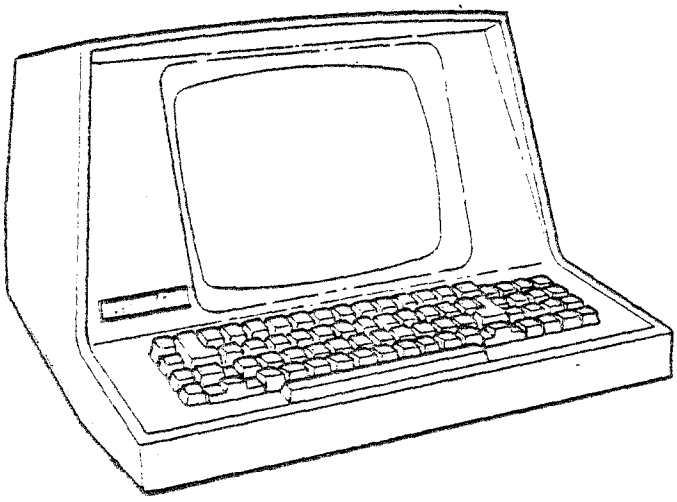
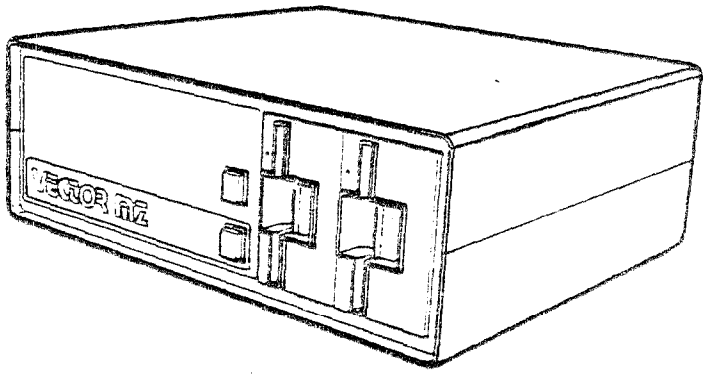
# MATRIX PRINTER






VECTOR

VECTOR GRAPHIC, INC.

# MP DOT MATRIX PRINTER

Revision 1

# USER'S MANUAL

Revision B

July 7, 1980

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Vector Graphic MP Dot Matrix Printer

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2. VECTOR GRAPHIC, INC., is given notice of the precise defect claimed within ten (10) days after its discovery;
3. The MP Dot Matrix Printer is promptly returned to VECTOR GRAPHIC, INC., at customer's expense, for examination by VECTOR GRAPHIC, INC., to confirm the alleged defect, and for subsequent repair or replacement if found to be in order.

Repair, replacement or correction of any defects in material or workmanship which are discovered after expiration of the period set forth above will be performed by VECTOR GRAPHIC, INC., at Buyer's expense, provided the MP Dot Matrix Printer is returned, also at Buyer's expense, to VECTOR GRAPHIC, INC., for such repair, replacement or correction. In performing any repair, replacement or correction after expiration of the period set forth above, Buyer will be charged in addition to the cost of parts the then-current VECTOR GRAPHIC, INC., repair rate. At the present time the applicable rate is $35.00 for the first hour, and $18.00 per hour for every hour of work required thereafter. Prior to commencing any repair, replacement or correction of defects in material or workmanship discovered after expiration of the period for no-cost-to-Buyer repairs, VECTOR GRAPHIC, INC., will submit to Buyer a written estimate of the expected charges, and VECTOR GRAPHIC, INC., will not commence repair until such time as the written estimate of charges has been returned by Buyer to VECTOR GRAPHIC, INC., signed by duly authorized representative authorizing VECTOR GRAPHIC, INC., to commence with the repair work involved. VECTOR GRAPHIC, INC., shall have no obligation to repair, replace or correct any MP Dot Matrix Printer until the written estimate has been returned with approval to proceed, and VECTOR GRAPHIC, INC., may at its option also require prepayment of the estimated repair charges prior to commencing work.

Repair Agreement void if the enclosed card is not returned to VECTOR GRAPHIC, INC. within ten (10) days of end consumer purchase.

## FOREWORD

| | |
|---|---|
| Audience | This manual is intended for computer distributors, or others with at least a moderate technical knowledge of small computers. |
| Scope | It will describe what the Vector Graphic MP Dot Matrix Printer does in the context of a computer system, how to use the printer both in Vector Graphic and in other S-100 systems, and how the printer works. |
| Organization | Each section is written at a uniform level of technical depth. "Perspective" describes WHAT the printer does and requires only a moderate knowledge of computer design. "User's Guide" describes HOW to install the MP and make it work and assumes the same level of knowledge plus the ability to use a few simple tools. "Theory of Operation" discusses WHY the board works and assumes a knowledge of digital electronics and software principles |

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Vector Graphic MP Dot Matrix Printer

## SPECIFICATIONS

| | |
|---|---|
| Interface | TTL level: 2 parallel output ports and 1 parallel input port. |
| Compatibility: | Designed for Vector Graphic systems though may be used with most Z-80 S-100 bus systems which can supply an additional 2-1/2 amps at +8VDC and -16 VDC. |
| I/O Ports Used | 56K systems: Ports 8 and 9 (I/O II standard addressing) |
| Software Driver | On 2708 PROM at EC00H-EFFFH for 56K systems. |
| RAM Used | Approximately 128 bytes at FC00H-FC63H |
| Throughput speed | 70 lines per minute. 150 characters per second. Has 1 line input buffer. |
| Printing Method | Unidirectional 7-wire x 5 column dot matrix. |
| Line Spacing | 6 lines per inch |
| olumn Spacing | 80 columns, 1/10 inch wide, software modifiable. 40/80 characters per line using software driver supplied with MP. |
| Character Size | 0.122 inch by 0.083 inch. |
| Resolution | 1/60 inch, horizontally and vertically. 60 dot positions per inch. |
| Copies | Original and 1 copy. Maximum paper thickness, 0.2 mm. |
| Form Width | 4 to 10 inches. |
| Sprocket Pins | 5/32" diameter, spaced 1/2" apart. |
| Paper Feed | Pin wheel actuated by pulse motor drive. |
| Paper Feed Speed | 10 lines per second. |
| Paper Loading | Through top of cabinet. |
| Print Head Life | 100 million character expectancy at 14 dots per character. |
| Drive Life | 5 million lines expectancy. |

| | |
|---|---|
| Ribbon | 0.5 inch x 36 feet; standard unicolor matrix printer ribbon, black or purple. Underwood type spools. |
| Power Required | +8VDC @ 2-1/2 A, -16VDC @ 2-1/2 A. |
| Environmental | 68°F to 104°F operating temperature range. 10% to 80% non-condensing humidity. |
| Dimensions | 7 inches high by 18 inches wide by 13 inches deep. |
| Weight | 21 lbs. |

# I. PERSPECTIVE

## 1.1 Compatibility

The Vector Graphic MP is a low cost, tractor feed, 80 column dot matrix printer. Though the MP was designed specifically for use with any Vector Graphic microcomputer system, it can be used with any S-100 Z-80 based system which has at least one parallel TTL input port, two parallel TTL output ports and can supply 2-1/2 amps at +8VDC and -16VDC to the printer.

## 1.2 Modifications to mainframe may be required.

If your printer was ordered separately and not part of a complete system, modifications may be necessary on your Vector Graphic mainframe, particularly if it was manufactured prior to 1/1/80.

