fastest possible print speed.

How It Works

All ASCII character data is presented to the FIFO memory, IM thru hex inverter/buffer IC12. NAND gate IC14A makes any necessary conversions from lower to upper case characters. 8 input NAND gate IC13 monitors the incoming ASCII data in search of a carriage return ($0D_{16}$ or $0000\ 1101_2$) control command. If it decodes a carriage return it will prepare normally high control flip-flop IC8A to go low on the falling edge of the "data ready" (input strobe) control signal. NOR gate IC15A decodes all control characters and along with IC15B inhibits any control characters from being loaded into the FIFO memory. NAND gate IC9A is responsible for generating the "data accepted" output whenever data has been accepted by the FIFO memory or acknowledged by the control character decode logic. It also inhibits the "data accepted" output while the printer is in the process of printing a line.

Control flip-flop IC8A's Q output is high when the printer is in the idle state. A FIFO full signal decoded by NOR gate IC15D or a decoded carriage return command by IC13 resets this flip-flop low which turns the printer's motor on thru transistors Q1 and Q2 located on the power supply board which starts a line print sequence.

When the print head advances to the "start of line" position, the roller arm microswitch changes states which flips RS latch NAND gate IC11D low which

allows free running oscillator IC10 to feed divide by 2 flip-flop, IC8B. This divide by 2 feeds both the dot counter, IC4, and solenoid timer IC6. This solenoid timer is used to set the "ON" time of the printer's solenoids. If set too long, the solenoids will overheat, if set too short, the printed lines will be too light. An "ON" time duration of 400 microseconds is the best compromise setting. Decade counter IC4 has its B and C outputs tied back to its zero reset inputs forcing it to become a modulo 6 counter. As the counter progresses from 0 to 4 inclusive, the selected character lines are decoded by the ROM, IC2 using the ASCII data fed to it by FIFO memory, IC1, and fed onto the solenoids thru buffers IC3 and IC7 and Darlington drivers 01 and Q7. Counter state 5 is decoded by the ROM as a blank for the one dot space necessary to separate the printed characters. In the latter phase of the five count the FIFO is shifted, the counter resets, and the sequence repeats. When the FIFO finally empties, the ROM is disabled and blanks the output for the rest of the print cycle. When the still moving print head reaches its normal "rest" position, the roller arm microswitch again changes states. This time RS latch NAND gate IC11C flips low setting control flip-flop IC8A back to normally high state.

Timer IC5 is a power up clear circuit which empties the FIFO memory and helps prevent random firing of the print solenoids during power up.

Note

When turning the printer off it is best to use the toggle switch on the front of the printer chassis. This toggle switch not only interrupts the 120

VAC being delivered to the power transformer on the printer but also disables the 40 VDC line feeding the solenoids. It is necessary to break this line while the DC voltages in the system are bleeding down in order to prevent the print solenoids from randomly firing and printing a vertical line on the paper.

In Case of Problems

In case of problems, the best procedure is to remove power and recheck all assembly steps. Since you are probably feeding the printer with a computer system, don't rule out a possibility of a problem either in the interconnection between the two or in the program driving the printer.

As far as the printer itself is concerned, check the voltages on the PR-40B board to make sure the DC voltages are within 10% of their specified ratings as shown on the PR-40B schematic. Other than this the only thing you can do is go thru the PR-40A board components one by one until you can pin down the source of the problem.

If you still cannot find the problem or do not wish to service the unit yourself, repair services are available from us at a cost of $20.00 labor plus parts.

