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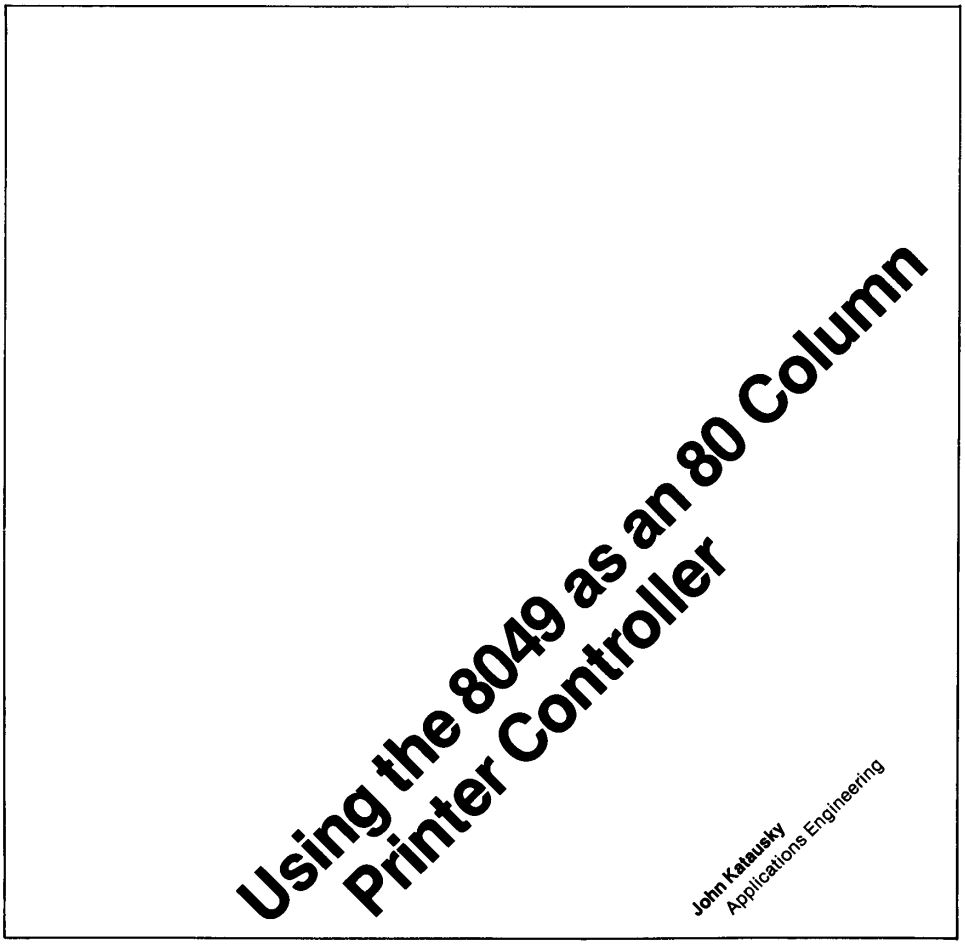
APPLICATION NOTE

AP-91



AFN-01364A-01

USING THE 8049 AS AN 80 COLUMN PRINTER CONTROLLER

I. INTRODUCTION

This Application Note details using INTEL's 8049 microcomputer as a dot matrix printer controller. Previous INTEL Application notes, (e.g. AP-27 and AP-54) described using intelligent processors and peripherals to control single printer mechanisms. This Application note expands upon the theme established in these prior notes and extends the concept to include a complete bi-directional 80 column printer using a single line buffer. For convenience this application note is divided into six sections:

1. INTRODUCTION
2. PRINT MECHANISM DESCRIPTION
3. INTERFACE CIRCUITRY
4. SOFTWARE
5. CONCLUSION
6. APPENDIX

Over the last few years 80 column output devices have become somewhat of a defacto output standard for business and some data processing applications. It should be mentioned that by no means is the 80 column format a "new" standard. 80 column computer cards have been around for more than 20 years and perhaps the existence of these cards in the early days of computers is why the 80 column format is a standard today.

Many CRT terminals use the 80 by N format and to complement this a number of printers use this same format. One reason, aside from those historic in nature, for the 80 column standard is that 80 columns of 12 pitch text on standard typewritten 8.5 inch by 11 inch paper completely fills up an entire line and allow ample room for margins. So, the 80 column format is an aesthetically convenient format.

Printers are usually divided into either impact or non-impact and a character or line oriented device. Impact printers actually use some type of "striker" to place ink on the paper. More often than not the ink is contained on a ribbon which is placed between the striker and the paper. Non-impact printers use some means other than direct pressure to place the characters on the paper. This type of printer is very fast because there is very little mechanical motion associated with placing the characters on the paper. However, because the paper is required to be treated with a special substance, it is not as convenient as an impact printer.

Character printers are capable of printing one character at a time. (Any standard home typewriter is in effect a character printer.) Line printers must print an entire line at a time. Line printers are usually quite a bit faster than character printers, but they usually don't offer the print quality of character printers.

In recent years, the "computer boom" has caused the price of printers to tumble markedly. High volume production, competition, and the tremendous demand for reliable print mechanisms have all contributed to the decrease in price. Because of their simplicity, line printer mechanisms have decreased in price faster than other mechanisms. Therefore, when high quality print is not needed, a line printer is a very attractive choice.

This application note describes how to control an 80 column impact-line printer with an 8049/8039. The complete software listing is included in the appendix. The 8049 is the high-performance member of the MCS-48™ microcontroller family. The Processor has all of the features of the 8048 plus twice the amount of program and data memory and an 11MHz clock speed. For details about the 8049, please refer to the MCS-48 user's manual.

II. PRINT MECHANISM DESCRIPTION

The model 820 printer is available from C. ITOH ELECTRONICS (5301 BEETHOVEN STREET, LOS ANGELES, CA 90066). This inexpensive and simple printer is ideal for applications requiring 80 columns of dot matrix alpha-numeric information.

The model 820 printer is comprised of three basic sub-assemblies; the chassis or frame, the paper feed mechanism, and the print head. The diagram in Figure 2.1 gives the physical dimensions of the basic print mechanism. The basic chassis for the printer is constructed out of four sheet metal stampings. These stampings are screwed together to form a sturdy base on which all other components of the printer are mounted.

The paper feed mechanism consists of a toothed wheel, a solenoid, a tension spring, and a "catcher." When the solenoid is activated, the arm of the solenoid pulls against the spring and drags over the toothed wheel. When the solenoid is released, its arm is pulled by the spring, but this time the arm grabs a tooth on the wheel and pulls the wheel forward which advances the paper. A "catcher," which is merely a piece of plastic held against the toothed wheel, is added to assure that the paper is advanced only one "tooth" position each time the solenoid is activated.

The print head is comprised of seven solenoids which are mounted in a common housing. The solenoids are physically mounted in a circle, but their hammers are positioned linearly along the vertical axis. These seven vertically positioned hammers are the strikers that actually do the printing.

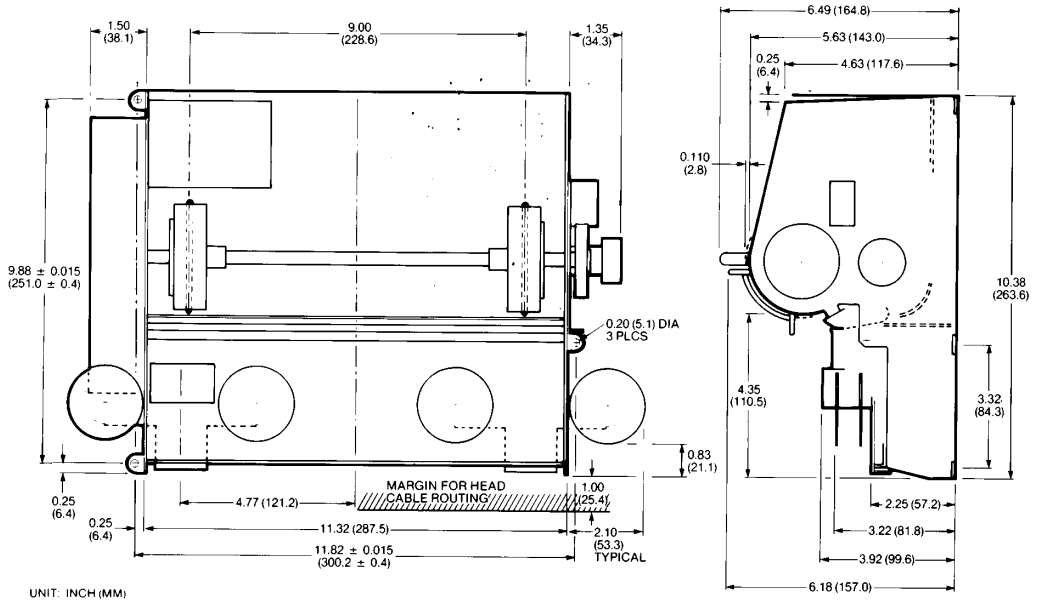


Figure 2.1 Physical Dimensions of C. ITOH Model 820 Printer

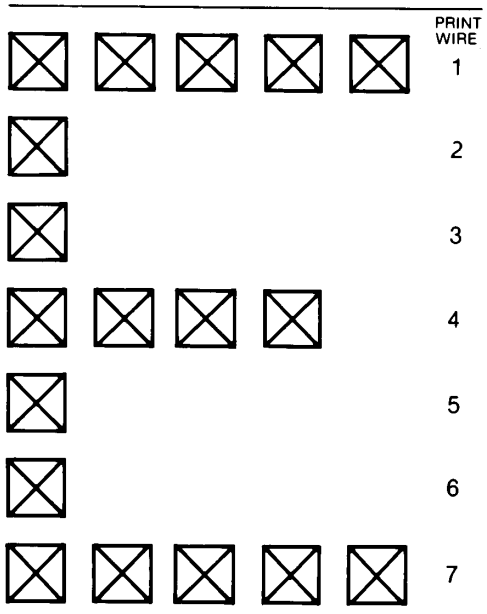


Figure 2.2 "Formation" of a Character by a Dot Matrix Printer

A motor, mounted toward the back of the print mechanism, drives a rubber toothed belt which turns a roller guide. A motor turns a guide that moves the print head from right to left and left to right. By properly timing the current flow through the solenoids while the print head is moving across the paper, characters can be formed. Figure 2.2 illustrates how the dot matrix printer "forms" its characters.

The timing pulses for the print head mechanism are generated by an opto-electronic sensor. This sensor, located on the left side plate of the printer, informs the print controller when to apply current to the print head mechanism. This "on-board timing wheel" assures that all characters will be properly spaced and that they will all be "in-line" in a vertical sense.

The print mechanism is also equipped with two additional sensors. These are the left home position sensor, located near the left front of the mechanism, and the right home position sensor, located near the right front of the print mechanism. These sensors simply tell the controller when the print head is in either the left or right home position. A complete timing chart for the printer is shown in Figure 2.3.

III. INTERFACE CIRCUITRY

The manual supplied with the printer recommends some specific interface circuitry. For the most part the circuitry used in this Application Note followed these suggestions. The circuitry needed to drive the print head solenoid is shown in Figure 3.1. This same

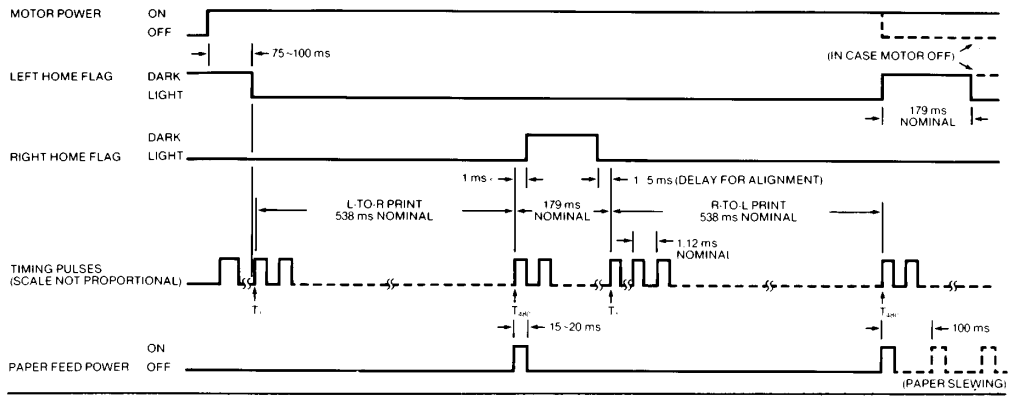


Figure 2.3 Timing Diagram of C. ITOH Model 820 Printer

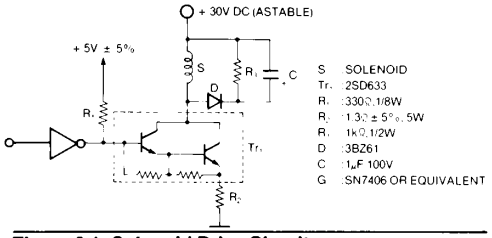


Figure 3.1 Solenoid Drive Circuit (Eliminate R_2 for Line Feed Solenoid)

circuit is used to drive the line feed solenoid except that the current limiting resistor R2 is eliminated. This resistor is not needed because the line feed solenoid is physically much larger than the print head solenoids and can tolerate much higher levels of current.

