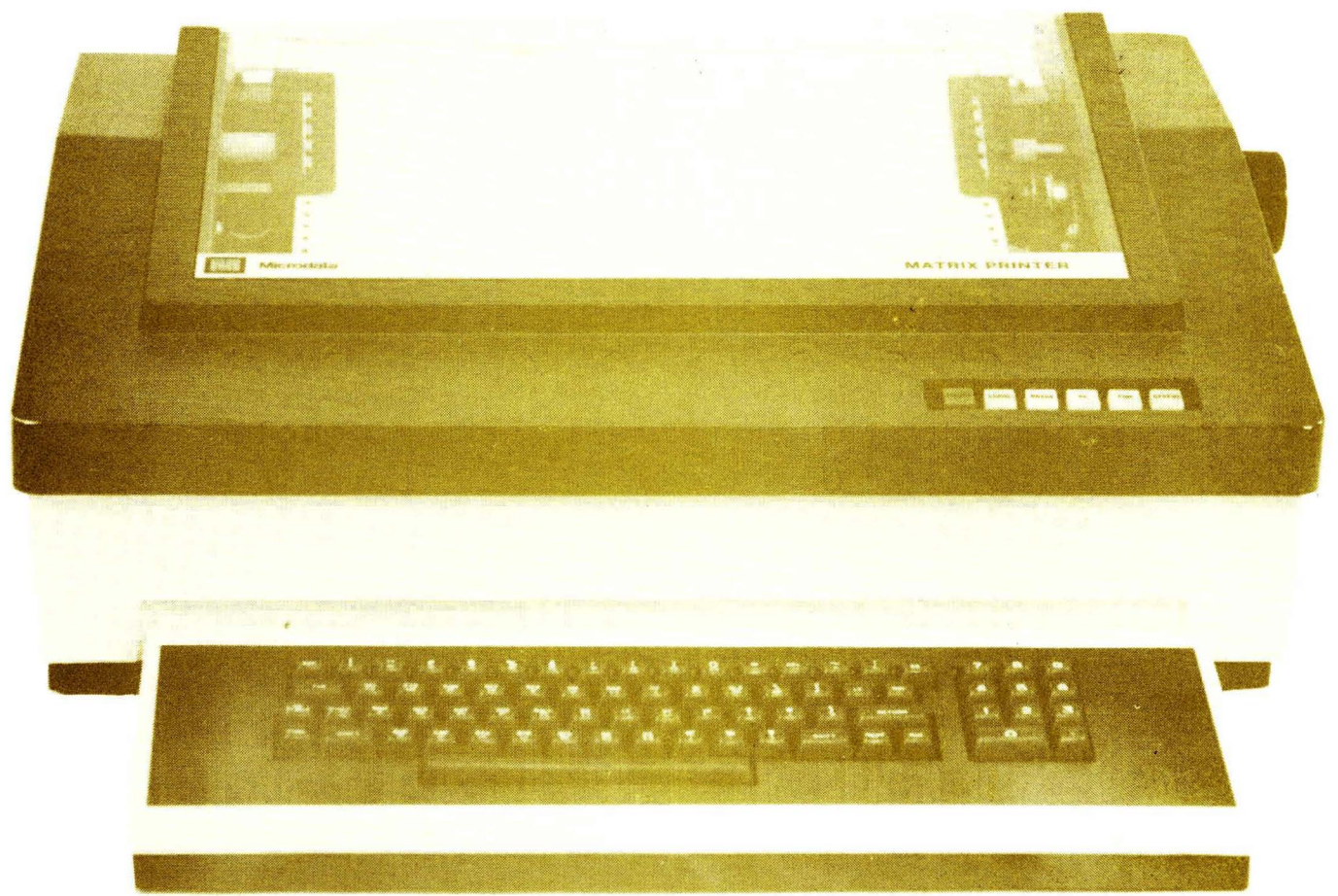


Technical Manual

MATRIX PRINTER



Technical Manual

MATRIX PRINTER

MANUAL NUMBER

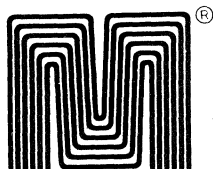
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Customer Service Training

FORWARD TO THE MATRIX PRINTER MAINTENANCE MANUAL

Chapters 1 through 4 of the Matrix Printer Technical Manual have been previously published as an Operator's Manual. Chapters 5 and 6 are here in the Maintenance Manual.

Together, the Operators and Maintenance Manuals constitute a complete Matrix Printer Technical Manual.

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SECTION 5

THEORY OF OPERATION

INTRODUCTION

This section provides a description of the mechanical operation and electronic functions of the Microdata Matrix Printer. The electronic level of detail is prepared to the functional block and circuit level, and is conducted on a signal flow basis. Photographs, line drawings, timing diagrams, functional block diagrams and simplified circuit schematics are used to support the text.

The Printer is capable of printing the maximum 132-character line at an average speed of 69 lines per minute. A character is printed as a unique combination of dots in a 12 x 7 dot matrix. A block diagram of the printer is shown in Figure 5-1. All operations of the printer are performed under the control of an internal microprocessor. It provides supervisory control for all other parts of the printer.

Physical description

The printer is physically and functionally divided into two sections:

- (1) The electronics module
- (2) The mechanical module

The printer functional block diagram is shown in Figure 5-2.

1. Electronics Module

The electronics module consists of the power supply/amplifier boards, the I/O board, the CPU board, the servo board, the data board, and the mother board.

a. Power Supply/Amplifier Board

The power supply provides both regulated and unregulated voltages for use throughout the printer. The regulated voltage supplies are equipped with over-voltage sensing circuits. The driver circuits for the carriage, paper feed tractors, and ribbon drive motors are located on this board.

b. I/O Board (either Serial or Parallel)

The serial I/O board provides the required hand-shaking signals for direct interface with an RS-232 modem. Input data is received in serial form and is converted into parallel by the UART housed on the board. Input information from the keyboard passes through the serial I/O board, under control of the microcomputer on the printer CPU board. This board also provides the optional HERE IS (answer back) data, which is converted into serial form for transmission to the modem.

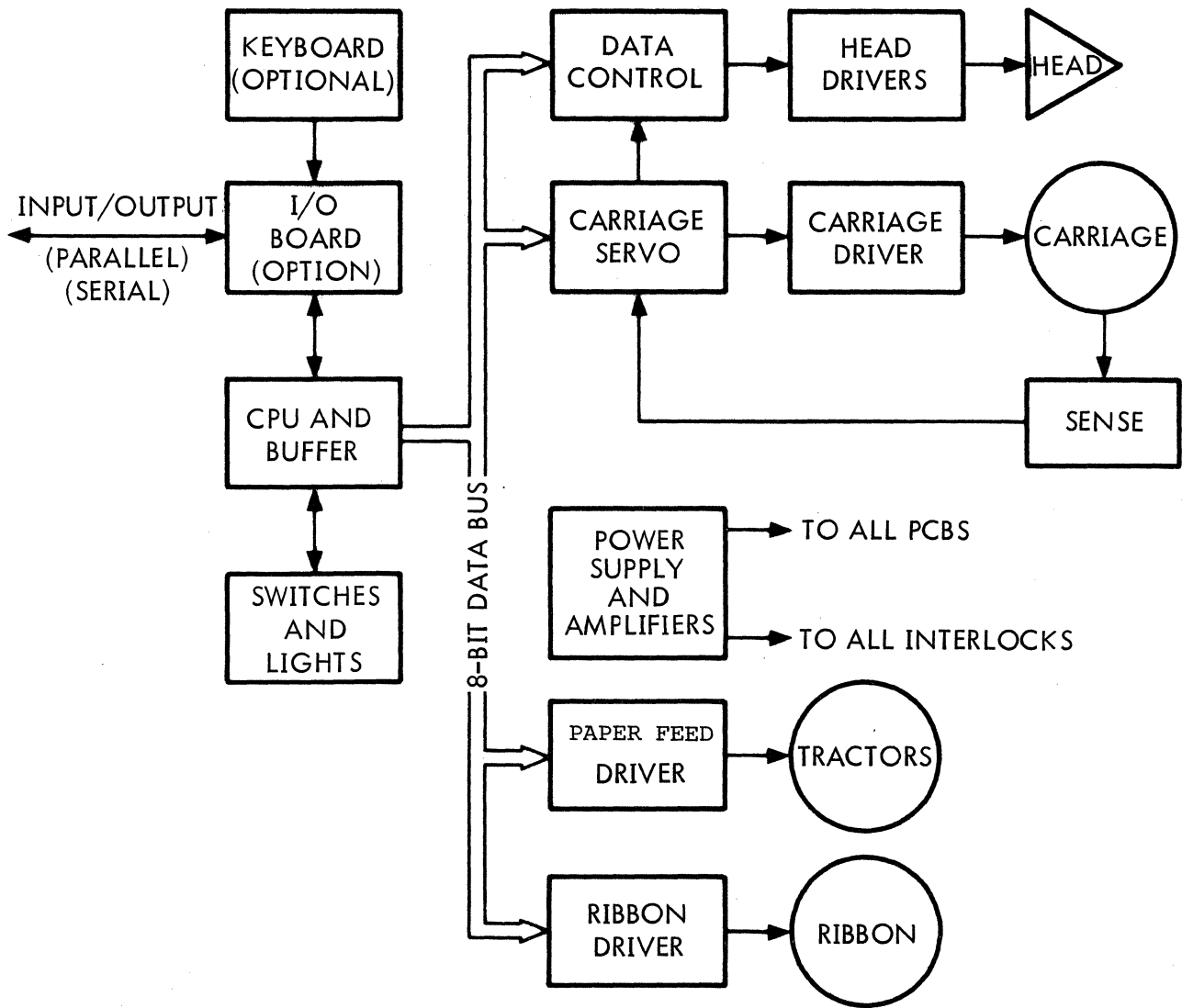


Figure 5-1. Printer Block Diagram

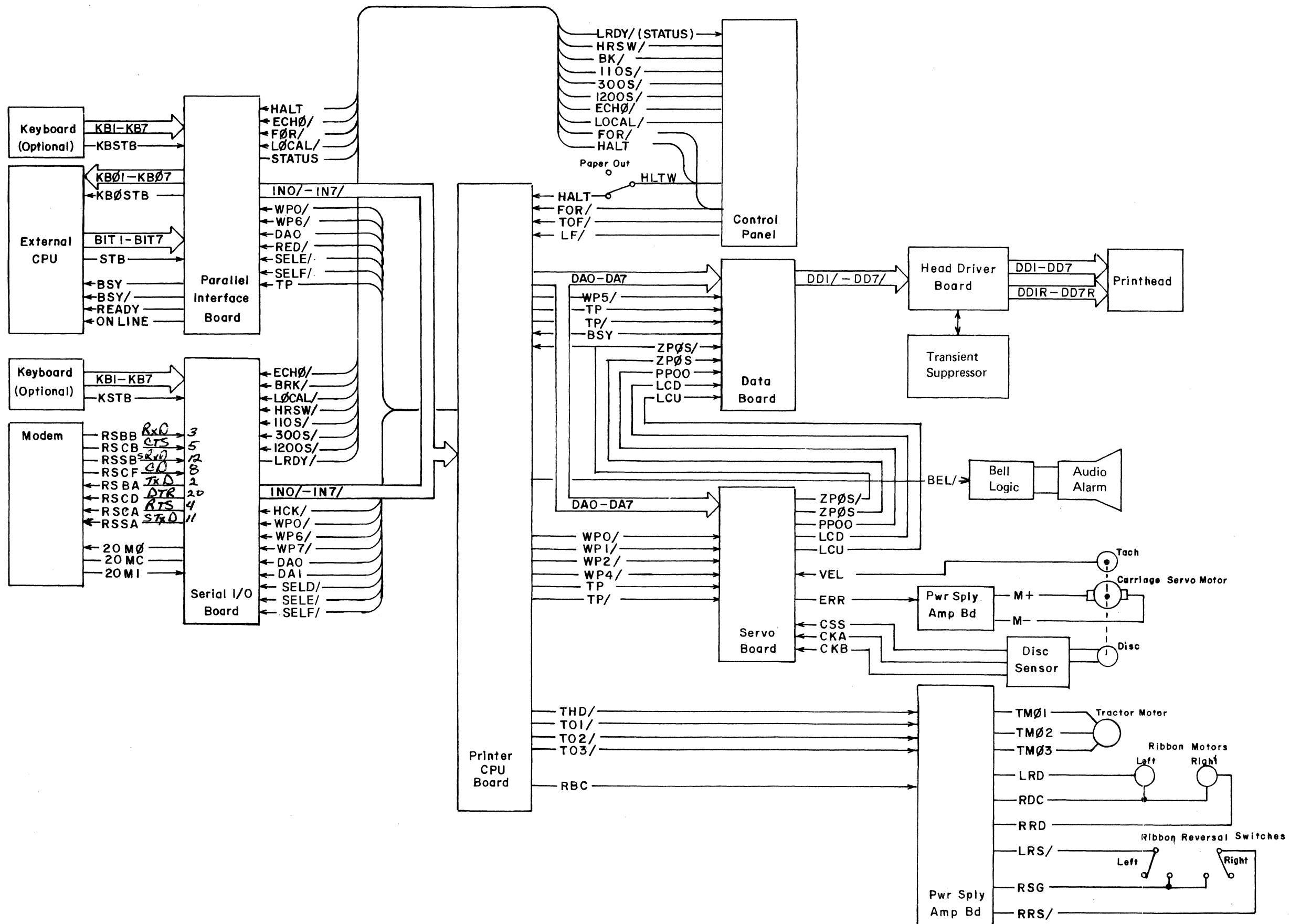


Figure 5-2.
Printer Functional
Block Diagram

The parallel I/O board provides the hand-shaking signals to interface with an external processor. Industry standard interfaces are provided and the board also provides interfacing logic for an optional keyboard.

c. CPU Board

The CPU board is the control unit for the printer. This board contains the microcomputer, control program memory, timing logic, and character buffer. The buffer has storage for 320 characters and 40 bytes of format data.

d. Servo Board

The servo board logic controls the carriage movement via signals to the carriage driver circuits mounted on the power supply/amplifier board. This board also monitors the carriage position and provides the data board with appropriate information.

e. Data Board

The data control section located on the data board buffers the characters to be printed, decodes the character into its dot matrix format and provides appropriate signals to the head drivers for subsequent printing by the head.

f. Mother Board

The mother board provides for interconnection between the electronics module and the mechanical module.

2. Mechanical Module

The mechanical module consists of the control panel, carriage drive and guide mechanisms, ribbon drive and control, and the paper feed drive.

a. Control Panel

The control panel houses the switches and indicators necessary for the operation of the printer.

b. Carriage Drive and Guide Mechanisms

The carriage drive mechanism provides lateral motion and guidance for the printhead. Carriage movement is controlled by the servo logic. The guide mechanism includes a sectored disc that feeds position and velocity information to the servo board. Other major elements are the platen and mounting for same, a lead screw driven by the carriage servo motor, the printhead and its head driver board. Printing is accomplished by causing appropriate dots in 12 x 7 matrix to be printed by the printhead. The head driver board houses the driver circuits that control the current flow through the printhead solenoids. Activating signals for the driver circuits are generated on the data board.

C. Ribbon Drive and Control

The ribbon drive consists of two motors, reversal switches, and mountings for the ribbon. Control is by the CPU board via the power supply board. The ribbon drive causes motion and maintains tension of the ribbon.

d. Paper Feed Drive

The paper feed drive consists of the tractor motor and two tractors. Control is by the CPU board via the power supply board. The paper feed drive provides paper motion in either direction in various size steps.

POWER SUPPLIES/AMPLIFIERS

The power supply logic board performs several functions in addition to supplying the required levels of power for circuit operations. The board contains all servo amplifiers, ribbon driver circuits, and the interlock circuit. The regulated supplies are equipped with overvoltage sensing circuits. The unregulated and regulated supplies are monitored for undervoltages. Figure 5-3 provides a simplified block diagram of the power supply outputs.


The incoming AC supply is fused at 3A and applied to the primary of transformer T1 through the POWER ON switch. Note that the cooling fan must be connected in order to complete the circuit.

The necessary AC voltages are provided by the secondaries of transformer T1. Diode bridge CR1 provides the regulated +5V and the regulated +12V along with the interlock (ILK) voltage. The -VHD output of bridge CR2 supplies the transistor drivers for the printhead solenoids. The tractor drive is supplied by -TD. Diode bridge CR3 supplies the voltages for use by the carriage servo motor (+MV and -MV). Diode bridge C4 supplies the regulated -10V.

The current drive for the paper feed tractor stepping motor is supplied by an amplifier on this board. The amplifier is designed to provide full drive current of approximately 1.4A to the motor for motion or 0.5A for holding current.

The power supply board also contains the power amplifier for the carriage servo motor. This is a linear amplifier with current feedback and a deadband. The gain of the amplifier is 3.3A per volt; this provides the torque supplied to the servo motor. The current is limited to +7A by a current clamp.

The interlock for the servo amplifier is located on the power supply logic board. The interlock circuit provides a signal that either cuts off or turns on certain transistors and clamp diodes; this turns the servo amplifier on or off. The ribbon drive circuit consists of two triacs and a direction flip-flop. The AC power is referenced to the power supply circuit so that the ribbon drive may be turned off by the interlocks.

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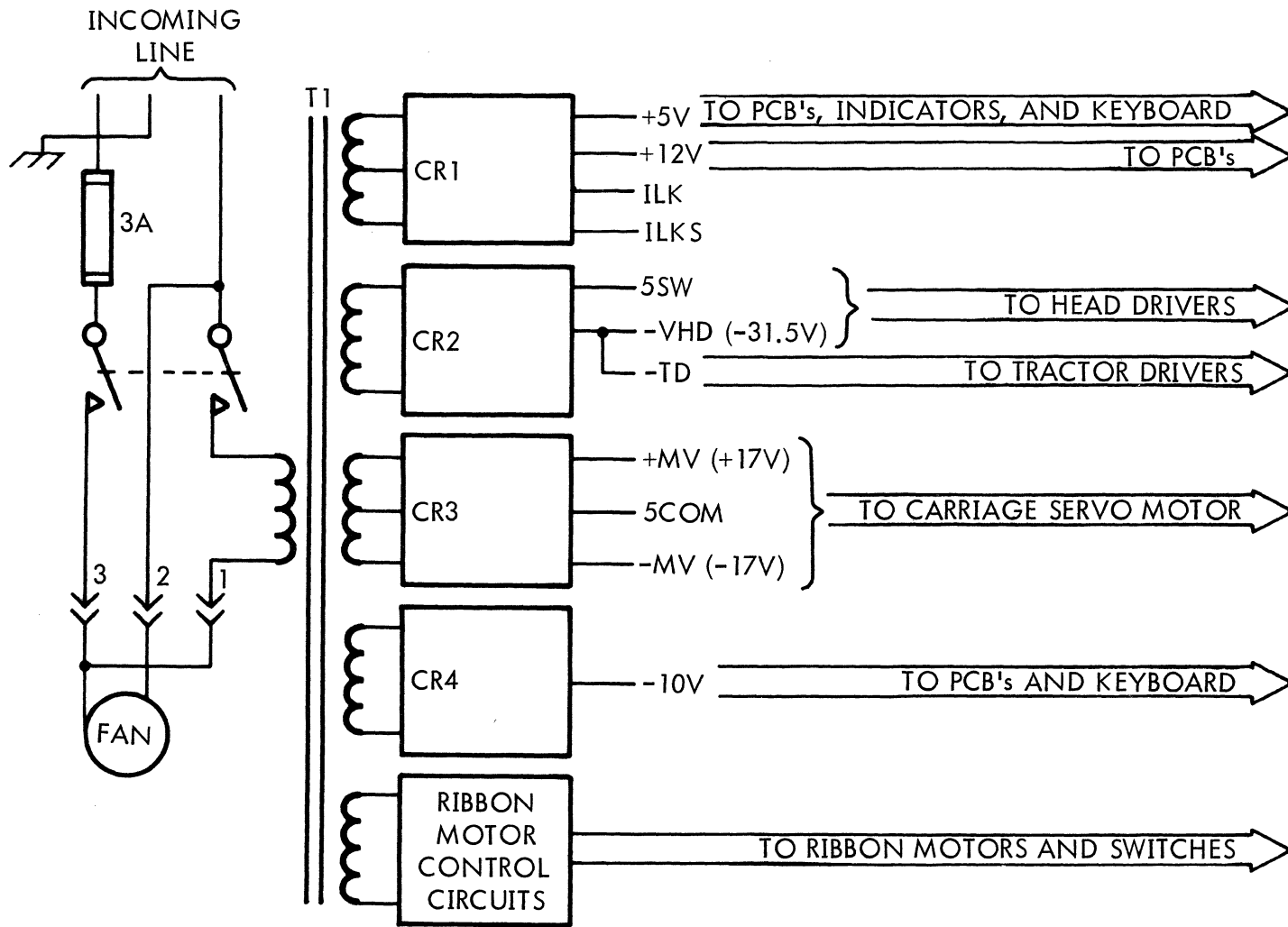


Figure 5-3. Power Supply Outputs

Power Supply

The power supply circuit provides the various required voltages for the printer.

1. +5V

Rectification for the +5V supply is provided by two of the four diodes in bridge CR1. Regulation of the +5V is performed by Z2, Q6 and the associated circuitry (see Figure 5-4). The circuit provides 3A of current. Overvoltage or crowbar protection is provided by SCR Q1, transistor Q19 and Zener diode CR30 along with their associated resistors and capacitors. If the circuit crowbars because of excessive current demand, operation of the circuit can be restored only by turning the power off and restarting.