Wiring Table - PR-40 Alphanumeric Printer

WIRE			FROM			TO		
STEP	LENGTH	GAUGE	PART	TERMINAL	SOLDER	PART	TERMINAL	SOLDER
1	full	-	T1	Black	-	TS-1	C	No
2	full	-	T1	Brown	-	TS-1		No
3	full	-	T1	Blk-Red	-	TS-1	A	No
4	full	-	T1	Brn-Whit.	-	TS-1	A	No
5	-	-	line cord	A	-	TS-1	A	Yes
6	-	-	line cord	B	-	Fl	A	Yes
7	12 1/4"	heavy	TS-1	C	Yes	S1	C	Yes
8	11 1/2"	heavy	Fl	B	Yes	S1	D	Yes
9	PR-40B's R6		C4	(+)	No	C4	(-)	No
10	4 1/2"	heavy	C4	(+)	No	S1	B	Yes
11	full	-	T1	Red	-	PR-40B	J1 pin 1	Yes
12	18"	heavy	C4	(-)	Yes	PR-40B	J1 pin 2	Yes
13	full	-	T1	Red	-	PR-40B	J1 Pin 3	Yes
14	18"	heavy	C4	(+)	Yes	PR-40B	J1 pin 4	Yes
15	15"	heavy	Sl	A	Yes	PR-40B	J1 pin 6	Yes
16	full	-	T1	Green	-	PR-40B	J1 pin 7	Yes
17	6'	heavy	TS-1	B	Yes	PR-40B	J1 pin 8	Yes
18	full	-	T1	Blue	-	PR-40B	J1 pin 9	Yes
19	full	-	Tl	Green	-	PR-40B	J1 pin 10	Yes
20	full	-	T1	Grn-Yel	-	PR-40B	J1 pin 11	Yes
21	full	-	Tl	Blue	-	PR-40B	J1 pin 12	Yes
22	full	-	T1	Grn-Yel	-	PR-40B	J1 pin 13	Yes
23	full	-	T1	Yellow	-	PR-40B	J1 pin 14	Yes
24	full	-	T1	Yellow	-	PR-40B	J1 pin 15	Yes
25	8"	heavy	PR-40B	+40	Yes	PR-40A	Ji pin 1	Yes
26	8"	aeavy	PR-40B	+8	Yes	PR-40A	J1 pin 3	Yes
27	8"	heavy	PR-40B	+40	Yes	PR-40A	J1 pin 4	Yes
28	8"	heavy	PR-40B	+8	Yes	PR-40A	J1 pin 6	Yes
29	8"	heavy	PR-40B	GND 2	Yes	PR-40A	J1 pin 7	Yes
30		heavy	PR-40B	G1	Yes	PR-40A	J1 pin 8	Yes
31	"	heavy	PR-40B	G1	Yes	PR-40A	J1 pin 9	Yes
32	8"	heavy	PR-40B	GND 2	Yes	PR-40A	J1 pin 10	Yes
33	8"	heavy	PR-40B	MC	Yes	PR-40A	J1 pin 11	Yes
34		heavy	PR-40B	-12	Yes	PR-40A	JI pin 12	Yes

Parts List PR-40A Printer Board

Resistors

R1 - R7	2.7K ohm 1/4 watt resistor
R8, R11 - R13, R21	10K ohm 1/4 watt resistor
R9, R10, R15, R16, R22 - R24	1K ohm 1/4 watt resistor
R14	100 ohm 1/4 watt resistor
R17	20K ohm trimmer resistor
R18	39K ohm 1/4 watt resistor
R19, R20	4.7K ohm 1/4 watt resistor
R25	10K ohm trimmer resistor
R26	15K ohm 1/4 watt resistor
R27	3.3M ohm 1/4 watt resistor
R28	1 M ohm 1/4 watt resistor

Capacitors

C1, C11	0.1 mylar capacitor
C2, C7 - C9	0.01 mfd capacitor
C3	0.47 mfd tantalum capacitor
C4, C6, C10, C12	0.1 mfd disc capacitor
C5	0.022 mylar capacitor
C13	220 mfd @10 VDC electrolytic capacitor

Semiconductors

IC1	3351 FIFO memory
IC2	5241 ABL character generator ROM
IC3, IC7	7407 hex O.C. buffer
IC4	7490 decade counter
ICS, IC10	555 timer
IC6	74121 one shot
IC8	7474 dual D flip flop
IC9	7420 dual 4-input NAND gate
IC11, IC14, IC16	7400 quad NAND gate
IC12	7404 hex inverter
IC13	7430 8-input NAND gate
IC15	7402 quad NOR gate
IC17	7805 voltage regulator
Dl - D7	15 volt zener diode 1N5245 or 1N4744
D8	1N4148 silicon diode
Q1 - Q7	RCA125 PNP Darlington transistor
Q8	2N5210 transistor

Misc

Fl - F7	minature fast acting fuse - Littlefuse #275 01.5 or equiv.

Parts List PR-40b Printer Board

Resistors

R1	2.2K ohm 1/4 watt resistor
R2	820 ohm 1/2 watt resistor
R3	100 ohm 1 watt resistor
R4	1K ohm 1/4 watt resistor
R5	120 ohm 1/2 watt resistor
R6	2.2K ohm 1 watt resistor

Capacitors

C1	5000 mfd @10 VDC electrolytic capacitor
C2	470 mfd @25 VDC electrolytic capacitor
C3	1 mfd @400 VDC capacitor
C4	4000 mfd @50 VDC electrolytic capacitor

Semiconductors

D1 - D6	1N5402 silicon rectifier
D7 - D8	1N4003 silicon rectifier
D9	12 volt 1 watt zener, 1N4742 or equiv.
Q1	SS1122 silicon transistor
Q2	T2800B triac

Misc.