The print head drivers are connected to an 8212 latch. The latch is interfaced to the BUS PORT on the 8049 and is enabled whenever the WR pin and the BIT 4 of PORT 1 are coincidentally low. The line feed driver is connected to PORT 1 BIT 1 of the 8049.

Note that the driver is simply a Darlington transistor that is driven by an open collector TTL gate. Resistor R2 is the current limiting resistor and diode D, capacitor C, and resistor R3 are used to "dampen" the inductive spike that occurs when driving solenoid S. This circuit is repeated for each of the seven solenoids in the print head. It should be mentioned that, although the type of Darlington transistor needed to drive the print head is not critical, a collector current rating of at least 5 amps and a breakdown voltage (Vceo) of at least 100 volts is needed. Transistors that do not meet these requirements will be damaged by the inductive kickback of the solenoids.

As mentioned in Section 2, the printer provides some sensor interface signals that are derived via three optoelectronic sensors. These signals must be amplified and converted to TTL levels in order to interface to the controller. This conversion is accomplished with a simple voltage comparator. Figure 3.2 is a schematic of the sensor interface circuitry. Note that hysterisis is employed on the voltage comparators. This eliminates "false" sensing.

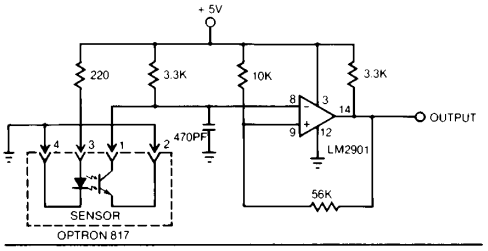


Figure 3.2 Example of Sensor Circuit

Motor control is accomplished by using a Monsanto MCS-6200 optically-coupled TRIAC. This part is ideal in this kind of application because it provides a simple means of controlling a line-operated motor without sacrificing the isolation needed for safe and reliable operation. Figure 3.3 is a schematic of the motor driving circuit.

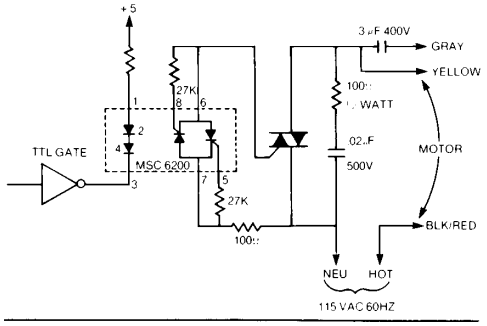


Figure 3.3 Motor Driving Circuit

To interface 8049 to the outside world one 8212 latch was used. This latch was connected to the BUS PORT and is enabled by an INS or MOVX instruction coincident with BIT 4 of PORT 1 being in a logical zero state. In this configuration, the 8212 was used to hold the data until read by the 8049. The connection of the 8212 to the 8049 is shown in Figure 3.4 and the parallel port timing diagram is shown in Figure 3.5. The 8212 parallel port was connected to the LINE PRINTER OUTPUT of an INTELLEC MICROCOMPUTER DEVELOPMENT SYSTEM.

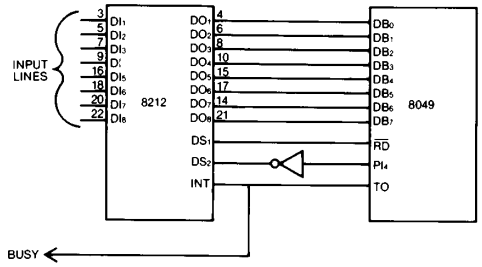


Figure 3.4 Connection of the 8212 Input Port to the 8049

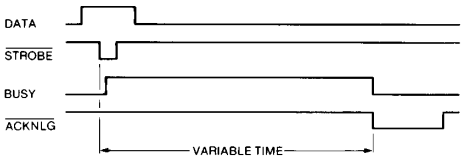


Figure 3.5 Parallel Port Timing

IV. SOFTWARE

As mentioned in Section 2, the bulk of the timing needed to control the printer is actually generated by the printer itself. Therefore, all the software must do is harness these timing signals and turn on and off the right solenoids at the right time.

To make things easy, the software needed to drive the printer is broken into four separate routines. These are:

1. INITIALIZATION ROUTINE
2. INPUT ROUTINE
3. OUTPUT ROUTINE
4. LOOKUP ROUTINE

The INITIALIZATION ROUTINE turns the motor on and checks the opto-electronic sensors. If a failure is found, the routine turns off the motor and loops on itself. This insures that the print mechanism is cycled properly before characters are accepted for printing. This routine also initializes all of the variables used by the printer.

The INPUT ROUTINE reads the characters that are present in the 8212 input port and writes them into the 8049's buffer memory. The routine then checks the characters to see if a CARRIAGE RETURN (ASCII OCH) has been transmitted. If a CR is detected, the input routine automatically inserts a LINE FEED as the next character. When the input routine detects a LINE FEED, it stops reading characters and sets the direction bits and the print bit in the status register. This action evokes the OUTPUT ROUTINE. A detailed flowchart of the INPUT ROUTINE is shown in Figure 4.1.

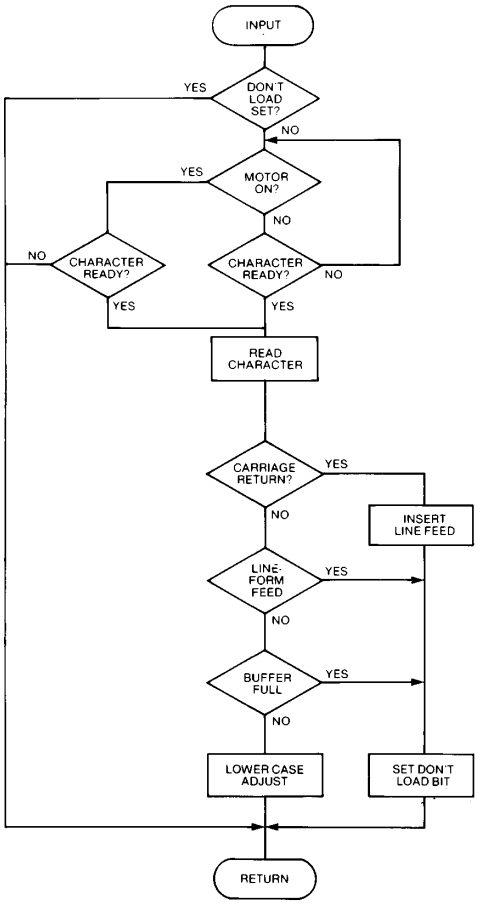


Figure 4.1 Input Routine Flowchart

The OUTPUT ROUTINE initializes both the input and output buffer pointers and then reads the characters from the 8049's buffer memory. After a character is read the OUTPUT ROUTINE calls the LOOKUP ROUTINE which reads the proper bit pattern to form that character. This bit pattern is then used to strobe the solenoids. After each character is printed, the OUTPUT ROUTINE calls the INPUT ROUTINE and another character is placed into the buffer memory. This type of operation guarantees that the input buffer cannot "overrun" the output buffer. A flowchart of the OUTPUT ROUTINE is shown in Figure 4.2.

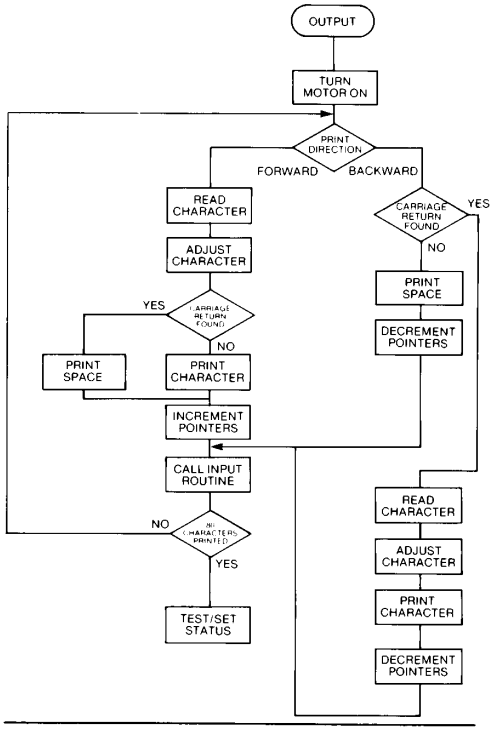


Figure 4.2 Output Routine Flowchart

IV-I. HANDLING THE I/O BUFFER

Since the C. ITOH Model 820 printer is capable of printing in both directions the 80 character buffer must be manipulated in a manner as to allow maximum input-output efficiency. This is accomplished by reversing the "direction" of the buffer memory each time the printer is printing from right to left. For simplicity, if it is assumed that the buffer is only five bytes long, Figure 4.3 can be used to help explain the buffer operation.

Initially the input buffer pointer is loaded with the address of the first location in the buffer memory. As characters are read, the input buffer pointer increments and fills the buffer memory as shown in Figure 4.3(b) through 4.3(f). When a CARRIAGE RETURN-LINE FEED (CRLF) is encountered the input buffer pointer and the output buffer pointer are reset back to the first location. The OUTPUT ROUTINE then reads the character from the first location in the buffer memory, increments the output buffer pointer and calls the INPUT ROUTINE, which reads another character from the parallel input port.

The OUTPUT ROUTINE reads the entire buffer, inserting space codes (20H) after a CR is detected, and the input buffer pointer follows the output buffer pointer as they "increment" up to the buffer memory. When the OUTPUT ROUTINE has printed the last character or space, the output buffer pointer and the input buffer pointer are set to point at the last location of the buffer memory. The OUTPUT ROUTINE then reads the character from the last location of the buffer memory and proceeds to "decrement" down the buffer memory. Space codes are inserted until a CR is found. Figure 4.3(1) to 4.3(0).

The input buffer pointer follows the output buffer pointer just as in the previous case. When the last, or in this case the first character is printed, the output buffer pointer and the input buffer pointer are set to point at the last location of the buffer memory. Now the pointers are "decrementing" down the buffer memory, but the printer is actually printing in a "normal" left to right fashion.

When the last character or space is printed, the output buffer and the input buffer pointer are set to the first location of the buffer memory and printing takes place in a reverse or right to left manner. After this line is printed, the print head and both buffer pointers are in the same position as they were initially. So, four lines must be printed before the buffer pointers and the print head complete a cycle. Each of these situations is handled separately by four different subroutines: CASE0, CASE1, CASE2, and CASE3.

IV-II. TIMING

All critical timing for the printer controller came from two basic sources; the timing sensors on the printer and the internal eight-bit timer of the 8049.

The internal timer of the 8049 was used to control the length of time the solenoids were fired (600 microseconds) and was also used as a "one-shot" to align the printer. This alignment is needed to make the "backward" printing line up vertically with the normal or forward printing. The "one-shot" is used to measure the time from the last column of the last character position until the right sensor flag is covered.

