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Interfacing of 2" thermal Printer Mechanism with Micro-Controller

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ABSTRACT
Fujitsu 2" Thermal Printer Mechanism (FTP-628-MCL-004) is ultra compact high speed, battery driven thermal printer, printing on 2-inch wide thermal paper (58mm). The FTP-628 MCL series can be used for a variety of applications, such as portable terminals, POS, ticket issuing terminals, label printers, banking terminals, measurement, medical equipment and ATMs. The interfacing card is planned to be designed using the Phillips P89V51RD2 microcontroller (8-bit µC with 256 Bytes RAM and 32 IOs). Printing data from source can be made input to the interfacing card over Centronic (Parallel), serial or USB channel using the standard data cable connectors. However, printing data from card to thermal printer is sent serially at a rate of 1 Mbits per sec. Dual Full-Bridge Driver L-298 has been used for controlling the stepper motor of the thermal printer. Character size is 16 x 22 dots (W x H) including six dots line gap. There are 384 dots on thermal head. Therefore, 24 no. of characters (24 columns) can be accommodated in a single line printing.
The proposed thermal printer mechanism employs six strobes for firing/printing of dots. For, controlling of temperature of the thermal head, the strobes are connected in three pairs on interfacing card i.e. Strobe – 1 and 2, Strobe - 3 and 4 and Strobe 5 and 6. Each pair of strobes is given 1 msec. of time for firing of dots, and that also maintains the temperature of the thermal head.

KEYWORDS :

1. Introduction

A thermal printer (or direct thermal printer) produces a printed image by selectively heating coated thermochromic paper, or thermal paper as it is commonly known, when the paper passes over the thermal print head. The coating turns black in the areas where it is heated, producing an image. A thermal printer is an inkless, noiseless, fast printer with high resolution dot image (0.125 x 0.125 mm). They are also smaller, lighter and consume less power, making them ideal for portable and retail applications like POS, toll tax booths, bus ticketing and deptt. stores. Any desired pattern/image can be printed because the characters are made using dot patterns.

Printer (or direct thermal printer) produces a printed image by selectively heating coated thermochromic paper, or thermal paper as it is commonly known, when the paper passes over the thermal print head. The coating turns black in the areas where it is heated, producing an image. Two- color direct thermal printers are capable of printing both black and an additional color (often red), by applying heat at two different temperatures.

2. Main Parts of a Thermal Printer

A thermal printer comprises these key components:

· Thermal head — generates heat; prints on paper
· Platen — a rubber roller that feeds paper
· Spring — applies pressure to the thermal head, causing it to contact the thermo-sensitive paper
· Controller boards — for controlling the mechanism

In order to print, one inserts thermo-sensitive paper between the thermal head and the platen. The printer sends an electrical current to the heating resistor of the thermal head, which in turn generates heat in a prescribed pattern. The heat activates the thermo-sensitive coloring layer of the thermo-sensitive paper, which manifests a pattern of color change in response. Such a printing mechanism is known as a thermal system or direct system.

