

PRT-MPF

PRINTER
OPERATION
MANUAL

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I. Introduction

The printer for Multitech's MPF-I microcomputer (PRT-MPF) is a small, low cost PC board on which a micro thermal printer is built. This optional peripheral enables your MPF-I to perform the printing function.

With your PRT-MPF, you can print out data and programs processed by your MPF-I as a form of permanent record at extremely low cost.

The printer board can be interfaced to MPF-I microcomputer with a flat 40 pins connector cable, which is provided by Multitech or its worldwide distributor network. To activate your PRT-MPF, you have to provide a power input of +9V/1A to it using a power adaptor which requires power input of either 110V or 220V.

The PRT-MPF is controlled by a single +5V EPROM 2532 which has a memory totaling 4K bytes. Since the monitor is programmable, you can design your own printer interface board by changing the monitor chip of your PRT-MPF. By doing so, you can familiarize yourself with the interfacing principles between microprocessor and printers. This is one of the unique features of PRT-MPF.

The PRT-MPF is very compact--only 11.15 cm wide and 15.40 cm long. It can be fitted easily into the package of MPF-I microcomputer.

The PRT-MPF uses a micro thermal printer(MTP201A).
It's mechanical specifications are as follows:

- a. Dimensions: 70mm (W) x 33mm (D) x 14.4mm (H)
- b. Weight: 45 grams
- c. Number of characters per line: 20 characters/
138 dots
- d. Width of printing per line: 46mm
- e. Size of characters: 2 x 1.7mm (5 x 7 dot
matrix) each character
- f. Space between lines: 1.8 ± 0.4 mm
- g. Width of paper: 58mm
- h. Tention of paper feed: more than 20 g
- i. Printing speed: approximately 0.8 line/per
second (when the voltage of motor is 5V)
- j. Life of printer: 500,000 lines (at standard
printing test condition)

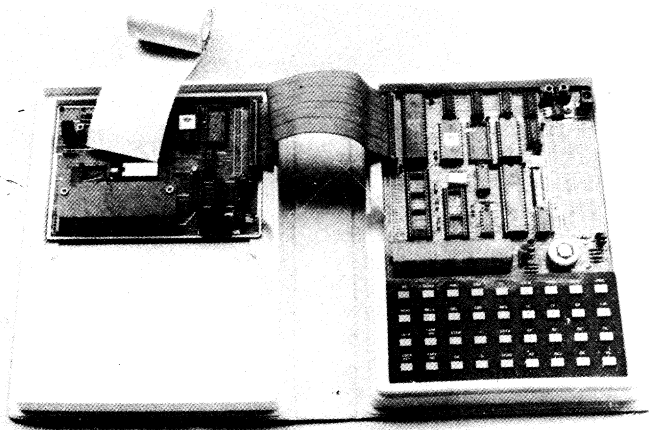
The printing method of PRT-MPF is as follows:

- a. Principle: thermal serial method
- b. Printing direction: from left to right
- c. Printing timing: tacho-generator synchronized
method

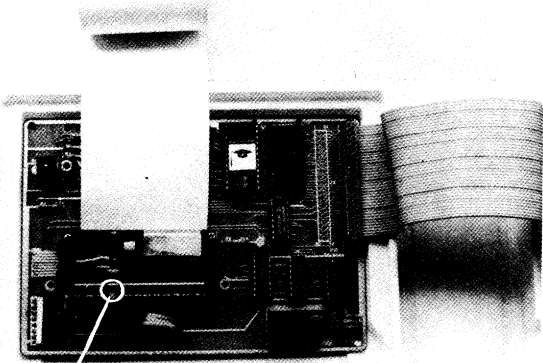
The power source of the printer board PRT-MPF is
5 +1V.

II. Installation Procedure

1. All power should be turned off.
2. Connect the CPU BUS of MPF-I with P1 on the PRT-MPF by flat cable.
3. Plug in the MPF-I power plug.
4. Plug in the PRT-MPF power plug.
5. Set up the thermal paper
 - a. Unwrap the thermal paper roll and put the paper roll as illustrated.

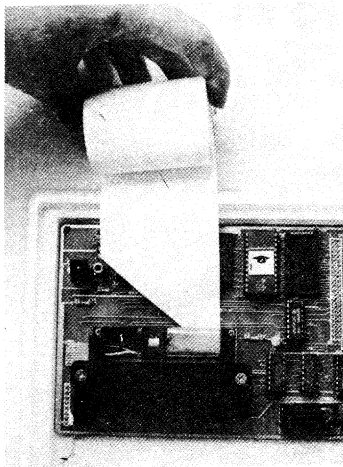


- b. Locate the thermal head.

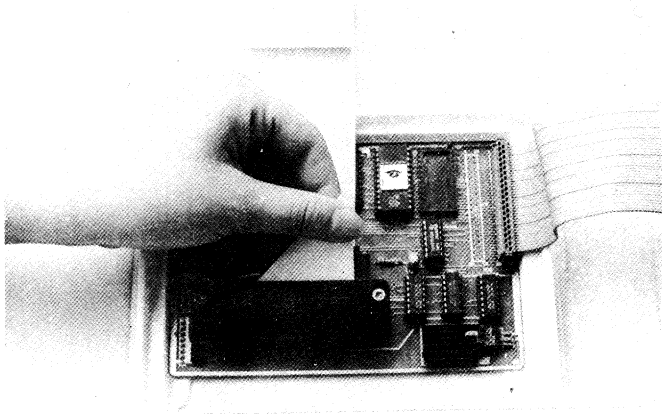


thermal head.