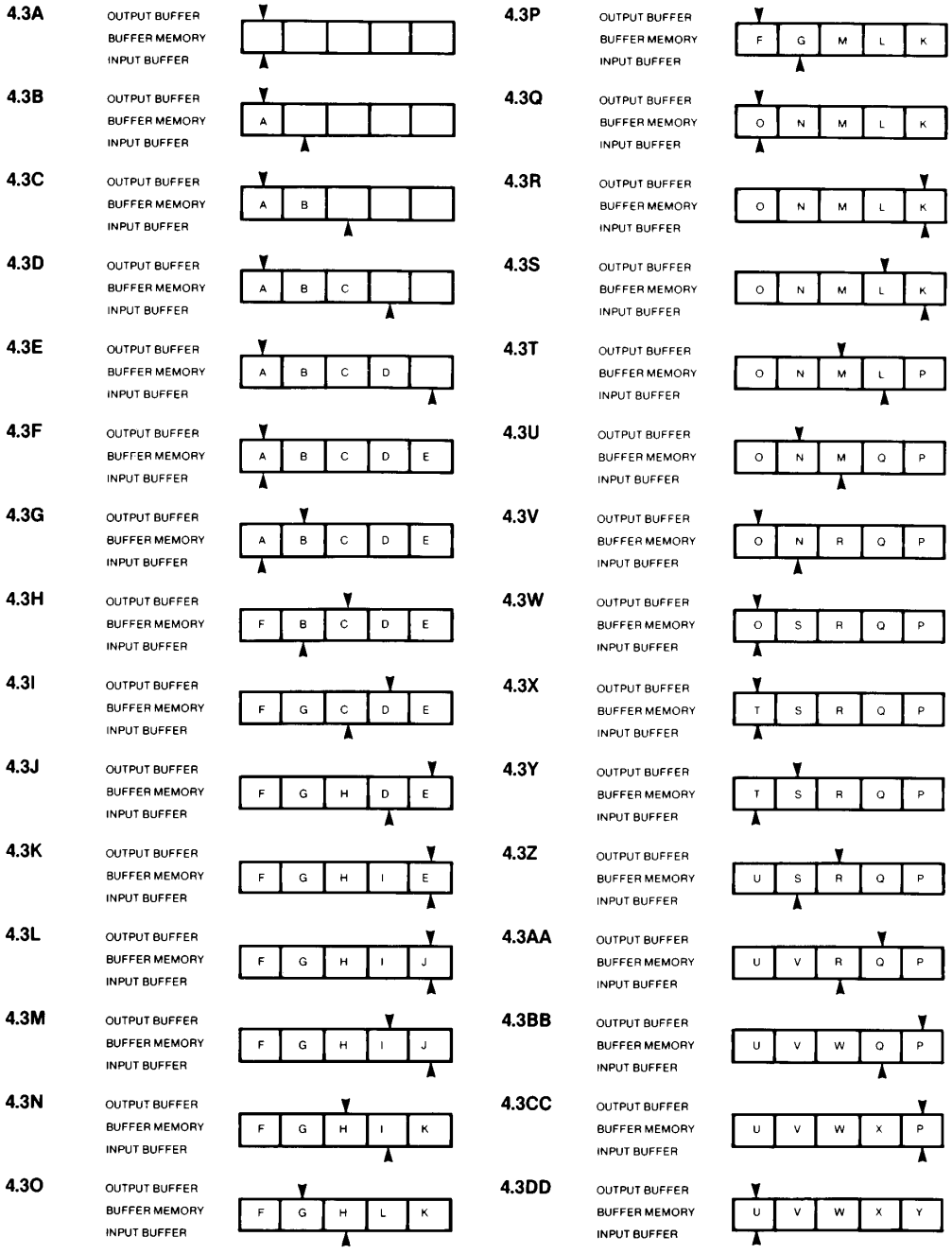


Figure 4.3 I/O Buffer Handler

When the print head reverses direction and the right sensor flag is uncovered, the timer is then used to determine where to start printing in the reverse direction.

The timer and the print wheel on the printer are used to determine when to place a character. The strobe from the print wheel informs the 8049 when to fire the solenoids and the timer allows the proper spacing between the characters.

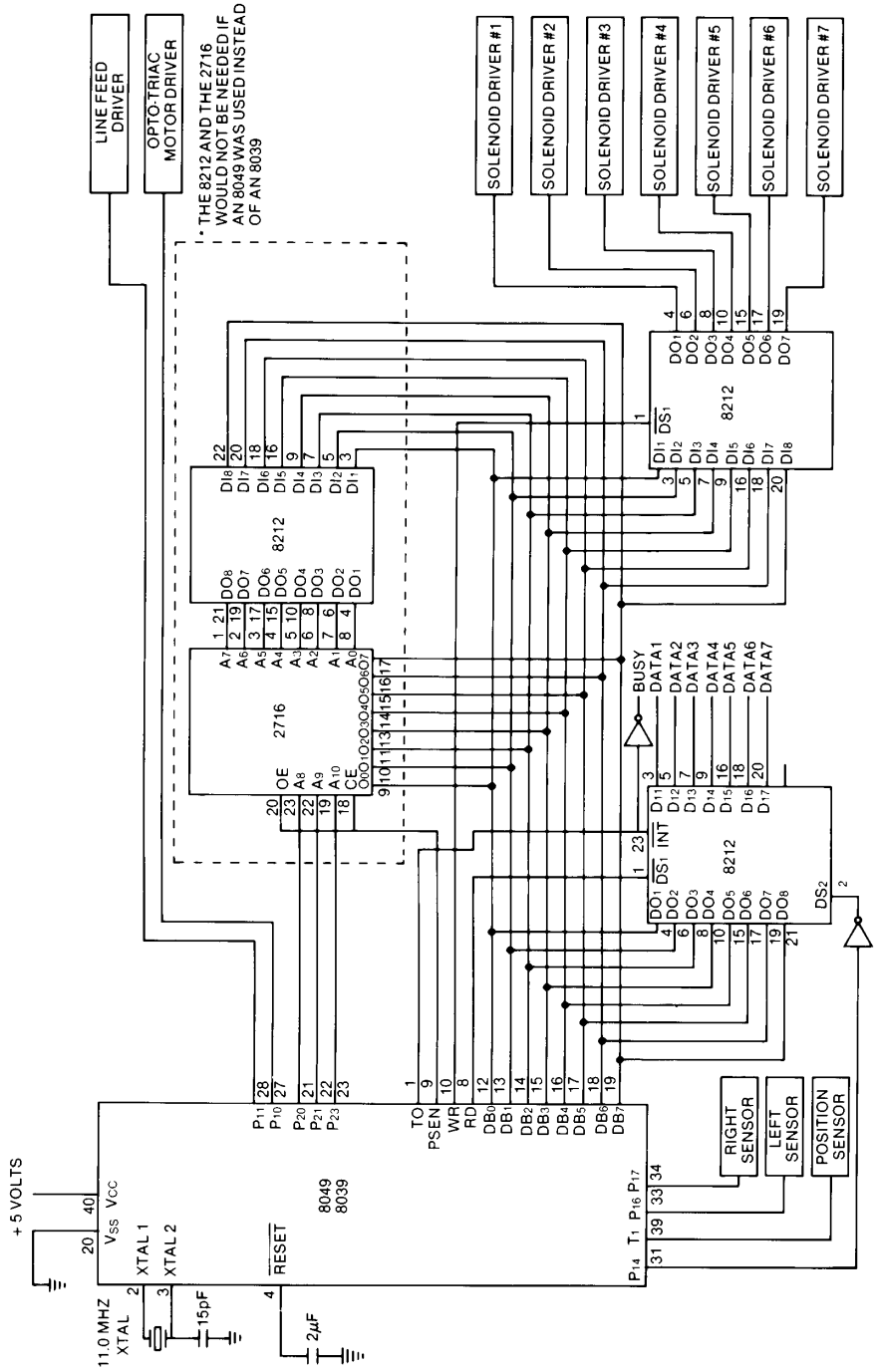
V. CONCLUSION

Although the full speed of the 8049 was not used in this application, the high speed of the 8049 makes it possible to "fine-tune" any critical timing parameters. Additionally, the extra available CPU time could be used to add an interrupt driven keyboard and display, such as the ones discussed in AP-40, to the printer. This would allow the printer to function as a complete "terminal".

Very little attempt was made to optimize the software, but still the entire program fits easily in 1.25K of memory; 750 bytes for printer control and 500 bytes for character lookup. Adding lower case to the printer would require an additional 500 bytes of lookup table. The remaining 250 bytes should be used to add "user" features such as tabs, double width printing, etc.

The high speed of the 8049 combined with its hardware and software architecture make it an ideal choice for controlling an 80 column, bi-directional line printer. The I/O structure of the 8049 minimizes the amount of external hardware needed to control the printer and the large amount of on-board program and data memory allow quite a sophisticated control program to be implemented.

APPENDIX A. SCHEMATIC DIAGRAM



APPENDIX B. MONITOR LISTING

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                    1          ;
                    2          ;*****************************************************************
                    3          ;
                    4          ; THIS PROGRAM IMPLEMENTS CONTROL OF THE C ITOH MODEL 820
                    5          ;PRINTER.  THE HARDWARE CONFIGURATION IS AS SUCH:
                    6          ;8212 INPUT PORT ON BUS = DATA INPUT
                    7          ;8212 OUTPUT PORT ON BUS = OUTPUT TO SOLENOID HAMMERS
                    8          ;T1 INPUT = CHARACTER POSITIONING SENSOR ON PRINTER
                    9          ;T0 INPUT = INTERRUPT FROM 8212 INPUT PORT
                   10          ;PORT 10 = MOTOR ON, LOW = ON
                   11          ;PORT 11 = LINE FEED STROBE, LOW = ON
                   12          ;PORT 16 = LEFT MARGIN SENSOR, LOW WHEN COVERED, HIGH WHEN OPEN
                   13          ;PORT 17 = RIGHT MARGIN SENSOR, LOW WHEN COVERED, HIGH WHEN OPEN
                   14          ;T1 = PIN 2 OF LM339, PRINT WHEEL SENSOR
                   15          ;PORT 16 = PIN 13 OF LM339
                   16          ;PORT 17 = PIN 14 OF LM339
                   17          ;
                   18          ;*****************************************************************
                   19          ;
                   20          ;SYSTEM EQUATES
                   21          ;
0000               22 INBUF    EQU     R0              ;POINTS AT INPUT LOCATION
0001               23 OUTBUF   EQU     R1              ;POINTS AT OUTPUT LOCATION
0002               24 SAVPNT   EQU     R2              ;STATUS FOR PRINTING
0003               25 STBCNT   EQU     R3              ;STROBE COUNTER
0004               26 TEMP1    EQU     R4
0005               27 STATUS   EQU     R5              ;BIT 0 = LINE FEED SET
                   28                                  ;BIT 1 = PRINT
                   29                                  ;BIT 2 = CONTINUE
                   30                                  ;BIT 3 = CR FOUND
                   31                                  ;BIT 4 = LF FOUND
                   32                                  ;BIT 5 = LF FOUND IN PRINTING
                   33                                  ;BIT 6 = PRINT DIRECTION
                   34                                  ;0 = RIGHT TO LEFT
                   35                                  ;1 = LEFT TO RIGHT
                   36                                  ;BIT 7 = BUFFER LOAD DIRECTION
                   37                                  ;0 = FIRST TO MAX
                   38                                  ;1 = MAX TO FIRST
0006               39 LINCNT   EQU     R6              ;THE LINE COUNTER
0007               40 JUNK1    EQU     R7
006F               41 MAX      EQU     6FH             ;MAX BUFFER LOCATION
0020               42 FIRST    EQU     20H             ;BOTTOM OF BUFFER
                   43 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                   44          ;
0000               45          ORG     0000H
                   46          ;
                   47          ;JUMP OVER THE INTERRUPT LOCATIONS
                   48          ;
0000 15            49          DIS     I                   ;DON'T USE INTERRUPTS
0001 3400          50          JMP     BGIN                ;BEGIN THE PROGRAM
                   51          ;
000A               52          ORG     0AH
                   53          ;
                   54          ;START THE PROGRAM
                   55          ;
                   56          ;LOOP UNTIL THE BUFFER FILLS UP
                   57          ;
000A FD            58 PRNT:    MOV     A,STATUS            ;GET THE STATUS
000B 3211          59          JB1     LPRNT               ;IF PRINTING, CONTINUE
000D 3400          60          CALL    LOBUF               ;READ INTO THE BUFFER
000F 040A          61          JMP     PRNT                ;LOOP
                   62          ;
                   63          ;THIS ROUTINE PRINTS A LINE
                   64          ;IT FIRST SAVES THE STATUS
                   65          ;AND THEN DETERMINES WHICH DIRECTION TO PRINT
                   66          ;AND HOW TO MANIPULATE THE BUFFER
                   67          ;
0011 34C9          68 LPRNT:   JMP     STWCHK              ;GO FIX UP THE STATUS
0013 F224          69 LPRNT1:  JB7     CASE23              ;JUMP TO CASE 2 AND 3
0015 0417          70          JMP     CASE01              ;JUMP TO CASE 0 AND 1
                   71          ;
                   72          ;CASE01: LOADING THE BUFFER FROM FIRST TO MAX
                   73          ;
0017 B928          74 CASE01:  MOV     OUTBUF,#FIRST       ;SET UP OUTBUF
0019 B828          75          MOV     INBUF,#FIRST        ;SET UP INBUF
001B FA            76          MOV     A,SAVPNT            ;GET THE SAVED STATUS
001C 94DC          77          CALL    MOTON               ;TURN ON THE MOTOR
001E D252          78          JB6     CASE1               ;PRINT FOWARD
0020 9483          79          CALL    PRNTBK              ;GET READY TO PRINT BACKWARDS
0022 0431          80          JMP     CASE0               ;PRINT BACKWARDS
                   81          ;
                   82          ;CASE23: LOADING BUFFER FROM MAX TO FIRST
                   83          ;
0024 B96F          84 CASE23:  MOV     OUTBUF,#MAX         ;SET UP OUTBUF
0026 B86F          85          MOV     INBUF,#MAX          ;SET UP INBUF
0028 FA            86          MOV     A,SAVPNT            ;GET THE PRINT STATUS
0029 94DC          87          CALL    MOTON               ;TURN ON THE MOTOR
002B D2C2          88          JB6     CASE3               ;PRINT LEFT TO RIGHT
002D 9483          89          CALL    PRNTBK              ;GET READY TO PRINT BACKWARDS
002F 042D          90          JMP     CASE2               ;PRINT RIGHT TO LEFT
                   91          ;
                   92 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