Modifications which may be required include wiring a printer power outlet into the power supply, installing a cable between the interface board and the back panel and installing a PROM on the PROM/RAM board.

All parts necessary for the modifications are included with the printer.

## 1.3 Software Driver

The Vector Graphic MP dot matrix printer's features are controlled by a software driver resident in RAM. In addition, a small printer driver access routine is necessary. Vector Graphic CP/M 2.X diskettes include this routine as part of the CONFIG module. Vector Graphic MDOS 8.6 diskettes will include this routine as an overlay file called SYSP. Besides printing 96 standard ASCII characters, an almost endless array of graphics characters are possible via direct assembly language software control. The PROM supplied with the system provides character generation and other necessary programming. A listing of the printer driver routine is included in the appendix of this manual. An MP Graphics Driver PROM provides software support for special graphics characters.

The printer driver supplied with the MP dot matrix printer will work, without modification, on Vector Graphic MZ, System B, 3030 and Memorite II microcomputers operating with the following software: MDOS, MZOS and CP/M. Simply follow the appropriate print instructions with the software to provide printed output.

While it is certainly possible to modify or rewrite the printer driver routine to operate with other systems, this is a job which should only be undertaken by someone familiar with Z-80 assembly language programming.

Note: You must have the 4.0 monitor to run the MP if using MDOS (version 8.6 or later).

## 1.4 Reliability and cost effectiveness of the printer.

The Vector Graphic MP Dot Matrix Printer is clearly a breakthrough in cost effectiveness. This was accomplished by driving the printer from the host computer and deriving power from the mainframe. This permits Vector Graphic to offer a compact printer which is eminently compatible with your Vector Graphic microcomputer at a truly advantageous price.

Considerable attention was given during design of the printer to the elimination of noise. It features an enclosure specially treated with sound absorbant material to reduce machine vibration and resultant noise.

In addition to the above features, the Vector Graphic MP Dot Matrix Printer has proven to be remarkably reliable. The life expectancy of the printer drive, for example, is estimated to be 5 million lines. Print head life expectancy is estimated to be 100 million characters.

The MP Dot Matrix Printer comes complete with all necessary cables, firmware, installation instructions and documentation. The unit is completely factory assembled and tested.

# II. USER'S GUIDE

In order to understand the User's Guide, you must be aware that the MP dot matrix printer was designed to work as part of a Z-80 based system, it is not intended to be a free standing unit. It cannot handle RS-232 or current loop signals directly, for example. By taking this approach and exploiting the inherent capabilities of the Z-80, however, Vector Graphic, Inc. is able to offer a dot matrix printer that can deliver exceptional performance to your system at low cost.

## 2.1 Modifications to the Vector Graphic Microcomputer

This section describes the modifications which must be made to the mainframe's power supply to accomodate the printer's power needs. If you are going to use the printer in an existing system that was not shipped with an MP printer, THIS SECTION IS VERY IMPORTANT.

However, if the printer was shipped as a part of a complete Vector Graphic computer system, aside from the section on plugging in the interconnecting cables, you may skip directly to the test section.

There are four cable assemblies, a small adapter printed circuit board, a diskette, and and a two PROM's supplied with the MP dot matrix printer. Two of the cables are used to connect from sources inside the computer to the rear panel of the computer. Two are used to connect from the back panel of the computer to the MP dot matrix printer. The small adaptor board is supplied for use with the Bitstreamer II I/O board. The PROM's are installed on the PROM/RAM board.

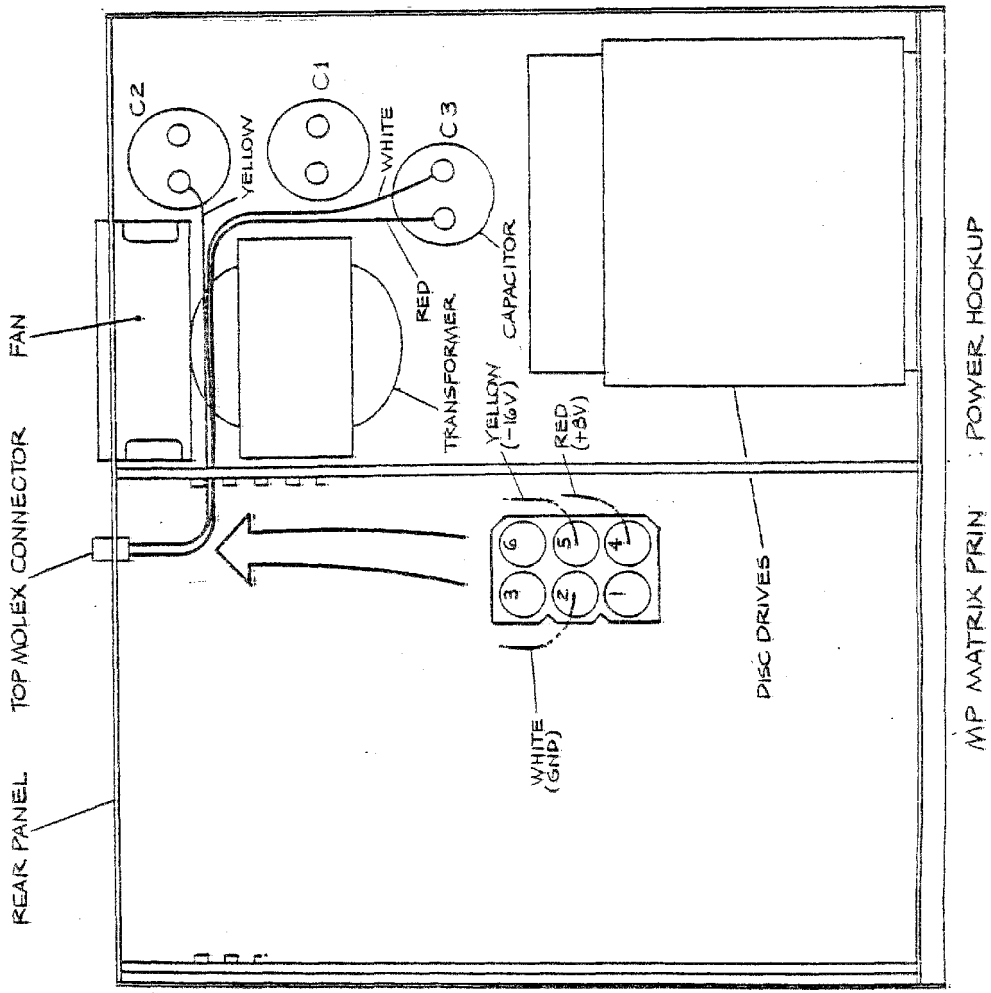
1) The four wire cable with a Molex-type plug on one end and spade lugs on the other ends is used to make power available from the internal power supply in the mainframe to the rear panel of the computer.

2) A 25 conductor flat cable which terminates in a DB-25S female connector on one end and a 24 pin DIP connector on the other is used to connect the Bitstreamer I/O board to the back panel of the computer.

3) The cable with a female Molex-type connectors on one end and a male on the other is used to connect the power supply in the mainframe to the MP.

4) The flat cable which terminates in a male DB-25S connectors on one end and a female DB-25S connector on the other is used to provide signals from the mainframe to the MP.

5) The adaptor board with two 34 pin sockets on one side and a 24 pin DIP socket on the other is used to connect the Bitstreamer II I/O board with the second cable listed above.