S1	DPST toggle switch
F1	2 1/2 amp slo-blo fuse
T1	Power Transformer - 120/240 VAC primary, 32 VAC @2A, 12.5 VAC @1A C.T., 120 VAC @200 Ma, 24 VAC @100 Ma. C.T. secondaries

SWTPC 6800/PR-40 Printer Diagnostic PRNTST-1

This printer diagnostic has been written to test and/or debug the SWTPC PR-40 printer when it has been interfaced to the SWTPC 6800 Computer System thru one of the MP-L parallel interface boards. It is assumed that before loading this program, the rest of the system is functioning normally with no problems. The program itself uses 6010 words and is loaded within the 128 word RAM used by the MIKBUG operating system on the MP-A Microprocessor/ System Board. A program may reside in external RAM memory simultaneously with the diagnostic loaded within the 128 word RAM, or the diagnostic may be run with no MP-M memory boards installed on the system at all. The diagnostic may be loaded either from tape or instruction by instruction using MIKBUG starting from address A014 thru A024 and then from address A048 thru A072. The address of the MP-L parallel interface board feeding the printer must be set using MIKBUG R to load the hexadecimal address of the selected port into memory locations A002 and A003 with the most significant byte going into A002 and the least significant byte going into A003. The starting address locations of the interface ports are given below:

Port		Address in Hex
I/0	#0	8000
I/0	#1	8004 (reserved for control interface)
I/0	#2	8008
I/0	#3	800C
I/0	#4	8010
I/0	#5	8014
I/0	#6	8018
I/0	#7	801C

Since the program counter is set when the program is initially loaded, the diagnostic is initiated as described in the "Go to User's Program" section of the Engineering Note 100. Once initiated, the program can be stopped only by depressing the "RESET" button. The program may then be re-started after resetting the program counter to A04A as described in the "Display contents of MPU registers Function" section of Engineering Note 100.

The diagnostic works by sending out an ASCII carriage return ($0D_{16}$) followed by ASCII characters 21_{16} thru $3F_{16}$ followed by a carriage return ($0D_{16}$), followed by ASCII characters 40_{16} thru 5E inclusive, repeating itself until stopped with the RESET switch.

Each character is output to the printer by first storing the ASCII character's bits 0 thru 6 on output lines 00 thru 06 of the selected MP-L Parallel Interface port, then bringing the normally high "Data Ready" line low via interface output control line C2 for at least one microsecond then returning the line high again. The data must be held stable on the interface output lines however until the printer acknowledges data receipt by bringing its normally high "Data Accepted" line momentarily low and then high again. This latter low to high transition signifies that the printer has accepted the character. The MP-L control line C1 fed by this line has been programmed to see the low to high "Data

Accepted" transition and responds by allowing the program to output the next sequential ASCII character.

To set the printer's line width adjustment, you should use Mikbug to change the data in memory locations A056 and A065 from $0D_{16}$ to 00_{16}. This will eliminate the transmitted carriage returns and force the printer to print a full 40 column line. The line width control should then be adjusted for symmetrical margins. The characters will still be printed sequentially but will not be identical from line to line.

DO NOT operate the printer more than a minute or so while running this diagnostic. Continuous printing of full length lines with no spacing between characters overheats the solenoids on the print mechanism which may decrease its operating life.

If you are using the SWTPC PR-40 printer with the SWTPC 6800 Computer System, you may use the OUTCHR subroutine listed from address A014 thru A024 in the PRNTST diagnostic within your own program for outputting characters to the printer. The index register must be loaded with the starting address of the MP-L Parallel Interface board feeding the printer. The character to be printed must be loaded into accumulator A and the contents of accumulator B are destroyed during the subroutine.

Never install or remove the interface board when the system is powered up. Doing so is not only hazardous to the equipment, but bypasses the normal power-up sequence required by the internal registers within the 6820 integrated circuit in order to guarantee proper operation.

```
A014    A7   OUTCHR   STA   A   0,X
A015    00
A016    C6            LDA   B   #$37
A017    37
A018    E7            STA   B   1,X
A019    01
A01A    C6            LDA   B   #$3F
A01B    3F
A01C    E7            STA   B   1,X
A01D    01
A0IE    6D   LOOP3    TST       1,X
A01F    01
A020    2A            BPL       LOOP3
A021    FC
A022    E6            LDA   B   0,X
A023    00
A024    39            RTS

A048    A0            MSB       Program Counter
A049    4A            LSB       Program Counter
A04A    FE   START    LDX       PARADR
A04B    A0
A04C    02
A04D    C6            LDA   B   #$FF
A04E    FF
A04F    E7            STA   B   0,X
A050    00
A051    C6            LDA   B   #$3F
A052    3F
A053    E7            STA   B   1,X
A054    01
A055    86   FSTLIN   LDA   A   #$0D
A056    0D
A057    8D            BSR       OUTCHR
A058    BB
A059    86            LDA   A   #$20
A05A    20
A05B    4C   LOOP1    INC   A
A05C    81            CMP   A   #$40
A05D    40
A05E    27            BEQ       NXTLIN
A05F    04
A060    8D            BSR       OUTCHR
A061    B2
A062    20            BRA       LOOP1
```

```
A063        F7
A064        86    NXTLIN      LDA    A     #$0D
A065        0D
A066        8D                BSR          OUTCHR
A067        AC
A068        86                LDA    A     #$3F
A069        3F
A06A        4C    LOOP2       INC    A     A
A04B        81                CMP    A     #$60
A06C        60
A06D        27                BEQ          FSTLIN
A06E        E6
A06F        8D                BSR          OUTCHR
A070        A3
A071        20                BRA          LOOP2
A072        F7
```