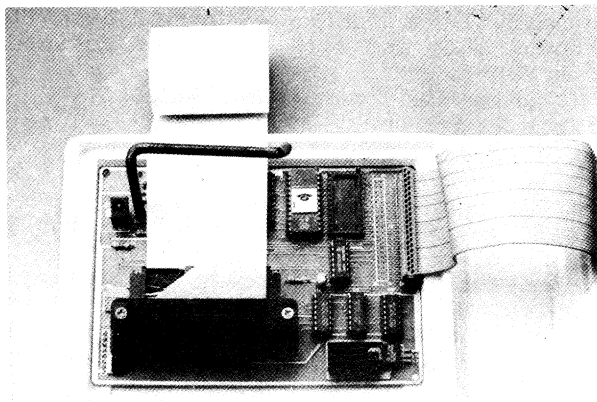
- c. Cut the thermal paper into an acute edge to make it easier to insert the thermal paper. (Note: A sharp edge is necessary to keep the thermal head from hindering the passage of the thermal paper.)



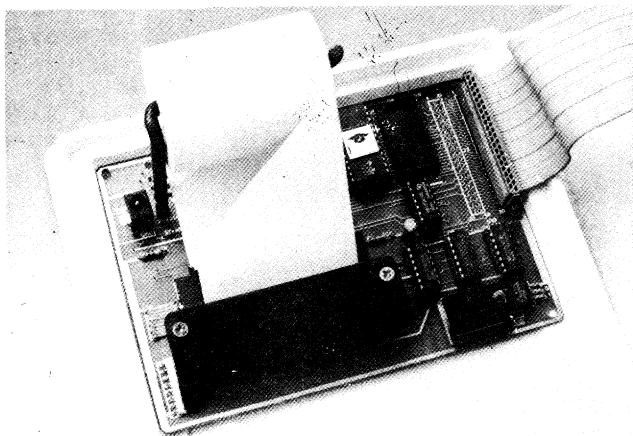
- d. Slip the thermal paper into the slit at the bottom of the thermal printer as illustrated. Push the paper band until the tip of the thermal paper rolls from the slit under the paper cutter.



- e. Locate the L-shaped paper support and screw it clockwise into the brass chassis on the PRT board.



- f. Put the thermal paper roll on the paper support.



6. As power adaptor output has no load, the voltage is about 13V, but the voltage is about 10V when power adaptor output has load.

III. PRT-MPF Specifications

3-1. Hardware Specifications

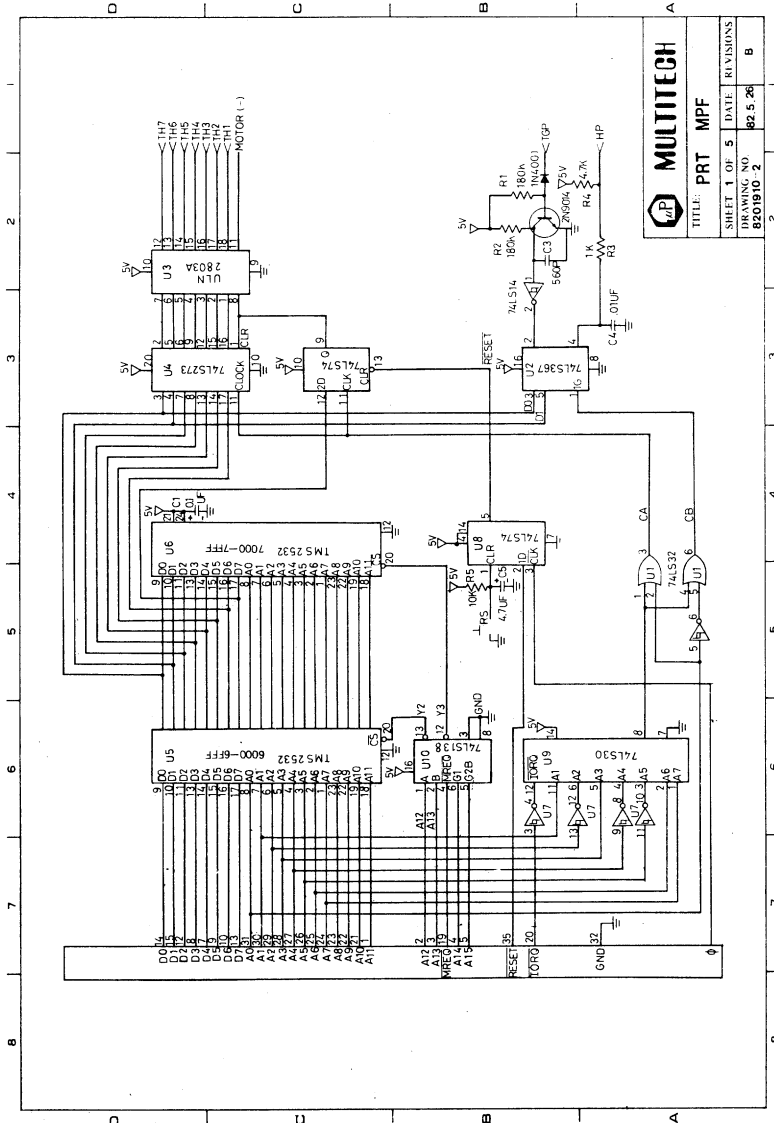
1. Compatible with MPF-I. Use 40 pins flat ribbon cable and male connector to interface with MPF-I.
2. ROM: (Read Only Memory)
Single +5V EPROM 2532 x 1 (2732 x 1 for new version), total 4K bytes.
Monitor EPROM Address: 6000-6FFF.
3. Memory expansion area:
Single +5V EPROM 2516/2716/2532 (2732 for new version), total 2K(4K) bytes.
On-Board Expansion Address: 7000-7FFF.
4. Display: MPF-I display.
5. Keyboard: MPF-I keyboard compatible.
6. System Power Consumption: +5V/350mA.
7. Main Power input: +9V/1A adaptor is provided, power adaptor input 110/220V.
8. Interface Connector/Cable: 40 pins flat ribbon cable and male connector used for interfacing to MPF-I.
9. Extension Connector area: 40 pins flat ribbon cable male connector area provides the bus for CPU option.
10. Printer:
Micro thermal printer MTP201A is a high performance thermal printer manufactured by the DAINI SEIKOSHA CO.
11. Physical Characteristic:
Height: 1.6 cm
Width: 11.15cm
Depth: 15.4cm