0831 F1             93 CASE0:  MOV     A,@OUTBUF        ;GET THE CHARACTER
0832 3491           94         CALL    FXPRNT           ;ADJUST FOR PRINTING
0834 B128           95         MOV     @OUTBUF,#28H     ;PUT A SPACE IN BUFFER RAM
0836 F242           96         JB7     FDC              ;FOUND A CR
0838 945E           97         CALL    INCTST           ;UPDATE OUTBUF
083A C6AE           98         JZ      WATCH0           ;WAIT FOR END
083C BF28           99         MOV     JUNK1,#28H       ;GET A SPACE TO PRINT
083E 9463          100         CALL    GTPRNT           ;GO PRINT A SPACE
0840 8431          101         JMP     CASE0            ;LOOP
0842 BF28          102 FDC:    MOV     JUNK1,#28H       ;GO PRINT THE LAST SPACE
0844 9463          103 FDC1:   CALL    GTPRNT           ;GO PRINT A CHARACTER
0846 945E          104         CALL    INCTST           ;CHECK OUT BUFFER
0848 C6AE          105         JZ      WATCH0           ;WAIT FOR THE END
084A F1            106         MOV     A,@OUTBUF        ;GET THE CHARACTER
084B B128          107         MOV     @OUTBUF,#28H     ;PUT A SPACE THERE
084D 3491          108         CALL    FXPRNT           ;FIX THE CHARACTER UP
084F AF            109         MOV     JUNK1,A          ;SAVE IT
0850 8444          110         JMP     FDC1             ;LOOP
                   111         ;
                   112         ;
                   113         ;CASE 1, PRINTING LEFT TO RIGHT, LOADING BUFFER FROM
                   114         ;FIRST TO MAX
                   115         ;
0852 F1            116 CASE1:  MOV     A,@OUTBUF        ;GET THE CHARACTER
0853 3491          117         CALL    FXPRNT           ;ADJUST FOR PRINTING
0855 AF            118         MOV     JUNK1,A          ;SAVE ACC
0856 B128          119         MOV     @OUTBUF,#28H     ;PUT A SPACE IN THE BUFFER
0858 F262          120         JB7     CRFOND           ;FOUND A CR?
085A 9463          121         CALL    GTPRNT           ;GO PRINT THE CHARACTER
085C 945E          122         CALL    INCTST           ;CHECK THE BUFFER
085E C675          123         JZ      WATCH            ;IS THE LAST CHARACTER BEING PRINTED?
0860 8452          124         JMP     CASE1            ;LOOP
0862 B128          125 CRFOND: MOV     @OUTBUF,#28H     ;PUT A SPACE IN THE BUFFER MEMORY
0864 BF28          126         MOV     JUNK1,#28H       ;PUT A SPACE IN TEMP LOCATION
0866 9463          127         CALL    GTPRNT           ;GO PRINT THE SPACE
0868 945E          128         CALL    INCTST           ;CHECK THE BUFFER
086A C675          129         JZ      WATCH            ;LAST CHARACTER PRINTED?
086C F1            130         MOV     A,@OUTBUF        ;GET THE NEXT CHARACTER
086D 3491          131         CALL    FXPRNT           ;ADJUST IT
086F 8462          132         JMP     CRFOND           ;LOOP
                   133 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                   134          ;
                   135          ;THIS ROUTINE CALLS THE LINE FEED
                   136          ;
0871 9478          137 DOLF:    CALL     LINEFD          ;STROBE LINE FEED SOLENOID
0873 B48A          138          JMP      PRNT            ;GO BACK TO THE PRINT ROUTINE
                   139          ;
                   140          ;THIS ROUTINE COMPLETES A LINE WHEN THE PRINT
                   141          ;HEAD IS MOVING LEFT TO RIGHT
                   142          ;
0875 27            143 WATCH:   CLR      A               ;ZERO ACC
0876 62            144          MOV      T,A             ;ZERO TIMER
0877 55            145          STRT     T               ;START THE TIMER
0878 3488          146          CALL     LOBUF           ;GO READ THE LAST CHARACTER
087A B9            147 LOOPW:   IN       A,P1            ;EXAMIN PORT ONE
087B F27A          148          JB7      LOOPW           ;CHECK RIGHT HAND SENSOR
087D 65            149          STOP     TCNT            ;STOP THE TIMER
087E FD            150          MOV      A,STATUS        ;GET THE STATUS
087F 5285          151          JB2      OVR1            ;JUMP IF CONTINUE IS SET
0881 94DF          152          CALL     MOTOF           ;TURN MOTOR OFF
0883 53FD          153          ANL      A,#0FDH         ;RESET BIT ONE
0885 53F8          154 OVR1:    ANL      A,#0F8H         ;RESET CONTINUE BIT
0887 AD            155          MOV      STATUS,A        ;RESTORE STATUS
0888 FA            156          MOV      A,SAVPNT        ;GET THE SAVED STATUS
0889 B271          157          JB5      DOLF            ;DO A LINE FEED IF BIT IS SET
088B B48A          158          JMP      PRNT            ;GO BACK TO PRINT ROUTINE
                   159          ;
                   160          ;
                   161          ;CASE 2, PRINTING RIGHT TO LEFT, LOADING BUFFER FROM
                   162          ;MAX TO FIRST
                   163          ;
                   164          ;
088D F1            165 CASE2:   MOV      A,@OUTBUF       ;GET THE CHARACTER
088E 3491          166          CALL     FXPRNT          ;ADJUST FOR PRINTING
0890 B120          167          MOV      @OUTBUF,#20H    ;PUT A SPACE IN BUFFER RAM
0892 F29E          168          JB7      FDCR            ;FIND A CR YET
0894 9472          169          CALL     DECTST          ;CHECK THE BUFFER
0896 C6AE          170          JZ       WATCHD          ;IF ZERO WAIT FOR SENSOR FLAG
0898 BF20          171          MOV      JUNK1,#20H      ;PUT SPACE IN TEMP LOCATION
089A 9463          172          CALL     GTPRNT          ;GO PRINT SPACE
089C B48D          173          JMP      CASE2           ;LOOP
089E BF20          174 FDCR:    MOV      JUNK1,#20H      ;GET A SPACE
08A0 9463          175 FDCR1:   CALL     GTPRNT          ;GO PRINT THE CHARACTER
08A2 9472          176          CALL     DECTST          ;CHECK THE BUFFER
08A4 C6AE          177          JZ       WATCHD          ;LEAVE IF DONE
08A6 F1            178          MOV      A,@OUTBUF       ;GET A CHARACTER
08A7 3491          179          CALL     FXPRNT          ;ADJUST THE CHARACTER FOR PRINTING
08A9 AF            180          MOV      JUNK1,A         ;SAVE IT
08AA B120          181          MOV      @OUTBUF,#20H    ;PUT A SPACE WHERE THE CHARACTER WAS
08AC B4A8          182          JMP      FDCR1           ;LOOP
                   183 $EJECT
```

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LOC  OBJ          SEQ          SOURCE STATEMENT

                   184          ;
                   185          ;THIS ROUTINE WAITS FOR THE SENSOR FLAGS TO BE COVERED
                   186          ;WHEN PRINTING RIGHT TO LEFT
                   187          ;
0BAE 3488          188 WATCHD:  CALL     LDBUF           ;GO READ THE LAST CHARACTER
0BB0 B9            189          IN       A,P1            ;GET SENSOR INFORMATION
0BB1 D2AE          190          JB6      WATCHD          ;LOOP IF SENSOR IS NOT COVERED
0BB3 FD            191          MOV      A,STATUS        ;GET THE STATUS
0BB4 52BA          192          JB2      OVR             ;SEE IF CONTINUE IS SET
0BB6 94DF          193          CALL     MOTOF           ;TURN THE MOTOR OFF
0BB8 53FD          194          ANL      A,#0FDH         ;RESET BIT 1
0BBA 53FB          195 OVR:     ANL      A,#0FBH         ;RESET BIT 3
0BBC AD            196          MOV      STATUS,A        ;RESTORE STATUS
0BBD FA            197          MOV      A,SAVPNT        ;GET THE SAVED STATUS
0BBE B271          198          JB5      DOLF            ;DO A LINE FEED
0BC0 B48A          199          JMP      PRNT            ;EXIT
                   200          ;
                   201          ;CASE 3, PRINTING LEFT TO RIGHT, LOADING BUFFER FROM
                   202          ;MAX TO FIRST
                   203          ;
0BC2 F1            204 CASE3:   MOV      A,@OUTBUF       ;GET A CHARACTER
0BC3 3491          205          CALL     FXPRNT          ;FIX FOR PRINTING
0BC5 AF            206          MOV      JUNK1,A         ;SAVE CHARACTER
0BC6 B120          207          MOV      @OUTBUF,#20H    ;PUT A SPACE IN THE BUFFER
0BC8 F2D2          208          JB7      CRFND           ;LEAVE IF A CR IS FOUND
0BCA 9463          209          CALL     GTPRNT          ;GO PRINT THE CHARACTER
0BCC 9472          210          CALL     DECTST          ;CHECK THE BUFFER
0BCE C675          211          JZ       WATCH           ;LEAVE IF DONE
0BD0 B4C2          212          JMP      CASE3           ;LOOP
0BD2 B120          213 CRFND:   MOV      @OUTBUF,#20H    ;PUT A SPACE IN THE BUFFER RAM
0BD4 BF20          214          MOV      JUNK1,#20H      ;GET A SPACE
0BD6 9463          215          CALL     GTPRNT          ;PRINT A SPACE
0BD8 9472          216          CALL     DECTST          ;CHECK THE BUFFER
0BDA C675          217          JZ       WATCH           ;LEAVE IF DONE
0BDC F1            218          MOV      A,@OUTBUF       ;GET NEXT CHARACTER
0BDD 3491          219          CALL     FXPRNT          ;ADJUST IT
0BDF B4D2          220          JMP      CRFND           ;LOOP
                   221 $EJECT
```

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LOC  OBJ          SEQ          SOURCE STATEMENT

