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Technical Note

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Electronic Interface for Digital Electronic Printer

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Contents

ELECTRONIC INTERFACE FOR DIGITAL ELECTRONIC PRINTER

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Slow speed low cost digital printers are now commercially available and there is a great need for a low cost electronic interface with a counter. This Note describes such an interface developed at the Physical Research Laboratory, Ahmedabad, for a rotating drum printer.

I. Introduction:

A large number of R & D organisations and industrial houses now-a-days opt for automatic digital printing using digital electronic printers. Most of the rotating drum type digital printers[1] available in the market have a printing speed of around 3 lines/second, and upto 18 columns including 0-9 numerals and special characters like *, @, +, —, etc. The printer generates two signals known as the drum-timing-signals and drum-reset-signals, which have amplitudes of around 0.5 volts p/p. These signals are used to generate various control signals and a character code. The information to be printed is compared with this code to give a pulse at an appropriate time which, in turn, is given to hammers for printing.

II. Principle of operation:

The system, as shown in Fig. 1, comprises a 6-digit pulse counter giving out a parallel 6-digit-BCD output, a digital printer giving drum-timing and drum-reset-signals, a pulse amplifier and a shaping circuit, a character code generator, 4-bit magnitude comparators, 4-bit latches to store the data to be printed, a control signal generator, hammer drivers and a power supply to supply various dc voltages.

The print command signal is given using a single-pole-double-throw switch with a debouncing circuitry[2] to overcome noise interference caused by ON/OFF operation of the switch. On the occurrence of this signal, the 6-digit BCD data available from the counter is latched to the output of the memory and made available to the input of the 4-bit comparators. On the occurrence of the next drum-reset-pulse, all the circuitry is reset and drum-timing-pulses are counted in a 4-bit binary counter. The output of this binary counter (code generator) is used as the other input to the 4-bit comparators which give an output pulse when the condition of equality of all the 4-bits at both its inputs is satisfied. These pulses are then amplified and fed to the hammers through the hammer drivers for digit-printing.

Since only 10 digits (0-9) are to be printed, at the count of the 11th pulse of the code generator all the circuits are reset again and two extra commands are generated. These two commands are the paper-feed and ribbon-feed. The whole sequence is repeated on the occurrence of the next print command signal.

III. System details:

The printer provides two pulse trains, namely, drum-timing-signals and drum-reset-signals. These are generated using magnetic sensors. Both the sensors are fixed on the body of the machine as shown in Fig. 2. There are two rotating shafts connected by gears with a ratio of 13. This means that for 13 rotations of the shaft of the drum-timing-signal the shaft of the drum-reset-signal rotates only once. There are two brass wheels fixed one on each shaft. The reset-signal generating wheel has only one magnet fixed on it, whereas the one generating the drum-reset-signal has two magnets at an angle of about 30°. Therefore, for each rotation of the drum one drum-reset-pulse is generated and 13 pairs of drum-timing-pulses are generated. Each pair of the pulses is synchronized with the position of each character on the drum which has 13 characters on it. The two pulse trains have a p/p voltage of only

0.5 to 0.7 volts and hence are amplified using the transistors T_1 and T_2 shown in Fig. 3. The amplified voltage is then fed to the TTL Schmitt-trigger (U_1). This gives out clean pulses rejecting low amplitude noise pulses. The drum timing-pulse output ($6U_1$) is connected to ($10\ U_{2-3}$) AND gate. The other input ($9\ U_{2-3}$) is from a J-K flip-flop ($9\ U_{3-2}$) and this goes high in the following sequence.

On the occurrence of a print command signal from switch S_1, the clock input of the flip-flop ($1\ U_{4-2}$) goes from high to low, causing its output Q to change to high and $\overline{Q}$ to low. The NAND gate ($U_{15-3,4}$) forms a debouncing circuit and is used to avoid triggering of circuits by noise pulses generated by the ON-OFF operation of the switch. The Q output of flip-flop ($12\ U_{4-2}$) is connected to AND gate ($5\ U_{2-2}$), the other input to this gate being the drum-reset-pulse. Thus the next reset pulse after the occurrence of the print command triggers a monoshot (U_6) and produces a positive pulse of duration around 10 milliseconds. The high to low transition of this pulse triggers the flip-flop ($5\ U_{3-2}$), and its Q output goes from low to high. This enables the drum-timing-pulses to appear at the input of the flip-flop ($1\ U_{3-1}$). This is connected in toggle-mode, dividing the pulses by two.

The pulses thus obtained are then counted in a 4-bit binary counter (U_5) generating a character code for the print cycle.