3-2. Function of Monitor Program

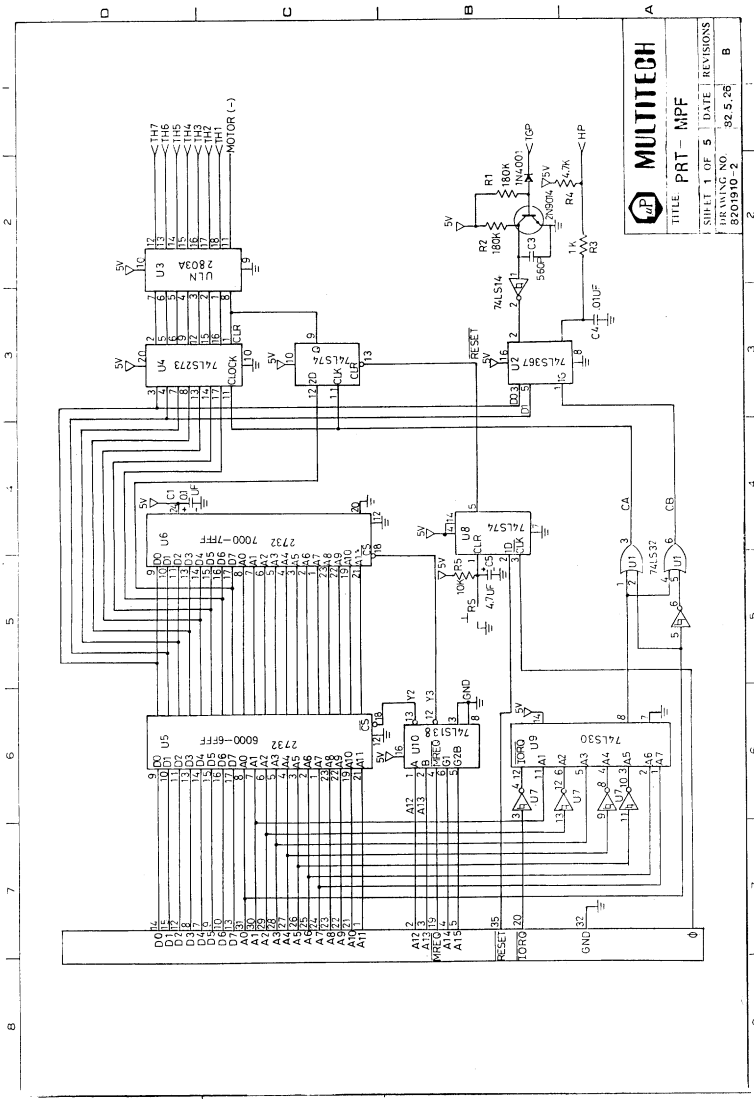
1. Built-in alphanumeric character patterns.
2. Built-in printer drive utility.
3. Built-in MPF-I memory dump utility.
4. Built-in MPF-I BASIC program listing utility.
5. Built-in Z80-Disassembler listing utility.

IV Theory of Hardware Circuit

4-1.PRT-MPF Hardware Circuit



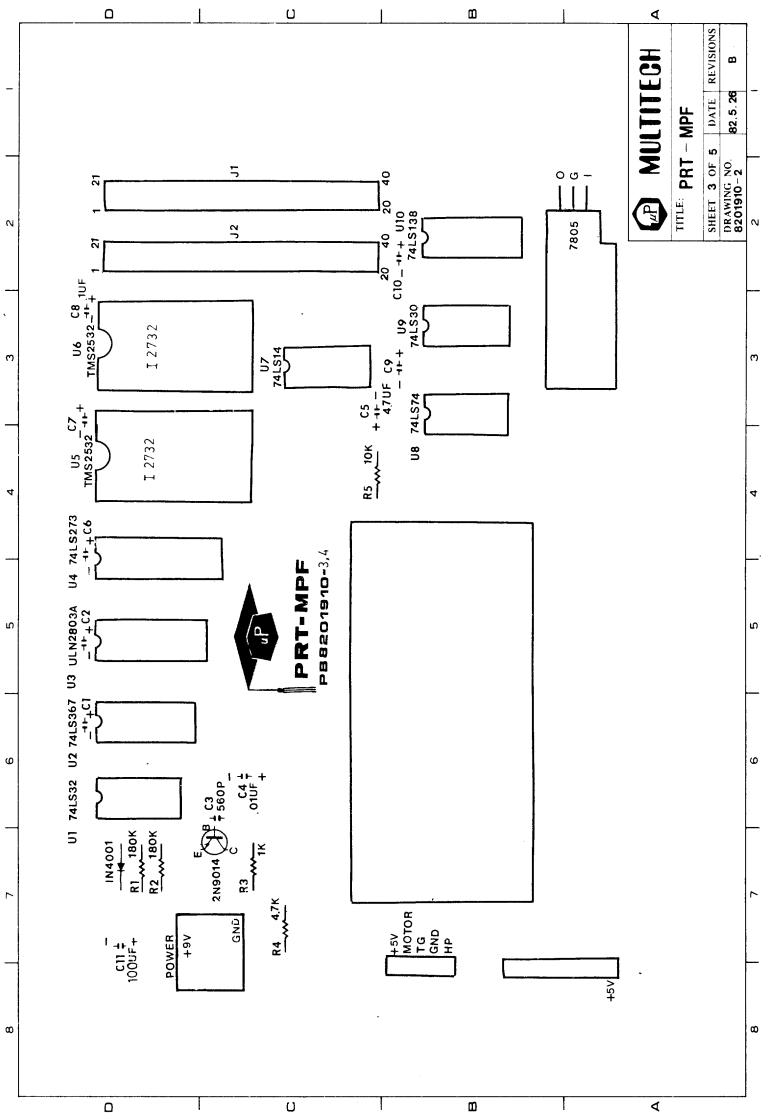
		TITLE: PRT MPF	
		SHEET 1 OF 5	DATE: 82.5.26
DRAWING NO: 8201910-2		REVISIONS: B	



