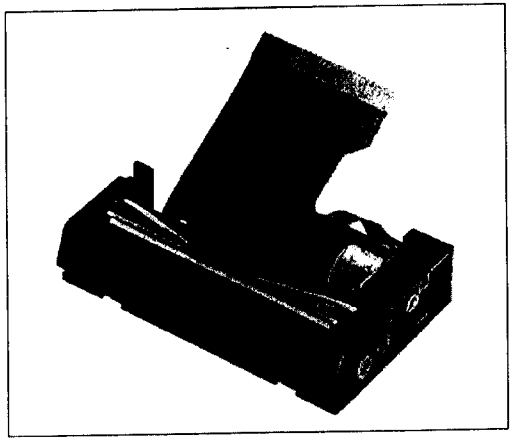
MP 205

Technical reference



1. Introduction

1.1. MP 205

The MP205 thermal printer mechanism is the smallest low voltage printer in the industry. The unique feature of combined lever/spring function offers a very compact solution with easy paper jam clerance.

1.2. MP 205 features

- Very compact printer (height is 15mm, width is 68.2, depth is 41mm)
- Up to 60 mm/s printing speed
- Ultra light (40g)
- Starting operating voltage from 4.2v
- High resolution printing (8 dots/mm)
- Life of 100 millions pulses, 50 kms
- Low consumption
- Low noise due to its technology (thermal)
- Easy jam clearance due to patented lever/spring

1.3. Revision history

Rev.	Date	Page	Revision item
-	02/05/97	-	Preliminary
A	13/08/97	12	FPC connector
B	17/DEC/98	9, 12	Stepper motor – FPC connectors

This manual provides complete information about MP 205 thermal printer mechanism. Further information are available upon request, such as high speed printing applications and reliability figures.

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Advanced Printing Systems

2. General characteristics

ITEM	MP 205 / MP 205S
Printing Method	Thermal dot line printing
Number of dots/line	384
Dots density (dot/mm)	8
Printing Width (mm)	48
Paper Width (mm)	58 +0/-1
Paper feed pitch (mm)	0.125
Paper Feed tension (g)	50 or more
Paper Hold tension (g)	80 or more
Dimension WxDxH (mm)	68.2 x 28(left side)/41(right side) x 15
Weight (g)	Approx 40
Head temperature detection	Thermistor
Head-up detection	No
Paper end detection	Photo-interruptor
Operation voltage range (V)	Dotline: From 4.2 to 8.5 / Logic: 5V+/-5%
Current consumption (A)	At printing: 5 V: 1.9 A (Head) (64 dots ON) 0,5A (Motor) 5V: 50 mA (Head) At paper feeding : 5V: 0,6A(Motor) 5V: <100uA (Head)
Recommended Paper	KF50-HDA or equivalent
Operating temperature range (°C)	0/+50
Operating humidity (RH%)	20-85 (no condensation)
Storage temperature range (°C)	-25/+70
Storage humidity (RH%)	10-90 (no condensation)

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3. Thermal Printhead and printing configuration

3.1. Outlines

Heat element structure	2 heaters/dot
Number of heat elements	384 dots
Heat element pitch	0.125 mm
Print width	48 mm (centered on paper)
Total width	54 mm
Average resistance	142 Ohms +/- 4%

3.2. Maximum conditions at 25°C

ITEM	MAXIMUM CONDITIONS		UNIT
Supply energy (25°C)	0.45	0.7	mJ/dot
Print Cycle (25°C)	2.5	5	ms/line
Logic voltage	7		volts
Supply voltage	8.5		volts
Head Temperature	65		°C
Number of dots to be energized simultaneously[1]	192		dots

1/ If energy above 0.7 mJ is applied to one dot, the print quality of this dot may be affected (usually by making a "light" print-out).
2/ If the print cycle is less than 2.5 ms/line (above 50 mm/s), then maximum supply energy value is decreased. For these applications, please contact APS for further information.
3/ In case of double-ply paper or special low energy paper, please contact APS for further information.