2. +12V

The other half of bridge CR1 provides the raw +14V for the +12V regulated supply. After passing through blocking diode CR5, the raw voltage is filtered and then regulated by Z1. The +12V supply provides up to approximately 100 milliamps of current (see Figure 5-4).

3. Interlock Source


The raw +14V used for the +12V supply is also used for the interlock circuit. After filtering, this voltage becomes the interlock source (ILKS). ILKS is connected to +ILK through normally closed interlock switches. If the incoming power fails, or if the interlocks are opened, the base of transistor Q3 is driven toward ground because of the -MV voltage supplied through resistor R12. This causes low +ILK voltage for the carriage motor's servo amplifiers and disables the servo motor (see Figure 5-4).

4. -VHD and -TD

These voltages are supplied by CR2. CR2 provides -31.5V in reference to ground. The -VHD supply is used to supply the head driver board which in turn supplies the printhead solenoids. The -TD supply is for the paper feed tractor motor. The 5SW supply is referenced 5V above ground by the action of zener diode CR9 and transistor Q2 (see Figure 5-4).

5. +MV and -MV Power

This supply is referenced to the +5V supply through the use of the center-tap of the transformer secondary. The +17V and -17V outputs (relative to +5V) supply the driver circuits for the carriage motor (see Figure 5-5).

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6. -10V Supply

The -10V power supply is a 15V regulated supply that is referenced to the +5V supply. It is designed to deliver 2A of current and it has overvoltage protection. Regulation is provided by Z3, transistor Q7 and their associated circuits (see Figure 5-5).

Power Amplifiers

The power supply contains the power amplifiers for the carriage servo and the paper feed tractors. The ribbon drive circuit is also located in the power supply.

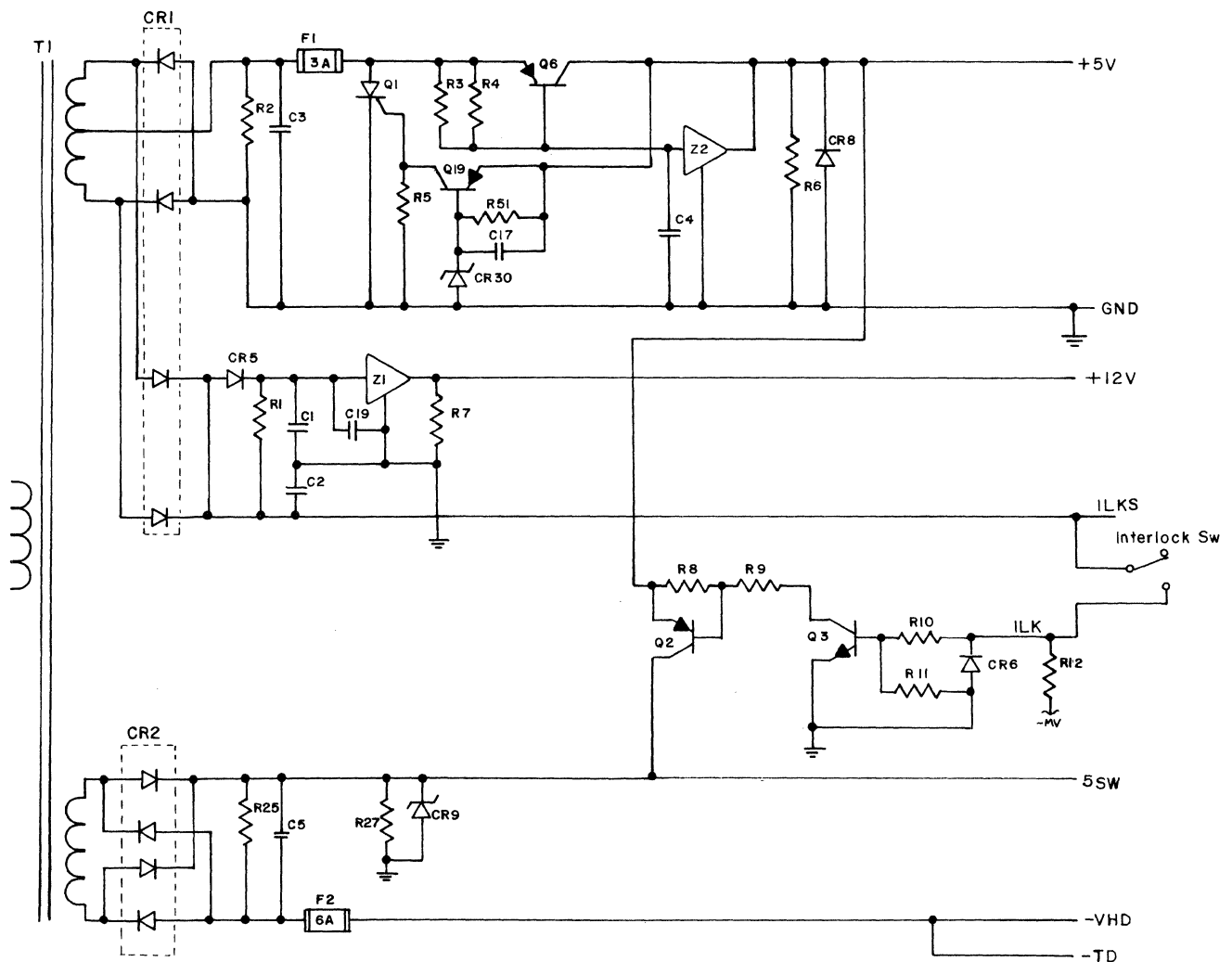


Figure 5-4. +5, +12, ILKS, -VHD, and -TD Supplies

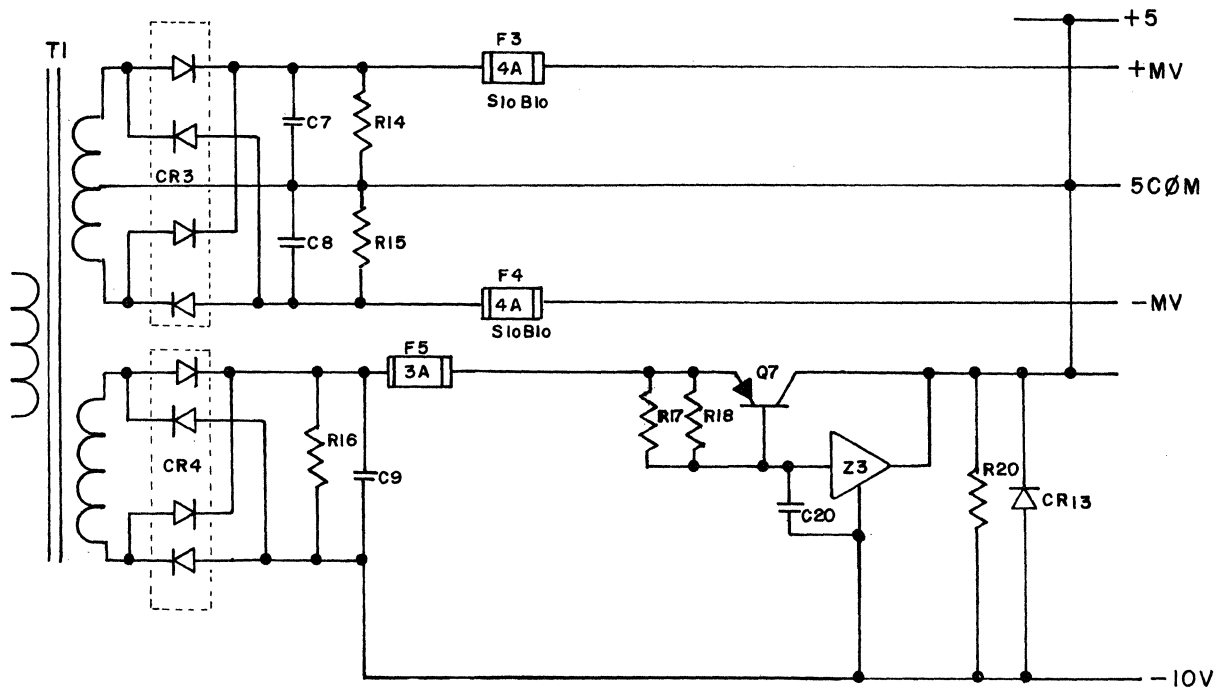


Figure 5-5. +MV, -MV and -10V Power Supplies

1. Carriage Servo Amplifier

Basically this amplifier is linear with current feedback and has a deadband. A current clamp is provided that limits the current to +7A. The current clamp is formed by diodes CR14 and CR15. These diodes become forward biased when 7A or greater is drawn by the servo motor. With R32 switched out of the feedback circuit, total circuit gain is attenuated accordingly to limit the output to the servo motor (M-) to +7A.

The ILK term provides the interlock for the servo amplifier. If ILK is high, Q16 and Q17 are cut off. Clamp diodes CR24 and CR25 are then reverse biased and the base drive to Q10 and Q12 is unaffected. If ILK falls, transistor Q17 turns on causing Q16 to turn on. The clamp diodes become forward biased, cutting off the base drive to Q10 and Q12. These then turn off the servo amplifier (see Figure 5-6).

2. Paper Feed Tractor Amplifier

This amplifier provides the current drive for the paper feed tractor stepping motor. It is designed to supply full drive current of about 1.4A to the motor when THD/ is high, or the holding current is about 0.5A when THD/ is low. THD/ is generated on the printer CPU board.

When T01 from the printer CPU board goes to ground, transistor Q20 is turned on provided power supply 5SW is at 5V is at 5V (interlocks in place). If THD/ is high, there is sufficient base drive to saturate Q20. The current is limited only by R50 and the resistance of the motor winding, so 1.4A are supplied to tractor motor phase 1. If THD/ is low, transistor Q18 is turned on, supplying emitter current to Q23. Transistor Q23 turns on when there is about 0.7V drop across resistor R50. The collector of Q23 then absorbs part of the base drive to Q20, holding the current supplied to tractor motor phase 1 to approximately 0.5A, the holding current level. See Figure 5-7.

3. Ribbon Drive

The ribbon drive consists of triacs Q8 and Q9, and direction flip-flop Z4. The AC power is referenced to the 5SW term so that the ribbon drive may be turned off by the interlocks. The ribbon drive circuit is controlled by the microprocessor. When no ribbon motion is desired, both Q8 and Q9 are enabled, providing drive to both ribbon motors, which turn in opposite directions. With drive to both motors, the ribbon does not move and tension is maintained. When motion is desired, current is maintained to the motor of desired direction, and disabled to the other motor (see Figure 5-8).

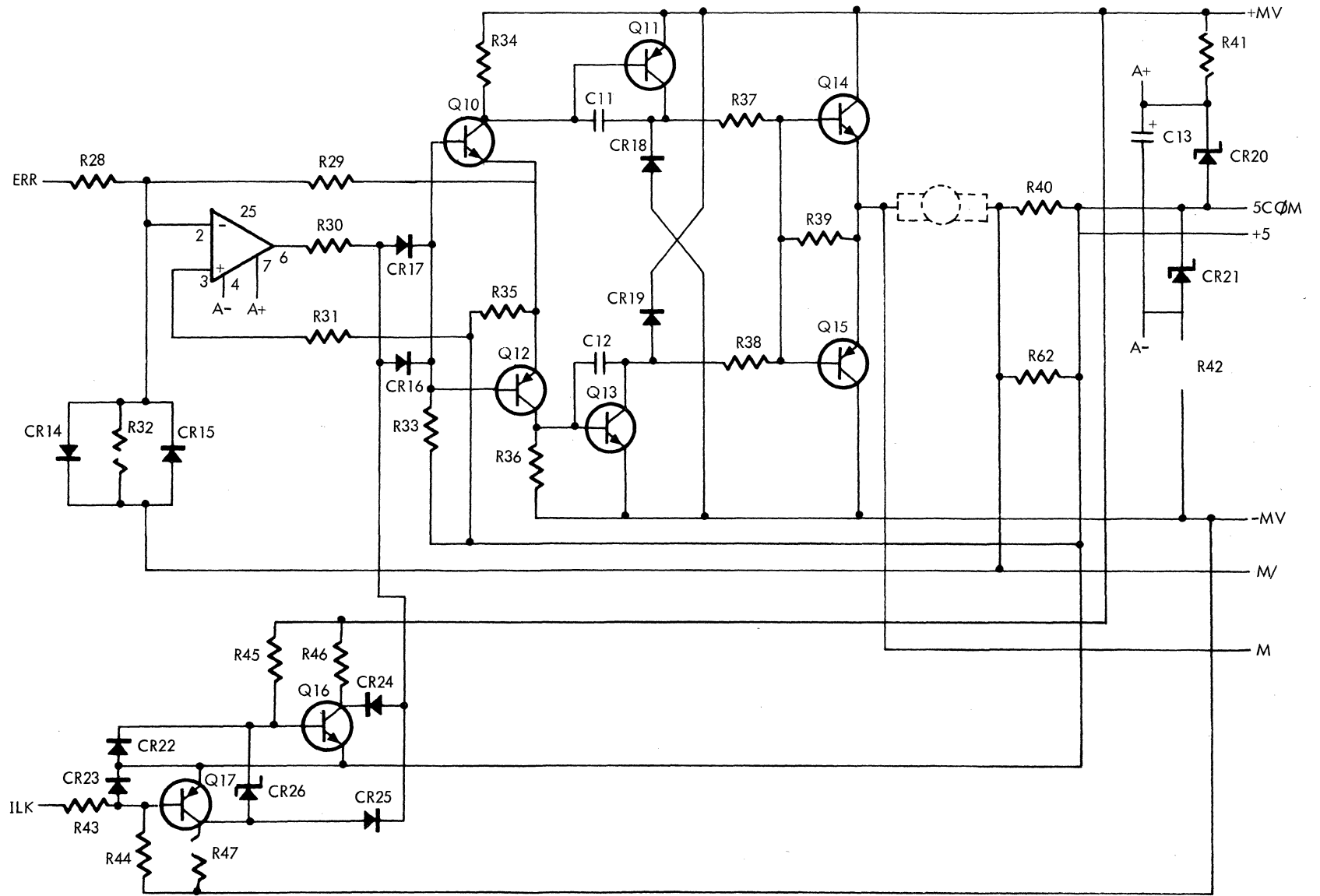
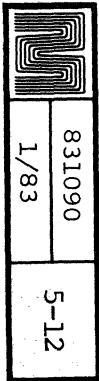


Figure 5-6. Carriage Servo Amplifier

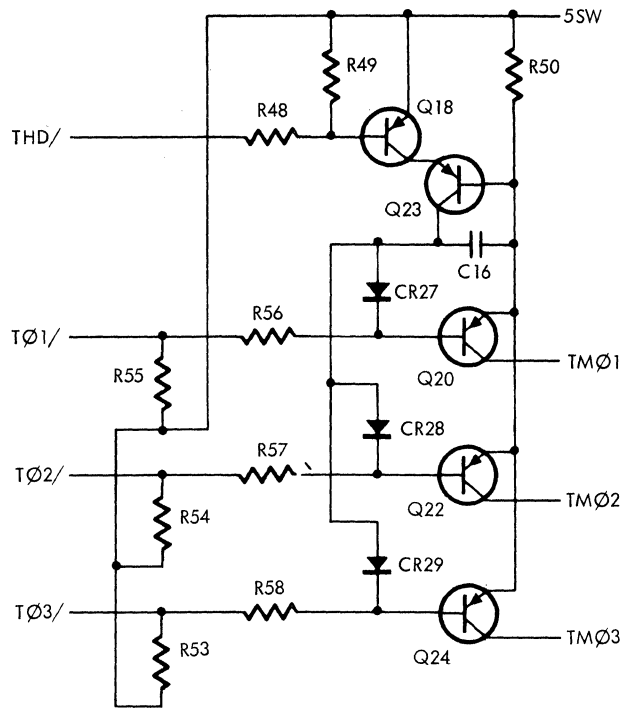


Figure 5-7. Paper Feed Tractor Amplifier

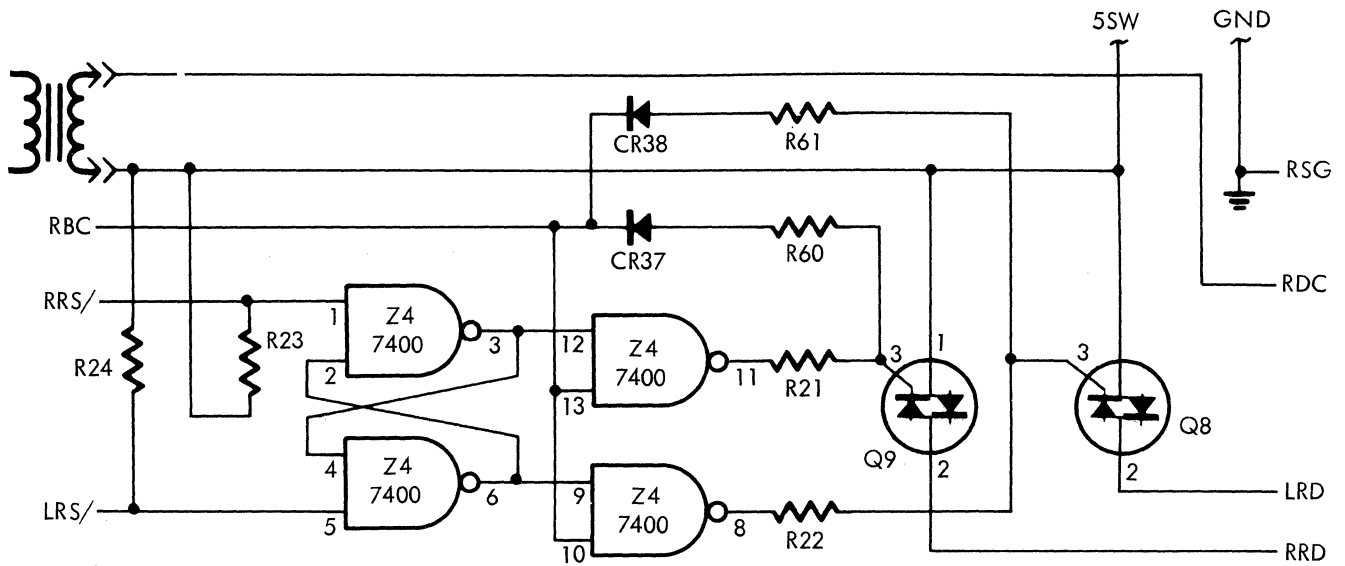


Figure 5-8. Ribbon Drive Circuit

PRINTER CPU BOARD

The printer CPU board provides all control logic for the programmed printer functions. It is organized basically as a microprocessor, complete with a central processing unit (CPU), I/O bussing, timing, working memory, and program memory. A block diagram of the control logic is provided in Figure 5-9.

Central Processor

The central processor for the microcomputer is the 4004 chip (10D). This is a 4-bit parallel unit designed to work in conjunction with the other elements to form a complete self-contained system.

Standard Memory and I/O Interface Chips

The 4008 (11C) and 4009 (11D) combine to form a standard memory and I/O interface set. The 4009 is primarily an instruction and I/O device. Incoming data from either the serial I/O board or the parallel interface board enters whenever the signal RED/ is low via the IN0/ through IN7/ input bus. The RED/ signal is activated under command of the 4004 central processor. The incoming data is broken into two 4-bit segments and transferred through the 4009 to the central processor via the D0/ through D3/ bus. The 4008 is an address latch that interfaces the program read only memory (PROM) chip with the 4004.

Program Read Only Memory


The operating program is stored within the PROM chips (12C, 12D, 13D). The output of the PROM (MD0 through MD7) is transferred to the I/O interface chip (4009), where it is broken into two 4-bit segments and transferred to the 4004 via the data bus (D0/ through D3/).

Working Memory

The working memory for the microcomputer is made up of twelve 320-bit random access memory (RAM) chips. Four of the twelve chips are addressed simultaneously by one of the three CMRAX lines. The bi-directional data bus (D0/ through D3/) is used for transferring data to and from the 4004. The output bus (R000/ through R030/) is used to generate the AUX0 through AUX3 and NCS terms. The RAM chips provide for storage of up to 308 8-bit input characters as well as providing for storage of 320 4-bit words from the central processor.

Computer Output

Output from the central processor is transferred to the I/O interface chip, 4009, and output through constantly enabled tristate drivers as OT0 through OT3. These output bus terms are used in conjunction with the AD4 through AD6 signals to activate circuits on the printer CPU board. These, in turn, control all operations of the printer.