0100                222          ORG     100H
                    223          ;
0100 89             224 LDBUF:   IN      A,P1            ;READ PORT 1
0101 B21C           225          JB5     LNMODE          ;BIT 5 = H = LINE MODE
0103 1207           226          JB0     ARND            ;JUMP AROUND IF MOTOR IS ON
0105 8981           227          ORL     P1,#81H         ;TURN THE MOTOR OFF
0107 920F           228 ARND:    JB4     NOFF            ;NO FORM FEED
0109 FE             229          MOV     A,LINCNT        ;GET THE LINE COUNTER
010A 4380           230          ORL     A,#80H          ;SET MSB
010C AE             231          MOV     LINCNT,A        ;RESTORE THE LINE COUNTER
010D 23FF           232          MOV     A,#0FFH         ;SET ACC
010F 721A           233 NOFF:    JB3     NOLF            ;JUMP IF NO LINE FEED
0111 9478           234          CALL    LINEFD          ;GO DO A LF OR FF
0113 89             235 BUTLOP:  IN      A,P1            ;READ THE PORT
0114 721A           236          JB3     NOLF            ;WAIT FOR SWITCH TO BE RELEASED
0116 921A           237          JB4     NOLF            ;WAIT FOR SWITCH TO BE RELEASED
0118 2413           238          JMP     BUTLOP          ;LOOP
011A 2400           239 NOLF:    JMP     LDBUF           ;LOOP
                    240          ;
                    241          ;FIRST SEE IF A CHARACTER IS PRESENT IN THE BUFFER
                    242          ;
011C 261F           243 LNMODE:  JNTO    CHAR            ;IF CHARACTER PRESENT, READ IT
011E 83             244          RET                     ;IF NOT, EXIT ROUTINE
                    245          ;
                    246          ;IF THERE IS A CHARACTER, READ IT
                    247          ;
011F FD             248 CHAR:    MOV     A,STATUS        ;GET THE STATUS
0120 5249           249          JB2     ARNDJP          ;IF CONTINUE IS SET, DON'T LOAD
0122 9249           250          JB4     ARNDJP          ;IF LF IS SET, DON'T LOAD
0124 724A           251          JB3     LFCRCK          ;WAS CR SET, SEE IF NEXT CHAR IS LF
0126 94D6           252          CALL    GTCAR           ;GO READ A CHARACTER
0128 3461           253 GOOD:    CALL    FXCHAR          ;MAKE SURE IT IS OK
012A A8             254          MOV     @INBUF,A        ;SAVE CHARACTER IN BUFFER MEMORY
012B FD             255          MOV     A,STATUS        ;GET THE STATUS
012C F239           256          JB7     SUB1            ;IF BIT 7 IS SET DECREMENT BUFFER
012E 18             257          INC     INBUF           ;UPDATE INBUF
012F 2378           258          MOV     A,#MAX+1        ;GET TOP
0131 D8             259          XRL     A,INBUF         ;ARE WE AT THE TOP?
0132 9649           260          JNZ     ARNDJP          ;IF NOT GET THE STATUS
0134 F8             261          MOV     A,INBUF         ;GET INBUF
0135 07             262          DEC     A               ;CHANGE BY ONE
0136 A8             263          MOV     INBUF,A         ;PUT IT BACK
0137 2449           264          JMP     ARNDJP          ;GET THE STATUS
0139 F8             265 SUB1:    MOV     A,INBUF         ;GET INBUF
013A 07             266          DEC     A               ;CHANGE BY ONE
013B A8             267          MOV     INBUF,A         ;PUT INBUF BACK
013C 231F           268          MOV     A,#FIRST-1      ;GET THE BOTTOM OF THE BUFFER
013E D8             269          XRL     A,INBUF         ;TEST THE BUFFER
013F 9649           270          JNZ     ARNDJP          ;IF NOT ZERO READ THE STATUS
0141 18             271          INC     INBUF           ;MOVE INBUF BACK
0142 2449           272          JMP     ARNDJP          ;GO GET STATUS
0144 FD             273 GETSTA:  MOV     A,STATUS        ;GET THE STATUS
0145 1249           274          JB0     ARNDJP          ;IF BIT 0 SET, BYPASS
0147 9258           275          JB4     STBIT1          ;IF LF IS FOUND, SET THE STATUS
0149 83             276 ARNDJP:  RET                     ;EXIT
                    277          ;
                    278          ;THIS ROUTINE "FORCES" A LF AFTER A CR
                    279          ;
014A 94D6           280 LFCRCK:  CALL    GTCAR           ;READ A CHARACTER
014C 238A           281          MOV     A,#8AH          ;GET A LINE FEED
014E 2428           282          JMP     GOOD            ;JUMP BACK
                    283          ;
                    284          ;THIS ROUTINE SETS THE STATUS BITS
                    285          ;
0150 FD             286 STBIT1:  MOV     A,STATUS        ;LOAD THE STATUS
0151 3259           287          JB1     STPRNT          ;IF STILL PRINTING, LEAVE
0153 4302           288          ORL     A,#02H          ;SET PRINT BIT
0155 0348           289          ADD     A,#48H          ;UPDATE POSITION COUNTER
0157 AD             290          MOV     STATUS,A        ;PUT STATUS BACK
0158 83             291          RET                     ;EXIT ROUTINE
0159 5260           292 STPRNT:  JB2     BYEBYE          ;CHECK CONTINUE BIT
015B 4304           293          ORL     A,#04H          ;SET CONTINUE BIT
015D 0348           294          ADD     A,#48H          ;UPDATE PRINT DIRECTION
015F AD             295          MOV     STATUS,A        ;PUT THE STATUS BACK
0160 83             296 BYEBYE:  RET                     ;EXIT
                    297          ;
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LOC  OBJ          SEQ          SOURCE STATEMENT

                   298          ;THIS ROUTINE "CONVERTS" LOWER CASE LETTERS TO
                   299          ;UPPER CASE
                   300          ;
0161 97            301 FXCHAR:  CLR     C                ;CLEAR THE CARRY
0162 537F          302          ANL     A,#7FH           ;STRIP MSB
0164 AF            303          MOV     JUNK1,A          ;SAVE ACC
0165 03A8          304          ADD     A,#0A8H          ;SEE IF NUMBER IS 60H
0167 E670          305          JNC     FINE             ;IF CARRY ISN'T SET, JUMP
0169 FF            306          MOV     A,JUNK1          ;GET ACC BACK
016A 37            307          CPL     A                ;SUBTRACT 20H FROM THE ACC
016B 0320          308          ADD     A,#20H
016D 37            309          CPL     A
016E 2474          310          JMP     FIXDUN           ;JUMP TO TEST CR LF
0170 37            311 FINE:    CPL     A                ;NOW SUBTRACT A0H FROM ACC
0171 03A8          312          ADD     A,#0A8H
0173 37            313          CPL     A
0174 AF            314 FIXDUN:  MOV     JUNK1,A          ;SAVE A
0175 D30D          315          XRL     A,#0DH           ;IS CHARACTER A CR
0177 967F          316          JNZ     LFTEST           ;IF IT IS NOT TEST LF
0179 FD            317          MOV     A,STATUS         ;GET THE STATUS
017A 4308          318          ORL     A,#08H           ;SET BIT 3
017C AD            319          MOV     STATUS,A         ;RESTORE THE STATUS
017D 248F          320          JMP     FIXFIN           ;LEAVE
017F FF            321 LFTEST:  MOV     A,JUNK1          ;GET CHARACTER BACK
0180 D30A          322          XRL     A,#0AH           ;IS IT A LF
0182 C689          323          JZ      FIXUP            ;IF ITS NOT, WE ARE DONE
0184 FF            324          MOV     A,JUNK1          ;GET THE CHARACTER BACK
0185 D30C          325          XRL     A,#0CH           ;IS IT A FORM FEED
0187 968F          326          JNZ     FIXFIN           ;IF NOT FORM FEED, JUMP
0189 FD            327 FIXUP:   MOV     A,STATUS         ;GET THE STATUS
018A 4310          328          ORL     A,#10H           ;SET BIT 4
018C AD            329          MOV     STATUS,A         ;RETURN THE STATUS
018D 3458          330          CALL    STBIT1           ;SET THE STATUS
018F FF            331 FIXFIN:  MOV     A,JUNK1          ;GET THE CHARACTER
LOC  OBJ          SEQ          SOURCE STATEMENT

0190 83            332          RET                      ;EXIT FIXCHAR
                   333          ;
                   334          ;THIS ROUTINE RECOGNIZES A LF, FF, AND CR
                   335          ;DURING THE PRINT OPERATION
                   336          ;IT ALSO FORCES A SPACE IF A CHARACTER FOUND
                   337          ;IN THE BUFFER IS NOT IN THE LOOKUP TABLE
                   338          ;
0191 AF            339 FXPRNT:  MOV     JUNK1,A          ;SAVE ACC
0192 D30C          340          XRL     A,#0CH           ;FORM FEED
0194 C682          341          JZ      FFFIX            ;GO SET FORM FEED
0196 FF            342          MOV     A,JUNK1          ;RESTORE CHARACTER
0197 D30D          343          XRL     A,#0DH           ;SEE IF IT IS A CR
0199 C6A8          344          JZ      CRFIX            ;LEAVE IF IT IS
019B FF            345          MOV     A,JUNK1          ;GET ACC BACK
019C D30A          346          XRL     A,#0AH           ;SEE IF IT IS A LF
019E C6AB          347          JZ      LFFIX            ;LEAVE IF IT IS
01A0 FF            348          MOV     A,JUNK1          ;GET CHARACTER BACK
01A1 53E0          349          ANL     A,#0E0H          ;SEE IF IT IS A CHARACTER
01A3 96BD          350          JNZ     ISCHAR           ;IF IT IS JUMP
01A5 2320          351          MOV     A,#20H           ;PUT A SPACE IN ACC
01A7 83            352          RET                      ;EXIT
01A8 4380          353 CRFIX:   ORL     A,#80H           ;SET BIT 7
01AA 83            354          RET                      ;EXIT
01AB FD            355 LFFIX:   MOV     A,STATUS         ;GET THE STATUS
01AC 4320          356          ORL     A,#20H           ;SET LF BIT IN STATUS
01AE AD            357          MOV     STATUS,A         ;PUT THE STATUS BACK
01AF 2320          358          MOV     A,#20H           ;GET A SPACE
01B1 83            359          RET                      ;EXIT
01B2 FD            360 FFFIX:   MOV     A,STATUS         ;GET THE STATUS
01B3 4320          361          ORL     A,#20H           ;SET LINE FEED BIT
01B5 AD            362          MOV     STATUS,A         ;PUT THE STATUS BACK
01B6 FE            363          MOV     A,LINCNT         ;GET THE LINE COUNT
01B7 4380          364          ORL     A,#80H           ;SET BIT 7
01B9 AE            365          MOV     LINCNT,A         ;PUT LINE COUNT BACK
01BA 2320          366          MOV     A,#20H           ;GET A SPACE
01BC 83            367          RET                      ;EXIT
01BD FF            368 ISCHAR:  MOV     A,JUNK1          ;GET CHARACTER BACK
01BE 533F          369          ANL     A,#3FH           ;STRIP THE TWO MSB
01C0 83            370          RET                      ;EXIT
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LOC  OBJ          SEQ          SOURCE STATEMENT

                   371          ;
                   372          ;THIS ROUTINE PRINTS THE CHARACTER IN THE ACC
                   373          ;
01C1 AC            374 PRNTIT:  MOV      TEMP1,A          ;SAVE CHARACTER
01C2 E7            375          RL       A                ;MULTIPLY BY TWO
01C3 E7            376          RL       A                ;MULTIPLY BY FOUR
01C4 6C            377          ADD      A,TEMP1          ;ADD ONCE TO MULTIPLY BY 5
                   378          ;
                   379          ;NOW SEE WHAT PART OF THE LOOKUP TABLE TO USE
                   380          ;
01C5 2C            381          XCH      A,TEMP1          ;PUT CHARACTER IN A, TARGET IN TEMP1
01C6 B2CA          382          JB5      SHORT            ;JUMP TO HIGH ADDRESS IF BIT 5 SET
01C8 44AB          383          JMP      PAGE1            ;GO TO FIRST PART OF LOOKUP TABLE
01CA 64AB          384 SHORT:   JMP      PAGE2            ;GO TO SECOND PAGE OF LOOKUP TABLE
                   385          ;
                   386          ;THIS ROUTINE TRIGGERS THE SOLENOIDS FOR 600 MICROSECONDS
                   387          ;AFTER WAITING FOR THE TRIGGER SIGNAL FROM THE PRINTER
                   388          ;*
01CC AF            389 FIRE:    MOV      JUNK1,A          ;SAVE THE ACC
01CD FD            390          MOV      A,STATUS         ;GET THE STATUS
01CE D2D4          391          JB6      NT1              ;SEE IF FORWARD OR BACKWARDS
01D0 56D0          392 FIREX:   JT1      FIREX            ;WAIT FOR T1
01D2 24D6          393          JMP      FIREY            ;LEAVE
01D4 46D4          394 NT1:     JNT1     NT1              ;LOOP
01D6 FF            395 FIREY:   MOV      A,JUNK1          ;GET ACC BACK
01D7 90            396          MOVX     @R0,A            ;TRIGGER THE SOLENOID
                   397          ;
                   398          ;NOW KILL 600 MICROSECONDS
                   399          ;
01D8 23F3          400          MOV      A,#0F3H          ;LOAD DELAY NUMBER
01DA 62            401          MOV      T,A              ;PUT IT IN TIMER
01DB 55            402          STRT     T                ;START THE TIMER
01DC 16E0          403 TSJTF:   JTF      KTDUN            ;LOOP ON TIMER FLAG
01DE 24DC          404          JMP      TSJTF            ;
01E0 27            405 KTDUN:   CLR      A                ;ZERO ACC
01E1 90            406          MOVX     @R0,A            ;TURN OFF SOLENOIDS
01E2 65            407          STOP     TCNT             ;STOP THE TIMER
01E3 83            408          RET                       ;EXIT FIRE ROUTINE
                   409 $EJECT
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LOC  OBJ          SEQ          SOURCE STATEMENT