C2
C1
C3
YELLOW
WHITE
RED
TRANSFORMER
CAPACITOR
FAN
TOP MOLEX CONNECTOR
REAR PANEL
YELLOW (-16V)
RED (+8V)
WHITE (GND)
DISC DRIVES
MP MATRIX PRIN : POWER HOOKUP
6
5
4
3
2
1

### 2.1.1 Power Supply Modifications

In order to run the MP dot matrix printer, a power supply cable must be wired into the mainframe power supply and then fastened to the rear of the computer. A separate cable then connects the mainframe to the printer.

1) Unplug the microcomputer from the outlet and disconnect the power supply cord from the back of the machine.

2) Wait at least one minute.

3) Unscrew the 4 screws which hold the cover to the frame using a Phillip's screwdriver. Remove the cover. The power supply components are on the right side of the computer and consist of a transformer, three electrolytic capacitors, two stud-type diodes and a bridge rectifier.

4) Make sure at least one minute has elapsed between the time you have disconnected the power and have taken the cover off.

5) Thread the four wires of the power cable, lug ends first, through a cut out in the back of the machine. If you are interfacing the MP to an S-100 computer not manufactured by Vector Graphic, Inc. see the note at the end of this section.

6) Identify capacitor C2. It is one of the two 28,000 mfd. capacitors and has white wires going to one terminal and yellow wires going to the other. Loosen the minus terminal on this capacitor (the one with the yellow wires attached to it) and fasten the yellow wire of the MP power cable to it using the spade lug attached. Tighten the terminal.

7) Identify capacitor C3. It is the 60,000 mfd. capacitor. The plus terminal of C3 has red wires attached to it, the minus terminal of C3 has white wires going to it. Loosen both these terminals and fasten the remaining two wires of the MP power cable to them: red to red, white to white. Tighten the terminal.

8) Identify capacitor C1. It is one of 28,000 mfd. capacitors and has white wires going to one terminal and purple wires going to the other. Loosen the minus terminal on this capacitor (the one with the purple wires attached to it) and fasten the purple wire of the MP power cable to it using the spade lug attached. Tighten the terminal.

9) You may test the voltages at the connector. Pin 2 is ground. Pin 1 should be approximately +8VDC. Pin 3 should be approximately -16VDC.

10) If you have an appropriate cut out in the rear of your mainframe, you may permanently fasten the connector to the rear panel. If you do not already have such a hole in the back panel of your computer, you have two options: you may leave the connector hanging loose out of the back or you may cut a hole in the back panel yourself. The dimensions of the hole required are .600 inch by .725 inch. Label this connector "PRINTER POWER CONNECTOR."

Note:

If you are interfacing the Vector Graphic MP dot matrix printer to an S-100 computer which was not manufactured by Vector Graphic, Inc., connect the yellow wire of the power cable assembly to your -16V source, the red wire to your +8V source, the purple wire to your +16V source, and the white wire to ground.

### 2.1.2 Bitstreamer I Board Modifications

In order to interface a Vector Graphic MP dot matrix printer to an S-100 system via the Vector Graphic Bitstreamer I board, two printed circuit traces must be cut and two jumpers must be added as per the following. The Bitstreamer I board may be identified by the single DIP switch on the upper left hand side of the board. The Bitstreamer II board has three DIP switches in the same position. If you are interfacing the MP dot matrix printer to a Vector Graphic microcomputer which is equipped with a Bitstreamer II I/O board, go to the next section.

1) On the component side of the board, there is a trace which begins at pin 10 of U17, runs underneath and exits from beneath the chip between pins 6 and 7. Cut this trace.

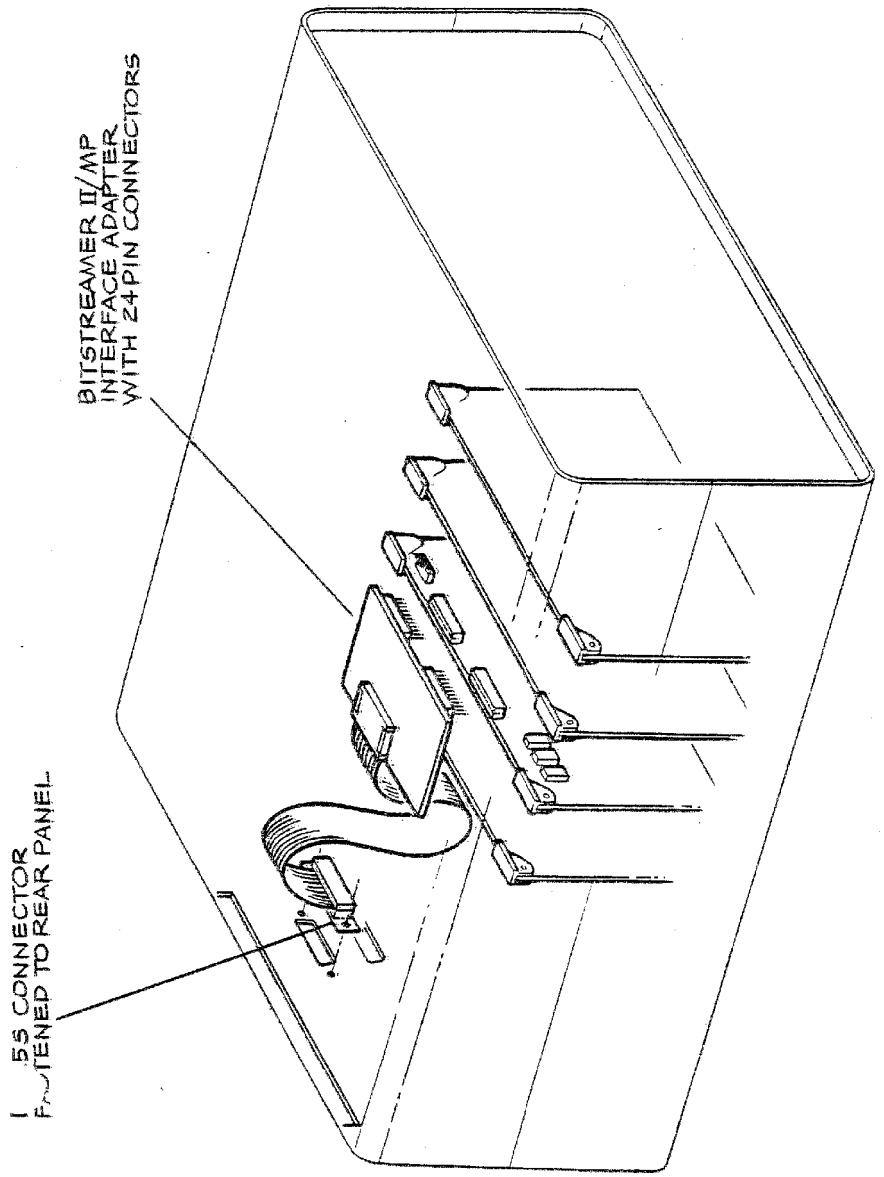
2) On the circuit side of the board, there is a trace which runs to pad 8 of J3. Cut this trace at the pad.

3) On the circuit side of the board, solder a jumper from pad 8 of J3 to pad 20 of J2.

4) On the circuit side of the board, solder a jumper from pad 17 of J3 to pad 19 of J2.

5) Plug in the cable with the 24 pin DIP connector to J3 of the Bitstreamer I board. Fasten the other end of the cable assembly (terminating in an DB-25S connector) to the back panel through one of the cut outs provided for this purpose. Label this connector "PRINTER SIGNAL CONNECTOR."

Note: Make sure that the original port addresses have not been changed.