On the occurrence of the print command at the flip-flop (1 U_{4-2}), its $\overline{Q}$ transition from high to low triggers a monoshot (U_8), generating a 1-millisecond pulse. This is then fed through the inverters/drivers (U_{9-1}, U_{9-2}) to the clock input of the latches (U_{24} through U_{29}), which in turn make a 6-digit information available to the comparators (U_{18} through U_{23}). The output of the code generator is fed to the comparators (U_{18} through U_{23}) via inverters and drivers (U_{10}, U_{11} and U_{12}). When the 4-bit input to the comparator from the memory side becomes equal to the 4-bit input from the character code generator, it gives out a pulse. The outputs of the comparators are connected to the AND gates (U_{30}, U_{31-1}), the other inputs to these AND gates being from $\overline{Q}$ of the flip-flop (8 U_{4-1}) through the inverter/driver (U_{7-2}). The outputs of these AND gates are connected to the hammers of the printer through the transistor drivers (T_3 through T_{14}). Most of the printer hammers operate with voltages between 15 and 25 and, therefore, transistor driver circuits are imperative for the hammers.

Since the printer has to print 10 digits (0-9), all the circuits are reset at the code generator count of 11. The reset circuitry uses NAND gate ($U_{7-1, 15-1, 2}$)

and monoshot (U_{14}). The NAND gate (U_{7-1}) output triggers another monoshot (U_{16}) which generates a pulse of duration around 0.5 microsecond. This pulse through the inverter (U_{13-2}), using transistor drivers (T_{15} to T_{18}), commands the paper-feed and ribbon-feed. To ensure the reliability of the printing cycle, each reset signal from the Schimitt-trigger (8 U_1) triggers a monoshot (U_{16}) generating a pulse of duration around 0.5 microsecond. This pulse resets all the circuits except the flip-flop (U_{4-2}) which actually starts the print cycle. Provision is made using a slide switch S_2 for automatically printing the counter data in case the counter has a print command output available.

The timing waveforms for the interface system are shown in Fig. 4. It is assumed that one of the digits to be printed is "5". The comparator output is shown when the output of the 4-bit character code generator is also "5" (Binary 0101). Reset, paper-feed and ribbon-feed signals are also shown.

IV. Conclusion:

An electronic interface system has been developed which has limitations of printing speed because each print cycle starts with the occurrence of a drum-reset-signal. However, for most commercial applications this speed is adequate. For slow speed data acquisition systems such as the α , β , γ and X-ray spectrometry for naturally occurring radioactive isotopes, Fabry-Perot interferometry etc. such an interface is most suitable.

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References

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2. Gray E.W. "Interface Circuitry Eliminates False Pulses" Popular Electronics, October, 1975.