                   410          ;
                   411          ;*****************************************************************
                   412          ;
                   413          ;THIS IS THE LOOKUP TABLE.  THE MSB IS NOT USED, THE MSB - 1
                   414          ;IS THE DOT THAT IS THE TOP OF ANY GIVEN CHARACTER AND THE
                   415          ;LSB IS THE DOT THAT IS THE BOTTOM OF ANY GIVEN CHARACTER
                   416          ;
                   417          ;*****************************************************************
                   418          ;
0200               419          ORG     200H
                   420          ;*
0200 3E            421 TABLE1:  DB      3EH             ;  *****
0201 41            422          DB      41H             ; *     *
0202 5D            423          DB      5DH             ; * *** *
0203 59            424          DB      59H             ; * **  *
0204 4E            425          DB      4EH             ; *  ***
                   426
0205 7C            427          DB      7CH             ; *****
0206 12            428          DB      12H             ;   *  *
0207 11            429          DB      11H             ;   *   *
0208 12            430          DB      12H             ;   *  *
0209 7C            431          DB      7CH             ; *****
                   432
020A 7F            433          DB      7FH             ; *******
020B 49            434          DB      49H             ; *  *  *
020C 49            435          DB      49H             ; *  *  *
020D 49            436          DB      49H             ; *  *  *
020E 36            437          DB      36H             ;  ** **
                   438
020F 3E            439          DB      3EH             ;  *****
0210 41            440          DB      41H             ; *     *
0211 41            441          DB      41H             ; *     *
0212 41            442          DB      41H             ; *     *
0213 22            443          DB      22H             ;  *   *
                   444
0214 7F            445          DB      7FH             ; *******
0215 41            446          DB      41H             ; *     *
0216 41            447          DB      41H             ; *     *
0217 41            448          DB      41H             ; *     *
0218 3E            449          DB      3EH             ;  *****
                   450
0219 7F            451          DB      7FH             ; *******
021A 49            452          DB      49H             ; *  *  *
021B 49            453          DB      49H             ; *  *  *
021C 49            454          DB      49H             ; *  *  *
021D 41            455          DB      41H             ; *     *
                   456 $EJECT
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LOC  OBJ          SEQ          SOURCE STATEMENT

                  457
821E 7F           458          DB       7FH              ; *******
821F 89           459          DB       89H              ;    *   *
8220 89           460          DB       89H              ;    *   *
8221 89           461          DB       89H              ;    *   *
8222 81           462          DB       81H              ;        *
                  463
8223 3E           464          DB       3EH              ;  *****
8224 41           465          DB       41H              ; *     *
8225 41           466          DB       41H              ; *     *
8226 51           467          DB       51H              ; * *   *
8227 71           468          DB       71H              ; ***   *
                  469
8228 7F           470          DB       7FH              ; *******
8229 08           471          DB       08H              ;    *
822A 08           472          DB       08H              ;    *
822B 08           473          DB       08H              ;    *
822C 7F           474          DB       7FH              ; *******
                  475
822D 00           476          DB       00H              ;
822E 41           477          DB       41H              ; *     *
822F 7F           478          DB       7FH              ; *******
8230 41           479          DB       41H              ; *     *
8231 00           480          DB       00H              ;
                  481
8232 20           482          DB       20H              ;  *
8233 40           483          DB       40H              ; *
8234 40           484          DB       40H              ; *
8235 40           485          DB       40H              ; *
8236 3F           486          DB       3FH              ;  ******
                  487
8237 7F           488          DB       7FH              ; *******
8238 08           489          DB       08H              ;    *
8239 14           490          DB       14H              ;   * *
823A 22           491          DB       22H              ;  *   *
823B 41           492          DB       41H              ; *     *
                  493
823C 7F           494          DB       7FH              ; *******
823D 40           495          DB       40H              ; *
823E 40           496          DB       40H              ; *
823F 40           497          DB       40H              ; *
8240 40           498          DB       40H              ; *
                  499
8241 7F           500          DB       7FH              ; *******
8242 02           501          DB       02H              ;       *
8243 0C           502          DB       0CH              ;     **
8244 02           503          DB       02H              ;       *
8245 7F           504          DB       7FH              ; *******
                  505
8246 7F           506          DB       7FH              ; *******
8247 04           507          DB       04H              ;      *
8248 08           508          DB       08H              ;    *
8249 10           509          DB       10H              ;   *
824A 7F           510          DB       7FH              ; *******
                  511 $EJECT
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LOC  OBJ          SEQ          SOURCE STATEMENT

                  512
824B 3E           513          DB       3EH             ;  *****
824C 41           514          DB       41H             ; *     *
824D 41           515          DB       41H             ; *     *
824E 41           516          DB       41H             ; *     *
824F 3E           517          DB       3EH             ;  *****
                  518
8250 7F           519          DB       7FH             ; *******
8251 09           520          DB       09H             ;    *  *
8252 09           521          DB       09H             ;    *  *
8253 09           522          DB       09H             ;    *  *
8254 06           523          DB       06H             ;     **
                  524
8255 3E           525          DB       3EH             ;  *****
8256 41           526          DB       41H             ; *     *
8257 51           527          DB       51H             ; * *   *
8258 21           528          DB       21H             ;  *    *
8259 5E           529          DB       5EH             ;  * ****
                  530
825A 7F           531          DB       7FH             ; *******
825B 09           532          DB       09H             ;    *  *
825C 19           533          DB       19H             ;   **  *
825D 29           534          DB       29H             ;  * * *
825E 46           535          DB       46H             ; *   **
                  536
825F 26           537          DB       26H             ;  *  **
8260 49           538          DB       49H             ; *  *  *
8261 49           539          DB       49H             ; *  *  *
8262 49           540          DB       49H             ; *  *  *
8263 32           541          DB       32H             ;  **  *
                  542
8264 01           543          DB       01H             ;       *
8265 01           544          DB       01H             ;       *
8266 7F           545          DB       7FH             ; *******
8267 01           546          DB       01H             ;       *
8268 01           547          DB       01H             ;       *
                  548
8269 3F           549          DB       3FH             ;  ******
826A 40           550          DB       40H             ; *
826B 40           551          DB       40H             ; *
826C 40           552          DB       40H             ; *
826D 3F           553          DB       3FH             ;  ******
                  554
826E 1F           555          DB       1FH             ;   *****
826F 20           556          DB       20H             ;  *
8270 40           557          DB       40H             ; *
8271 20           558          DB       20H             ;  *
8272 1F           559          DB       1FH             ;   *****
                  560
8273 7F           561          DB       7FH             ; *******
8274 20           562          DB       20H             ;  *
8275 18           563          DB       18H             ;   **
8276 20           564          DB       20H             ;  *
8277 7F           565          DB       7FH             ; *******
                  566 $EJECT
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LOC  OBJ          SEQ          SOURCE STATEMENT

                  567
0278 63           568          DB       63H             ; **   **
0279 14           569          DB       14H             ;   * *
027A 08           570          DB       08H             ;    *
027B 14           571          DB       14H             ;   * *
027C 63           572          DB       63H             ; **   **
                  573
027D 03           574          DB       03H             ;      **
027E 04           575          DB       04H             ;     *
027F 78           576          DB       78H             ; ****
0280 04           577          DB       04H             ;     *
0281 03           578          DB       03H             ;      **
                  579
0282 61           580          DB       61H             ; **    *
0283 51           581          DB       51H             ; * *   *
0284 49           582          DB       49H             ; *  *  *
0285 45           583          DB       45H             ; *   * *
0286 43           584          DB       43H             ; *    **
                  585
0287 7F           586          DB       7FH             ; *******
0288 7F           587          DB       7FH             ; *******
0289 41           588          DB       41H             ; *     *
028A 41           589          DB       41H             ; *     *
028B 41           590          DB       41H             ; *     *
                  591
028C 02           592          DB       02H             ;      *
028D 04           593          DB       04H             ;     *
028E 08           594          DB       08H             ;    *
028F 10           595          DB       10H             ;   *
0290 20           596          DB       20H             ;  *
                  597
0291 41           598          DB       41H             ; *     *
0292 41           599          DB       41H             ; *     *
0293 41           600          DB       41H             ; *     *
0294 7F           601          DB       7FH             ; *******
0295 7F           602          DB       7FH             ; *******
                  603
0296 10           604          DB       10H             ;   *
0297 08           605          DB       08H             ;    *
0298 04           606          DB       04H             ;     *
0299 08           607          DB       08H             ;    *
029A 10           608          DB       10H             ;   *
                  609
029B 40           610          DB       40H             ; *
029C 40           611          DB       40H             ; *
029D 40           612          DB       40H             ; *
029E 40           613          DB       40H             ; *
029F 40           614          DB       40H             ; *
                  615 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                  616          ;
02A8 8888         617 PAGE1:   MOV     STBCNT,#88H      ;ZERO STROBE COUNTER
02A2 FA           618          MOV     A,SAVPNT         ;GET DIRECTION
02A3 37           619          CPL     A                ;FLIP BITS
02A4 D2B3         620          JB6     BAKWRD           ;IF BACKWARD JUMP OUT
02A6 FC           621 LKL0:    MOV     A,TEMP1          ;GET THE TARGET
02A7 A3           622          MOVP    A,@A             ;GET THE DATA
02A8 34CC         623          CALL    FIRE             ;STROBE THE SOLENOIDS
02AA 1C           624          INC     TEMP1            ;INCREMENT THE POINTER
02AB 1B           625          INC     STBCNT           ;INCREMENT THE STROBE COUNTER
02AC FB           626          MOV     A,STBCNT         ;GET THE STROBE COUNTER
02AD D385         627          XRL     A,#85H           ;IS IT FIVE
02AF 96A6         628          JNZ     LKL0             ;REPEAT IF NOT FIVE
02B1 84AE         629          JMP     SETTIM           ;GO BACK
02B3 FC           630 BAKWRD:  MOV     A,TEMP1          ;GET THE TARGET
02B4 B3B4         631          ADD     A,#B4H           ;COMPENSATE FOR GOING BACKWARDS
02B6 AC           632          MOV     TEMP1,A          ;SAVE IT
02B7 FC           633 LKL01:   MOV     A,TEMP1          ;GET THE TARGET
02B8 A3           634          MOVP    A,@A             ;GET THE DATA
02B9 34CC         635          CALL    FIRE             ;STROBE THE SOLENOIDS
02BB FC           636          MOV     A,TEMP1          ;GET TEMP1
02BC B7           637          DEC     A                ;DECREASE BY ONE
02BD AC           638          MOV     TEMP1,A          ;PUT IT BACK
02BE 1B           639          INC     STBCNT           ;INCREMENT THE STROBE COUNTER
02BF FB           640          MOV     A,STBCNT         ;GET THE STROBE COUNTER
02C0 D385         641          XRL     A,#85H           ;IS IT FIVE
02C2 96B7         642          JNZ     LKL01            ;REPEAT IF NOT FIVE
02C4 84AE         643          JMP     SETTIM           ;GO BACK, CHARACTER IS DONE
                  644 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                   645          ;*
0300               646          ORG      300H
                   647          ;*
                   648
0300 00            649          DB       00H              ;
0301 00            650          DB       00H              ;
0302 00            651          DB       00H              ;
0303 00            652          DB       00H              ;
0304 00            653          DB       00H              ;
                   654
0305 00            655          DB       00H              ;
0306 00            656          DB       00H              ;
0307 5F            657          DB       5FH              ; * *****
0308 00            658          DB       00H              ;
0309 00            659          DB       00H              ;
                   660
030A 00            661          DB       00H              ;
030B 07            662          DB       07H              ;      ***
030C 00            663          DB       00H              ;
030D 07            664          DB       07H              ;      ***
030E 00            665          DB       00H              ;
                   666
030F 14            667          DB       14H              ;    * *
0310 7F            668          DB       7FH              ; *******
0311 14            669          DB       14H              ;    * *
0312 7F            670          DB       7FH              ; *******
0313 14            671          DB       14H              ;    * *
                   672
0314 24            673          DB       24H              ;   *   *
0315 2A            674          DB       2AH              ;   * * *
0316 7F            675          DB       7FH              ; *******
0317 2A            676          DB       2AH              ;   * * *
0318 12            677          DB       12H              ;    *  *
                   678
0319 23            679          DB       23H              ;   *   **
031A 13            680          DB       13H              ;    *  **
031B 08            681          DB       08H              ;     *
031C 64            682          DB       64H              ; **  *
031D 62            683          DB       62H              ; **   *
                   684
031E 36            685          DB       36H              ;  ** **
031F 49            686          DB       49H              ; *  *  *
0320 56            687          DB       56H              ; * * **
0321 20            688          DB       20H              ;  *
0322 50            689          DB       50H              ; * *
                   690 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                   691
0323 00            692          DB       00H             ;
0324 00            693          DB       00H             ;
0325 07            694          DB       07H             ;     ***
0326 00            695          DB       00H             ;
0327 00            696          DB       00H             ;
                   697
0328 1C            698          DB       1CH             ;    ***
0329 22            699          DB       22H             ;   *   *
032A 41            700          DB       41H             ; *     *
032B 00            701          DB       00H             ;
032C 00            702          DB       00H             ;
                   703
032D 00            704          DB       00H             ;
032E 00            705          DB       00H             ;
032F 41            706          DB       41H             ; *     *
0330 22            707          DB       22H             ;  *   *
0331 1C            708          DB       1CH             ;   ***
                   709
0332 22            710          DB       22H             ;  *   *
0333 14            711          DB       14H             ;   * *
0334 7F            712          DB       7FH             ; *******
0335 14            713          DB       14H             ;   * *
0336 22            714          DB       22H             ;  *   *
                   715
0337 00            716          DB       00H             ;     *
0338 00            717          DB       00H             ;     *
0339 7F            718          DB       7FH             ; *******
033A 00            719          DB       00H             ;     *
033B 00            720          DB       00H             ;     *
                   721
033C 00            722          DB       00H             ;
033D 40            723          DB       40H             ; *
033E 30            724          DB       30H             ;  **
033F 00            725          DB       00H             ;
0340 00            726          DB       00H             ;
                   727
0341 00            728          DB       00H             ;     *
0342 00            729          DB       00H             ;     *
0343 00            730          DB       00H             ;     *
0344 00            731          DB       00H             ;     *
0345 00            732          DB       00H             ;     *
                   733
0346 00            734          DB       00H             ;
0347 00            735          DB       00H             ;
0348 40            736          DB       40H             ; *
0349 00            737          DB       00H             ;
034A 00            738          DB       00H             ;
                   739
034B 20            740          DB       20H             ;  *
034C 10            741          DB       10H             ;   *
034D 08            742          DB       08H             ;    *
034E 04            743          DB       04H             ;     *
034F 02            744          DB       02H             ;      *
                   745
0350 3E            746          DB       3EH             ;  *****
0351 51            747          DB       51H             ; * *   *
0352 49            748          DB       49H             ; *  *  *
0353 45            749          DB       45H             ; *   * *
0354 3E            750          DB       3EH             ;  *****
                   751
0355 00            752          DB       00H             ;
0356 42            753          DB       42H             ; *    *
0357 7F            754          DB       7FH             ; *******
0358 40            755          DB       40H             ; *
0359 00            756          DB       00H             ;
                   757
035A 62            758          DB       62H             ; **   *
035B 51            759          DB       51H             ; * *   *
035C 49            760          DB       49H             ; *  *  *
035D 49            761          DB       49H             ; *  *  *
035E 46            762          DB       46H             ; *   **
                   763
035F 21            764          DB       21H             ;  *    *
0360 41            765          DB       41H             ; *     *
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