BITSTREAMER II/MP INTERFACE

### 2.1.3 Bitstreamer II Board Modifications

If you are interfacing the Vector Graphic MP dot matrix printer with the Bitstreamer II board, use the following procedure.

1) An adapter board has been supplied with the MP. Connect the adapter board to the two 34 pin connectors on top of the Bitstreamer II board, orienting the board so that the 24 pin DIP socket is towards the rear panel.

2) Take the cable which has a 24 pin DIP plug on one end and an DB-25S female connector attached to the other end and plug the DIP plug into the DIP socket on the adapter board. Make sure the notches on the socket and the plug are on the same end.

3) Attach the connector on the other end of the cable to one of the blank cut outs at the back panel which has been provided for this purpose. Label this connector "PRINTER SIGNAL CONNECTOR."

SIGNAL CABLE PIN OUT DIAGRAM

| BITSTREAMER II SOCKET | DB-25 CONNECTOR | 24 PIN DIP SOCKET | PORT | DESCRIPTION |
|---|---|---|---|---|
| J4- 2* | 18 | 5 | AO0 | Step enable |
| J4- 3 | 19 | 6 | AO1 | Step phase A |
| J4- 4 | 22 | 9 | AO2 | Step phase B |
| J4- 5 | 23 | 10 | AO3 | Motor on |
| J4-11 | 8 | 17 | AI0 | Timing |
| J4-12 | 21 | 8 | AI1 | Home |
| J5- 2 | 17 | 4 | BO0 | Wire 1 (top) |
| J5- 3 | 16 | 3 | BO1 | Wire 2 |
| J5- 4 | 15 | 2 | BO2 | Wire 3 |
| J5- 5 | 14 | 1 | BO3 | Wire 4 |
| J5- 6 | 24 | 11 | BO4 | Wire 5 |
| J5- 7 | 25 | 12 | BO5 | Wire 6 |
| J5- 8 | 12 | 13 | BO6 | Wire 7 (bottom) |
| J5- 1 | 11 | 14 | BO7 | Strobe |

* J4 is the left hand socket on top of the I/O II board.

Note: Make sure the original port addresses have not been changed. On a 56K system using the I/O II board, the parallel port addresses should be set at 8 and 9 (factory standard.)

### 2.1.4 Installing the PROM on the PROM-RAM board

The following instructions tell you how to install the Printer Driver PROM on the 12K Vector Graphic PROM-RAM board.

1) You may identify the PROM-RAM board in your computer by the row of 8 24-pin DIP sockets at the top of the board. With the power off, remove this card from your machine. Block B must be addressed at E000H for 56K systems. Check your PROM/RAM board manual for details.

2) Install the Printer driver PROM in socket 11. Make sure the notch on the PROM matches the indicated notch on the board.

3) Plug the PROM-RAM back into its socket on the motherboard.

4) The PROM installation is now complete.

## 2.2 Cable Hook-Up

To connect the cables between the computer and the printer, do the following:

1) With the power at the mainframe turned off, connect the printer power cable (Molex connectors at both ends) to the printer power connector on the back panel of the mainframe and the matching connector at the back of the MP.

2) With the power at the mainframe still turned off, connect the printer signal cable (the flat wide cable with a 25 pin connector at each end) from the printer signal connector on the back panel of the mainframe to the matching connector at the back of the MP. The cable hook-up procedure is now complete.

### 2.2.1 Connecting MP to ZCB Board

If you have a Vector Graphic system equipped with a ZCB board, do the following:

1) If you have a ZCB board which contains 1K monitor PROMs in sockets U20 and U21, install the printer driver PROM in socket U22. If your ZCB board contains a 2K monitor ROM in socket U22, place the printer driver PROM in socket U20.

2) Place the ZCB-MP interface card on the parallel port socket at the top of the ZCB board.

3) Connect the cable to the MP Interface and to the rear of the computer. Fasten the PB-225 connector to one of the cutouts with the hardware provided.

## 2.3 Loading Paper

To load paper into the Vector Graphic MP dot matrix printer:

1) Remove the clear plastic top from the printer.

2) Tilt tractor feed mechanism forward until it stops.

3) Place box of fan folded paper behind printer.

4) Feed paper carefully into paper guide inlet at top of printer until it feeds up between platen and print head. Open tractor guides. Pull paper up through tractor assemblies, aligning guide holes in paper with tractor feed pins. It would be convenient, at this time, to position the top of the next form just above the print line. Make sure that both left and right sides are aligned correctly, otherwise the paper will bind. One easy way to do this is to count the number of holes from the top of form to the first (top) pins on either tractor. They should be the same. Now close the tractor guides.

5) Replace the plastic cover on the printer. The paper feeding process is now complete.

## 2.4 Initial Testing

After the cables have been hooked up and paper has been installed in the MP, some initial testing can be done to assure that everything is working properly. Two test procedures are provided, one for Vector Graphic systems under MDOS and one for Vector Graphic systems under CP/M.

NOTE:

When used with the printer driver furnished, the printer will not print a line until a Carriage Return has been received unless the automatic CRLF function has previously been selected. The characters received are stored in a buffer until a Carriage Return causes the program to send an entire line to the printer.

### 2.4.1 Testing the MP and Printer Driver under MDOS

To test the MP and printer driver software in a Vector Graphic system using MDOS:

1) Boot up MDOS using the normal procedure.

2) Load the printer driver call routine from the MDOS (8.6 version or later) system diskette by typing SYSP (return).

3) Assign the port used by the printer by typing ASSIGN 2,3 (return).

4) Type FILES (return). A list of the files present on the disk should now be printed on the MP dot matrix printer.

### 2.4.2 Testing the MP and Printer Driver under CP/M

To test the MP and printer driver software in a Vector Graphic system using CP/M.

1) Boot up CP/M using the normal procedure.

2) Type CONFIG (return). The program will prompt you on various system choices. In response to the question about printers, type D. By typing YES to the question about making the selection permanent, the system will configure itself to work with the MP printer every time it is booted up.

3) Type ©P. This causes the MP to print all data input from the keyboard. Type a few words of your choice to confirm that the printer is operating properly. By typing DIR (return), a list of the files on your diskette will be printed. Typing ©P will toggle the print function on and off.

## 2.5 Printer Control Commands

The following commands cause the MP to perform the listed functions provided the system has been initialized as explained in the following two sections. These commands will work from the keyboard or they can be sent under program control to perform various print functions.

1) Tab: type ©I or the (tab) key.

2) Line feed: type ©J or (lf) key.

3) Form feed: type ©L.

4) Carriage return: type ©M or (return) key.

5) Toggle auto. CRLF flag: type (ESC) and A.

6) Toggle character/graphic flag: (ESC) and G.
(Works only if MP Graphic PROM is present.)

7) Toggle 80/40 flag: (ESC) and N.

8) Set top of form: (ESC) and T.

9) Set form length: (ESC) and Fxx. xx designates form length in 1/6 inch increments. For values above 99 lines use A, B and C to represent 10, 11 and 12. These values are valid only for the tens place, they are not valid for the units position. To set a form length of 11", xx=66; 14", xx=84. (Note: This command works only under program control.)

### 2.5.1 Printer Control Commands-MDOS

To use the MP under MDOS, initialize the system as follows.

1) Insert the diskette (MDOS 8.6 or later) and boot up the system by typing B.

2) Type SYSP (return).

3) To turn printer on type ASSIGN 2,3 (return).