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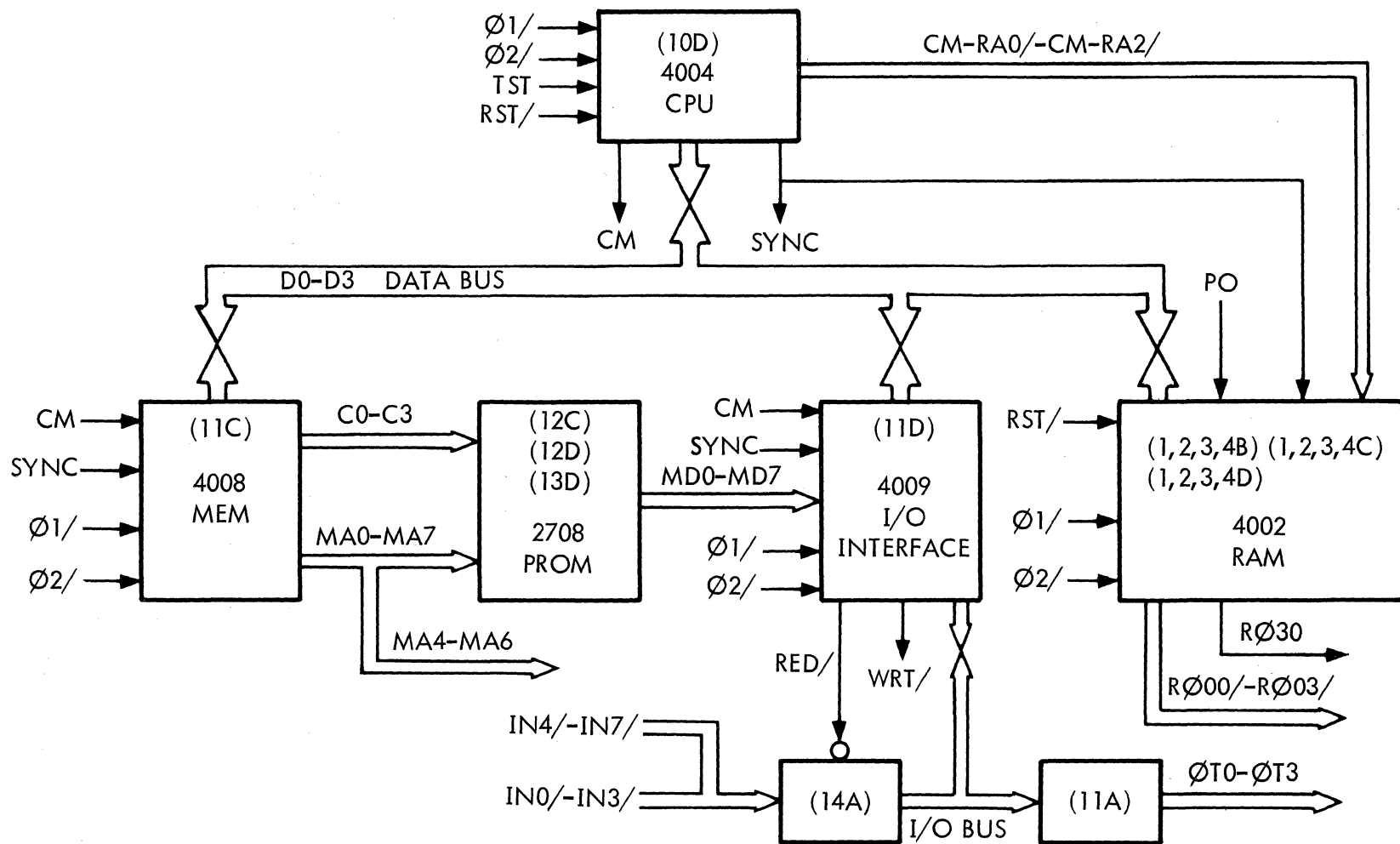


Figure 5-9. Microprocessor Block Diagram

Timing

Generation of timing pulses used throughout the printer are provided by the 4201A timing generator (5C) and its associated circuitry. The 4.8384 MHz crystal-oscillator signal is divided by 7 within the timing generator to produce the 691.2 KHz signal HCK. HCK is further divided by 2 in flip-flop 7C-9 to produce the 345.6 KHz timing pulses TP and TP/. Phased timing pulses O1/ and O2/ are used to sequence the operation of the microprocessor. A schematic of the circuit and the related waveforms are provided in Figure 5-10.

CPU Memory Timing

A diagram of the CPU memory timing, along with definitions, is provided in Figure 5-11. The cycle starts with the CPU sending a SYNC signal to the PROM, RAM, I/O device and address latch. During the next three sub-cycles (A1, A2 and A3), the PROM address is transferred to the PROM. The output of the PROM is transferred during sub-cycles M1 and M2. During the last three sub-cycles, the CPU executes the instruction and addresses the RAM.

Generation of DAX Signals and WPX/Signals

The output signals from the printer CPU board are controlled by the contents of the output bus (OT0 through OT3) and the three address lines, MA4, MA5 and MA6. These are shown in Figure 5-12. The three MA signals are decoded in chip 15A under the control of the WRT/ signal from the I/O interface chip, 11D. The state of the WRT/ signal is controlled by the 4004 CPU. The WRT1 and WRT2 signals clock the data on the output bus into two latches, 9A and 10A. The 8-bit data output (DAO through DA7) is transmitted to the data board for decoding and printing, and to the servo board to control the carriage. The WP0/ through WP7/ signals are developed by the decode of OT0, OT1 and OT2 when enabled by T3. These WPX/ signals control various operations throughout the other printer boards such as WP3/ equals BEL/, which activates the audio alarm.

Generation of Select and Test Signals

The four SELECT SIGNALS (SELO, SELD, SELE, and SELF) are controlled by the three MA lines (MA4, MA5, and MA6) along with the WRT/ signal (see Figure 5-13). The SELX signals control operations on the serial I/O board or the parallel interface board. These signals also initiate an interrupt to the CPU via the TST input. When a SELO, SELD, SELE, or SELF signal is activated, the following conditions are sampled via 13A.

SELO	Paper tractor busy (TBSY high)
SELD	Data buffer not busy (BSY/ high)
SELE	Ribbon drive busy (RBC high)
SELF	Carriage not at zero position (ZPOS/ high)

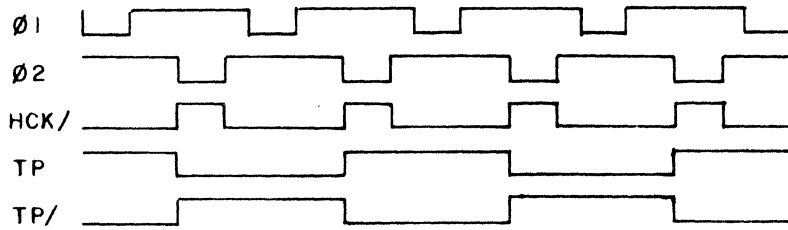
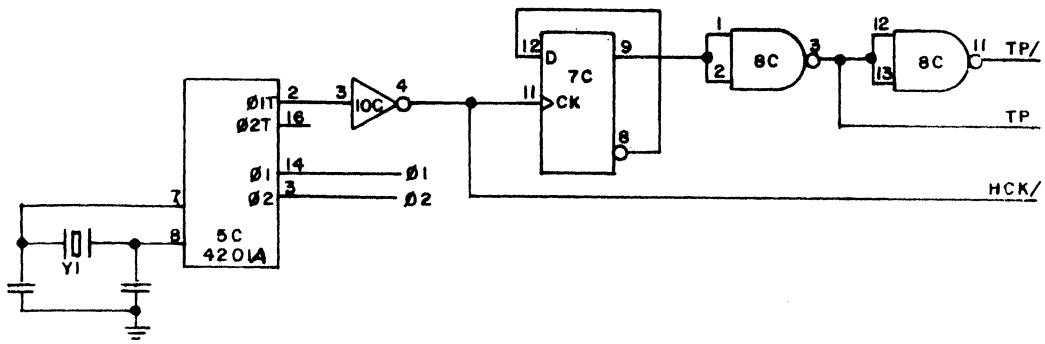


Figure 5-10. Generation of HCK/, TP, TP/, Ø1/, Ø2/

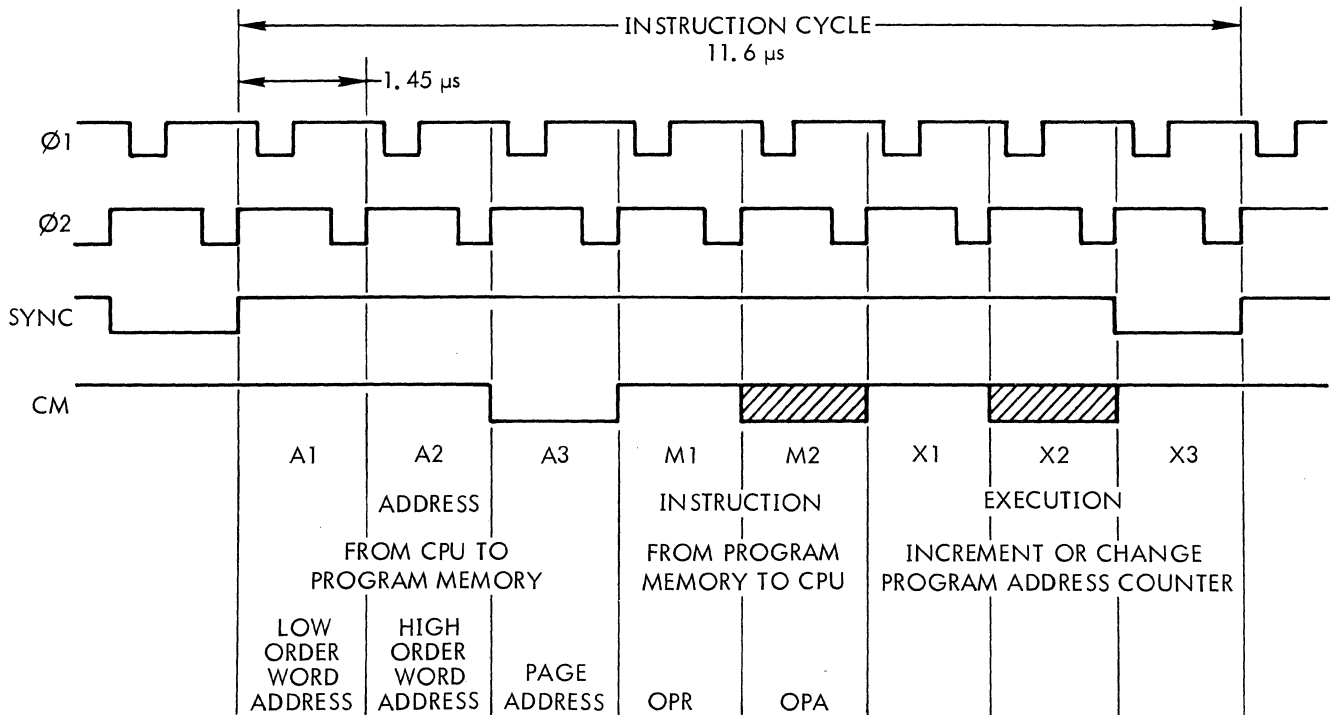


Figure 5-11. CPU Memory Cycle Timing and Definitions

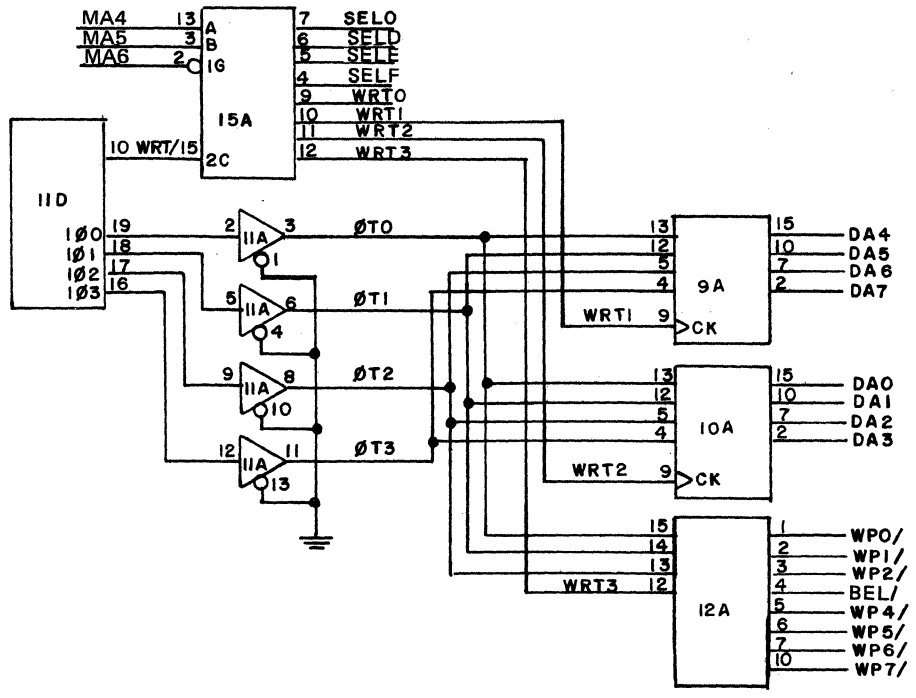


Figure 5-12. Generation of WPX and DAX Signals

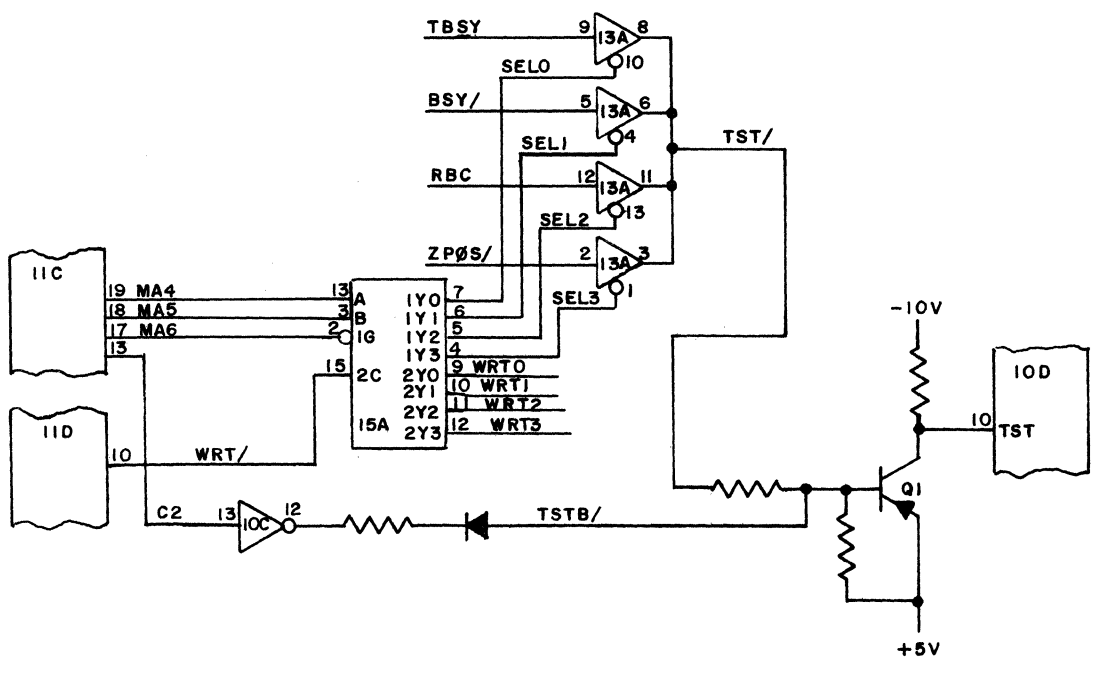


Figure 5-13. Generation of SEL and TST

If any of these four conditions exist, TST/ will be driven high, causing the CPU to initiate an interrupt. The TSTB/ signal is an OR function for driving the interrupt when the memory is active. An interrupt from either of these conditions triggers a program jump.

Inputs From the Control Panel

Activation of the SELO signal permits the CPU to monitor the state of four switches on the control panel via the input bus (INO/ through IN3/) as presented in Figure 5-14.

The HALT line is normally low and goes high when the paper out switch opens or the RUN/STOP switch on the control panel is placed in the STOP position.

Ribbon Control

Ribbon drive clock RBC is produced by one-shot oscillator 6B and flip-flop 7C as sampled by HCK/. While HCK/ is a continuous clock, RBC is inhibited while the tractor is operating by TBSY via gate 6A (Figure 5-15).

Tractor Control

The tractor step control bits (TO1/, TO2/ and TO3/) are generated in quad flip/flop 8A by the I/O bus signals (OTO, OT1, and OT2) when enabled by WRT0. A tractor holding current signal (THD/) is generated for nominally 10 milliseconds from one-shot oscillator 8B. The one-shot is triggered by WRT0 (see Figure 5-16).

Alternate Character Set Enable

The NCS signal from 10C is generated from RO30/ coming from the RAM. This signal is sent to the data board to initiate selection of the alternate character set.

I/O INTERFACE BOARD

The I/O interface board provides an interface with an external host processor and the printer. This board also houses logic for connecting an optional keyboard and the circuits for the status indicator on the control panel. The interface is available in either a parallel interface or a serial interface.

Parallel I/O Board

1. Receipt of Host Data

Data from an external processor enters the parallel I/O board as BIT1 through BIT7 (see Figure 5-17). The clocking input (STB) for the two buffer chips (6A and 7A) also clocks the BUSY flip-flop, causing it to set. This clock signal is generated from either 2C-3 or 2C-6, depending upon which jumpers are connected. BUSY remains set until the microprocessor accepts the data. See Operator's Manual, Table 2-8, for jumper data.