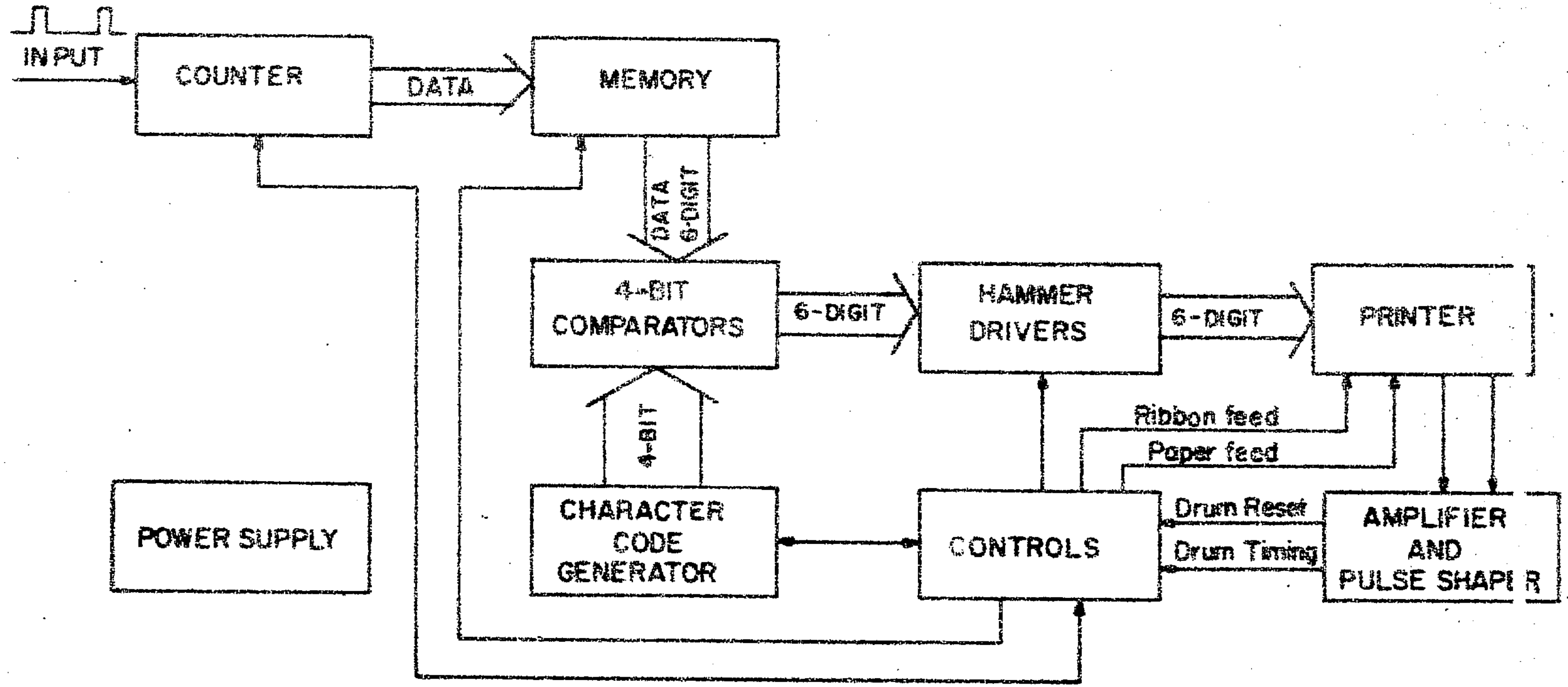

Fig. I – BLOCK DIAGRAM OF ELECTRONIC INTERFACE FOR DIGITAL ELECTRONIC PRINTER.