4) To turn printer off type ASSIGN 2,2 (return)

NOTE:
Form length may also be set under MDOS (versions 8.6 and later) by typing SETFORM "N" (return) while in the operating system. N may be any number from .5 to 21.5 in .5 (inch) increments.

### 2.5.2 Printer Control Commands-CP/M

1) The first time the printer is used with a particular CP/M diskette, the CONFIG routine must be run. After this has been done once, it does not have to be repeated provided that the same diskette is used each time.

2) To turn the printer on under CP/M type ©P.

3) To turn the printer off type ©P.

Note: To use any of the commands which use the (ESC) key, touch the key lightly, key in the next letter(s) and depress (return).

### 2.5.3 Printer Control Commands-Basic

The printer can be controlled from Micropolis Basic by doing the following:

In the immediate mode, the command LISTP can be used to output a program listing to the printer.

During program execution, output may be printed by writing to a print file. For example:

```
10 OPEN 1"*P"
20 PUT 1,X;
30 CLOSE 1
```

The printer can be controlled from Microsoft Basic by doing the following:

In the immediate mode, the command LLIST will output a program listing to the printer.

During program execution, output may be printed by simply using the LPRINT

or the LPRINT USING commands.

## 2.6 Maintenance and Repair of the printer

In order to assure satisfactory printer performance, it is recommended that repairs and overhauls should be done by the Vector Graphic Dealer. Normal maintenance, however, such as changing ribbons and periodic lubrication, may be done by a person with average mechanical skill by following the instructions which follow.

### 2.6.1 Changing Ribbons

Note:
Replace ribbon only with a type intended for use with dot matrix printers. DO NOT use an ordinary typewriter ribbon, even for "emergency use". To do so will result in poor print quality and shortened print head life.

1) Remove both spools and the ribbon in place if there is one. Pay attention to how it is threaded.

2) Remove the new ribbon and spools from their package.

3) Unwind approximately 24 inches of ribbon from the feed spool.

4) Place the feed spool on the left spindle and the take-up spool on the right spindle.

5) Thread the ribbon from the feed spool around the rollers, reverse control levers, and frame sides.

6) Tighten the ribbon by manually turning one of the spools. The ribbon installation is now complete.

### 2.6.2 Periodic Lubrication

In order to insure proper operation, certain points of the MP must be lubricated at specific intervals. Three different lubricants are required:

| Code | Description |
|---|---|
| O2 | Light Machine Oil |
| G2 | Light Grease |
| G11 | Light Moly Grease |

NOTE:
It is strongly suggested that in order to maximize printer life only lubricants purchased from Vector Graphic be used. Any substitution will result in shortened printer life.

First interval lubrication

The points illustrated in the appendix under "Lubrication Points-Printer" must be lubricated using the lubricants specified on the diagram at least once every 6 months or 1 million lines of use, whichever comes first.

Second interval lubrication

The points illustrated in the appendix under "Lubrication Points-Ribbon Mechanism" MP ribbon mechanism must be lubricated with G2 lubricant every 2-1/2 million lines or every six months, whichever comes first.

Third interval lubrication

It is suggested that your MP dot matrix printer be overhauled by your Vector Graphic Dealer every 5 million lines of use to assure dependable long life.

## 2.7 Special Graphics Characters

The MP Graphics Driver Prom is available as standard equipment. In order to understand how to create special graphics characters, it is necessary to know how "normal" characters are generated and printed. The same principle is used whether the output is a printed letter on a page or a number on a video display. What happens is this: in response to a command to print an ASCII character, the operating system or high level language consults a look up table already in computer memory. It obtains from this table the column codes of the letter it is going to print. There are as many column codes as the character matrix is wide. For example, for the MP the number of column codes required for each character is 5. The column codes are eight bit binary numbers, generally expressed as two hexadecimal digits. For example, in response to a command to print the ASCII letter "R", the system would find in the look up table the following five column codes: 11111110, 00010010, 00110010, 01010010, 10001100. (In hex, FE, 12, 32, 52 and 8C.) You will notice that since the matrix is 5X7, the least significant bit is not used and is always 0. Thus, the numbers are always even. These binary numbers are plotted on a 5X7 grid, starting with the first (most significant) bit of the first number which is plotted as the first dot or non-dot at the bottom-most point of the first column. You then plot up the column, converting each one to a dot and each 0 to a space (non-dot). When you reach the eighth (least significant) bit, you ignore it and start on the leftmost bit of the next column code continuing in this manner until the fifth column code is completed.

Example

| Column | Number | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|---|
| | Code | 0 | 0 | 0 | 0 | 0 | Least significant bit |
| | | 1 | 1 | 1 | 1 | 0 | |
| | | 1 | 0 | 0 | 0 | 1 | |
| | | 1 | 0 | 0 | 0 | 1 | |
| | | 1 | 1 | 1 | 1 | 0 | |
| | | 1 | 0 | 1 | 0 | 0 | |
| | | 1 | 0 | 0 | 1 | 0 | |
| | | 1 | 0 | 0 | 0 | 1 | Most significant bit |

ASCII "R"

| | Binary | Hex |
|---|---|---|
| Column 1 | 11111110 | FE |
| Column 2 | 00010010 | 12 |
| Column 3 | 00110010 | 32 |
| Column 4 | 01010010 | 52 |
| Column 5 | 10001100 | 8C |

To create special graphics characters, first sketch the desired character on a 5x7 grid (graph paper would be useful for this.) Rotate the paper 90 degrees to the right. From left to right, change each dot to a 1, each non dot to a 0. Add an extra 0 at the end of each 7 bit number to change it into an eight bit number. Convert that eight bit number into two hexadecimal digits. Do this for each of the five columns needed for each character. Store the 5 pairs of hex digits created in this manner in a table at a convenient area in memory. The table thus created can consist of up to 95 characters, each composed of 5 column codes. Make sure that the space used for the table does not conflict with the operating system or other higher level software you may be using in conjunction with the printer. If you wish to save the graphic character data you have just created, it is suggested that you do so at this point. The printer driver must be told where to find the table of graphics characters, so store the address of the first hex pair at FC50/1H.

The printer hardware strobes the character code to the print wires when the most significant bit goes low. This is taken care of in the printer driver furnished by a 'RRC' instruction. If you are writing your own printer driver, be sure to include an 'RRC' instruction on the hex code before it is transmitted to the printer.

# III. THEORY OF OPERATION

## 3.1 Print wire firing

The firing of the 7 print wires are controlled by the 8 bit output of port B. The signal from output bits 1-7 (the character column bits) are each presented to an input on a 7426 NAND gate (U3 and U8) and held there for a predetermined time by the software. Simultaneously, the 8th (most significant) bit of Port B provides the strobe pulse needed to activate the pulse width timer.

The pulse width timer (V1) is used to regulate the timing of the print wire solenoid actuation. This is particularly important since print quality is dependent upon a precise amount of energy being applied to the solenoids. The strobe pulse from the 8th bit triggers the 555 timer to begin timing, holding the output high. Capacitor C1 begins charging. If the voltage present is slightly higher than normal, it will charge quickly and then turn off the timer. Conversely, if the voltage is lower than normal, C1 will take longer to charge and the output of the timer will be held up longer. Thus this timer is able to compensate for differences in supply voltage, ensuring that the energy supplied to the print wire solenoids remains constant no matter what the variation. Transistor Q1 is used to convert the signal output of analog IC V1 to digital IC voltage levels while inverting it at the same time. This signal is again inverted through inverter on U5 and is presented to one of the inputs of the AND gate U2.