MULTITECH

TITLE PRT - MPF

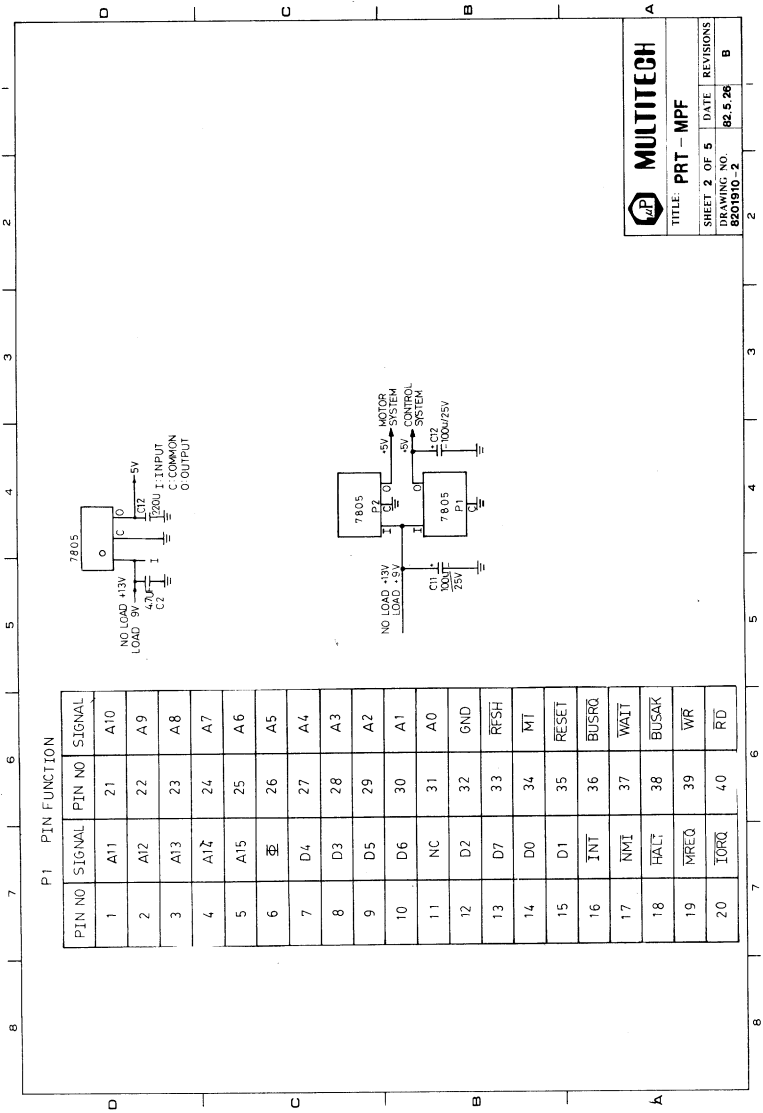
SHEET 1 OF 5	DATE	REVISIONS
ISSUANCE	92 5 26	B
8201910 - 2		