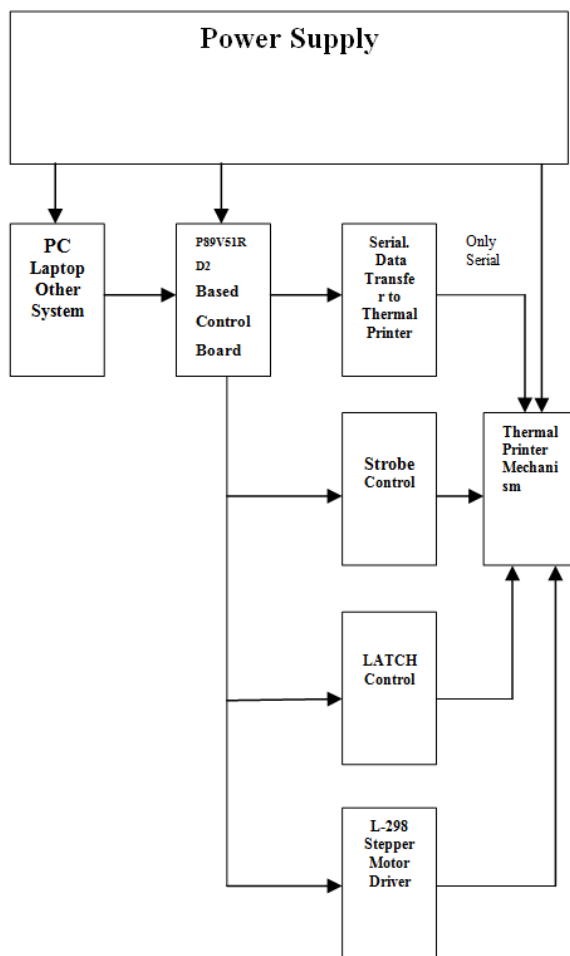## 3. Block Diagram of the System

Figure 1. Block Diagram

The Firmware can manage multiple bar code types, graphics and logos. They enable the user to choose between different resident fonts (also including Asian fonts) and character sizes. Controller boards can drive various sensors like paper low, paper out, door open, top of form etc., and they are available with the most commonly used interfaces, such as RS-232, parallel, USB or wireless. For point of sale application some
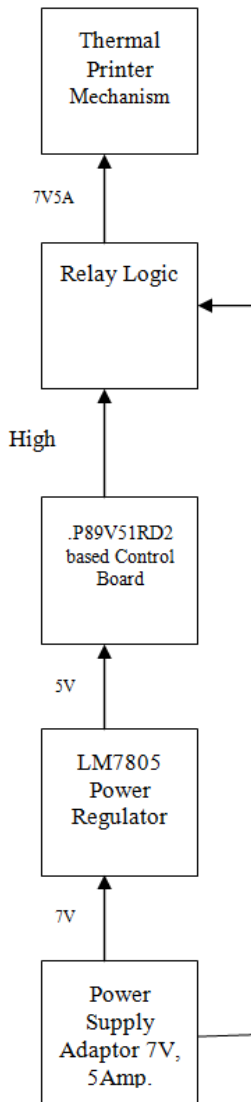
boards can also control the cash drawer.

Figure 2: Control Logic

4. Interfacing Details
The thermal head consists of the heating elements and the head driver to control and drive the heating elements. The serial print data input from DATAIN (DI) synchronize with the CLOCK (CLK) and transferred to the shift register, and stored in the latch register by the LATCH (LAT) signal. Head energizing signal (print command STR 1 to 4) turns the gate on, and the heating element corresponding to the stored data is energized

The power supply requirement for thermal printer mechanism is 4.5 V to 8.5 V with 5 amp. of max. current. For, a power adaptor of 7V, 5 amp. has been used as shown in above figure.

Power Supply adaptor when connected to AC Mains gives 7V at 5Amp. current. This is given to input terminal of power regulator LM7805 to get regulated +5V supply for control board Vcc requirement. The control board controls the relay logic to get 7V, 5 amp. power supply for thermal printer mechanism. The relay logic is formed by using AND gate 74HC08 and transistor BC557 (PNP). This is given in schematic diagram.

5. Stepper Motor Driver
Stepper motor driver is LT 298 IC. It is a 16 pin IC. The stepper motor driver circuit has two major tasks:

• To change the current and flux direction in the phase windings

• To drive a controllable amount of current through the windings, and enabling as short current rise and fall times as possible for good high speed performance.

Item	Specification
Drive system	Bipolar drive
Excitation system	2-2 phase excitation
Step angle	0.8 degrees
Voltage	4.5 to 8.5V
Current	1A

Table 1: Stepper motor Specifications

Switching of the excitation phase in the following order, feeds the paper in the forward direction. At any one time only 2 phases will be on. A, A and B, B will always be opposite of each other this is called 2-2 phase excitation.