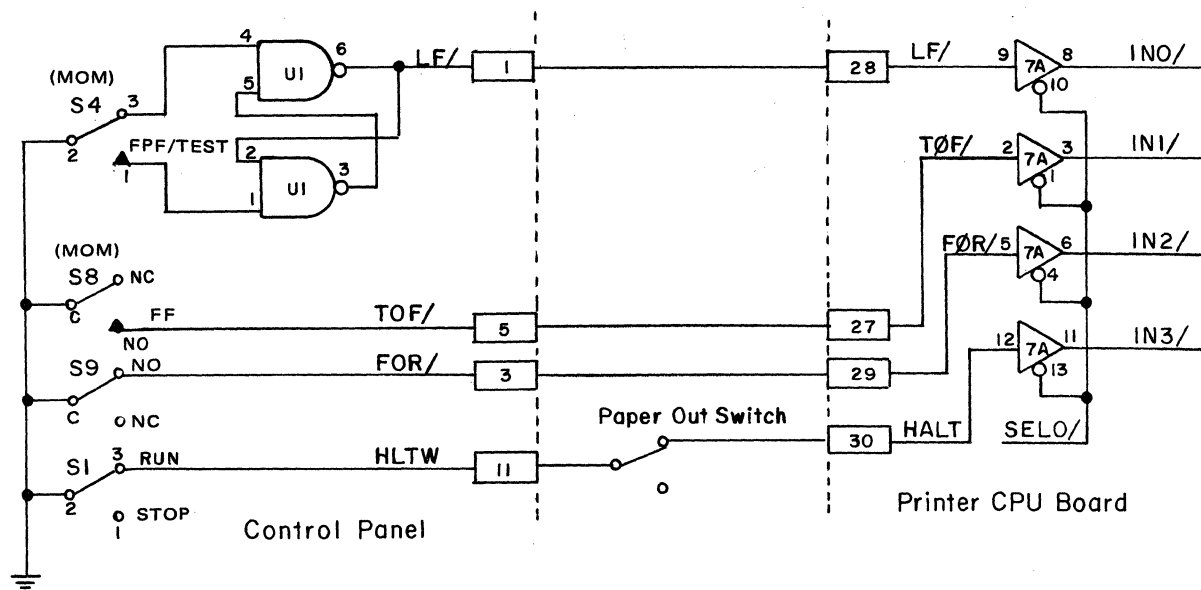


Figure 5-14. Inputs from Control Panel to Printer CPU Board

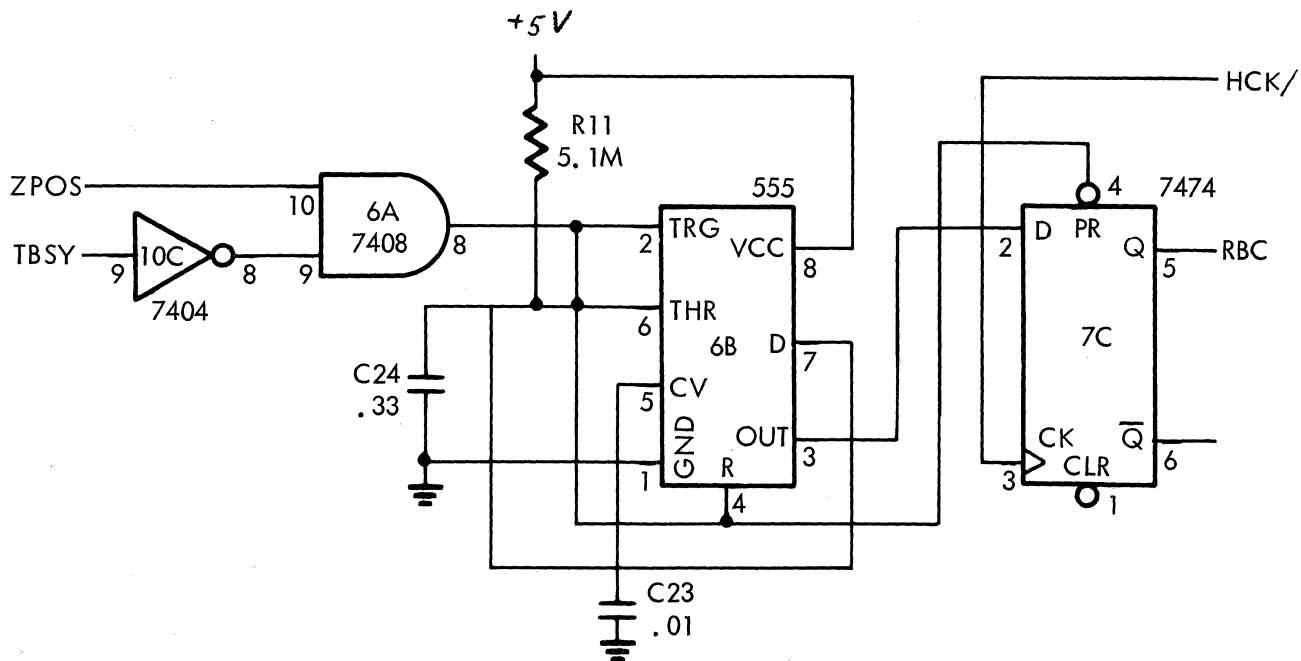


Figure 5-15. Ribbon Control

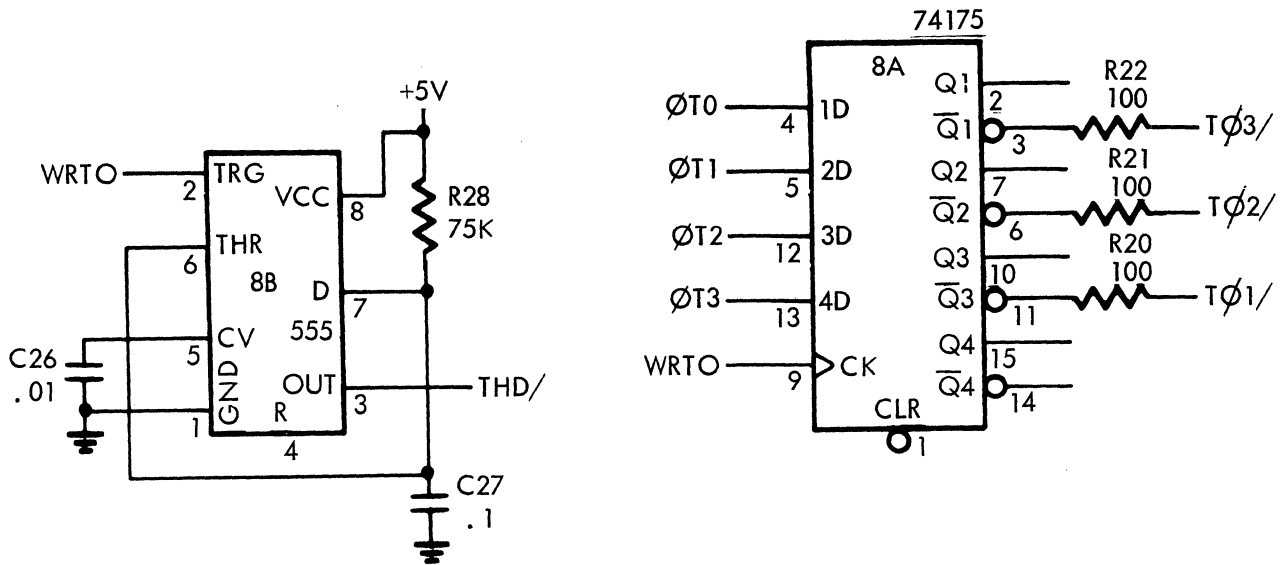


Figure 5-16. Tractor Control

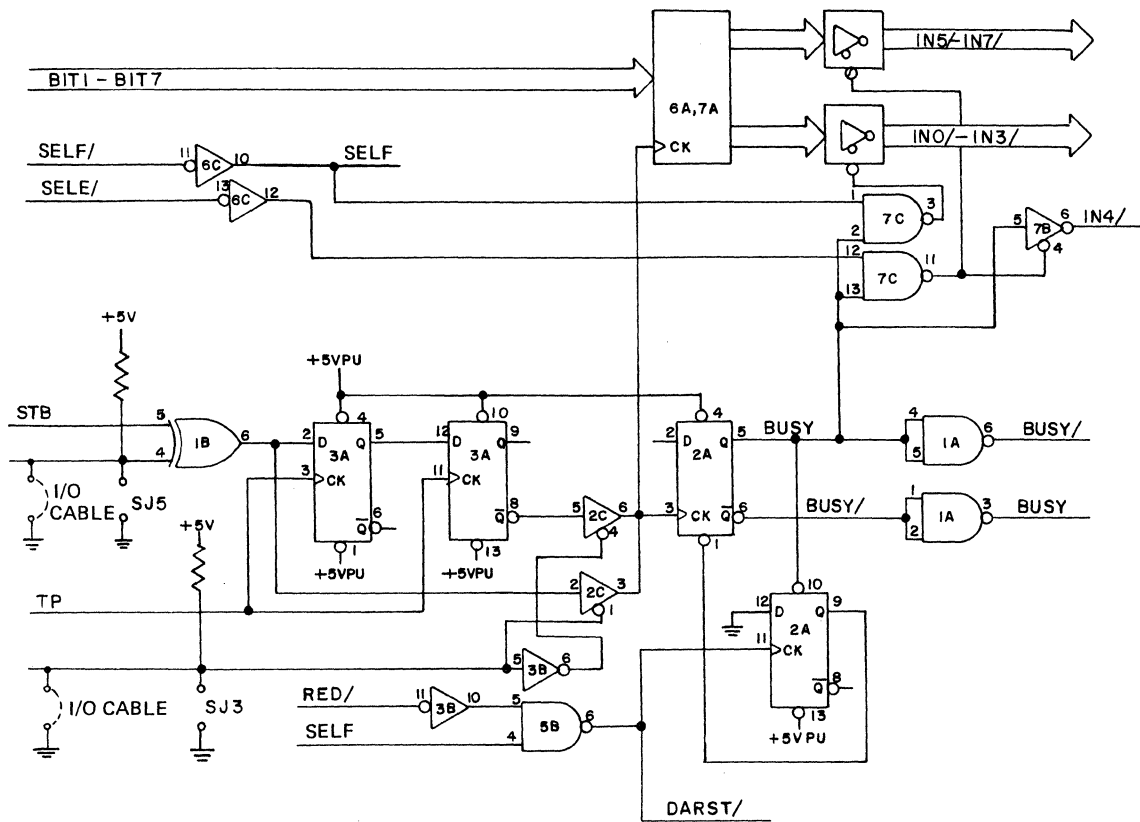


Figure 5-17. Parallel Data From External CPU

If SJ3 is connected, the circuit is designed to interface in the Centronix mode of operation. Gate 2C-6 is disabled and gate 2C-3 is enabled. This jumper configuration is accomplished via the internal I/O cable connecting the I/O board to the rear panel.

With SJ3 disconnected, the Data Products interface is emulated. The input strobe is delayed by two TP clocks before clocking the input buffers and the BUSY flip-flop, via 2C. This performs the function of a deglitching circuit, unless the glitches occur at the frequency of TP.

The circuit can interface with either a positive or a negative strobe. If jumper SJ5 is connected, a negative strobe produces a negative output from 1B-6. If SJ5 is open, a positive strobe will cause a negative output from 1B-6. This jumper configuration is accomplished via the internal I/O cable connecting the I/O board to the rear panel.

The printer CPU board can test the state of the BUSY signal by activating the SELE/ line and examining IN4/. This action also transfers the upper three bits into the printer CPU board (IN5/ through IN7/). The microprocessor then activates the SELF/ and RED/ signals, which read in the lower four data bits (IN0/ through IN3/) and reset the BUSY flip-flop.

2. Keyboard Data

The 7-bit input from the keyboard (KB1-KB7) is strobed into input buffer 8C and 9C by the KBSTB signal from the keyboard (see Figure 5-18). The dual flip-flop of 5C acts as a delay, allowing the incoming keyboard data to settle in the input buffer before generating KBBSTB. This in turn generates KBOSTB if LOC/ is not active. If LOC/ is not active, the keyboard data (KB01-KB04) is then transferred via the interface to the host system. Also at this time, the keyboard data is transferred to the microprocessor as IN0/ -IN7/ when the microprocessor activates SELE/ and SELF/. This occurs if the printer is not BUSY and either LOCAL or ECHO/ (half duplex) is active. Flip-flop 5C-5 is then primed (set) by either DARST/ (SELF/ and RED/) or WP0/ to allow succeeding data transfers from the keyboard.

3. READY and ON LINE Signals

The parallel interface board provides READY and ON LINE signals to the external host processor. The circuitry involved in the generation of these two signals is presented in Figure 5-19.

READY is true whenever DHALT/ is high, indicating that the RUN/STOP switch is in the RUN condition and/or a paper-out fault does not exist. If jumper SJ6 is installed, READY goes false whenever the buffer is full. If jumper SJ4 is installed, READY is true whenever the forms-override feature is active. Jumper SJ1 controls the polarity of the READY output signal. If the jumper is in, READY is active low for a true. If the jumper is not installed, the READY signal is active high for a true.

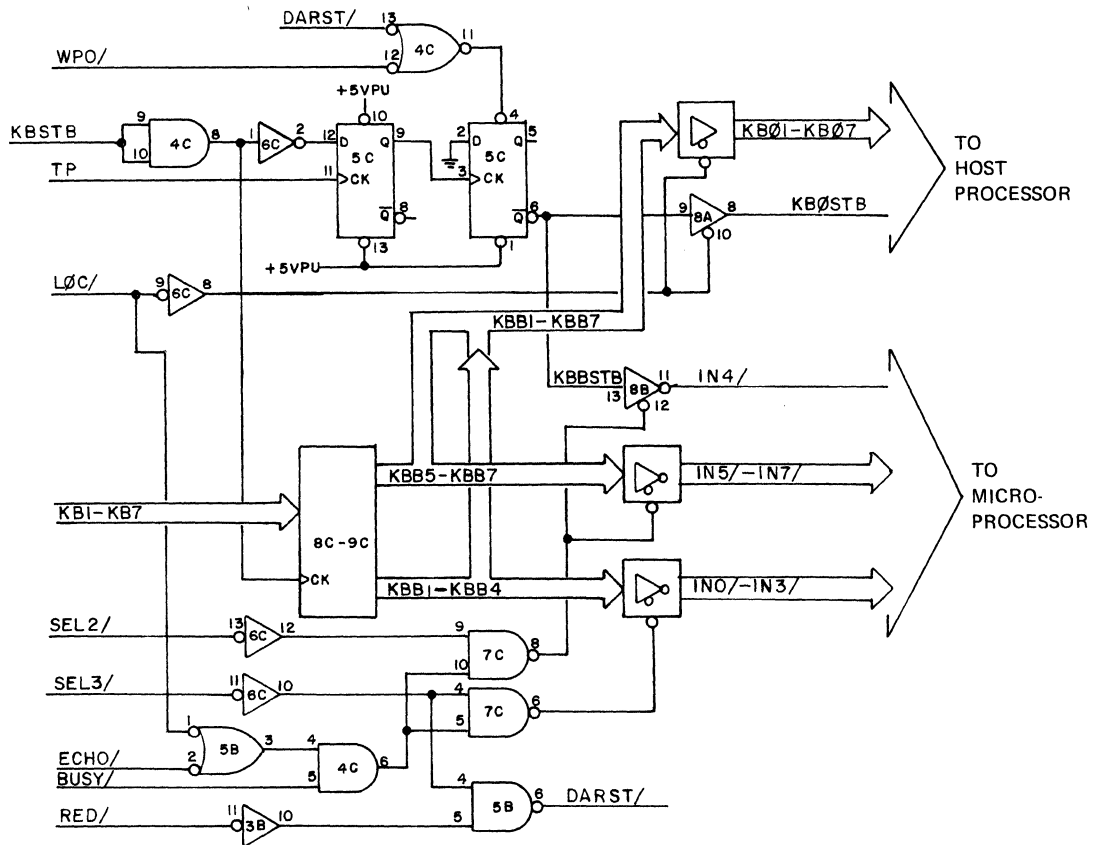


Figure 5-18. Receipt and Transmission of Keyboard Data

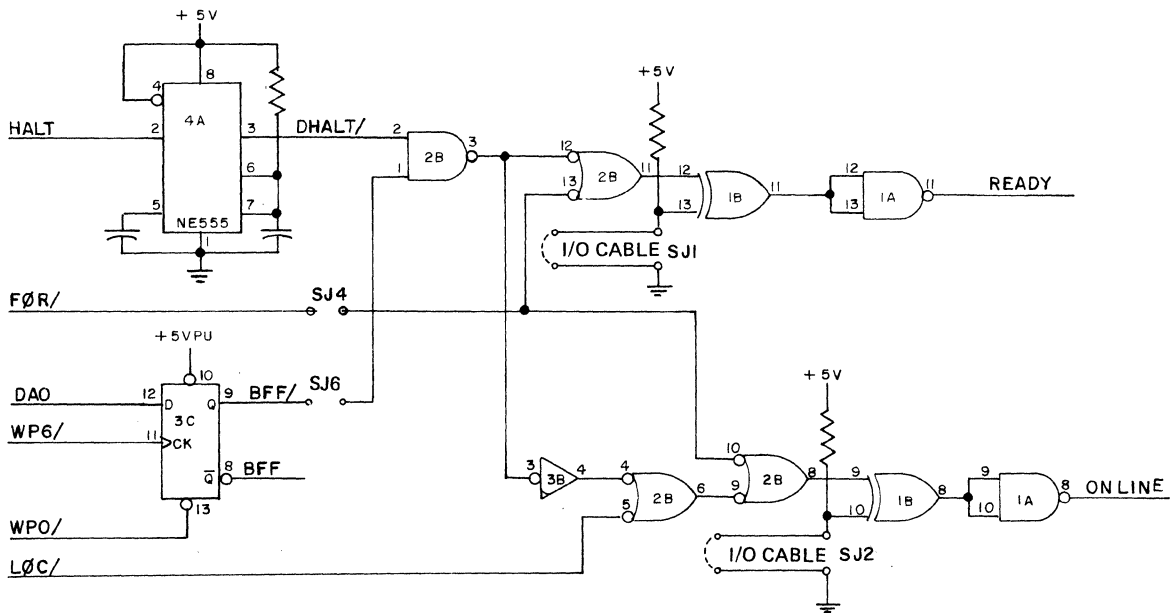


Figure 5-19. READY and ON LINE Circuits

The ON LINE signal is made up of the three signals used in the generation of the READY signal, plus the LOC/ signal. The REMOTE/LOCAL switch must be in the REMOTE position in order for the printer to be in the ON LINE condition. If jumper SJ2 is installed, ON LINE is true when the output is low. Conversely, if the jumper is not installed, an active high is true.

Jumpers SJ1 and SJ2 are normally configured by the internal I/O cable connecting the I/O board to the read panel. Jumper SJ4 is installed as the standard configuration.

4. STATUS Logic

The logic circuits for the STATUS lamp on the control panel are housed on the parallel interface board. A diagram of the circuitry is presented in Figure 5-20. The STATUS lamp can be in one of four conditions, indicating one of four states, as follows:


- (1) Flashing - Indicates a paper out condition or the printer is in a STOP state (RUN/STOP in STOP).
- (2) Glowing dimly - The parallel interface board is receiving data.
- (3) Off - The microprocessors buffer is full.
- (4) On - The three previously mentioned conditions do not exist.

Circuit 4A (NE555) is mechanized as a one-shot. As long as the HALT input is low, indicating neither a paper-out nor a STOP condition, 4A-3 outputs a constant high. When HALT goes high, the one-shot completes its time-out and goes low, enabling the input to gate 4B-3. This circuit performs the function of a deglitcher to eliminate switch bounce.

The second NE555 (4a) is configured as a low frequency oscillator. When 4B-1 is high, the output of the STATUS line causes the lamp to flash at approximately a 2.5 Hz rate. As previously mentioned, if HALT is low, the output of 4A-3 is constantly high, enabling 4B-13. The BUSY/ line changes from a high to a low at the frequency of the input strobe. This causes the STATUS line to turn the lamp on and off rapidly, resulting in a dimly glowing condition.

Whenever the buffer goes full, the printer CPU board causes the buffer-not-full flip-flop to reset and BFF/ goes low, turning the lamp off.

If none of the three previously mentioned conditions exist (HALT is low, BFF/ is high, and BUSY/ is a constant high), the STATUS lamp is fully illuminated.

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	1/83	

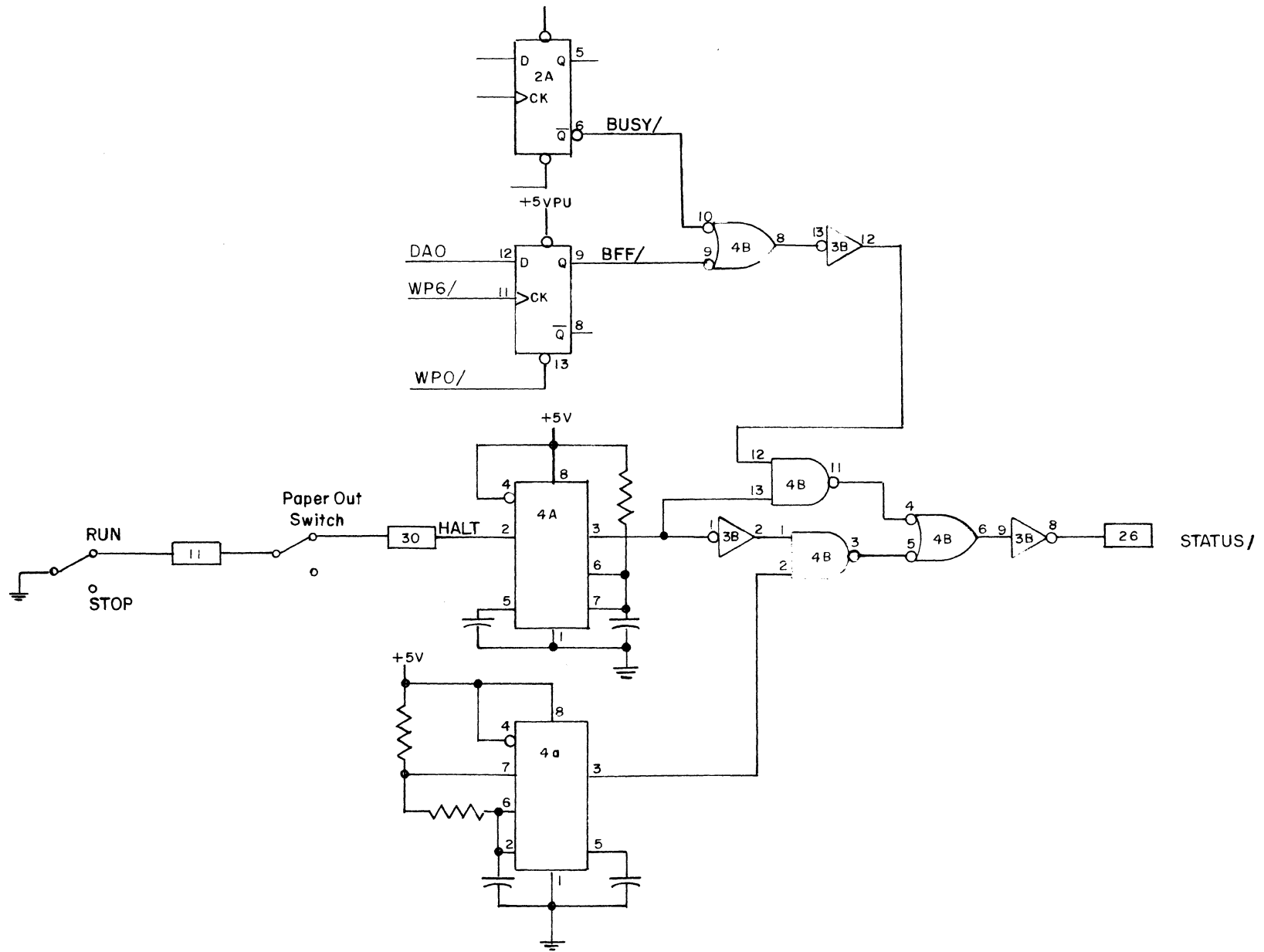


Figure 5-20. STATUS Logic

Serial I/O Board

The serial I/O board provides for serial input/output communications between the printer and an external host device, using either an RS-232 compatible interface or a 20-milliamp current loop. The board also houses the logic for the automatic answer-back (HERE IS) feature as well as the interface circuits for the optional keyboard.

1. Receipt of Host Data

For an external device to transmit to the printer, two signals must be true; data terminal ready (RSCD), and supervisory transmitted data (RSSA). For RSCD to be true the printer must have POWER ON, not be in LOCAL and not be in a HERE IS transmission (HRT/). The RSSA signal reflects the state of the 320 character buffer on the CPU board, and goes false (reset) when the buffer is full. This makes RSSA false. Therefore RSSA is true when the character buffer is not full. The signal RSSA can be transmitted as a high-true (space) or a low-true (mark), depending upon jumpers SJ3 and SJ4. The normal configuration is with SJ4 in (RSSA high-true = space). See Figure 5-21.

Data from the external device is input to the serial I/O board on either the RSBB/ line or the 20MI line (see Figure 5-22). In order to enable the path to the UART, the following conditions must be met:

- (1) HRT/ must be high, indicating the HERE IS (answer back) logic is inactive.
- (2) Carrier detect (RSCF) must be high and the printer can not be in the local mode.

As the serial data is input, the UART strips off the start and stop characters and the parity bit, and converts the data into parallel form. The microprocessor on the printer CPU board can determine whether or not the UART has transferred the character to the output holding register (DR is high). This is accomplished by activating the SELE/ line and testing the condition of IN4/ (see Figure 5-23). At the same time, this action transfers the upper three bits (IN5/, IN6/ and IN7/) of the character to the printer CPU board.