0361 49           766          DB       49H             ; *  *  *
0362 4D           767          DB       4DH             ; *  ** *
0363 33           768          DB       33H             ;  **  **
                  769
0364 18           770          DB       18H             ;    **
0365 14           771          DB       14H             ;   * *
0366 12           772          DB       12H             ;   *  *
0367 7F           773          DB       7FH             ; *******
0368 10           774          DB       10H             ;   *
                  775
0369 27           776          DB       27H             ;  *  ***
036A 45           777          DB       45H             ; *   * *
036B 45           778          DB       45H             ; *   * *
036C 45           779          DB       45H             ; *   * *
036D 39           780          DB       39H             ;  ***  *
                  781
036E 3C           782          DB       3CH             ;  ****
036F 4A           783          DB       4AH             ; *  * *
0370 49           784          DB       49H             ; *  *  *
0371 49           785          DB       49H             ; *  *  *
0372 31           786          DB       31H             ;  **   *
                  787
0373 01           788          DB       01H             ;       *
0374 71           789          DB       71H             ; ***   *
0375 09           790          DB       09H             ;    *  *
0376 05           791          DB       05H             ;     * *
0377 03           792          DB       03H             ;      **
                  793
0378 36           794          DB       36H             ;  ** **
0379 49           795          DB       49H             ; *  *  *
037A 49           796          DB       49H             ; *  *  *
037B 49           797          DB       49H             ; *  *  *
037C 36           798          DB       36H             ;  ** **
                  799 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                  800
                  801          DB       46H             ;  *    **
837D 46           802          DB       49H             ;  *   *   *
837E 49           803          DB       49H             ;  *   *   *
837F 49           804          DB       29H             ;   * *   *
8380 29           805          DB       1EH             ;    ****
8381 1E           806
                  807          DB       00H             ;
8382 00           808          DB       00H             ;
8383 00           809          DB       14H             ;    * *
8384 14           810          DB       00H             ;
8385 00           811          DB       00H             ;
8386 00           812
                  813          DB       00H             ;
8387 00           814          DB       48H             ;  *
8388 48           815          DB       34H             ;   ** *
8389 34           816          DB       00H             ;
838A 00           817          DB       00H             ;
838B 00           818
                  819          DB       08H             ;     *
838C 08           820          DB       14H             ;    * *
838D 14           821          DB       22H             ;   *   *
838E 22           822          DB       41H             ;  *     *
838F 41           823          DB       00H             ;
8390 00           824
                  825          DB       14H             ;    * *
8391 14           826          DB       14H             ;    * *
8392 14           827          DB       14H             ;    * *
8393 14           828          DB       14H             ;    * *
8394 14           829          DB       14H             ;    * *
8395 14           830
                  831          DB       00H             ;
8396 00           832          DB       41H             ;  *     *
8397 41           833          DB       22H             ;   *   *
8398 22           834          DB       14H             ;    * *
8399 14           835          DB       08H             ;     *
839A 08           836
                  837          DB       02H             ;       *
839B 02           838          DB       01H             ;        *
839C 01           839          DB       59H             ;  * **  *
839D 59           840          DB       05H             ;     * *
839E 05           841          DB       02H             ;       *
839F 02           842 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

03AB BBBB          843 PAGE2:   MOV     STBCNT,#0BBH      ;ZERO STROBE COUNTER
03A2 FA            844          MOV     A,SAVPNT          ;GET DIRECTION
03A3 37            845          CPL     A                 ;FLIP BITS
03A4 D2B5          846          JB6     BKWRD             ;IF BACKWARD JUMP OUT
03A6 FC            847 LKHI:    MOV     A,TEMP1           ;GET THE TARGET
03A7 0360          848          ADD     A,#60H            ;ADJUST THE TARGET
03A9 A3            849          MOVP    A,@A              ;GET THE DATA
03AA 34CC          850          CALL    FIRE              ;STROBE THE SOLENOIDS
03AC 1C            851          INC     TEMP1             ;INCREMENT THE POINTER
03AD 1B            852          INC     STBCNT            ;INCREMENT THE STROBE COUNTER
03AE FB            853          MOV     A,STBCNT          ;GET THE STROBE COUNTER
03AF D3B5          854          XRL     A,#B5H            ;IS IT FIVE
03B1 96A6          855          JNZ     LKHI              ;REPEAT IF NOT FIVE
03B3 84AE          856          JMP     SETTIM            ;GO BACK
03B5 FC            857 BKWRD:   MOV     A,TEMP1           ;GET THE TARGET
03B6 0364          858          ADD     A,#64H            ;COMPENSATE FOR GOING BACKWARDS
03B8 AC            859          MOV     TEMP1,A           ;SAVE IT
03B9 FC            860 LKHI1:   MOV     A,TEMP1           ;GET THE TARGET
03BA A3            861          MOVP    A,@A              ;GET THE DATA
03BB 34CC          862          CALL    FIRE              ;STROBE THE SOLENOIDS
03BD FC            863          MOV     A,TEMP1           ;GET TEMP1
03BE 07            864          DEC     A                 ;DECREASE BY ONE
03BF AC            865          MOV     TEMP1,A           ;PUT IT BACK
03C0 1B            866          INC     STBCNT            ;INCREMENT THE STROBE COUNTER
03C1 FB            867          MOV     A,STBCNT          ;GET THE STROBE COUNTER
03C2 D3B5          868          XRL     A,#B5H            ;IS IT FIVE
03C4 96B9          869          JNZ     LKHI1             ;REPEAT IF NOT FIVE
03C6 84AE          870          JMP     SETTIM            ;GO BACK, CHARACTER IS DONE
                   871 $EJECT
```