TITLE: PRT - MPF

SHEET	3 OF 6	DATE	REVISIONS
DRAWING NO.	82C1910-2	82.5.26	B

4-2.PRT-MPF Pin Function P1



P1 PIN FUNCTION

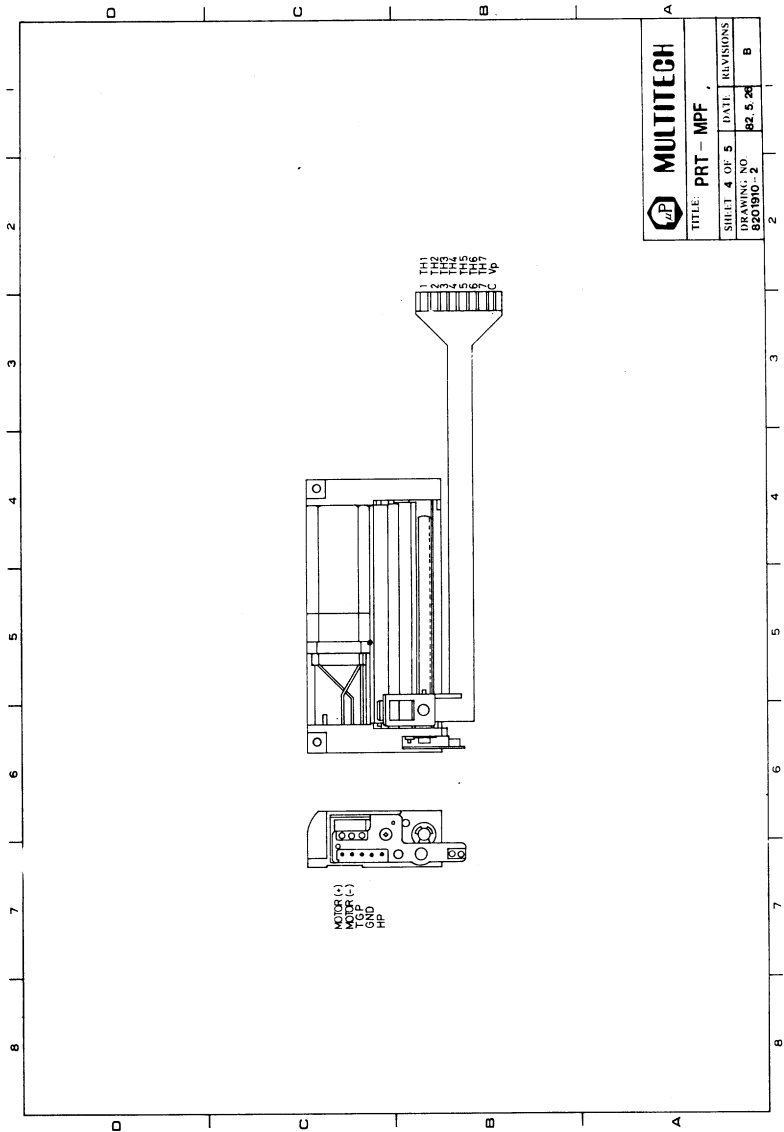
PIN NO	SIGNAL	PIN NO	SIGNAL
1	A11	21	A10
2	A12	22	A9
3	A13	23	A8
4	A14	24	A7
5	A15	25	A6
6	A16	26	A5
7	D4	27	A4
8	D3	28	A3
9	D5	29	A2
10	D6	30	A1
11	NC	31	A0
12	D2	32	GND
13	D7	33	REFSH
14	D0	34	M1
15	D1	35	RESET
16	INT	36	BUSRQ
17	NMI	37	WAIT
18	HALT	38	BUSAK
19	MREQ	39	WR
20	IORQ	40	RD

MULTITECH

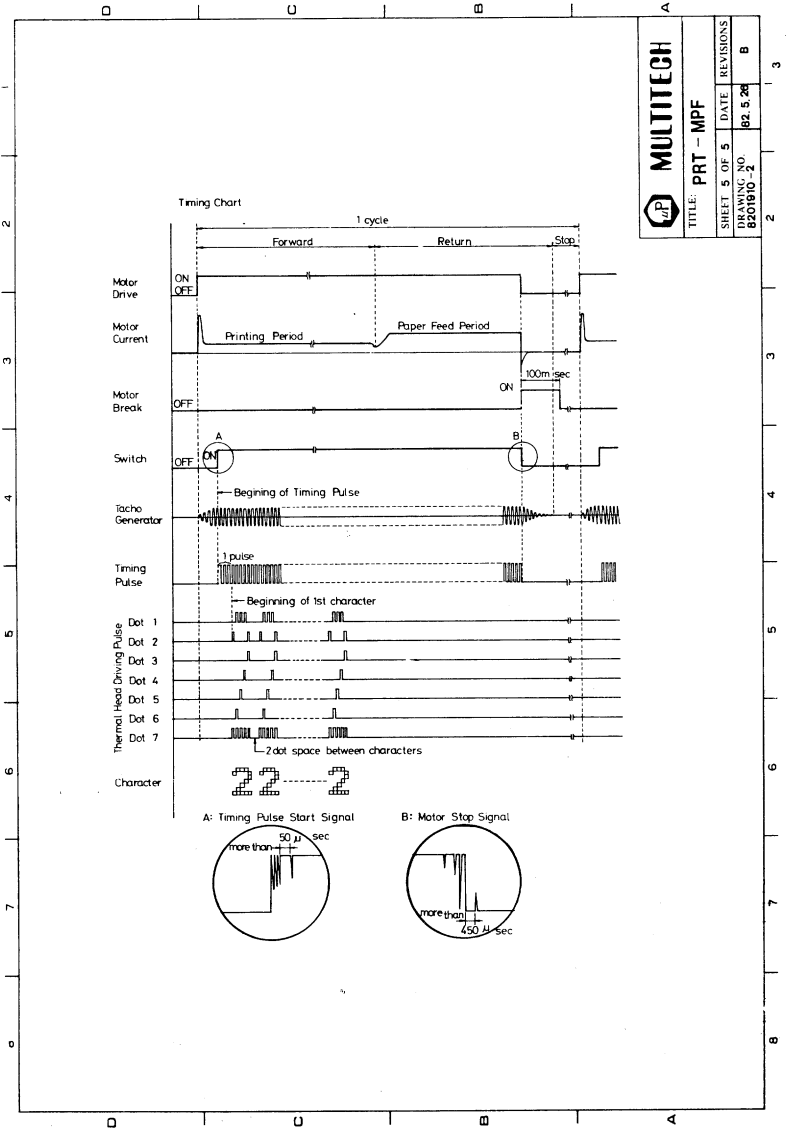
TITLE: PRT - MPF

SHEET 2 OF 5	DATE	REVISIONS
DRAWING NO. 8201910-2	82.5.26	B

4-3.MTP201A



4-4. Timing chart of MTP201A



MULTITECH

TITLE: PRT - MPF

SHEET	OF	DATE	REVISIONS
5	5		
820190-2		82.5.28	B

4-5. Theory of Operation

1. Printing Method

- (1) Principle
Thermal serial method
- (2) Printing Direction
From left to right
- (3) Printing Timing
Tacho-generator synchronized method
- (4) Home Detecting method
The switch is off when the head comes to the left position.
The motor shall stop when the switch turns off (110 μ sec Low Level detecting).
Printing shall start when the switch turns on (50 μ sec High Level detecting).
(1 dot space)