The printer CPU board then activates both the SELF/ and RED/ lines. SELE/ going low transfers the lower four bits of the character (INO/, IN1/, IN2/, and IN3/) to the printer CPU board while RED/ going low resets the UART receive register (DRR).

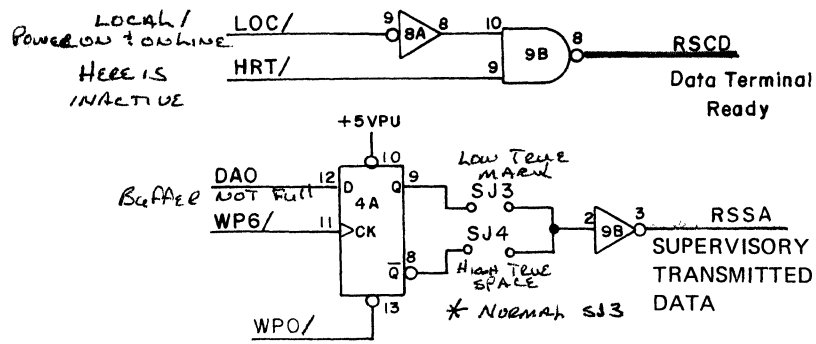


Figure 5-21. Data Terminal Ready and Supervisory Transmitted Data

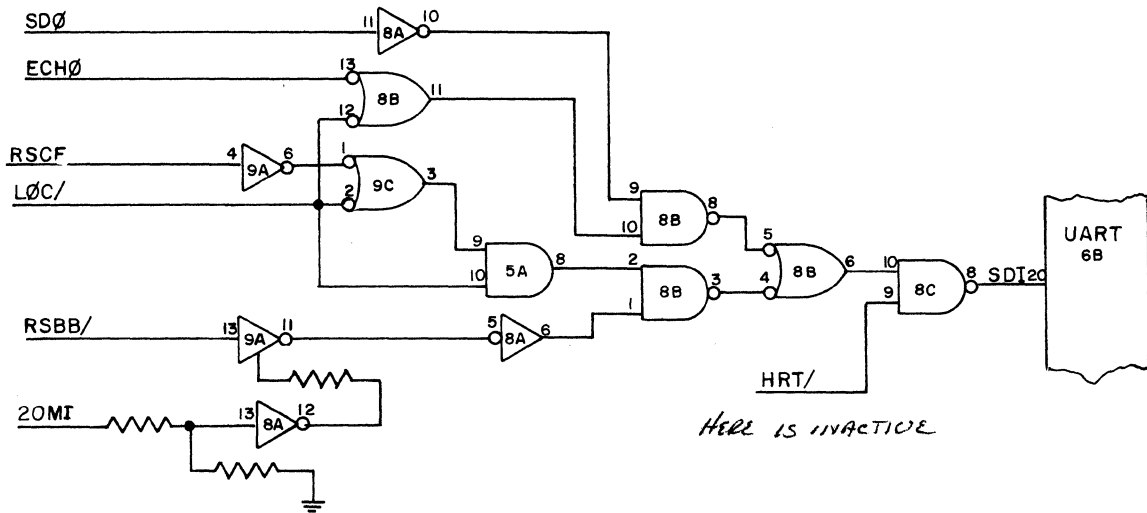


Figure 5-22. Serial Data Input

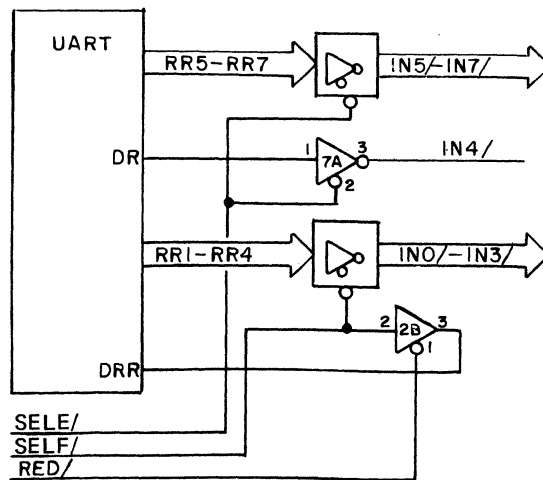


Figure 5-23. Parallel Data to CPU Board

2. Baud Rate Selection and Receive/Transmit Clock

A circuit diagram of the baud selection and clock generation logic is shown in figure 5-24. The baud rate selection switch (S3) on the control panel provides for selection of baud rates of 110, 300 and 1200 baud. The position of switch S3 controls the value of the count loaded into counters 1C and 1B. The count in the counter is incremented by the 691.2 KHz signal HCK/ from the printer CPU board. The carry output of 1C is ANDed with the next high of HCK/ and then divided by two to generate the CCK signal. This clocking signal is used for both the receive and transmit clocks for the UART.

3. Answer Back Logic and Keyboard Input Logic (optional)

The answer back (HERE IS) logic provides for a 31-character response to an external "Enquire" code (see Figure 5-25). Action is initiated by the setting of the HERE IS flip-flop, 4B-5, either by WP7/ from the printer CPU board going low or by activation of the HERE IS switch on the control panel (HRSW/).

The PROM (4C) holds thirty-two 8-bit characters, of which only thirty-one are transmitted. The 32nd character is coded as hexadecimal 80, and is used as a stop-action code for the HERE IS logic. The PROM addressing is controlled by counter 3C and flip-flop 3B-9. Clocking for the circuitry is provided by the output of the baud rate generator, CCK. Circuit operation is performed in conjunction with the timing of:

- (1) Request to send (RSCA)
- (2) Clear to send (RSCB)
- (3) Transmit holding register empty (THRE)
- (4) Transmit register empty (TRE)

A timing diagram of the operation is provided in Figure 5-26. Termination of the response action is initiated when HSD8, the eighth bit from the PROM, goes high, which occurs when the stop action code of hexadecimal 80 is output. The following high of TRE causes flip-flop 4B-5 to reset, placing a high on the CE input of the PROM (4C-15), inhibiting any further output.

The parallel input to the UART is shared by both the PROM output and the keyboard output. During the time that the response from the PROM is being output, the keyboard input is inhibited by the HRS line being high. Loading of the parallel input of the UART is affected by the HSTB/ (HERE IS strobe) signal, but only if the keyboard strobe (KBSTB) line is low.

Keyboard input to the UART is enabled when the HRS line is low, indicating the HERE IS logic is not active. At this time, HSTB/ will be false or high, and the loading of the UART is strobed by the KBSTB signal from the keyboard (see Figure 5-27).

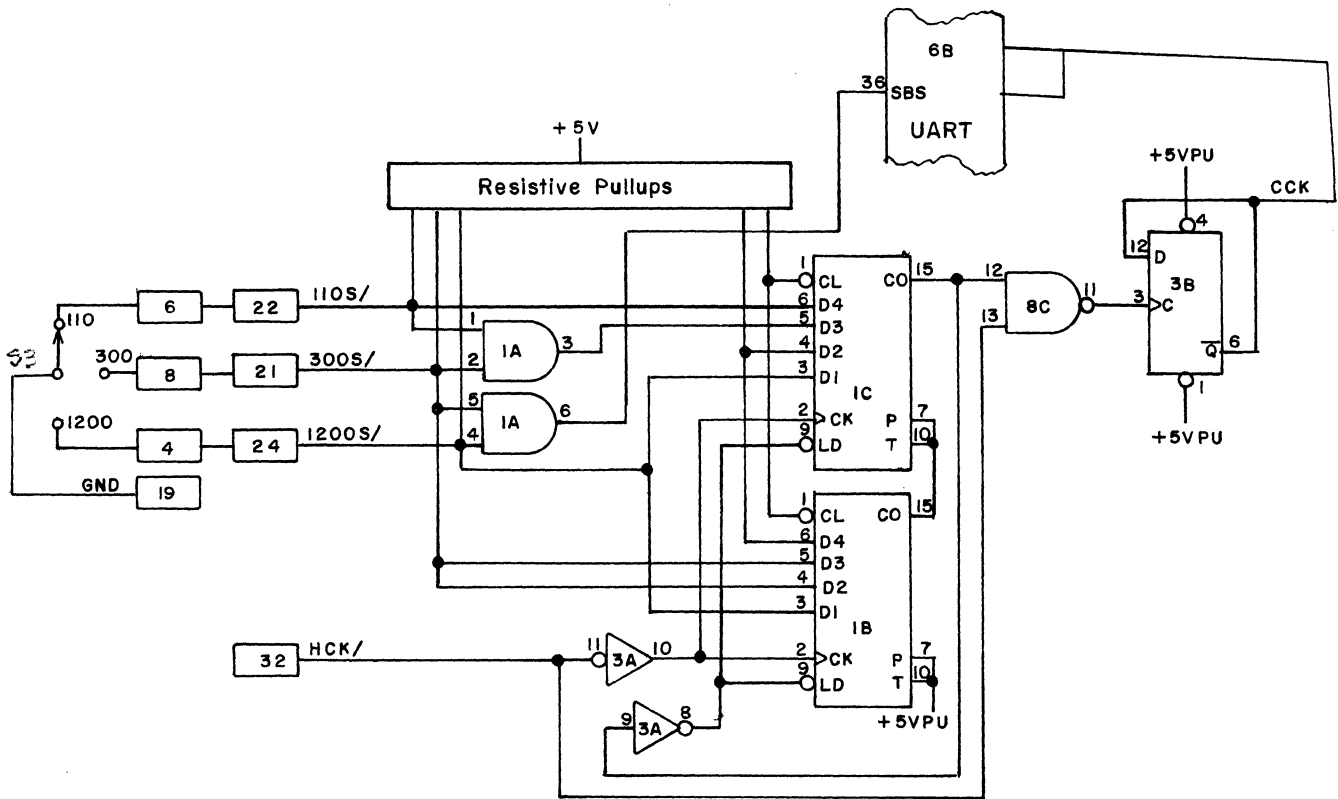


Figure 5-24. Baud Rate Selection and Clock

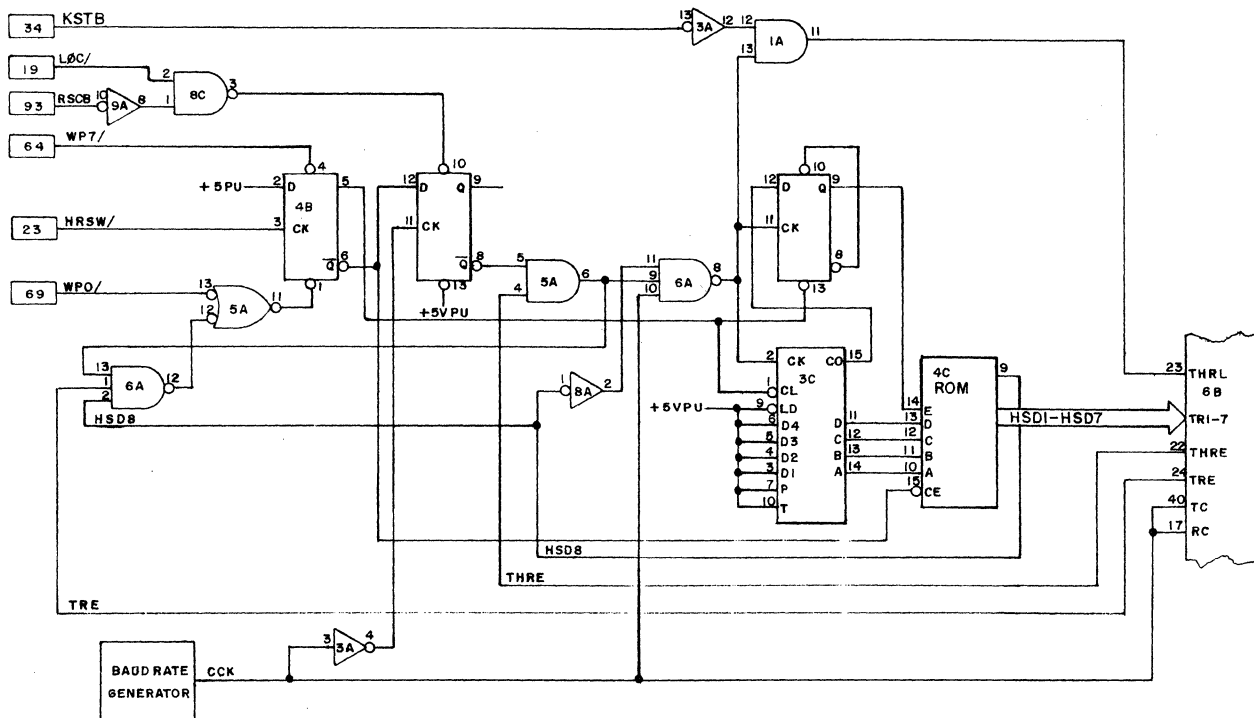


Figure 5-25. HERE IS Logic Circuitry

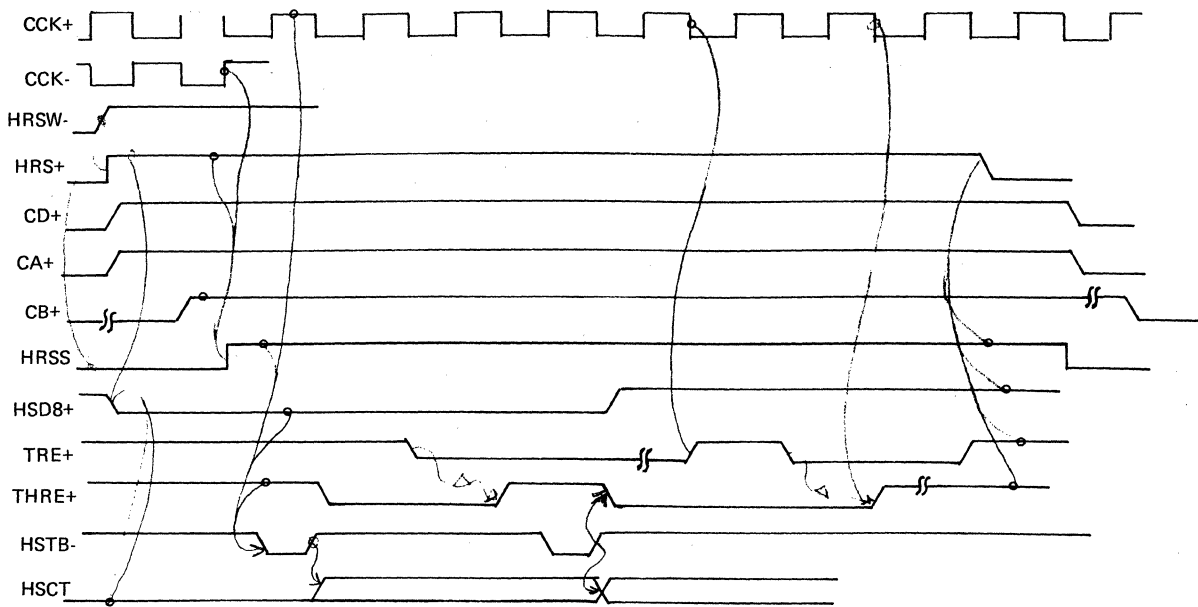


Figure 5-26. HERE IS I/O Timing

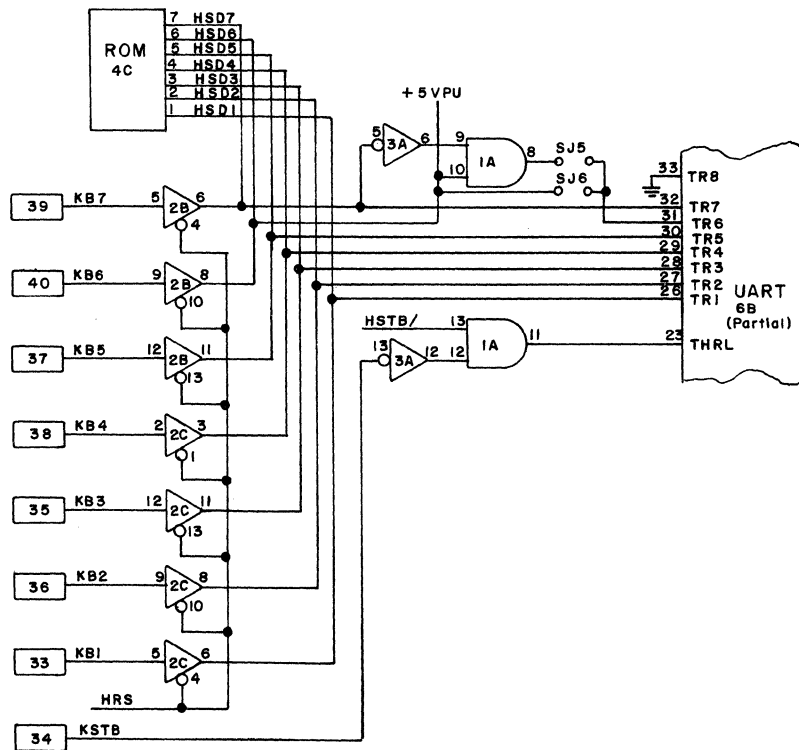


Figure 5-27. Parallel Input to UART

Jumpers SJ5 and SJ6 are used to control the input ASCII code. In the normal configuration, with SJ6 installed, the full ASCII code is enabled. If SJ5 is installed, all characters are stored as uppercase characters only.

If the HALF/FULL duplex switch on the control panel is in the HALF duplex position (ECHO/ is low), or if the REMOTE/LOCAL switch is set to LOCAL, the serial data output (SDO) is transferred to the host processor. It is echoed back through UART as SKI to be transferred to the CPU board and then becomes a printed character (see Figure 5-22). If in FULL duplex during REMOTE operation, data is transmitted to the host, but will not print on the printer.

4. Serial/Parallel Data Output

Serial output from the UART is initiated by the printer CPU board activating the request to send (RSCA) signal. If the external device is ready to receive, it will respond with clear to send (RSCB). The printer CPU board can test the state of this line, along with the carrier detect (RSCF), supervisory receive data (RSSB), and bit 8 out of the UART. This is accomplished by issuing a SELD/ signal and examining the input bus (INO/ through IN3/). See Figure 5-28.

The polarity of RSSB can be either high-true (space) or low-true (mark) via jumpers SJ1 and SJ2. The normal configuration is SJ2 installed.

Serial data output from the UART (SDO) is output to an external device through the RS-232 line, RSBA, or via a 20-milliamp current loop as 20MI/. Note that the activation of the BREAK/ switch on the control panel will inhibit either transmission (see Figure 5-29).

Parallel data from the keyboard can be output serially to the external device, or routed back to the UART as SDI, converted into parallel form again and then input to the printer CPU board.

5. Parity Selection

Jumpers SJ7 and SJ8 control the parity bit. The even parity enable (EPE) input to UART determines whether even or odd parity is generated. SJ7 in generates odd parity whereas SJ7 out generates even parity.

The parity inhibit (PI) input will inhibit generation if it is high. If parity is inhibited, the 8th bit is forced to a zero for all characters (no parity). This is without jumper SJ8. When SJ8 is installed, parity is generated per the selection of SJ7. The normal configuration for these jumpers is SJ8 installed and SJ7 open. This provides for transmission of a 7-bit character with even parity. See Operator's Manual, Table 2-8.

DATA BOARD AND HEAD DRIVER

Data Board

The circuits on the data board control the printing of the characters stored within the printer CPU board buffer memory. The block diagram shown in Figure 5-30 presents the major elements necessary to print a character. The functions of these elements are summarized below.

- . Input buffer: Receives the input character from the printer CPU board. This buffer works in conjunction with the character buffer to form a double-buffer input.
- . Character buffer: Contains the character currently being decoded and printed.