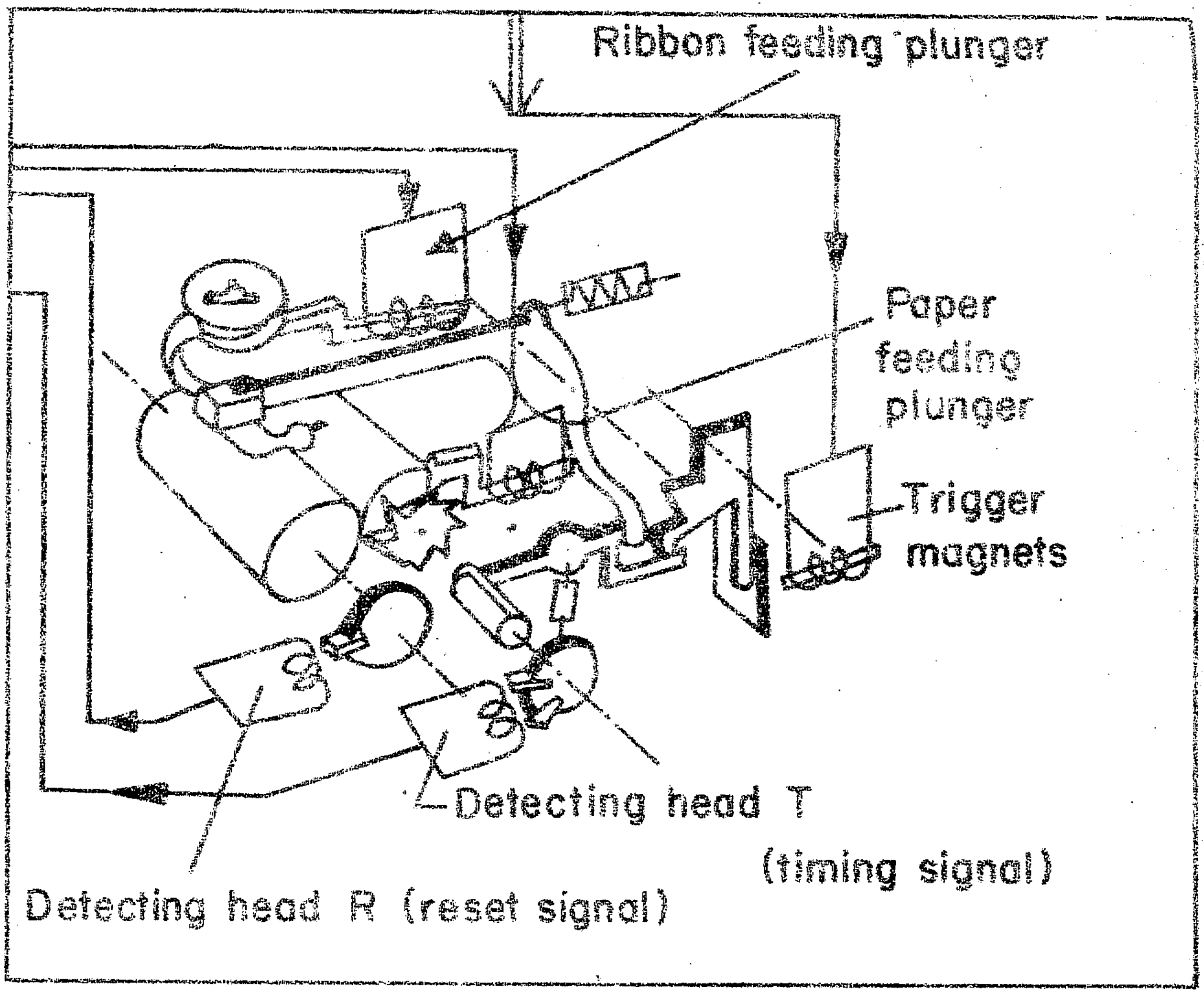

FIG. 2: DRUM RESET AND TIMING SIGNAL GENERATION

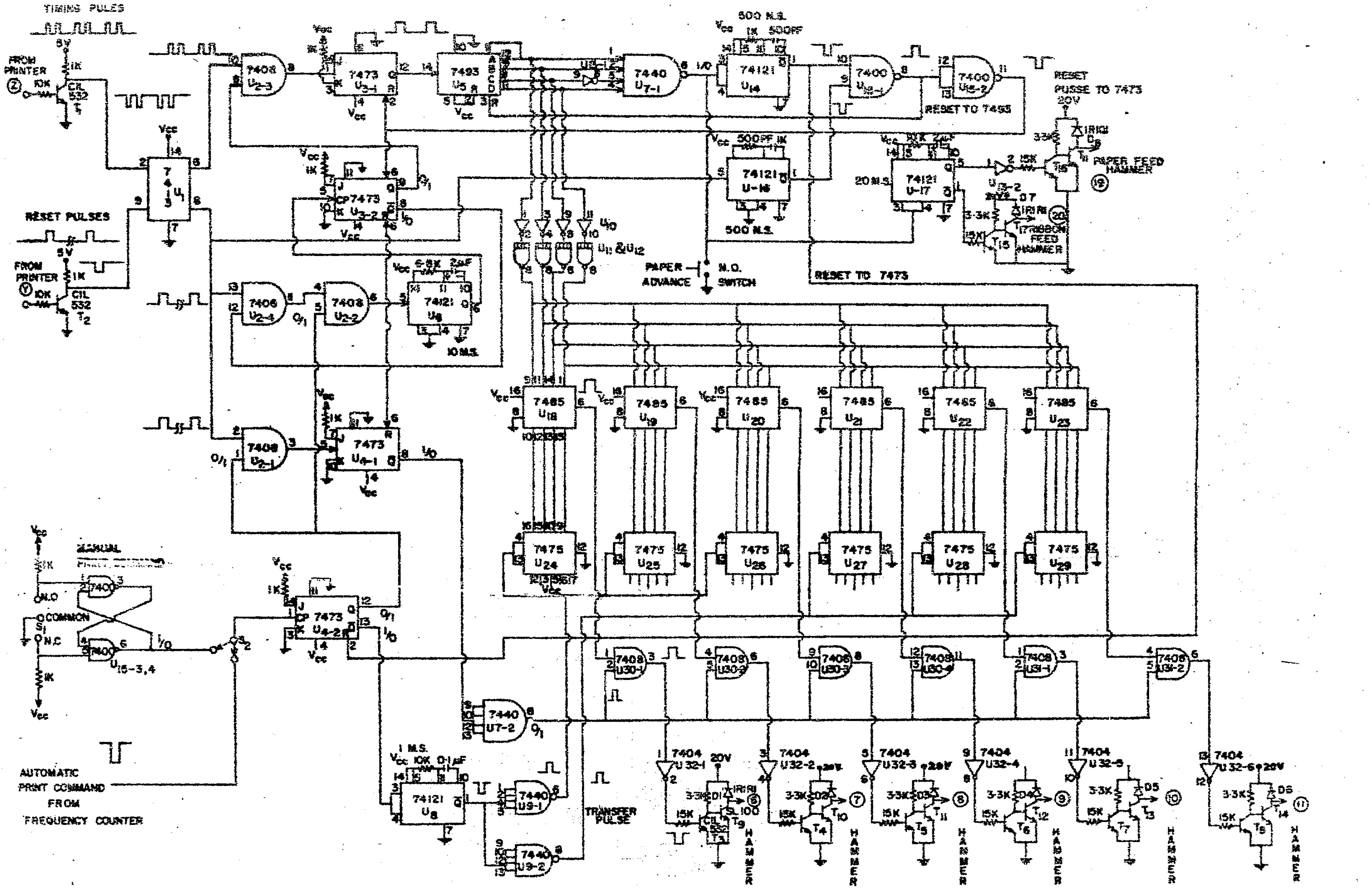

Fig.3 CIRCUIT DIAGRAM FOR ELECTRONIC