2. Characteristics of Motor Drive

- (1) Voltage of Power Source:
5 \pm 1V
- (2) Current Consumption of Motor:
Less than 170 mA while printing.
(at standard temperature and standard relative humidity)
Less than 250 mA while paper feeding.
(at standard temperature and standard relative humidity)
- (3) Motor Starting Current:
700 mA max. (DC 5V)
- (4) Brake Current:
500 mA max. (DC 5V)
- (5) Motor Stop Time:
60 msec typ.. (at the rated load of 5V)
max. 100 msec (at the min. load of 6V)
- (6) Motor Stop signal:
Within 1 msec after a switch is OFF.

3. TG Output Characteristics

- (1) TG Output Voltage:
 - 5V p-p (at rated load of 5V)
 - max. 9V p-p (at the min. load of 6V)
 - min. 2V (at the max. load of 4V)
- (2) TG Period:
 - 4 msec (at the rate load of 5V)
 - max. 8 msec (at the max. load of 4V)
 - min. 2.5 msec (at the min. load of 6V)
- (3) Internal Resistance:
 - 100 - 500 Ω

4. Characteristics of Switch

- (1) OFF Time
 - TG Output: more than 8 cycles
- (2) Contact Resistance
 - Less than 10 Ω (at the current of 50 μ A)
- (3) Current
 - 1 mA max. (5 V DC max.)

5. Summary

- (1) The printer prints on heat sensitive roll paper by means of seven thermal elements, which can print 5 x 7 matrix dot characters. The seven thermal elements are mounted in fixed position on a moveable thermal head. During a print cycle, the thermal head is driven from left to right in a horizontal line. The individual thermal elements are turned on for discrete intervals during the thermal head movement forming the partial characters. The printed characters formed by dot patterns stored in the PRT-MPF monitor. After a row of characters has been printed, the motor driven platen advances the paper vertically by one line.

- (2) When the thermal head is turned on, the printer will print by means of the state of the seven thermal elements. Thermal element TH1-TH7 are controlled by ULN2803A. When the output of ULN2803A is high, the thermal element is turned off and will not print.
- (3) The motor speed is depended on the voltage source.
- (4) The content of memory address 65FCH controls the intensity of the printer. The typical value is 18H, the user may change 18H to 19H or 1AH. This will imprve intensity of the printer. Of course, the intensity of the printer will be decreased as changing 18H to 17H or 16H.

V. General Conception

5-1. Monitor Program of PRT-MPF

1. The stack pointer of PRT-MPF is 1F7CH.
2. The system RAM areas of PRT-MPF monitor program are 1FF4-1FFF and 1F7D-1F9F(line buffer). User's program should avoid destroying the system RAM areas of PRT-MPF.
3. If system RAM area does not exist (i.e. the system RAM area is not RAM), then Z80-Disassembler, BASIC listing, Memory dump will be destroyed.

5-2. General Conception of BASIC-MPF

a. Variable Name: The length is one or two characters. If the length is one character, it must be any of alphanumeric letter A-F. If the length is 2 characters, the first must be an alphanumeric letter A-F, the second must be any of numeric digit 0-9.

b. System RAM areas of BASIC-MPF

1800		ORG	1800H	
1800	VARBUF:	DEFS	2* (6*10H+6)	;Variables
18CC		DEFS	1	buffer
18CD	LINBUF:	DEFS	21	
18E2	FLAG:	DEFS	1	
18E3	STOP:	DEFS	2	
18E5	ST--:	DEFS	2	
18E7		DEFS	1	;Delimiter FF

PRGBOT:

END

Overlay the MPF-I keyboard with the BASIC name plate. Next key in **GOTO** **2** **0** **0** **0** **RUN** (0800 for 4K monitor). The BASIC Interpreter will first clear RAM buffer(1800H - 1FADH) i.e. set the contents of RAM buffer to be zero. Secondly, set the value of memory address 18E7 to be the delimiter-FF. Thus, if we set the starting to be 2017 (or 0817 for 4K monitor) and press the **RUN** key, the contents of user's program would not be destroyed.

- c. The storage area of user's program begins at the memory address - 18E8H and terminates by a delimiter-FF. For example, if users key in only one instruction as follows.

```
010 LET A5 = 180
```

The BASIC Interpreter will accept the keyword and convert the keyword into the corresponding BASIC internal code. The above instruction occupies 12 bytes of memory. Please refer to the Page 15 of BASIC-MPF OPERATION MANUAL.

18E7	FF
18E8	00
18E9	01
18EA	00
18EB	1F
18EC	0A
18ED	05
18EE	18
18EF	00
18F0	00
18F1	01
18F2	08
18F3	80
18F4	FF
18F5	XX

The BASIC Interpreter sets Bit 7 of the last byte of each statement as the delimiter with a view to distinguish from another statements. From the above example, we know that 18F3 80 will be displayed when this statement is going on with another statements.