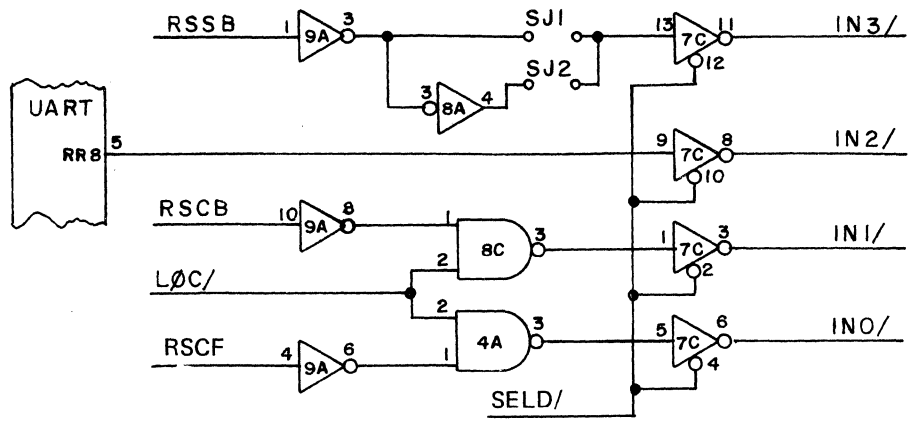


Figure 5-28. Status Signals to CPU Board

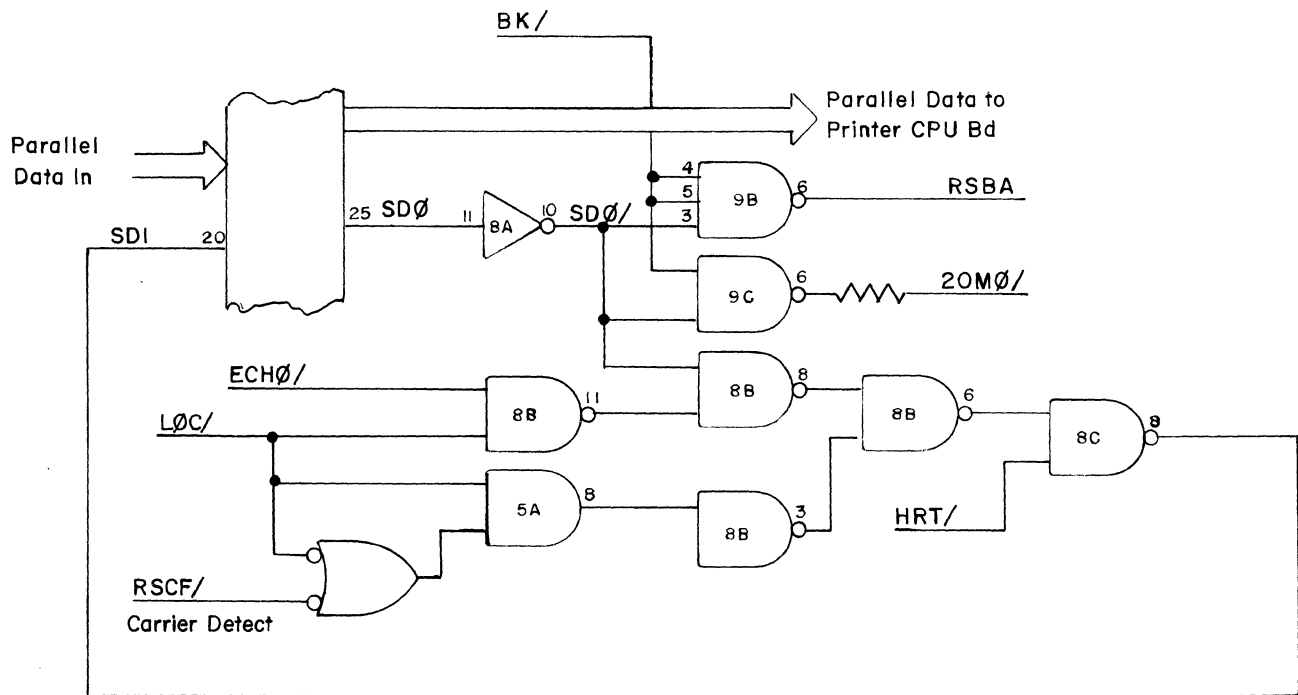


Figure 5-29. Serial/Parallel Data Output from UART

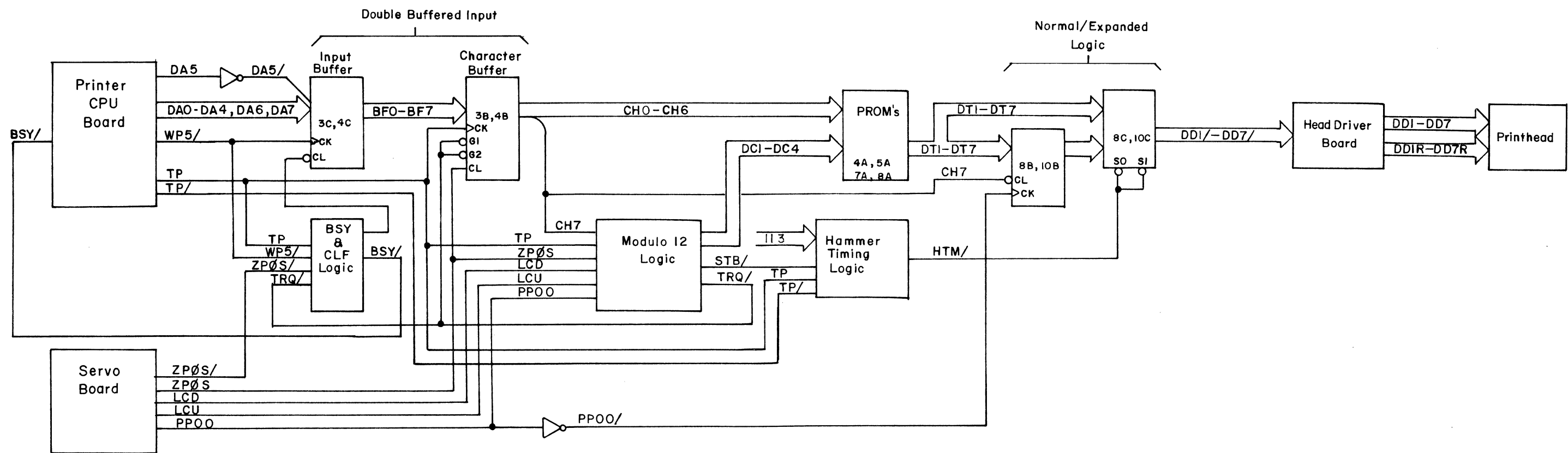


Figure 5-30. Printing the Stored Characters

- . Dot counter: A modulo 12 counter. Controls addressing of the decoder PROM and transfer of the character in the input buffer to the character buffer.
- . Character PROM: Converts the character stored in the printer CPU board buffer into the dot matrix character format.
- . Hammer timing logic: Controls the firing time of the printhead solenoids.
- . Normal/Elongated logic: Controls whether the decoded character is printed in normal or the elongated size.

1. Input Buffer and Character Buffer

A functional block diagram of the double buffered input to the data board is presented in Figure 5-31.

The character to be printed is transmitted to the data board via the DA bus and is loaded into the input buffer by the WP5/ signal. At the same time, WP5/ clocks the BSY flip-flop, causing it to set and BSY/ to go active low to the printer CPU board.

The TRQ/signal from the dot counter logic goes low for one clock cycle. The next high of TP causes several events to occur:

- (1) The CLF flip-flop resets.
- (2) The character stored in the input buffer is transferred to the character buffer.
- (3) The BSY flip-flop resets. BSY/ to the printer CPU board goes false (high).
- (4) The contents of the input buffer clears.

One clock period later, TRQ/ goes high and the CLF flip-flop resets. The printer CPU board can now transfer the next character to be printed to the input buffer.

2. Dot Counter

The dot counter logic (see Figure 5-32) is mechanized as a modulo 12 counter. The LCD and LCU signals from the servo board control whether the count increments or decrements. The STB/ signal is used in the hammer timing logic, while TRQ/ is used to transfer the character from the input buffer to the character buffer. The DC1 through DC4 signals address the decoded PROMs.

3. Character PROM, Normal/Elongated Logic and Hammer Timing

The signals CH0 through CH6 from the character buffer, along with DC1 through DC4 from the dot counter logic, will be used to address the decoded PROMs (see Figure 5-33).

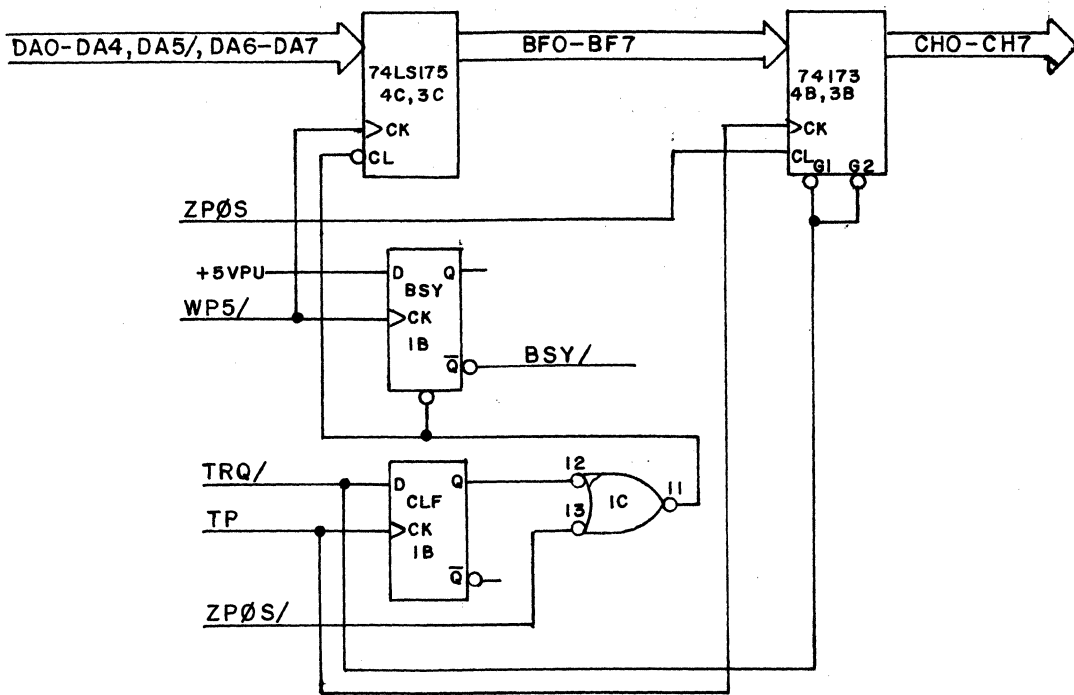


Figure 5-31. Double Buffered Input to Data Board

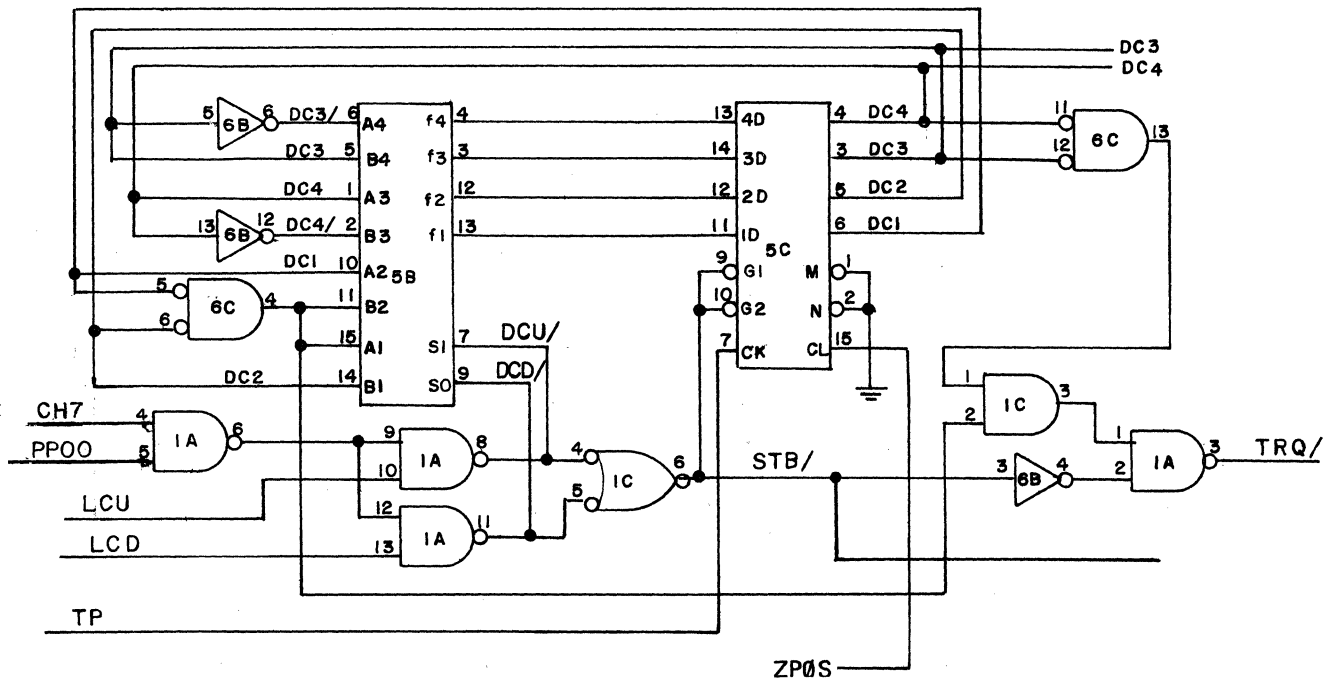


Figure 5-32. Dot Counter

The PROM output is applied to both the normal character output gates, 10C and 8C, and to the delayed or elongated character gates, 10B and 8B. Both the A and the B inputs to chips 10C and 8C are always enabled. If an elongated character is to be printed (CH7 is high), DT1 through DT7 are loaded into the delayed character gates by PP00/. Thus, for elongated characters, whenever CH7 is high, each dot is printed in its normal position and also delayed and printed in the subsequent dot position.

The hammer timing logic controls the firing time of the hammers. Initially, the counter is loaded with the value of 113. STB/ from the dot counter causes the TN flip-flop to set and enable the counter. The counter counts up until there is a carry output (255 plus 1). The carry output will go high after 143 counts, causing the TM flip-flop to reset with the next TP. Since one clock period is 2.9 microseconds, a delay of 415 microseconds is generated. The DD1/ through DD7/ signal to the printhead are therefore enabled for 415 microseconds.

Head Driver Board

The transistor drivers for the printhead solenoids provide a controlled voltage-current source to the solenoids. Since all seven circuits are identical, only the circuit for solenoid number one will be described (see Figure 5-34).

Circuit action is initiated by DD1/ going low and driving transistor Q2 into saturation. This action causes the full 31.5V to be applied to the printhead solenoid. The L/R time constant of the circuit causes the current to rise exponentially such that it requires 400 microseconds to reach 2A. At this time the voltage drop across R3 will be 0.6V, and Q1 will be forward biased. The collector of Q1 absorbs part of the base drive for Q2, limiting the current through Q2 to 2A.

After 415 microseconds, DD1/ goes high, driving both Q1 and Q2 into cutoff. The back EMF generated by the solenoid is dissipated through zener diode CR1 and blocking diode CR2.

Timing diagrams of the normal and elongated character printing are provided in Figures 5-35 and 5-36.

SERVO BOARD AND CARRIAGE CONTROL

A block diagram showing all the major elements of the carriage control circuitry is presented in Figure 5-37. The major functions of the individual blocks are summarized below.

- . Disc and disc sensor: Provides absolute lateral position feedback and control electronics.
- . Synchronization circuits: Synchronizes the disc sensor outputs with the printer logic.