Due to mechanical considerations, two conditions have to be met before the print wires can fire. The print head has to be off the home position and dot (column) timing has to be received.

This is taken care of by IC U4. A signal indicating that the print head is off the home position is received from the printer mechanism via J2-13. This clears the 7474 flip-flop. The dot timing from the printer mechanism clocks the Q output of the flip flop. The Q signal is ANDed at U2 with the pulse from the pulse width timing circuit discussed above. This resultant signal is logically NANDed with the character column bits. If both inputs are high, the NAND gate pulls the print wire solenoid transistor base low, permitting current to flow through the solenoid thereby firing print wire. Diode, resistor and capacitor wired in series/parallel to the solenoid are for arc suppression and current limitation.

## 3.2 Line feed control

The tractor feed mechanism is driven by a stepper motor which is under software control via the MP interface. A stepper motor functions when its coils are energized in a predetermined sequence. This pulls the armature around in a very exact and precise manner.

The stepper motor in the MP's tractor feed mechanism functions by the printer driver software sending 2 sequences of signals on two output lines of Port A. As the signal is received from the the output line it is split between a buffer and an inverter. If the first bit received is a 0, this goes through the buffer portion of the circuit, causing the base of the transistor to go low, switching it on and causing current to flow through the stepper motor coil. The same signal, going through the inverter causes the base of the transistor to go high, blocking current flow through the emitter-collector circuit. The diodes in the circuit prevent current surge when the coil is turned off.

The sequence of bits sent to the first line of Port A is 0110. The sequence sent to the second line is 0011. The coils are energized in the following order: 1 & 4, 1 & 3, 2 & 3, 2 & 4, 1 & 4, etc. The printer driver program determines how many cycles are needed and sends the appropriate number of cycles. Twenty four cycles or steps are needed to complete one line feed.

# IV. APPENDIX

## 4.1 Function of Graphics Driver PROM

The MP Graphics Driver is a program which allows you to use the Vector MP Dot Matrix Printer to print images created on the high resolution graphics board. It can also be used to print patterns specified by 1 byte hex codes.

The MP Graphics Driver program is supplied on a 2708 EPROM which fits into slot 10 on the Vector Graphic PROM/RAM board and is addressed at E800H for 56K systems. If you have a ZCB board which has an 8316 Monitor ROM in socket U22, socket U21 is addressed at E800H and the Graphics Driver PROM should be placed there. See section 2.1.4 in this manual for EPROM installation instructions. If you have a ZCB board which has two 2708 EPROMs in sockets U20 and U21, you cannot use the graphics driver PROM with the board as is. See your dealer about getting your ZCB board modified so that it will accomodate the printer driver PROM in U20, the graphics driver PROM in U21, and a new 2K ROM in socket U22.

## 4.2 Graphics Driver Commands

Though the Graphics Driver is independent of the MP printer driver, it shares several commands with it. In addition, there is a command (ESC) G which allows the user to toggle back and forth between the printer driver and the graphics driver. When going from the printer driver to the graphics driver, (ESC) G must be followed by the hex address of a 480 character buffer in user memory. The address must be expressed in Intel format, that is, the first and second pairs of hex address digits must be reversed. For example, A000H would be entered as 00A0H.

The control commands shared between the printer and graphics driver are:

| | | |
|---|---|---|
| ©I or (TAB) | = | Tab |
| ©J or (LF) | = | Linefeed |
| ©L | = | Formfeed |
| ©M or (RETURN ) | = | Carriage Return |

## 4.3 Printing Under Program control

There are three commands which will cause the MP to print what is displayed on the high resolution graphics board monitor. In the following list, ADDR stands for the address of the High Resolution Graphics board expressed in the Intel format, as explained above.

(ESC) D ADDR - Will cause the MP to print the screen in digital mode, bit for bit.

(ESC) R ADDR - Causes the MP to print the screen in reversed digital mode,

that is, all 0's are printed as 1's and vice versa.

(ESC) V ADDR - Prints the grey scale image of what is on the screen, if the High Resolution Graphics Board is in the grey scale mode. If the board is set for the digital mode, the program will attempt to combine the digital bits together as if they were hex bytes and produce unpredictable results.

## 4.4 Other Print Functions

You can set the graphics driver to generate an automatic carriage return-line feed (CRLF) every time it has received 480 hex bytes sent to it. To do this, type or have the program send an (ESC) A. To toggle the function off, type or have the program send an (ESC) A again.

The graphics driver will also permit the user to print images from hex bytes stored in a buffer area in user memory. The hex bytes must be between the values of 80 and FF. The driver can be set in the 4 or 7 wire print mode by keying or having the program send an (ESC) M.

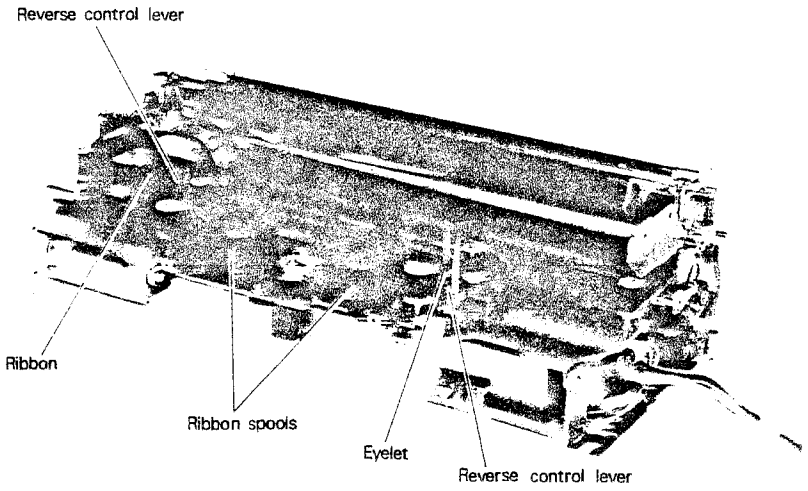
The user then sends the data to the program which then prints it when it receives a carriage return. If more than 480 bytes have been sent to the program without a carriage return, all data after the 480th byte will be lost.

To transmit a particular line, from program memory, for instance, the user would have to encode the 480 desired bytes and store it in program memory. He would further have to write a simple assembly language program which would fetch each of the successive bytes from program memory, move it to the 'C' register, push the contents of all registers onto the stack and call E803H for 56K systems. The program stores each of the bytes in its internal buffer and will print what has been received whenever it receives the hex code for a carriage return unless it is in the automatic CRLF mode in which case it will automatically print the line whenever 480 characters have been received.

The amount of space between the lines can also be specified using the (ESC) N command. This must be followed immediately by a 1 byte (2 hex digits) from 00-FFH. This controls the number of pulses sent to the stepping motor which pulls the paper through the tractors. Hex values of 0A and 11 are suggested as starting points for the 4 and 7 wire mode, respectively. Once this value has been set, the CRLF code will step the same number of pulses until it has been reset or a 4/7 wire switch is performed.

Setting of the ribbon:

1) Set the ribbon along the ribbon setting course shown in Photo 3.16.




CAUTION: See to it that the eyelet of the ribbon be situated between the ribbon detector lever and the ribbon spool.

**Photo 3.16 Ribbon Setting Course**

2) Check if the ribbon spools have been properly placed on the spool shafts.

**Fig. 3.15 Setting of Ribbon Spool**

3) Check if the ribbon is correctly engaged with the ribbon detector lever and the ribbon guide.