3.3. Typical printing conditions

Supply voltage : 5 volts
Power consumption : 0.123 W/dot
Print cycle : 5 ms (25 mm/s)
Energy per dot, E_0 : 0.31 mJ (from 1 to 64 dots on simultaneously)
Supply current : 3.8 A Peak (192 dots on)

[1] This condition satisfies the print density as defined in section 3.3

Item	Symbol	Electrical conditions	Unit		
Supply voltage	Vh	5.0	V		
Power consumption	Po	0.123	W/dot	64	dots
Print cycle	S.L.T	3.0	ms/line	fired	at the
Energy consumption (on time)	Eo (Ton)	0.36	mJ/dot	5° C	same time
		(2.96)	ms		
		0.31	mJ/dot	25° C	
		(2.53)	ms		
		0.28	mJ/dot	45° C	
		(2.28)	ms		
Supply current	Io	1.9	A		

The print optical density is then 1,0 minimum with a maximum variation of 0,3. This measurement is done at the full black pattern by Macbeth densitometer RD-914. Full black pattern means all dots printing pattern (100% black area) printed under correct paper speed.

3.4. General printing conditions

The following formula allows to calculate the heating time T_{on} depending on driving voltage V_H:

$$T_{on} = \frac{E_0}{P_0} = E_0 * \frac{(N * R_{com} + R_{av} + R_{ic} + R_l)^2}{V_H{}^2 * R_{av}}$$

Where:

E_0 is the nominal energy (0.31 mJ)
V_H is the driving voltage (5 v)
R_{av} is the average resistance (142 Ohms)
N is the number of dots energized simultaneously
R_{com} is the common resistance (0.05 Ohm)
R_{ic} is the driver saturated resistance (15 Ohms)
R_l is the lead resistance (10 Ohms)

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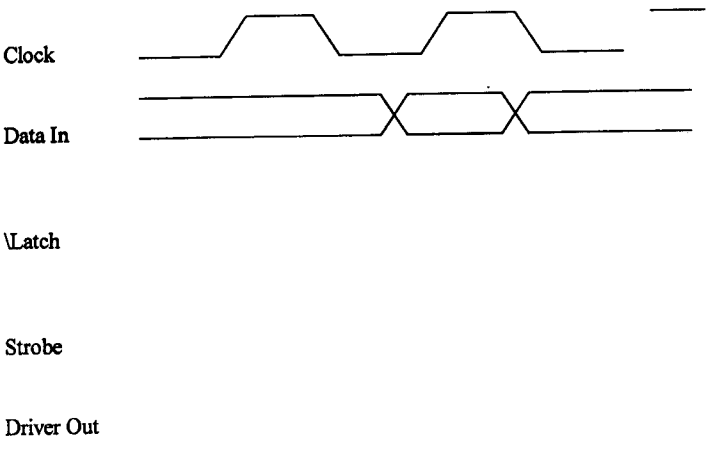
3.5. *Operation precautions*

1/ When continuous printing is performed, the supply energy should be reduced so that the substrate temperature monitored through the thermistor will remain below 65°C.
2/ When the printhead operation is finished, print supply voltage should be reduced to the ground level and remained until next printhead operation.
3/ If printing sound, for example sticking sound, please adjust the paper feed speed or pulse to avoid these kind of mechanical resonnance
4/ In order to avoid surge and voltage drops across power wires, Vh and Gnd cable length should be less than 100 mm, and 47uF aluminium capacitor is required between Vh an Gnd at controller board side.
5/ please pay attention that the paper does not have characterisitcs that could affect the printhead life (high abrasivity, too low sensitivity or abnormal chemicals)

3.6. *Electrical Characteristics*

The following chart gives the timing for driving the printhead:



!!! ATTENTION !!!
In order to prevent any dot element damage, the power on and off sequence must be the following:

- **Turn-on**: Make sure that the printhead voltage is applied simultaneously or after the logic voltage.
- **Turn-off**: Make sure that the printhead voltage is removed simultaneously or before the logic voltage.