```
LOC  OBJ          SEQ          SOURCE STATEMENT

                   872          ;
0400               873          ORG     400H
                   874          ;
0400 27            875 BGIN:    CLR     A                ;ZERO ACC
0401 90            876          MOVX    @R0,A            ;TURN OFF THE SOLENOIDS
0402 9408          877          CALL    SETUP            ;SET UP THE PRINTER
0404 943F          878          CALL    VARSET           ;SET UP THE SOFTWARE
0406 840A          879          JMP     PRNT             ;GO START
                   880          ;
0408 23FE          881 SETUP:   MOV     A,#0FEH          ;LOAD ACC WITH VALUE TO TURN ON MOTOR
040A 39            882          OUTL    P1,A             ;TURN ON MOTOR
                   883          ;
                   884          ;NOW DELAY 3.2 SECONDS WHILE CHECKING RIGHT SENSOR
                   885          ;
040B BC85          886          MOV     TEMP1,#85H       ;LOAD DELAY VALUE ONE
040D BFFF          887 SELFC:   MOV     JUNK1,#0FFH      ;LOAD DELAY VALUE TWO
040F BEFF          888 SELFB:   MOV     LINCNT,#0FFH     ;LOAD DELAY VALUE THREE
0411 09            889 SELFA:   IN      A,P1             ;READ PORT ONE
0412 37            890          CPL     A                ;MAKE THINGS RIGHT
0413 F21D          891          JB7     DONER            ;IS BIT 7 SET?
0415 EE11          892          DJNZ    LINCNT,SELFA     ;SMALL LOOP
0417 EF0F          893          DJNZ    JUNK1,SELFB      ;BIGGER LOOP
0419 EC0D          894          DJNZ    TEMP1,SELFC      ;BIGGEST LOOP
041B 845A          895          JMP     ERROR            ;SOMETHING IS WRONG
                   896          ;
                   897          ;NOW MAKE SURE THE RIGHT SENSOR IS CLEARED
                   898          ;
041D BFFF          899 DONER:   MOV     JUNK1,#0FFH      ;SET UP DELAY
041F BEFF          900 SELF:    MOV     LINCNT,#0FFH     ;SOME MORE DELAY
0421 09            901 SELF1:   IN      A,P1             ;GET THE FLAG INFORMATION
0422 F22A          902          JB7     DONEF            ;IS FLAG CLEARED?
0424 EE21          903          DJNZ    LINCNT,SELF1     ;IF NOT LOOP
0426 EF1F          904          DJNZ    JUNK1,SELF       ;LOOP SOME MORE
0428 845A          905          JMP     ERROR            ;LEAVE IF FLAG IS NOT UNCOVERED
                   906          ;
                   907          ;NOW CHECK THE LEFT SENSOR IN THE SAME MANNER AS THE
                   908          ;RIGHT SENSOR.  EXCEPT DELAY ONLY 2.5 SECONDS
                   909          ;
042A BC84          910 DONEF:   MOV     TEMP1,#84H       ;LOAD DELAY 1
042C BFFF          911 SELFCC:  MOV     JUNK1,#0FFH      ;LOAD DELAY 2
042E BEFF          912 SELFBB:  MOV     LINCNT,#0FFH     ;LOAD DELAY 3
0430 09            913 SELFAA:  IN      A,P1             ;READ THE PORT
0431 37            914          CPL     A                ;CHANGE THINGS AROUND
0432 D23C          915          JB6     DONEL            ;OK IF BIT 6 IS A ZERO
0434 EE30          916          DJNZ    LINCNT,SELFAA    ;SMALL LOOP
0436 EF2E          917          DJNZ    JUNK1,SELFBB     ;BIGGER LOOP
0438 EC2C          918          DJNZ    TEMP1,SELFCC     ;BIGGEST LOOP
043A 845A          919          JMP     ERROR            ;SOMETHING IS WRONG
043C 8901          920 DONEL:   ORL     P1,#01H          ;TURN MOTOR OFF
043E 83            921          RET                      ;GO BACK
                   922          ;
                   923          ;NOW SET UP THE VARIABLES
                   924          ;
043F 23FE          925 VARSET:  MOV     A,#0FEH          ;LOAD THE TIMER
0441 62            926          MOV     T,A
0442 55            927          STRT    T                ;START THE TIMER
0443 B828          928          MOV     INBUF,#FIRST     ;LOAD INPUT BUFFER
0445 BE88          929          MOV     LINCNT,#88H      ;SET LINE COUNT
0447 BD88          930          MOV     STATUS,#88H      ;SET FORWARD BIT
                   931          ;
                   932          ;NOW CLEAR THE RAM AREA BY WRITING SPACE CODES
                   933          ;
0449 B928          934          MOV     OUTBUF,#FIRST    ;LOAD OUTBUF
044B 2320          935 CLRMEM:  MOV     A,#20H           ;PUT SPACE CODE IN ACC
044D A1            936          MOV     @OUTBUF,A        ;PUT SPACE CODE IN DATA MEMORY
044E 19            937          INC     OUTBUF           ;UPDATE THE POINTER
044F F9            938          MOV     A,OUTBUF         ;MOVE THE POINTER INTA ACC
0450 D37B          939          XRL     A,#MAX+1         ;SEE IF DONE
0452 964B          940          JNZ     CLRMEM           ;LOOP IF NOT CLEARED
                   941          ;
                   942          ;NOW CLEAR THE 8212
                   943          ;
0454 99EF          944          ANL     P1,#0EFH         ;SET ENABLE BIT
0456 80            945          MOVX    A,@INBUF         ;CLEAR THE 8212 INPUT BUFFER
0457 8910          946          ORL     P1,#10H          ;RESET ENABLE BIT
                   947          ;
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```
LOC  OBJ          SEQ          SOURCE STATEMENT
                    948          ;NOW EXIT VARSET
                    949          ;
0459 83             950          RET                         ;LEAVE INITIALIZATION
                    951          ;
                    952          ;THIS ROUTINE TURNS THE MOTOR OFF AND LOOPS
                    953          ;
045A 89FF           954 ERROR:   ORL     P1,#0FFH            ;TURN OFF MOTOR
045C 845C           955 DEAD:    JMP     DEAD                ;LOOP BECAUSE SOMETHING IS WRONG
                    956          ;
                    957          ;THESE ARE ALL SUBROUTINES THAT ARE CALLED
                    958          ;
045E 19             959 INCTST:  INC     OUTBUF              ;UPDATE THE POINTER
045F 2378           960          MOV     A,#MAX+1            ;GET THE VALUE FOR THE LAST CHARACTER
0461 D9             961          XRL     A,OUTBUF            ;DO THE TEST
0462 83             962          RET                         ;EXIT
0463 89             963 GTPRNT:  IN      A,P1                ;READ PORT ONE
0464 37             964          CPL     A                   ;FLIP BITS
0465 D263           965          JB6     GTPRNT              ;LOOP UNTIL SENSOR IS UNCOVERED
0467 1668           966 TSTJTF:  JTF     PIT                 ;SEE IF TIMER FLAG IS SET
0469 8467           967          JMP     TSTJTF              ;TEST FLAG
046B 65             968 PIT:     STOP    TCNT                ;STOP THE TIMER
046C FF             969          MOV     A,JUNK1             ;GET THE CHARACTER
046D 34C1           970          CALL    PRNTIT              ;PRINT THE CHARACTER
046F 341C           971          CALL    LNMODE              ;GET ANOTHER CHARACTER
0471 83             972          RET                         ;EXIT
0472 F9             973 DECTST:  MOV     A,OUTBUF            ;GET OUTBUF
0473 07             974          DEC     A                   ;REDUCE BY ONE
0474 A9             975          MOV     OUTBUF,A            ;PUT BACK IN OUTBUF
0475 D31F           976          XRL     A,#FIRST-1          ;SEE IF IT IS ALL THE WAY DOWN
0477 83             977          RET                         ;EXIT
                    978          ;
                    979          ;THIS ROUTINE DOES A LINE FEED
                    980          ;
0478 FE             981 LINEFD:  MOV     A,LINCNT            ;GET THE LINE COUNT
0479 F298           982          JB7     DOFF                ;IF BIT 7 IS SET, DO A FORMFEED
047B 99FD           983 LFDO:    ANL     P1,#0FDH            ;TURN ON THE SOLENOID
047D BC4D           984          MOV     TEMP1,#4DH          ;LOAD ONE DELAY
047F BF93           985 LFLP1:   MOV     JUNK1,#93H          ;LOAD ANOTHER DELAY
0481 EF81           986 LFLP2:   DJNZ    JUNK1,LFLP2         ;LOOP
0483 EC7F           987          DJNZ    TEMP1,LFLP1         ;LOOP SOME MORE
0485 8982           988          ORL     P1,#02H             ;TURN OFF LF SOLENOID
0487 1E             989          INC     LINCNT              ;UPDATE THE LINE COUNTER
0488 FE             990          MOV     A,LINCNT            ;GET THE LINE COUNT
0489 D328           991          XRL     A,#28H              ;IS PAGE DONE
048B 968F           992          JNZ     NOTDON              ;SKIP OVER
048D BE88           993          MOV     LINCNT,#88H         ;ZERO LINE COUNTER
                    994          ;
                    995          ;NOW DELAY 90 MILLISECONDS
                    996          ;
048F BC88           997 NOTDON:  MOV     TEMP1,#38H          ;LOAD DELAY VALUES
0491 BFFF           998 LDP1:    MOV     JUNK1,#0FFH         ;
0493 EF93           999 LDP2:    DJNZ    JUNK1,LDP2          ;GENERATE DELAY
0495 EC91          1000          DJNZ    TEMP1,LDP1          ;
0497 83            1001          RET                         ;LINE FEED IS DONE
                   1002          ;
                   1003          ;THIS ROUTINE DOES A FORM FEED
                   1004          ;
0498 09            1005 DOFF:    IN      A,P1                ;GET THS STATUS
0499 37            1006          CPL     A                   ;FLIP ACC
049A 53C0          1007          ANL     A,#0C0H             ;LEAVE ONLY TWO MSB'S
049C C698          1008          JZ      DOFF                ;IF A FLAG ISN'T COVERED, LOOP
049E 8981          1009          ORL     P1,#81H             ;TURN THE MOTOR OFF
04A0 947B          1010          CALL    LFDO                ;GO DO ONE LINE FEED
04A2 FE            1011 FFCK:    MOV     A,LINCNT            ;GET THE LINE COUNT
04A3 537F          1012          ANL     A,#7FH              ;STRIP BIT SEVEN
04A5 D388          1013          XRL     A,#88H              ;IS IT DONE
04A7 C6AD          1014          JZ      FFDONE              ;LEAVE IF IT IS
04A9 947B          1015          CALL    LFDO                ;STROBE THE SOLENOIDS
04AB 84A2          1016          JMP     FFCK                ;CHECK THE FORM FEED OUT
04AD 83            1017 FFDONE:  RET                         ;EXIT FORM FEED
                   1018          ;
04AE 23EB          1019 SETTIM:  MOV     A,#0EBH             ;GET DELAY VALUE
04B0 62            1020          MOV     T,A                 ;PUT IN TIMER
04B1 55            1021          STRT    T                   ;START THE TIMER
04B2 83            1022          RET                         ;EXIT
                   1023          ;
```

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LOC  OBJ          SEQ          SOURCE STATEMENT
04B3 42           1824 PRNTBK: MOV      A,T              ;GET THE TIMER
04B4 37           1825         CPL      A                ;TWOS COMPLEMENT ACC
04B5 17           1826         INC      A
04B6 17           1827         INC      A
04B7 17           1828         INC      A
04B8 17           1829         INC      A
04B9 17           1830         INC      A                ;ADJUST TIMER
04BA 62           1831         MOV      T,A              ;PUT IT BACK IN THE TIMER
04BB 89           1832 INLOOP: IN       A,P1             ;READ PORT 1
04BD F2C8         1833         JB7      CONPBK           ;IF SENSOR IN NOT COVERED, LEAVE
04BE 84BB         1834         JMP      INLOOP           ;OTHERWISE LOOP
04C0 55           1835 CONPBK: STRT     T                ;START THE TIMER
04C1 16C5         1836 CONPB:  JTF      RDTOPT           ;SEE IF READY TO PRINT
04C3 84C1         1837         JMP      CONPB            ;OTHERWISE LOOP
04C5 23FF         1838 RDTOPT: MOV      A,#0FFH          ;LOAD A
04C7 62           1839         MOV      T,A              ;PUT IT IN THE TIMER
04C8 83           1840         RET                       ;EXIT
                  1841         ;
                  1842         ;THIS ROUTINE ADJUSTS AND SAVES THE STATUS DURING PRINTING
                  1843         ;
04C9 FD           1844 STACHK: MOV      A,STATUS         ;GET THE STATUS
04CA 92D2         1845         JB4      LFSET            ;SET LINE FEED BIT
04CC AA           1846 B4RET:  MOV      SAVPNT,A         ;SAVE THE STATUS
04CD 53C2         1847         ANL      A,#0C2H          ;RESET EVERYTHING EXCEPT
                  1848                                   ;DIRECTION AND PRINT
04CF AD           1849         MOV      STATUS,A         ;PUT THE STATUS BACK
04D0 8413         1850         JMP      LPRNT1           ;EXIT
04D2 4320         1851 LFSET:  ORL      A,#20H           ;SET BIT 5
04D4 84CC         1852         JMP      B4RET            ;JUMP BACK
                  1853         ;
                  1854         ;THIS ROUTINE READS A CHARACTER AND PUTS IT IN THE ACC
                  1855         ;
04D6 99EF         1856 GTCAR:  ANL      P1,#0EFH         ;SET ENABLE BIT
04D8 88           1857         MOVX     A,@INBUF         ;READ THE CHARACTER
04D9 8910         1858         ORL      P1,#10H          ;RESET ENABLE BIT
04DB 83           1859         RET                       ;EXIT GTCHAR
                  1860         ;
                  1861         ;THIS ROUTINE TURNS THE MOTOR ON
                  1862         ;
04DC 99FE         1863 MOTON:  ANL      P1,#0FEH         ;TURN MOTOR ON
04DE 83           1864         RET                       ;EXIT
                  1865         ;
                  1866         ;THIS ROUTINE TURNS THE MOTOR OFF
                  1867         ;
04DF 8901         1868 MOTOF:  ORL      P1,#01H          ;TURN MOTOR OFF
04E1 83           1869         RET                       ;EXIT
                  1870         ;
                  1871         END                       ;DONE

USER SYMBOLS
ARND   0107   ARNDJP 0149   B4RET  04CC   BAKWRD 02B3   BGIN   0408   BKWRD  03B5   BUTLOP 0113   BYEBYE 0160
CASE0  0831   CASE01 0817   CASE1  0852   CASE2  0880   CASE23 0824   CASE3  08C2   CHAR   011F   CLRMEM 0446
CONPB  04C1   CONPBK 04CB   CRFIX  01AB   CRFND  08D2   CRFOND 0862   DEAD   045C   DECTST 0472   DOFF   0498
DOLF   0871   DONEF  042A   DONEL  043C   DONER  041D   EPROR  045A   FDC    0842   FDC1   0844   FDCP   089E
FDCR1  0848   FFCK   04AE   FFDONE 04AD   FFFIX  01B2   FINE   0178   FIRE   01CC   FIREX  01D8   FIREY  01D6
FIRST  0828   FIXDUN 0174   FIXFIN 018F   FIXUP  0189   FXCHAR 0161   FXPRNT 0191   GETSTA 0144   GOOD   0128
GTCAR  04D6   GTPRNT 0463   INBUF  0888   INCTST 045E   INLOOP 0488   ISCHAR 01B0   JUMP1  0807   NTDUN  01E0
LDBUF  0188   LFCRCK 014A   LFDD   0478   LFFIX  01AB   LFLP1  047F   LFLP2  0481   LFSET  04D2   LFTEST 017F
LINCNT 0806   LINEFD 0478   LKHI   03A6   LKHI1  0389   LKLO   02A6   LKLO1  02B7   LNMODE 011C   LOOPW  0874
LOP1   0491   LOP2   0493   LPRNT  0811   LPRNT1 0813   MAX    006F   MOTOF  04DF   MOTON  04DC   NOFF   01BF
NOLF   011A   NOTDON 043F   NT1    01D4   OUTBUF 0801   OVR    0884   OVR1   0885   PAGE1  0248   PAGE2  03A8
PIT    046B   PRNT   0804   PRNTBK 04B3   PRNTIT 01C1   RDTOPT 04C5   SAVPNT 0802   SELF   041F   SELF1  0421
SELFA  0411   SELFAA 0438   SELFB  04BF   SELFBB 042E   SELFC  0480   SELFCC 042C   SETTIM 04AE   SETUP  0408
SHORT  01C9   STACHK 04C9   STATUS 0805   STBCNT 0803   STBIT1 0150   STPRNT 0159   SUB1   0139   TABLE1 0200
TEMP1  0804   TSJTF  01DC   TSTJTF 0467   VARSET 043F   WATCH  0875   WATCHD 08AE

ASSEMBLY COMPLETE,  NO ERRORS
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