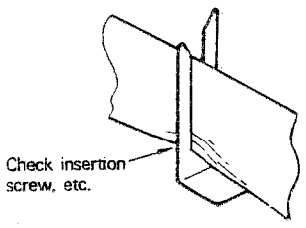


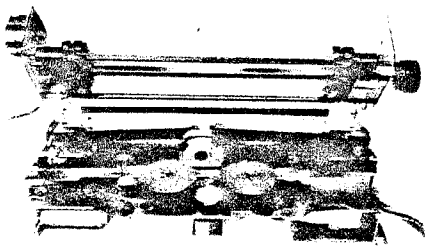
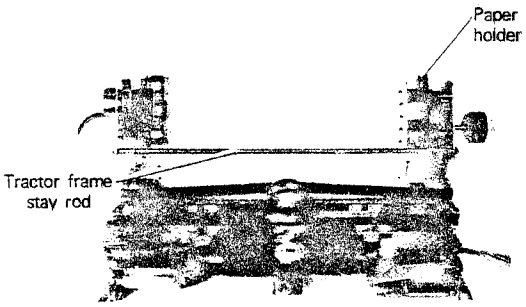
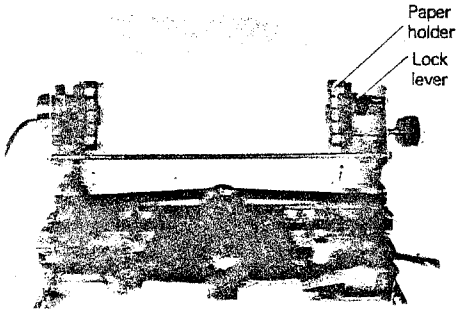
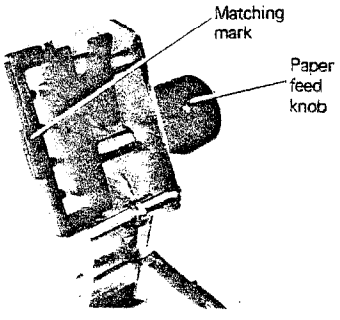

**Fig. 3.16 Setting of Inked Ribbon**

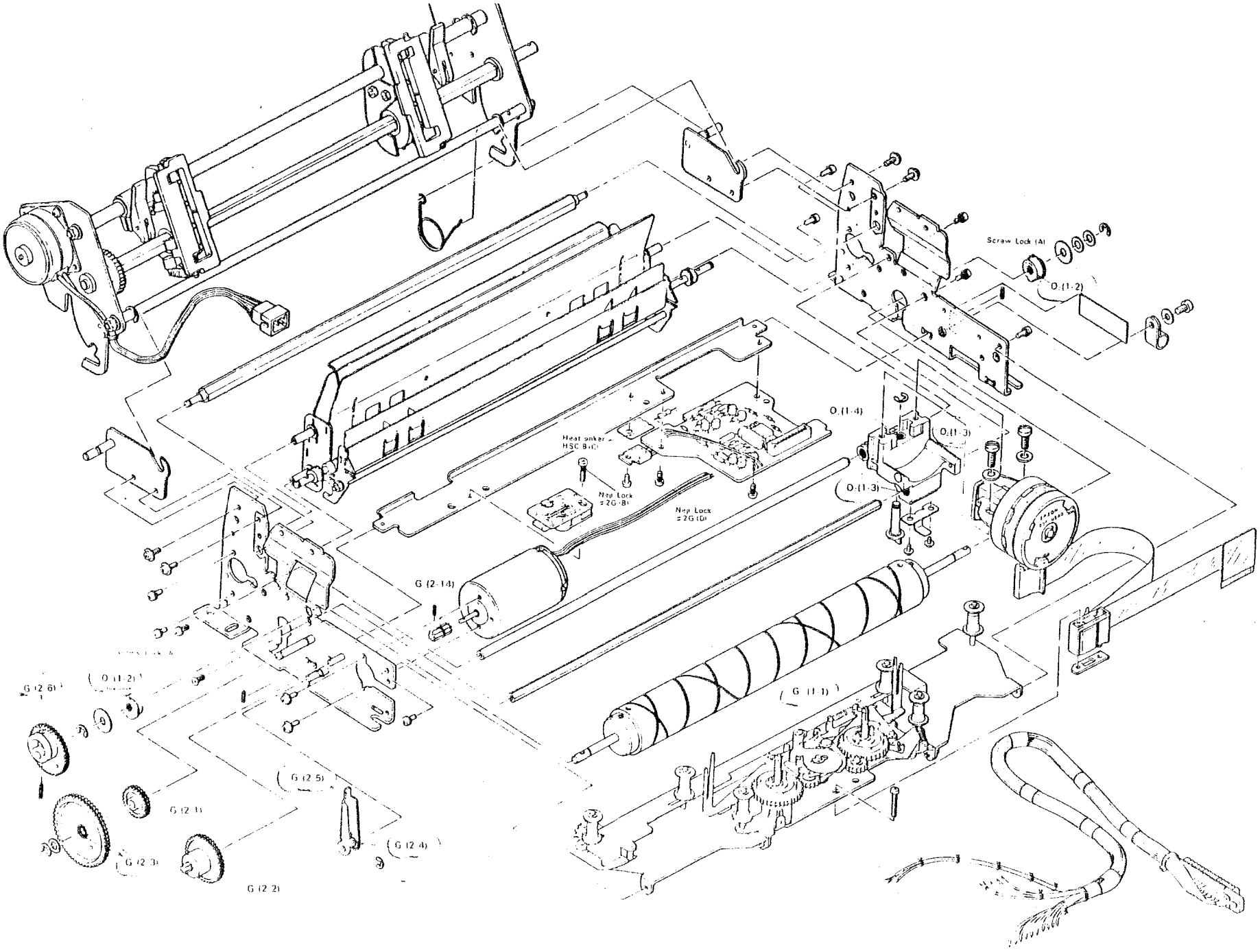
4) After setting the ribbon and conducting check 3) above, give two or three turns to the ribbon spools to see if the ribbon has been properly set or not.

CAUTION: In setting or removing the ribbon, be careful that printer parts be not stained with the ink contained in the ribbon.