The following table gives all the printhead electrical characteristics:

ITEM	SYMBOL	MINI	TYP.	MAXI	UNIT
Print voltage	VH	3.5	5.0	8.5	V
Logic voltage	Vdd	4.75	5.00	5.25	V
Logic current	Idd	-	-	48	mA
Input voltage (High)	VIH	0.8vdd	-	vdd	V
Input voltage (Low)	VIL	0	-	0.2vdd	V
Data input current (DI) High	ILHDI	-	-	0.5	uA
Data input current (DI) Low	ILLDI	-	-	-0.5	uA
STB 1 to 6 input current (High)	IIHSTR	-	-	30	uA
STB 1 to 6 input current (Low)	IILSTR	-	-	-0.5	uA
Clock input current (High)	ILH CLK	-	-	3	uA
Clock input current (Low)	ILL CLK	-	-	-3	uA
Latch input current (High)	IIH LAT	-	-	3	uA
Latch input current (Low)	IIL LAT	-	-	-3	uA
-	-	-	-	-	-
-	-	-	-	-	-
Data out output voltage (High)	VDOH	4.45	-	-	V
Data out ouptput voltage (Low)	VDOL	-	-	0.05	V
Output voltage (driver out)	VOL	-	1.0	-	V
Clock frequency	fCLK	-	-	8	MHz
Clock width	twCLK	30	-	-	ns
Data setup time	tsetupDI	30	-	-	ns
Data hold time	tholdDI	10	-	-	ns
Latch width	twLAT	100	-	-	ns
Latch setup time	tsetup LAT	200	-	-	ns
Latch hold time	tholdLAT	50	-	-	ns
Data out delay time	tdDO	-	-	120	ns
STR setup time	tsetup STB	300	-	-	ns
Driver out delay time	tdo	-	-	5	us

Note: 1/The first bit of data (dot 1) entered is the first bit of data printed (FIFO), left side of TPH, top view (gearing side of the printer).
2/ STB 1 to STB 6 drive one sixth of the printhead, starting from dot 1.

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3.7. *Thermistor*

When performing continuous printing, it is recommended that the supply energy should be reduced so that the substrate temperature monitored through the thermistor will remain below the maximum temperature shown in section 3.2.

The thermistor specification is the following:

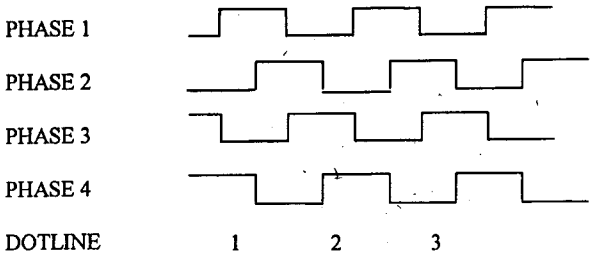
- R25, resistance at 25°C: 30 KOhms +/- 5% at 25°C
- B value: 3950 KOhms +/- 2%
- Operating temperature : -20°C to +80°C
- Time constant: Max. 30 sec (in the air)

Then the resistance value, R, versus temperature, T (in °C), is given by this formula:

$$R(T) = R25 * e^{B*(\frac{1}{T+273} - \frac{1}{25+273})}$$

4. Stepper motor

The paper feed pitch for stepper motor is 2 steps for one dotline (0,125 mm). For good print quality you are advised to keep the current into the windings between two successive dotlines.
The timing diagram is then as follows:



There are four different positions for the stepper motor. The driving is bipolar and can be achieved with circuits like Rohm BA6845FS. Please refer to the IC's data sheet for further informations. It is recommanded not to exceed 0.2v like voltage drop in the stepper motor driver circuit.
The coil resistance is 12 Ohms and rated current is 6500 mA (5 volts) when paper is fed at 20 mm/s.

Note: With a maximum speed of 12 mm/s automatic paper loading can be achieved (with head in down position) at 5V.

In order not to overheat the stepper motor it is required to respect the following ON/OFF ratio for the stepper motor:

Voltage	Max. Paper feed time (mn)	ON/OFF Ratio
< 4.8	-	100 %
4.8	3	90 %
6	2	40 %
7	1.305	35 %
8.5	305	30 %

Additionnal optimization can be achieved by using chopper driving in the stepper motor. To reduce current and potential noise, the current needs to be kept into the windings (slow graphics printout,...). Please contact APS for further information and application nots for continuous printing at 5 volts.