- d. The stack pointer of the BASIC Interpreter is 1F9FH because the USERSTK of MPF-I is 1F9FH. Thus, if the user's programs are so large that in excess of the memory address - 1F9FH, the programs storing in the BASIC Interpreter and the MPF-I monitor will be disordered.

5-3. Monitor Subroutines

5.3.1 Summary

ADDRESS	MNEMONIC	FUNCTION
63A0	GETN	Convert one hexadecimal digit into ASCII code
65AC	MTPPRT	Print out the contents of line buffer
66A0	SHIFT	Drive the thermal head shift right
63C4	PL INEFD	Line feed
668FH	PL INE	Drive the paper vertically by two lines

5.3.2 GETN

[Address]: 63A0

[Function]: Convert one hexadecimal digit to ASCII code.

[Input]: The data stored in A.

[Output]: The first number is stored in (DE+1), and the second is in (DE+2), DE is increased by 2.

[Register]: Destroy AF, DE, BC.

Example: Convert the data in register A to ASCII code and the results is stored in 1820H.

1800		ORG	1800H
1800	111F18	LD	DE, 181FH
1803	3E8F	LD	A, 8FH
1805	CDA063	CALL	GETN
1808	76	HALT	

Press **PC** then **GO** key, the hexadecimal digit in register A is converted to ASCII code the data in memory address 1820H is 38H, the data in memory address 1821H is 46H.

5.3.3 MTPPRT

[Address]: 65AC

[Function]: Print out the contents of line buffer.

[Input]: IX points to the line buffer.

[Output]: Print the contents of line buffer out.

[Register]: Destory AF', B'.

Example: Print out the message "MY NAME IS PRT-MPF".

1800		ORG	1800H
1800	DD212018	LD	IX, 1820H
1804	CDAC65	CALL	MTPPRT
1807	76	HALT	
1820		DEFB	4DH
1821		DEFB	59H
1822		DEFB	20H
1823		DEFB	4EH
1824		DEFB	41H
1825		DEFB	4DH
1826		DEFB	45H
1827		DEFB	20H
1828		DEFB	49H
1829		DEFB	53H
182A		DEFB	20H
182B		DEFB	50H
182C		DEFB	52H
182D		DEFB	54H
182E		DEFB	2DH
182F		DEFB	4DH
1830		DEFB	50H
1831		DEFB	46H
1832		DEFB	0DH

5.3.4 SHIFT

[Address]: 66A0

[Function]: Drive the thermal head to shift right.

[Input]: Delay time depends on register B.

[Output]: Printer head shifts to the right.

[Register]: Destroy A,B, only.

Example: Drive the printer head to shift right 1cm.

1800		ORG	1800H
1800	0645	LD	B,45H
1802	CDA066	CALL	SHIFT
1803	76	HALT	

5.3.5 PL INEFD

[Address]: 63C4
[Function]: line feed
[Input]: None
[Output]: Drive the paper vertically by one line.
[Register]: Destory A, B only.

Example: Drive the printer vertically by one line print out the message "LINE FEED" and feed the line twice.

1800		ORG	1800H
1800	CDC463	CALL	PL INEFD
1803	DD212018	LD	IX,1820H
1807	CDAC65	CALL	MTPPRT
180A	CDC463	CALL	PL INEFD
180D	CDC463	CALL	PL INEFD
1810	76	HALT	
1820	DEFB	4CH	
1822	DEFB	49H	
1822	DEFB	4EH	
1823	DEFB	45H	
1824	DEFB	20H	
1825	DEFB	46H	
1826	DEFB	45H	
1827	DEFB	45H	
1828	DEFB	44H	
1829	DEFB	0DH	

5.3.6 PL INE

[Address]: 668F

[FUNCTION]: Drive the paper vertically by two lines.

[Input]: None

[Output]: Drive the paper vertically by two lines.

[Register]: Destroy A, B, only.

Example: Drive the printer to print out the message "LINE" and feed twice.

1800		ORG	1800H
1800	DD212018LD	LD	IX,1820H
1804	CDAC65	CALL	MTPPRT
1807	CA8F66	CALL	PL INE
180A	76	HALT	
1820	DEFB	4CH	
1821	DEFB	49H	
1822	DEFB	4EH	
1823	DEFB	45H	
1824	DEFB	ODH	

Example: The ASCII code 0A is a line feed code, so the following program is the same as the above program.

1800		ORG	1800H
1800	DD212018	LD	IX,1820H
1804	CDAC65	CALL	MTPPRT
1807	76	HALT	
1820	DEFB	4CH	
1821	DEFB	49H	
1822	DEFB	4EH	
1823	DEFB	45H	
1824	DEFB	0AH	
1825	DEFB	0AH	
1826	DEFB	ODH	

VI. Operation Introduction

The PRT-MPF functions should be operated under the monitor control. There are four utilities in the PRT-MPF monitor program as follows:

1. Printer driver utility
[Address]: 65ACH
2. Z80-Disassembler listing utility
[Address]: 6000H
3. Memory dump utility
[Address]: 6300H
4. BASIC program listing utility
[Address]: 6400H
5. Printer line feed
[Address]: 6500H

6-1. Printer Driver Utility

[Address]: 65AC

The following procedures instruct user how to implement the utility in order to print out data in line buffer.

1. Set IX points to the line buffer (the starting address of the line buffer can be printed from the line you appoint).
2. The data length in line buffer could be stretched as you want but each row should be separated by 0AH and the characters in every row can't be more than 20.
3. The end of the line buffer should be terminated by an ASCII code 0DH.
4. The data in line buffer should be ASCII code only (0A, 0D and 20-5F).
5. The ASCII code 0AH stands for line feed.
6. As to the example, please refer to 5.3.3.
7. If users want to use this Driver Utility with another microcomputer system, the system must be Z80 CPU based computer system.