Sequence	Signal name			
	A	B	$\overline{A}$	$\overline{B}$
Step 1	Low	Low	High	High
Step 2	Low	High	High	Low
Step 3	High	High	Low	Low
Step 4	High	Low	Low	High

Table 2: Stepper motor sequence

5. Strobes Control
There are six strobes in 2" inch thermal printer mechanism to control 384 dots/heating elements on thermal head. However, they are grouped in three pairs of two strobes each.

µC port pin P2.0 controls Strobe-1 and 2.

µC port pin P2.1 controls Strobe-3 and 4.

µC port pin P2.2 controls Strobe-5 and 6.

Each strobe is given 1.5 msec. ON time in order to get a good print quality. 1.5 msec. ON time is obtained using Timer-0 of microcontroller.

6. Data Transfer, Latch and Printing
Data from µC to printer mechanism is transferred serially over 1 MHz Baud rate using SBUF register of the microcontroller.
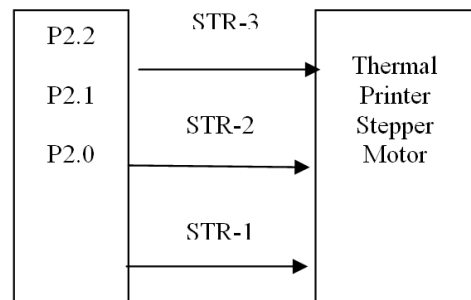

Figure 3: Interfacing Schematic

The sequence of data flow is as follows:
➢ Data from system (PC, ATM, or any other system) is received in control board buffer using parallel, serial or USB mode.
➢ From Control board buffer, the data is sent over serial mode to Data-In register of thermal printer mechanism using SBUF register of µC.
➢ Once one line data i.e. 384 bits are transferred to thermal printer, the LATCH signal is sent.
➢ After LATCH signal, the data is printed by activating the strobe signals followed by motor feeds.
➢ Latch signal is a boundary signal between 2 lines. Latch signal gives the indication to printer for printing the 24 characters. Enable signal indicates motor to move one step forward.

7. Results and Conclusion

The print out of the text from thermal printer mechanism is shown on left side. Characters from 0 to 9, A to Z and all symbolic characters available on standard key board have been generated. Further, any language or other characters may be generated using dot matrix patterns and can be stored in the character array of the program with its ascii code. Better or more dark print outs can be obtained if the strobe timing is increased from 1.5 msec. to 2 msec or more. But this will sluggish the printing and also more current will be required for operation.

The strobe timing however can also be controlled using the thermister resistance readings, which is placed at the centre of the thermal head. However, from experience on thermal printer mechanism, it has been observed that 1.5 msec. strobe timing gives good quality print outs at good speed.
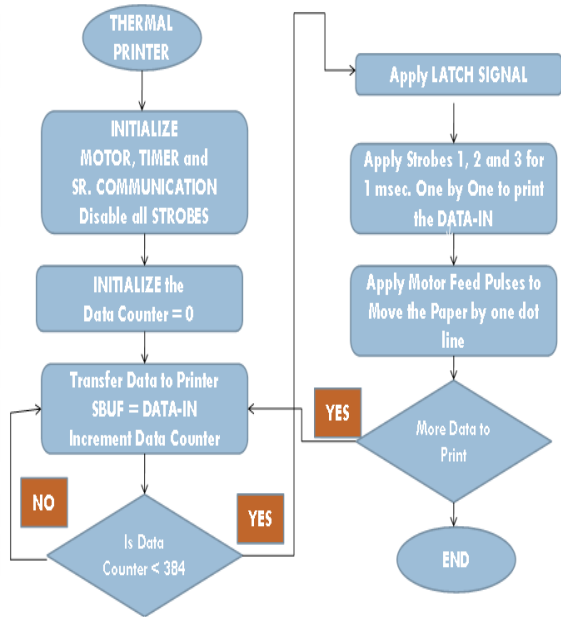

Figure 4: Flow chart

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