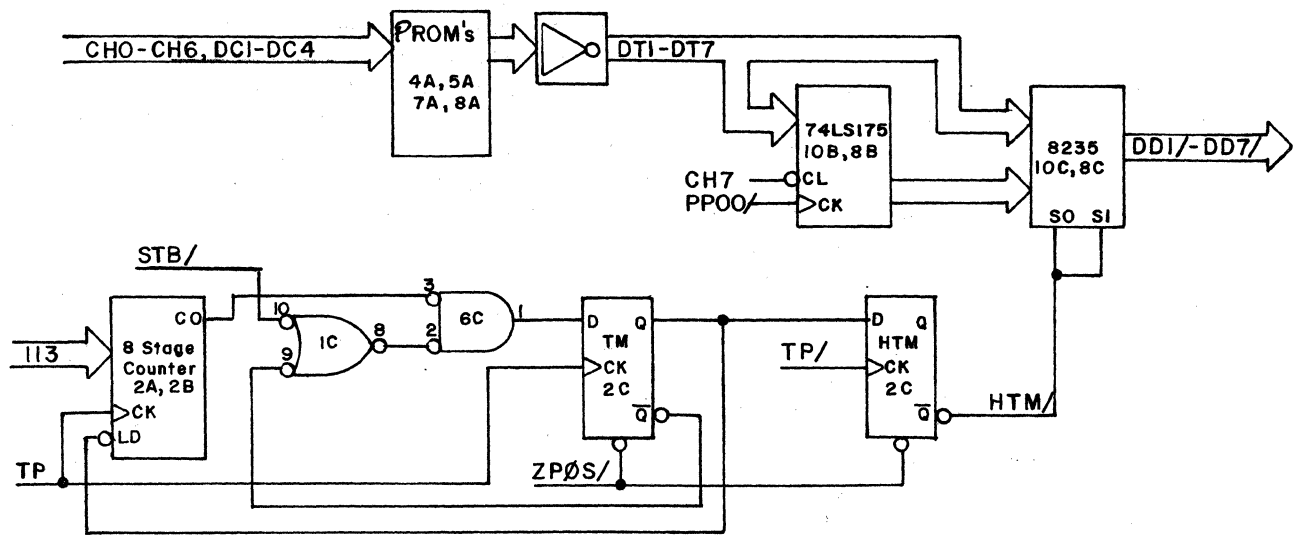


Figure 5-33. Character PROM, Normal/Elongated Logic, Hammer Timing

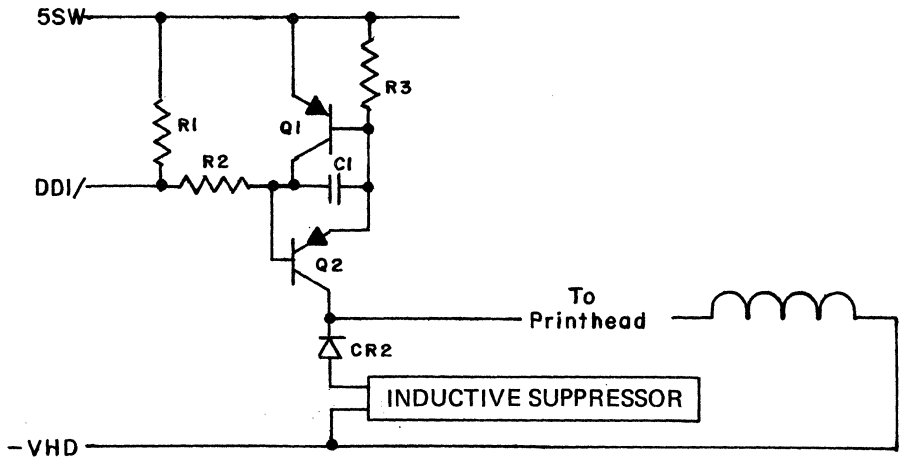


Figure 5-34. Printhead Driver Circuit

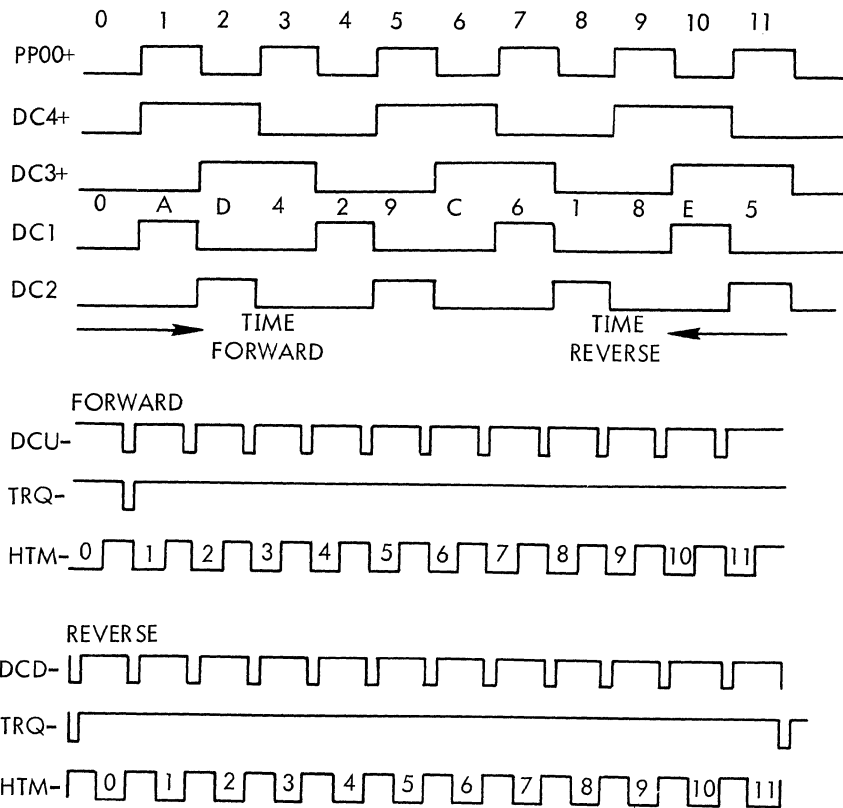


Figure 5-35. Normal Character Print Timing

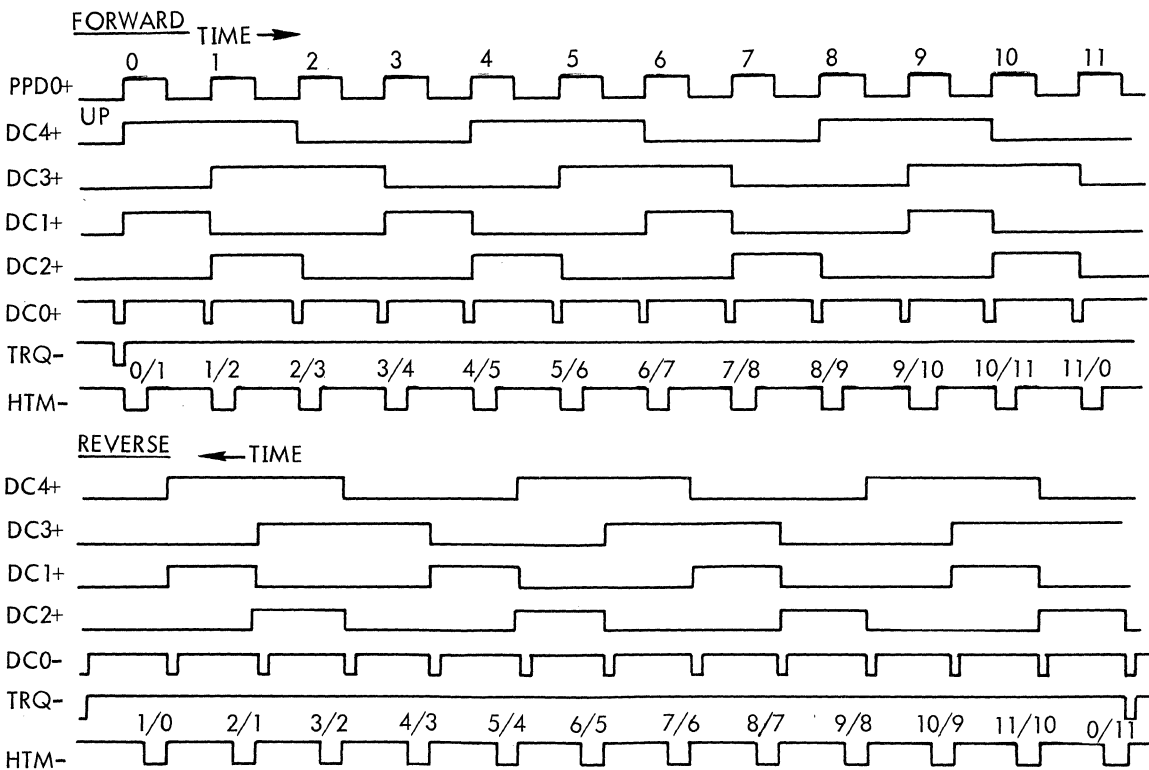


Figure 5-36. Elongated Character Print Timing

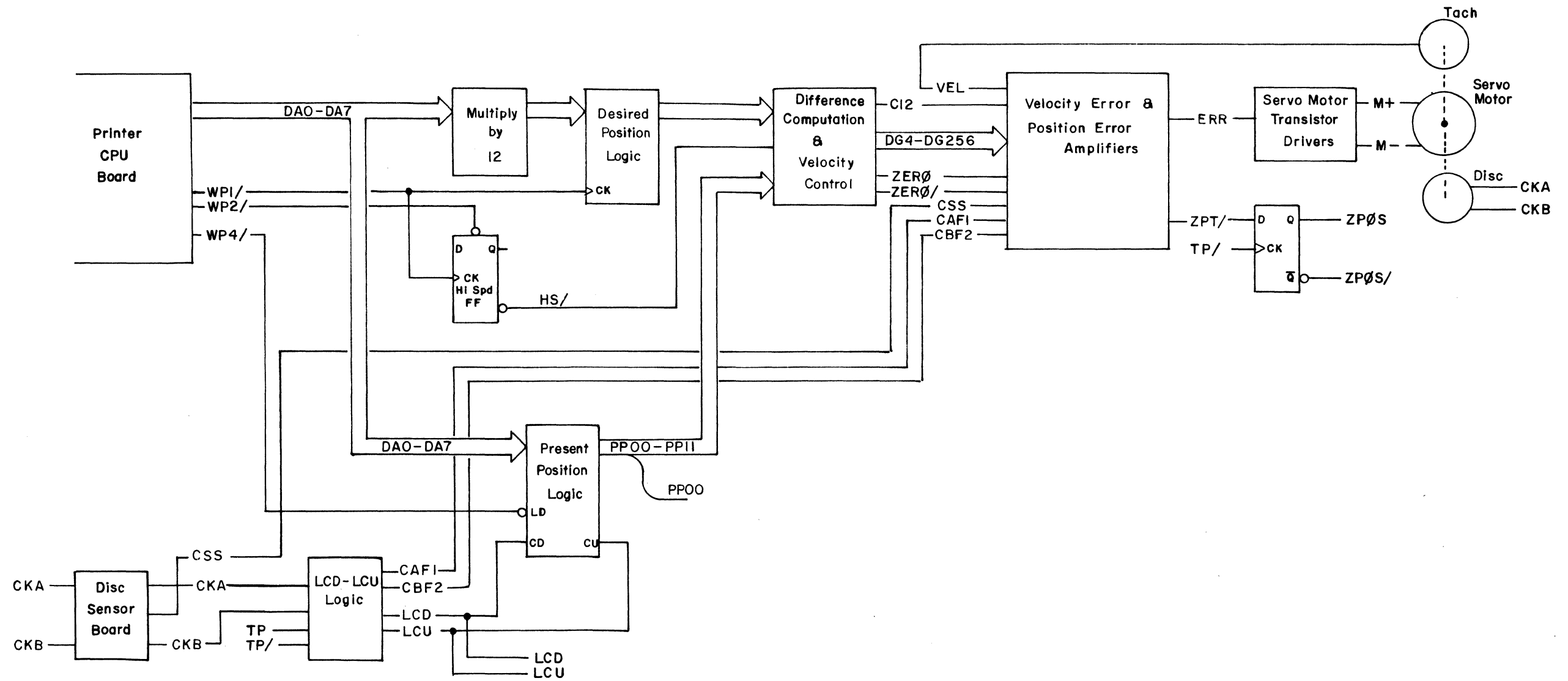


Figure 5-37. Carriage Control

- . Present position logic: Monitors the present position of the carriage with respect to the left margin.
- . Desired position logic: Converts desired character position received from the printer CPU board into dot position.
- . Difference computation: Computes the difference between the desired and the present position of the carriage. Outputs control signals to the analog circuitry which control direction and speed of the carriage.
- . Analog circuits: Monitors position and velocity of the carriage.
- . Servo amplifier: Controls current to the carriage servo motor.

Disc and Disc Sensor

The disc contains 144 slots around its periphery and is attached to the lead screw which drives the carriage. Disc motion information is supplied to the disc sensor via a pair of LED/phototransistors mounted in a U-shaped light guide. The disc sensor outputs raw quadrature signals CKA and CKB to the synchronization logic and CSS to the analog control circuitry. Figure 5-38 shows the generation of CKA, CKB and CSS.

Synchronization Logic

A timing diagram of the synchronization signals is provided in Figure 5-39.

A diagram of the circuitry involved in the synchronization of the outputs of the disc sensor (CKA/ and CKB/) and the generation of the LCU and LCD signals is presented in Figure 5-40.

The CKA and CKB are clocked into flip-flops 3A-15 and 3A-10 by TP/ to develop the CAF1 and CBF1 signals. The CBF1 signal is clocked into a third flip-flop to develop the CBF2 signal. The relationship between CBF1 and CBF2 is such that a detectable rise or fall of CKB generates one and only one clock. An undetectable rise or fall of CKB (one that occurs prior to the rise of TP/) causes CBF1 to be unstable for a period of time; however, the instability does not last and CBF1 is stable by the time TP/ goes high.

Appropriate conjunctions of CBF1, CBF2 and CAF1 develop the logic count down (LCD) and the logic count up (LCU) signals. These signals are used to control the present position logic and are transmitted to the data board to control printhead action.

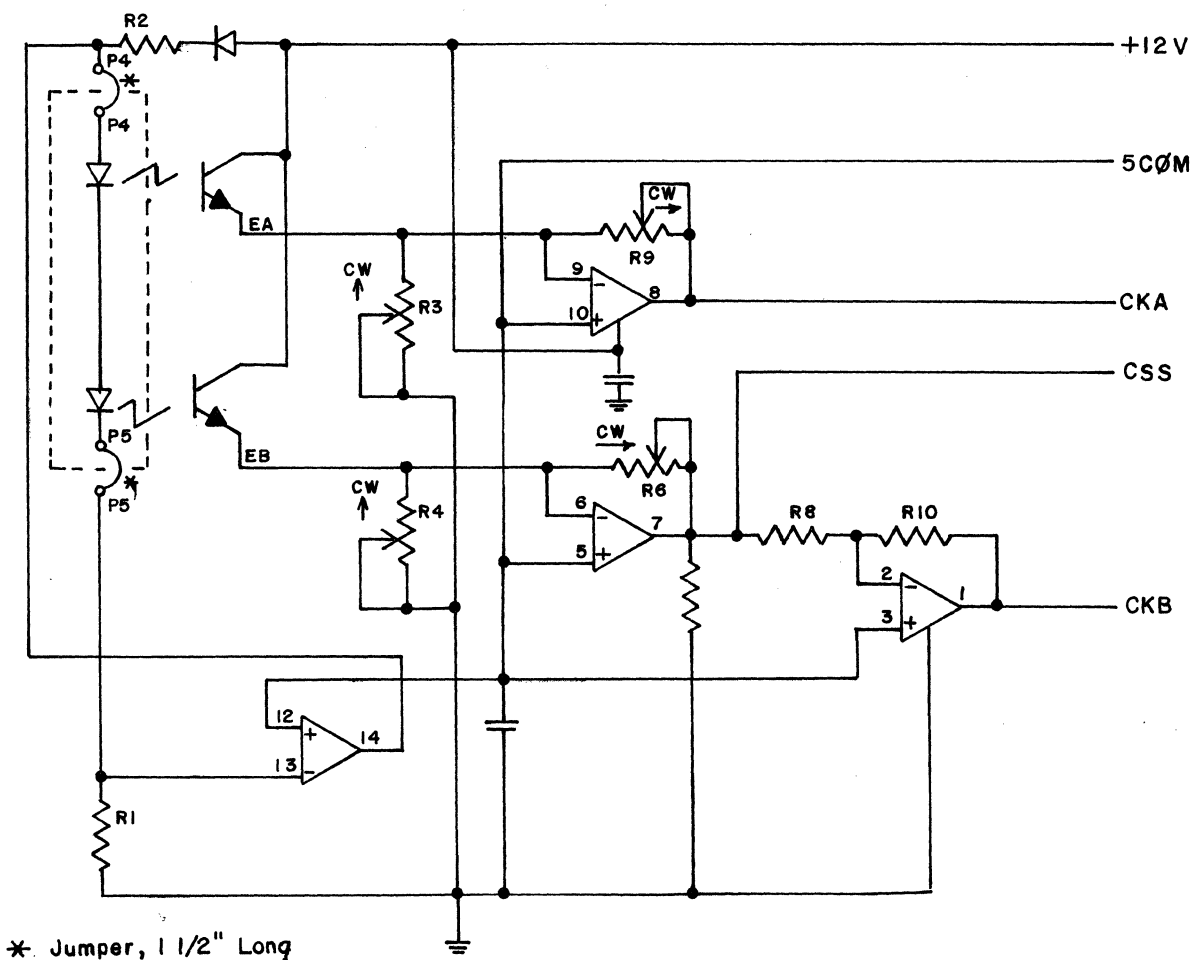


Figure 5-38. Generation of CKA, CKB, and CSS

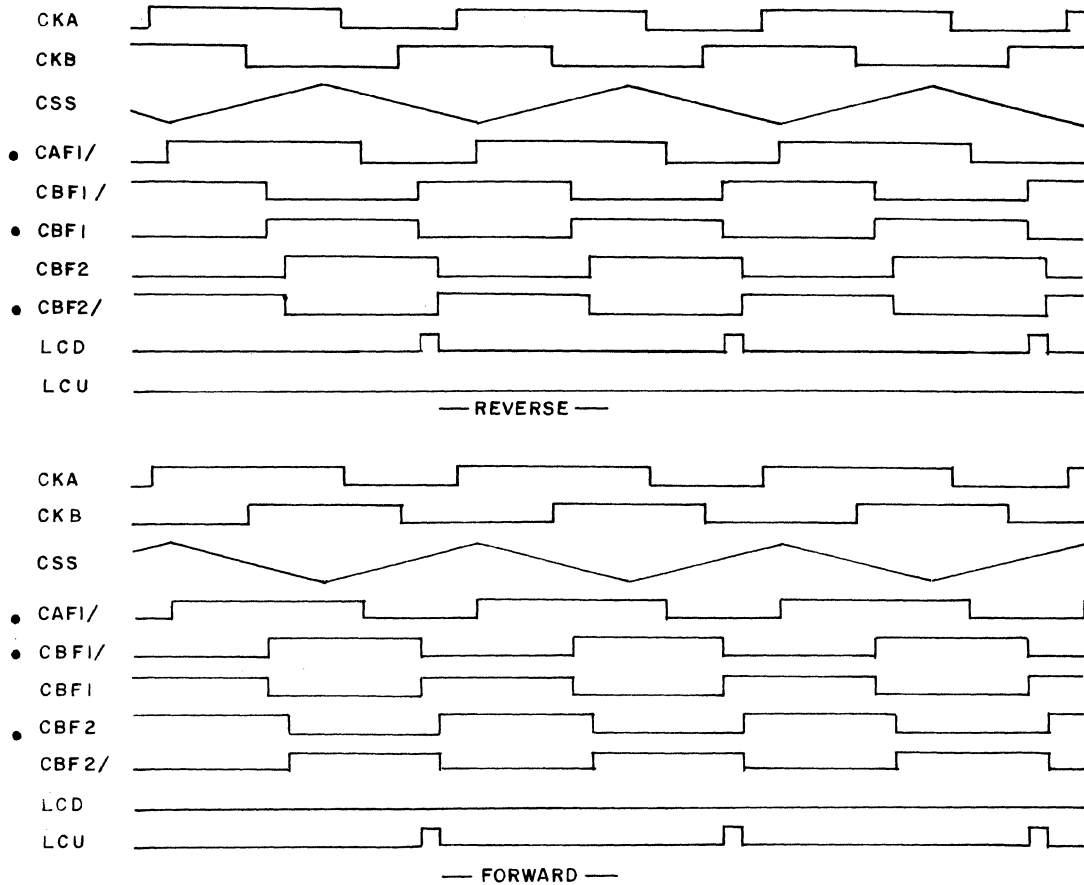


Figure 5-39. Disc and CSS Timing

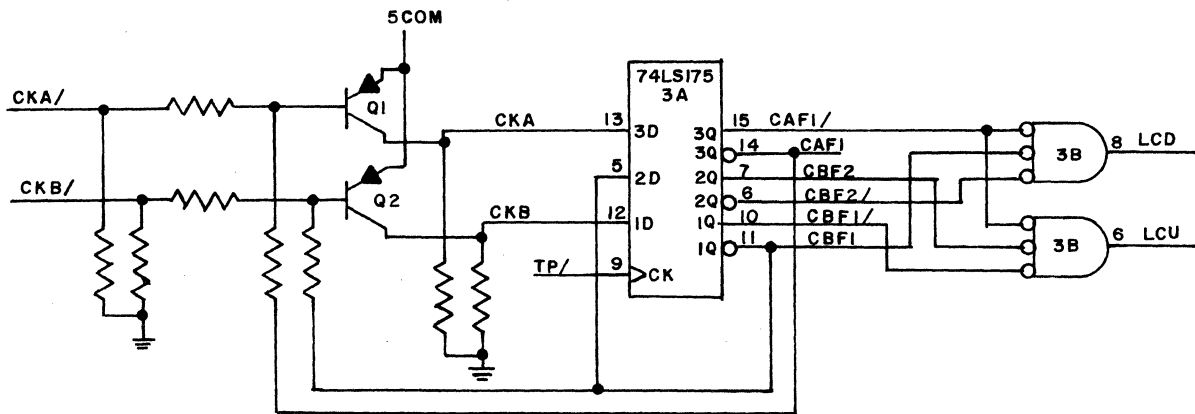


Figure 5-40. Generation of LCU and LCD

Present Position Logic

Present position (PP) of the carriage is maintained by the present position register (5A, 5B and 5C) on the servo board. An initial count is loaded into the counter from data supplied on the DA bus in conjunction with the WP4/ signal. The count in the counter is incremented whenever LCU occurs and is decremented whenever LCD occurs (see Figure 5-41).

By inversion of the twelfth bit to develop PP11, present position is actually 2 (2048) counts greater than the current position of the carriage. The current position is defined as the number of dot positions to the left margin. This is done so that PP may always be considered as a positive value without creating any ambiguity about the point CP=0. Thus, if PP11 is high (PP is greater than or equal to 2), then CP is greater than or equal to 0; if PP11 is low (PP is less than 2), then CP is less than 0 (or the carriage is left of the left margin).

Desired Position Logic

The desired position register (2A, 2B and 2C-6 in Figure 5-42) holds the desired position to which the carriage must move. The value of desired position (DP) is defined as the number of dot position to the right of the left margin, plus 2. The printer CPU board outputs character position (the number of characters to the right of the left margin) via the DA0 through DA7 bus. Since there are 12 dot positions allotted for one character, the data supplied by the printer CPU board must be multiplied by 12 before it is loaded into the desired position register. This multiplication is performed in the two adder chips, 1A and 1B.

Difference Computation and Velocity Control

The control of the servo velocity and the computation of the difference between the present position and the desired position of the carriage is performed by the circuits shown in Figure 5-43.

In general, if the value of PP is less than the value of DP, the carriage must move to the right to increase PP. Conversely, if PP is greater than DP, the carriage must move to the left to decrease PP.

Difference values DIF0/ through DIF11/ are developed via the exclusive OR-gates 6A, 6B and 6C, while the direction to move is defined by C12. If C12 is high, the carriage must move to the left; if C12 is low, the carriage must move to the right.

AND-gates 7A, 7B, and 7C are used to develop negative OR combinations which are buffered to form the digital DGX signals. The HS flip-flop (2C) provides an alternate path for generating high speed carriage movement.

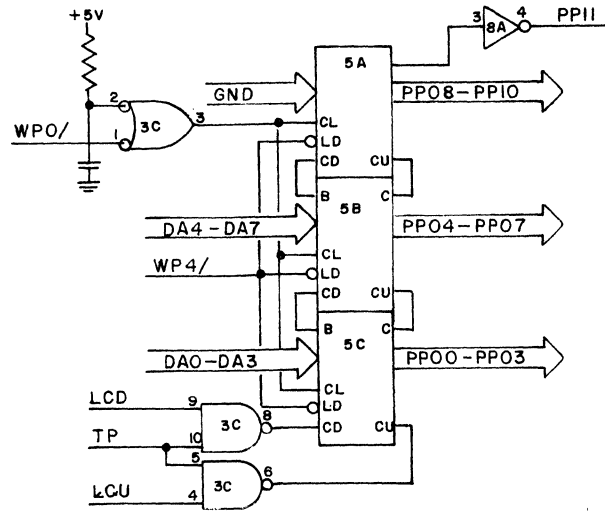


Figure 5-41. Present Position Logic

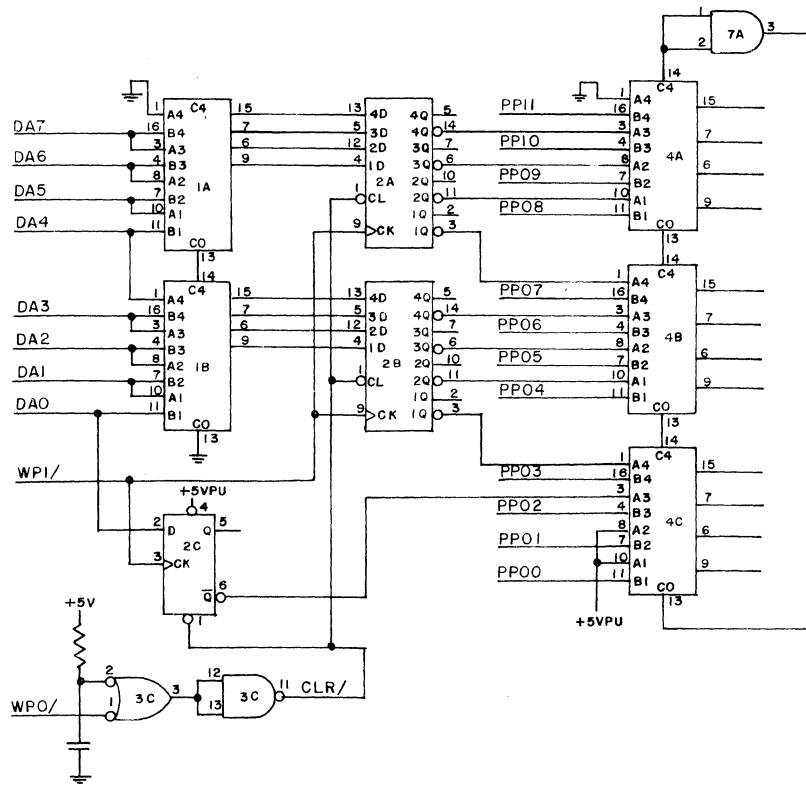


Figure 5-42. Desired Position Logic

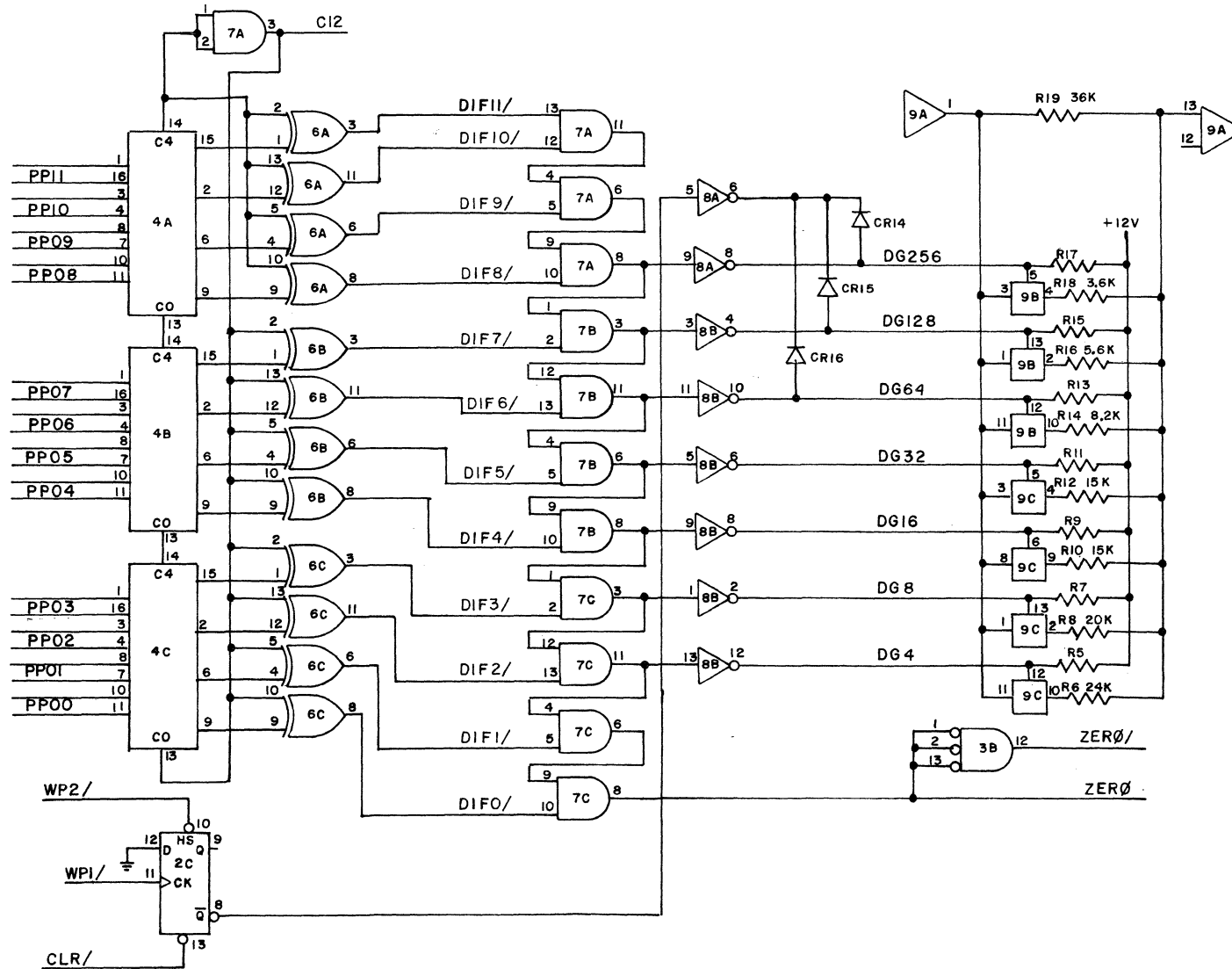
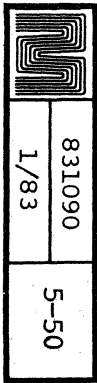


Figure 5-43. Difference Computation and Velocity Control

The ZERO and ZERO/ signals will be used, in conjunction with the C12 and CBF2 lines, in the analog circuitry to control the direction of the carriage.