INTERFACE FOR DIGITAL ELECTRONIC PRINTER

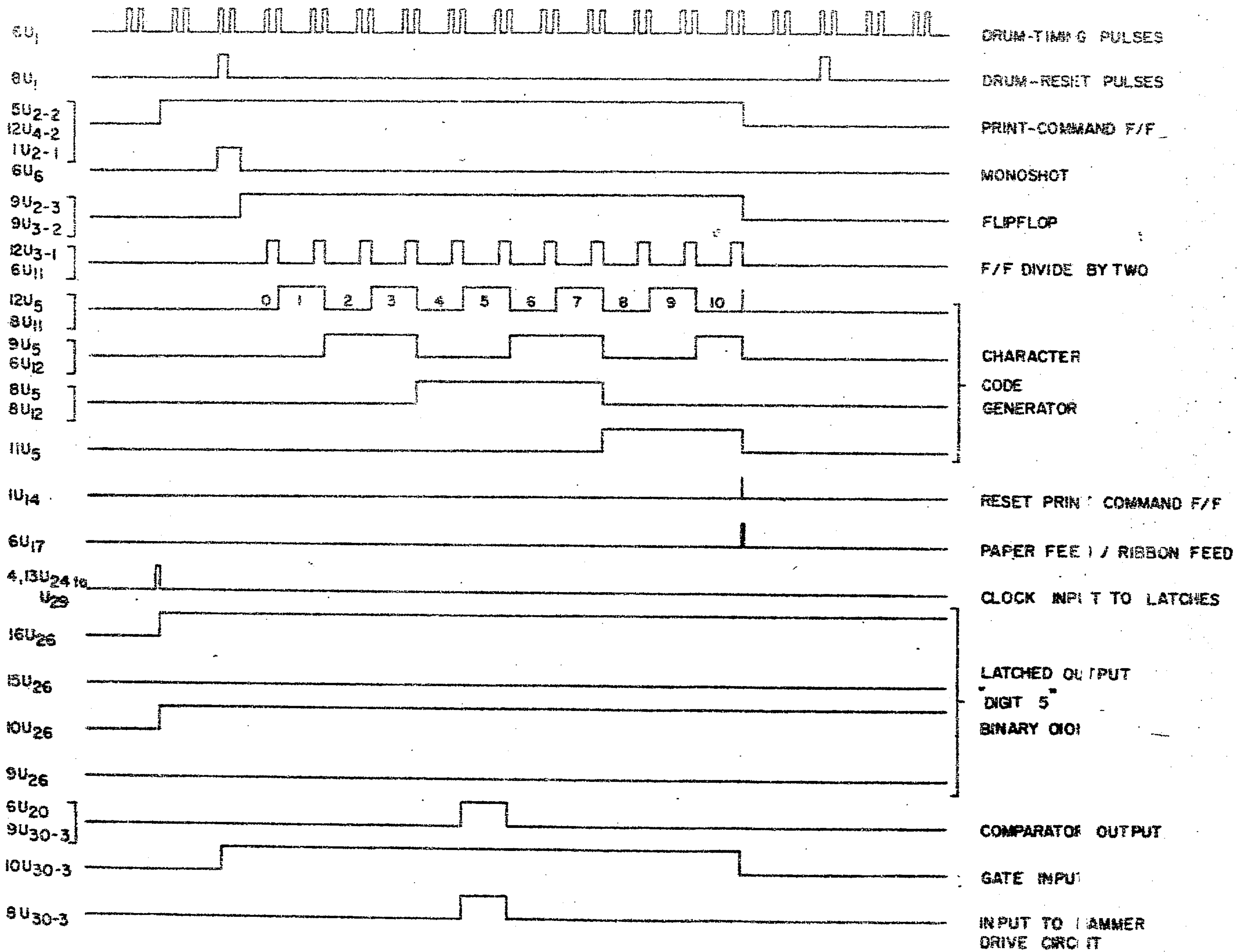

Fig.- 4 TIMING WAVEFORMS OF ELECTRONIC INTERFACE FOR DIGITAL ELECTRONIC PRINTER.