5. Example of printer driving

Although the printer consumption can be maintained at about 2 amperes (peak of current), the following chart gives the maximum characterisitcs for printing speed and paper feed that can be achieved with the MP205 printer mechanism.

		MP 205	MP205
Voltage	Heating Time (ms)	Paper feed (mm/s)	Printing speed (mm/s)
4.2	3.6	15	20
5	2.53	35	30
5.5	2.1	50	35
6	1.75	60	42
6.5	1.49	60	50
7	1.3	60	57
7.5	1.13	60	60
8	1	60	60
8.5	0.87	60	60

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6. Sensors

6.1. Head up and down

The head-up function works as follows. The wire spring that presses the head against the rubber roller can rotate. This in turn releases the pressure against the head and opens it. There is no sensor motoring the position of the spring. Please note that the life of the thermal head will not be affected as the life of the head was originally qualified with the head exposed to the air.

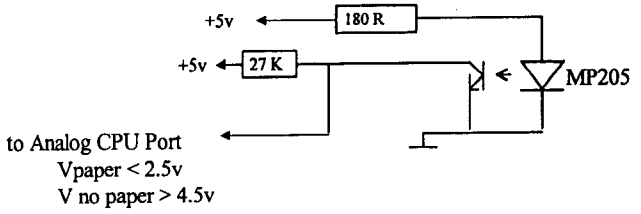
6.2. End of paper sensor

MP 205 has an end of paper sensor that functions using a photo-transistor. Arrange the circuitry so that no energy is applied to the head when the mechanism runs out of paper. If the head is energized in the down position and with no paper in the mechanism, both roller and head may get severely damaged.

General specifications:

ITEM	Symbol	CONDITIONS	Min	Typ	Max	Unit
Forward current photodiode	I_F	V_F= 5v± 5%	-	20	30	mA
Reverse current	I_R	V_r= 5V	-	-	10	uA
Output dark current	I_{CEO}	V_{CE}= 10V	-	-	0.2	uA
Light current	I_L	V_{CE} = 5V I_F = 20mA	90	-	660	uA
Time	T_R	V_{CE} = 2 V I_C = 0.1 mA R_L = 1KΩ	-	30	-	us
Fall time	T_F		-	25	-	us

One possible interfacing is as follows:



7. Pin out assignement

7.1. Flexi-cable connector

MOLEX 39-51-3274 (straight tail) or 34-51-3273 (right angle) = ZIF type (zero insertion force)
JST 27-FE-BT-VK-N (top entry type) or 27-FE-ST-VK-N (side entry type)

7.2. FPC Signals

Only one FPC gathered all the signals to the printer

Pin Number	Signal name	Function
1	CO	Collector of photo-transistor
2	VF	Anode of photo-sensor
3	L_GND	Gnd for logic
4	VH	Dotline voltage
5	VH	Dotline voltage
6	DI	Data input
7	STB6	Sixth strobe
8	STB5	Fifth strobe
9	STB4	Fourth strobe
10	P_GND	Gnd for logic
11	P-GND	Gnd for dotline
12	P-GND	Gnd for dotline
13	P-GND	Gnd for dotline
14	TM	Thermistor first terminal (second in Gnd)
15	STB3	Third strobe
16	STB2	Second strobe
17	STB1	First strobe
18	Vdd	Logic voltage
19	CLK	Serial clock
20	\LAT	Latch
21	DO	Data output
22	VH	Dotline voltage
23	VH	Dotline voltage
24	SM4	Fourth phase of stepper motor A
25	SM3	Third phase of stepper motor B
26	SM2	Second phase of stepper motor ~A
27	SM1	First phase of stepper motor ~B

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8. Life in standard printing conditions

Life is defined as a changein the resistance value of any dots equal to 15% from their initial value.
Head temperature shall not exceed the maximum 60°C with thermistor reading.

Then:

- Pulse life : 100.10^6 Pulses
- Abrasion life: 50 kms guaranteed

9. Mechanical and housing

See attached drawing.

10. Ordering code

Standard MP 205: MP 205