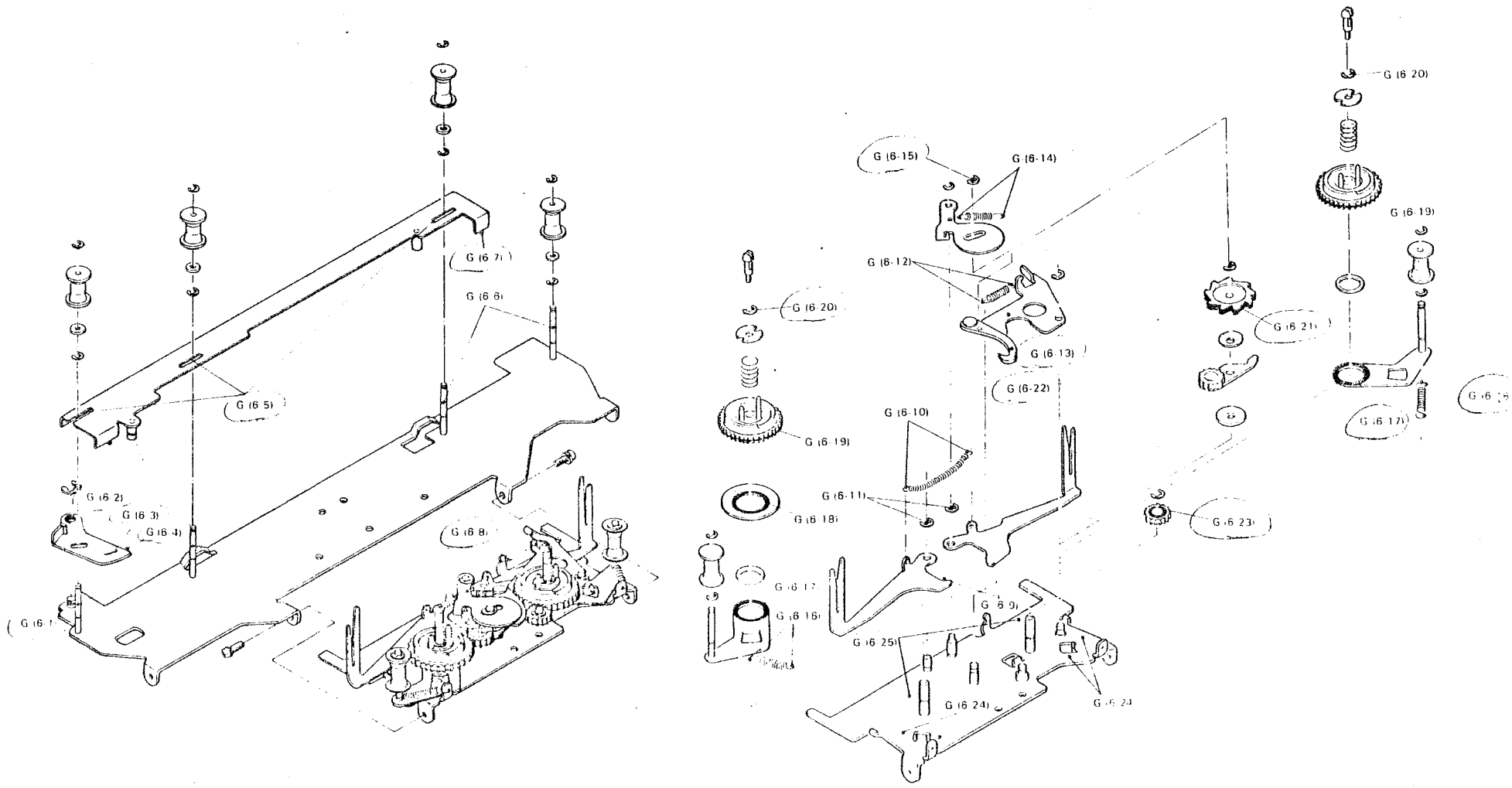
(b) Type T:

Continuous business form can be easily set in the printer by following the steps below.

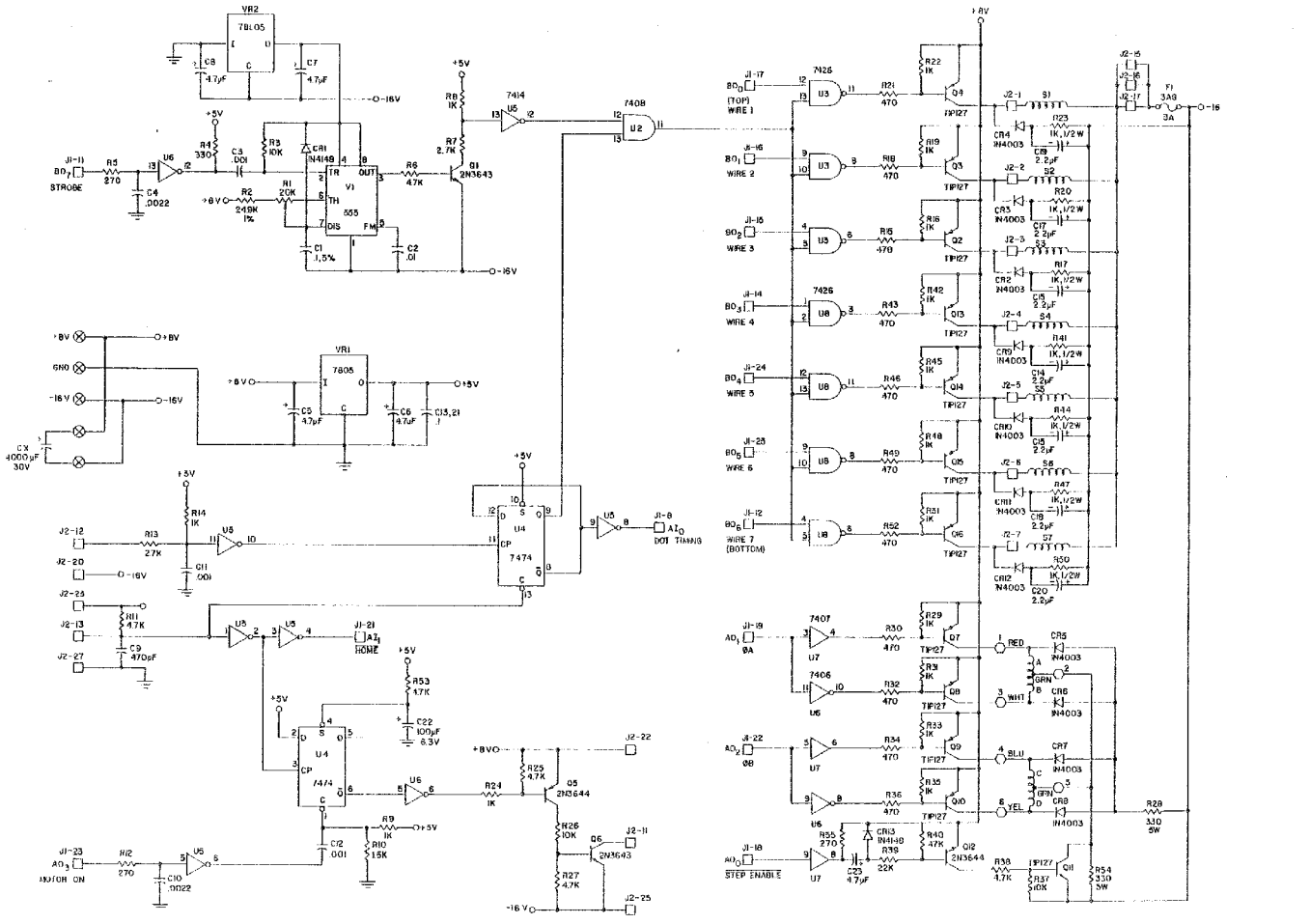
| SETTING STEPS | ILLUSTRATION |
|---|---|
| 1. Raise the tractor unit up (turn it toward the printer front side).<br>2. Insert the paper into the printer via the paper inlet located on the rear side of the printer. |  <br>**Photo 3.11** |
| 3. After the leading end of the paper has come out of the printer, put the tractor unit back to its initial position (turn it toward the rear side of the printer). Then, raise the paper holders up, and engage paper feed holes on tractor pins.<br>NOTE: The paper should be set on the tractor unit from the front side of the printer after its leading end has passed behind the tractor stay rod.<br>4. After putting the paper holders back into position, loosen the lock lever and adjust the tension of paper in the direction of width. (Turning the lock lever toward the front of the printer causes it to be loosened, and toward the rear, tightened.) |  <br>**Photo 3.12** |
| 5. Referring to the matching mark, position the paper by operating the paper feed knob. |  <br>**Photo 3.13** |
| |  <br>**Photo 3.14** |




Lubrication Points




Lubrication Points
(Ribbon Unit)

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VECTOR MP INTERFACE