6-2.Z80-Disassembler Listing Utility

[Address]: 6000

This utility can disassemble object code from memory into symbolic Z80 instructions. Starting from a specified address, each byte of memory is disassembled until a valid OP code is decoded. Once a valid OP code is found, the appropriate number of following bytes are disassembled to determine and display the instruction operand. Invalid OP code are indicated by question marks. User can set the memory area in blocks. To abort the disassembly operation at any time press the RESET button of MPF-I.

Example: Disassemble the data of 0000-0040H in memory.

Key	Display	Comments
RS	<input type="text" value="UPF--1"/>	; System reset
ADDR <input type="text" value="6"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/>	<input type="text" value="6.0.0.0.31"/>	; Set the starting address of Z80-disassembler
GO	<input type="text" value="x x x x -S"/>	; S is the mnemonics of the starting address
<input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="0"/>	<input type="text" value="0.0.0.0.-S"/>	; Set the starting address on 0H
+	<input type="text" value="x x x x -E"/>	; E is the mnemonics of the ending address
<input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="4"/> <input type="text" value="0"/>	<input type="text" value="0.0.4.0.-E"/>	; Set the ending address on 0040H
+	<input type="text" value="0.0.0.0.-d"/>	; d is the mnemonics of a reference counter
GO	<input type="text"/>	; Execute the disassembler program
	<input type="text" value="LF"/>	; Disassembler finished. Press any key except the RS, MONI, INTR, USER KEY, the printer will line feed automatically.

[Description]:

1. Suppose the user loads in the wrong parameter i.e. $E < S$, the display appears `[-Err]`.
2. To abort the disassembler operation at any time, press the RESET button of MPF-I.
3. Invalid OP code are indicated by question marks.
4. Numbers in Z80 instruction set are all hexadecimal numbers.
5. Assignment of Module Origins:
d is the mnemonics of reference counter in memory. The linker maintains a reference counter which is similar to the CPU program counter and is used to assign sections of machine code to memory locations. By default, relocatable modules are located in continuous memory areas automatically by assigning the current value of the reference counter to be the module's origin and then incrementing the reference counter by the module's length. If users press the following key `ADDR` `6` `0` `0` `0` `GO`, then the value of d will be set to be zero in this Z80-Disassembly Utility. If users set the value of S and E but not to change the contents of d, then Z80-Disassembly Utility will work from the starting address S. If users change the content of d, then the Z80-Disassembly Utility will execute from the starting address of S but set the program counter beginning with the content of d. For example, mnemonics of S and E are the address of memory expansion area, but mnemonics of d is the reference counter. Users can put BASIC Interpreter into U6 of the PRT-MPF. Set the contents of S and E to be 7000H and 77FFH respectively but set the contents of d to be 2000H, and the result will be the same as putting the BASIC Interpreter into u7 of the MPF-I. Set the content of S and E to be 2000H, 27FFH respectively, and don't change the content of d i.e. keep the content of d to be zero.

6-3. Memory Dump Utility

[Address]: 6300

The memory dump utility can dump specified memory contents. It prints out the hexadecimal contents of the four consecutive memory locations per line, starting at the specified address.

Example: Dump the data of 000-0040 in memory

Key	Display	Comments
[RS]	[UPF--1]	; System reset
[ADDR] [6] [3] [0] [0]	[6.3.0.0.31]	; Set the starting address of program
[GO]	[x x x x -E]	; S is the mnemonics of the starting address
[0] [0] [0] [0]	[0.0.0.0.-S]	; Set the starting address on 0H
[+]	[x x x x -E]	; E is the mnemonics of the ending address
[0] [0] [4] [0]	[0.0.4.0.-E]	; Set the ending address on 0040
[+]	[0.0.0.0.-d]	; d is the mnemonics of a reference counter
[GO]	[]	; Execute the dump memory program
	[LF]	; Memory dump finished. Press any key, the printer will line feed automatically.
[RS]	[UPF--1]	; Return to the monitor program of MPF-1.

1. The display is showing [-Err] if the loading parameters have any mistakes (i.e. $E < S$).
2. If we want to print out only one byte, then the values of S and E must be the same.
3. The usage of d in this section is the same as 6.2.

6-4. BASIC Program Listing Utility

[Address]: 6400

The BASIC program utility can convert the MPF BASIC internal code from memory into symbolic BASIC instructions. It can list out all the BASIC program in MPF-I.

For example: List out the BASIC PROGRAM in the MPF-I. Before executing this utility, users should make sure if it exists some memory of the MPF-I.

Key	Display	Comments
[RS]	[UPF--1]	; System reset
[ADDR] [6] [4] [0] [0]	[6.4.0.0.18]	; set the starting address of Dis-BASIC program
[GO]	[LST]	; Key in number or press [GO] key directly
[GO]	[]	; Execute the Dis-BASIC program
	[BASIC .]	; Dis-BASIC finished, and return to the BASIC Interpreter

1. If there is no BASIC program in memory of the MPF-I, the printer will print out the message 'NO PROGRAM'.
2. When display shows [LST], key in the number, and the printer will print numbers of lines. For example, if you want to print out ten the BASIC instructions, key in the hexadecimal number 0A and press [GO] key, the printer will start to print.
3. When display shows [LST], press [GO] key directly, the printer will print out all the BASIC program.
4. User's BASIC program in MPF-I are terminated by a delimiter code FF if "FF" is detected, the printer will stop printing.

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