The digital DG lines control whether gates 9B and 9C act as closed or open switches. The state of these digital switches control the amount of drive current to the servo motor.

Analog Computations

The carriage servo system operates in either the velocity mode when the carriage is moving, or the position mode when the carriage is held stationary. The analog circuitry is presented in Figure 5-44.

The direction control signal (DIR/) is developed as an analog voltage at 9A-1 and is derived from ZERO, ZERO/, C12 and CBF2/. The DIR/ output at 9A-1 is -2V to drive the to the right and +2V to drive the carriage left.

Velocity feedback from the tachometer (VEL) is amplified in velocity amplifier 10B-1 and compared with the DIR signal at the summing junction of R25 and R26. The output of the summing amplifier 10B-7 is velocity error (VE). In the velocity mode the VE signal is applied to the input of amplifier 10B-14 through digital switch 10A-8. The action of the switch, closed or open, is controlled by signals CAF1/ and ZERO. The ERR output of amplifier 10B-14 is used to control the direction and speed of the carriage servo motor.

Position error (PE) is developed in amplifier 10B-8 from the linear disc signal CSS. PE is applied to the input of the ERR amplifier 10B-14 through digital switch 10A10 when the servo is in the position mode.

The zero position signals (ZPOS and ZPOS/) are developed by the circuit shown in Figure 5-45. The outputs of 8A-10 and 8A-12 are also used to control the operation of the digital switches used in the selection of the velocity and position modes.

Servo Amplifier and Servo Motor

The servo amplifier circuit and the servo motor wiring are shown in Figure 5-46. The direction and speed of the motor are controlled by the ERR signal from the servo board. The output of amplifier Z5-6 controls the biasing of transistors Q10 and Q12. The resultant current flow through Q10 and Q12 controls the biasing of the four driver transistors, Q11, Q13, Q14 and Q15. The biasing of these four driver transistors controls the direction and amplitude of the current flow through the servo motor.

Current is limited to +7A by the current clamp formed with CR14 and CR15. These diodes become forward biased when the servo motor draws more than 7A.

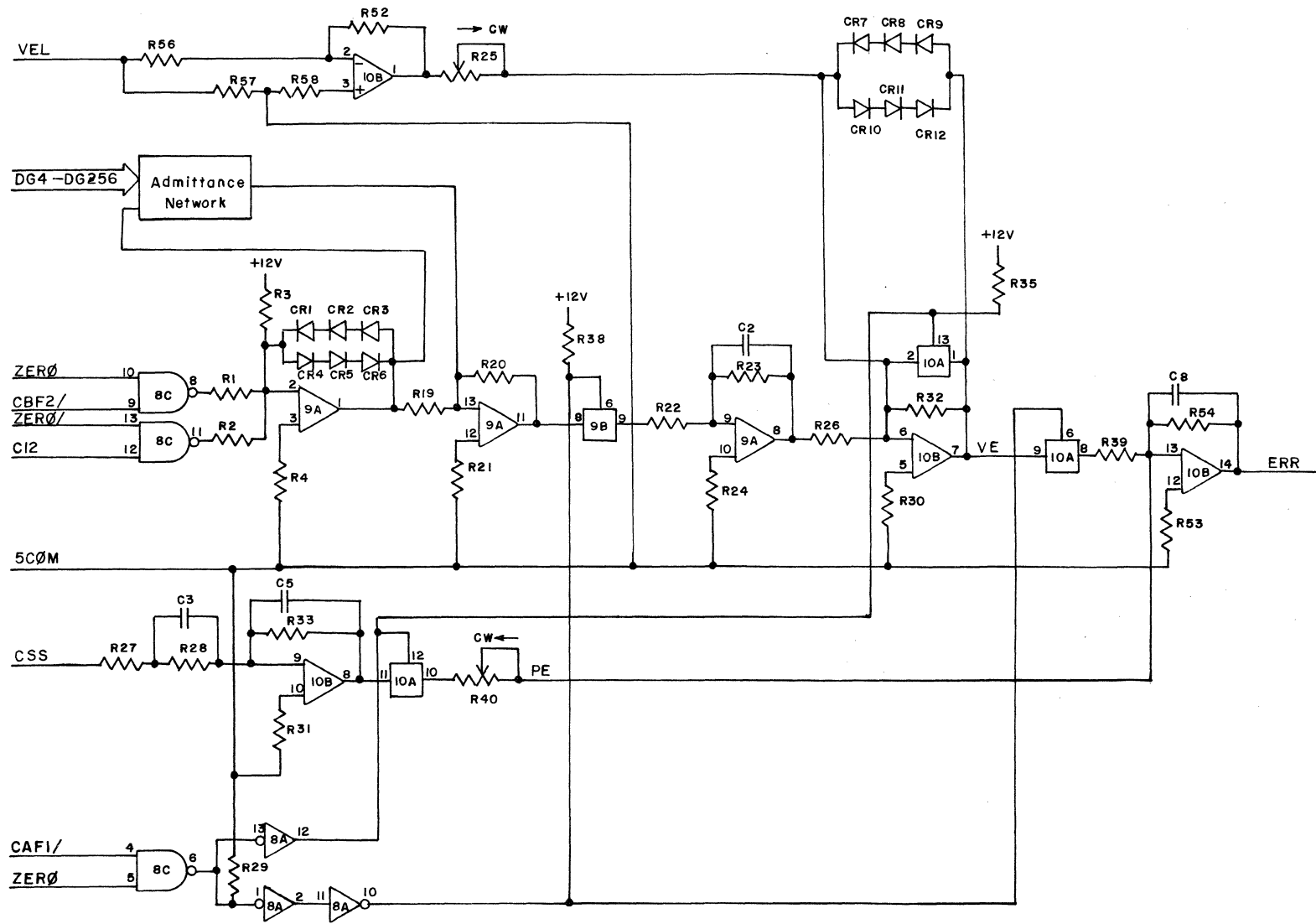
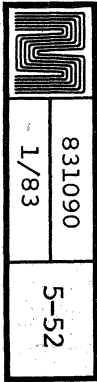


Figure 5-44. Carriage Analog Circuits

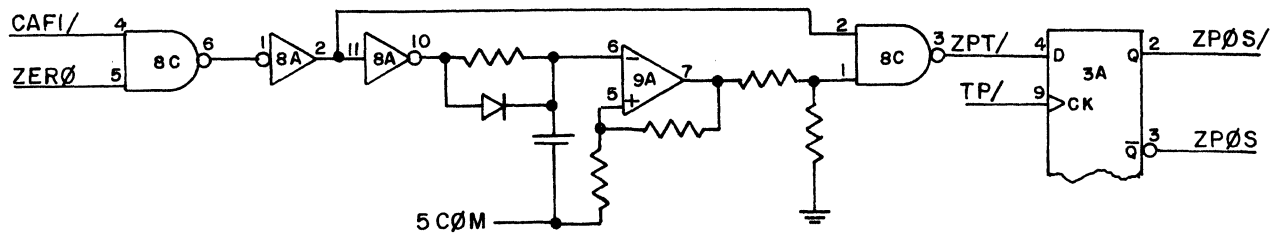


Figure 5-45. Generation of ZPOS

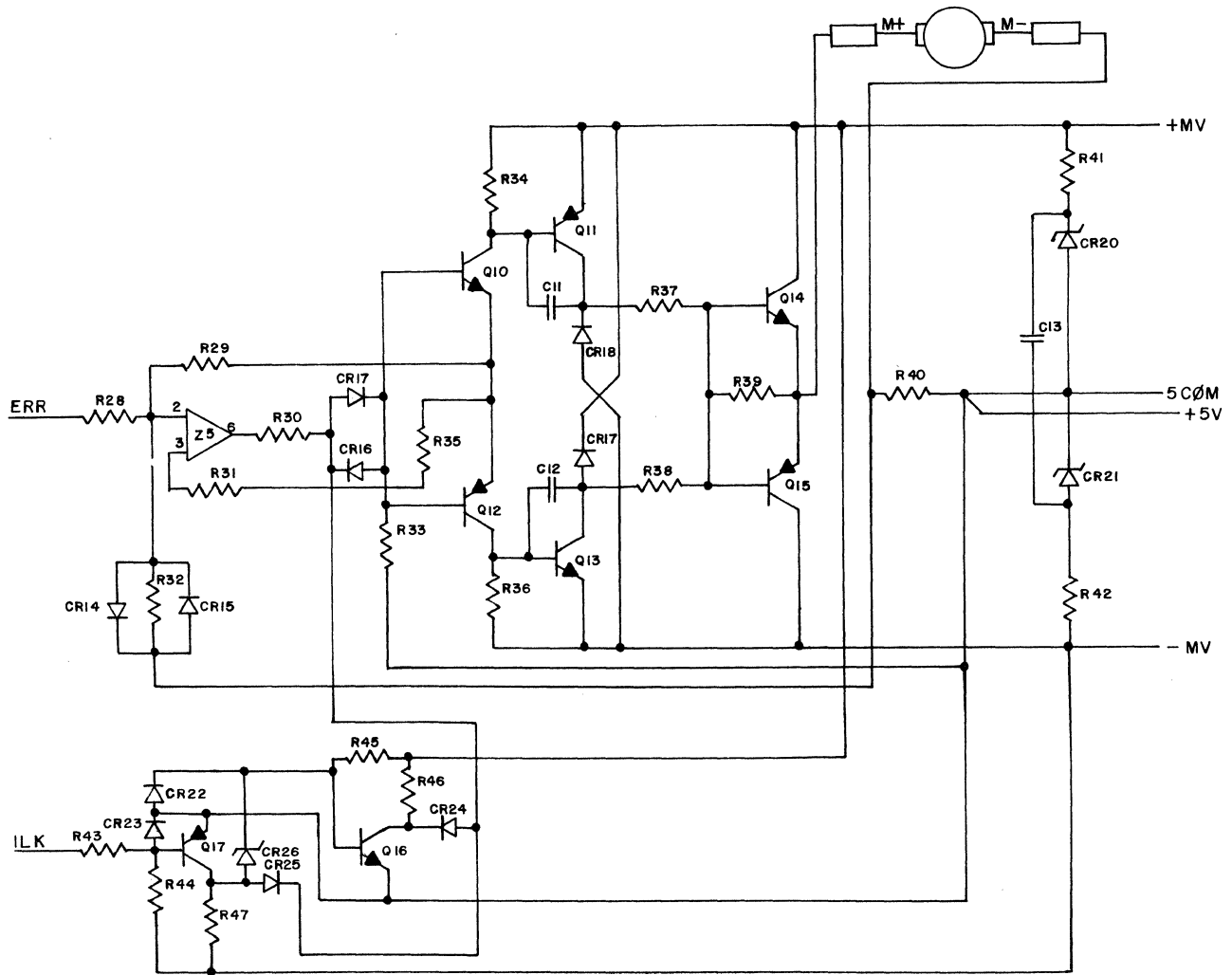


Figure 5-46. Servo Amplifiers

The interlock for the servo amplifier is provided by the signal ILK. If ILK goes low, both transistors Q16 and Q17 will be forward biased, causing clamping diodes CR24 and CR25 to conduct and cut off the base drive to transistors Q10 and Q12. This is to prevent overdriving the amplifiers when the tach (P/J 18) is not connected.

Carriage Drive Mechanism

The carriage drive mechanism provides lateral motion and guidance for the printhead. See Figure 5-47. Drive is provided by a stainless steel screw with a lead of 1.2 inches, coupled directly to a low-inertia, printed circuit armature, DC servo motor. The opposite end of the lead screw is mounted in a soft bearing, which compensates for run-out in the screw. The velocity compensating tachometer is mounted at the left end of the screw.

Guidance for the carriage is provided by two 1/2-inch diameter hardened steel guide rods. These side-frame, mounted rods are aligned parallel to the platen. The rod nearest to the platen is rigidly mounted, while the other rod is soft-mounted.

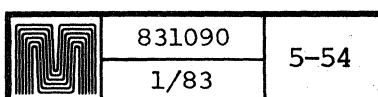
The durable molded plastic carriage contains three linear bearings that fit over the guide rods. Two bearings in the guide rod position nearest the platen provide angular rigidity. The third bearing operates over the floating guide rod. The error induced by the "soft" rear guide is very small because of the large ratio of motion when reflected to the platen.

Mounted to the carriage is a Teflon-impregnated delrin nut that matches the lead of the drive screw. The nut is segmented and spring-loaded to provide anti-backlash properties.

The printhead is mounted on the carriage. The wires are driven by their own individual solenoids, mounted at the rear of the head. The solenoids are coupled to the head driver board located on the control panel via a flexible flat cable. The spacing between the head and the platen is adjustable to accommodate varying thicknesses of forms.

CONTROL PANEL

The control panel houses the controls and indicators listed the Operator's Manual, Table 4-1. The controls are used to move paper control to local or remote operation, and to select one of three baud rates at HALF/FULL duplex mode. The controls are also used for serial I/O operation and other features detailed in the following paragraphs. The indicators provide a visual indication of certain conditions.



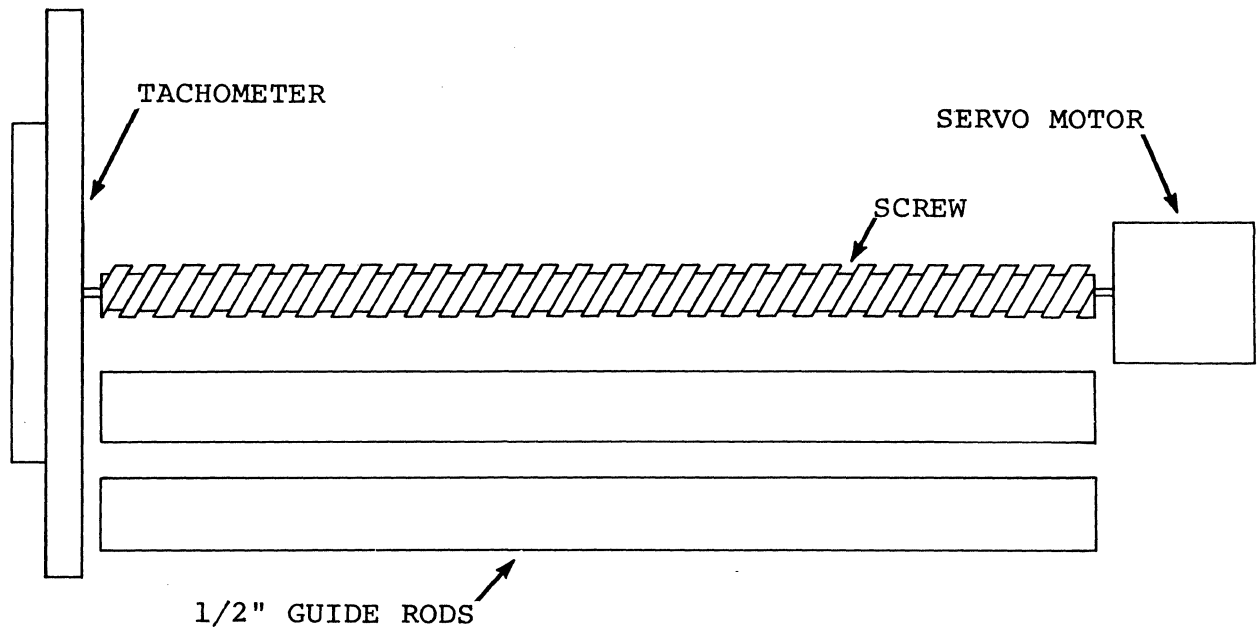


Figure 5-47. Carriage Drive Mechanism

Lamp Supply

The supply for the four lamps on the control panel (POWER, LOCAL, FOR, and STATUS) is furnished by the circuit shown in Figure 5-48. Failure of all four indicator lamps to light would indicate a power supply malfunction of a faulty voltage regulator, VR1. The POWER indicator lights whenever AC power is supplied to the printer and the on/off switch on the rear of the printer is on.

Paper Movement Controls/Indicator

The three switches on the control panel that affect paper movement are shown in Figure 5-49. The FPF/TEST switch (S4) is a momentary action switch that causes paper to move 1/6 of the line (1/36 inch) each time it is activated when the RUN/STOP switch is in the STOP position.

The FF (form feed) switch (top of form) causes paper to advance to the top of form of the next page each time it is activated.

The FOR (forms override) switch, S9, allows printing to the bottom of the form after the paper-out switch activates. The forms override indicator (DS3) will light whenever the forms override switch (S9) is activated.

RUN/STOP Switch

Placing switch S1 in the STOP (hold) position activates the STOP line to the printer CPU board, as presented in Figure 5-50. Note that a paper-out condition can cause the same effect.

LOCAL switch

The LOCAL/REMOTE must be in REMOTE for the printer to be online. The LOCAL position allows for instructions and adjustments for internal printer functions. See Figure 5-51.

STATUS Indicator

The STATUS lamp is activated whenever the LRDY/ line goes low, causing transistor Q1 to forward bias. The indicators provided by this lamp will vary, depending upon whether the serial I/O board or the parallel interface board, is installed (see Figure 5-52).

The indicators provided when the parallel interface board is installed are as follows:

- Flashing--Out of paper or RUN/STOP switch is in STOP.
- Glowing dimly--Receiving data from an external source.
- Off--Character buffer on the printer CPU board is full.
- On--None of the three conditions shown above exist.
Printer is in normal static condition.

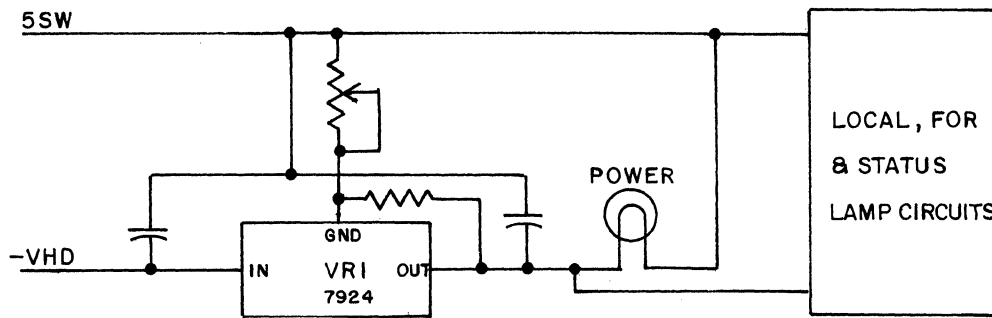


Figure 5-48. Control Panel Lamp Supply

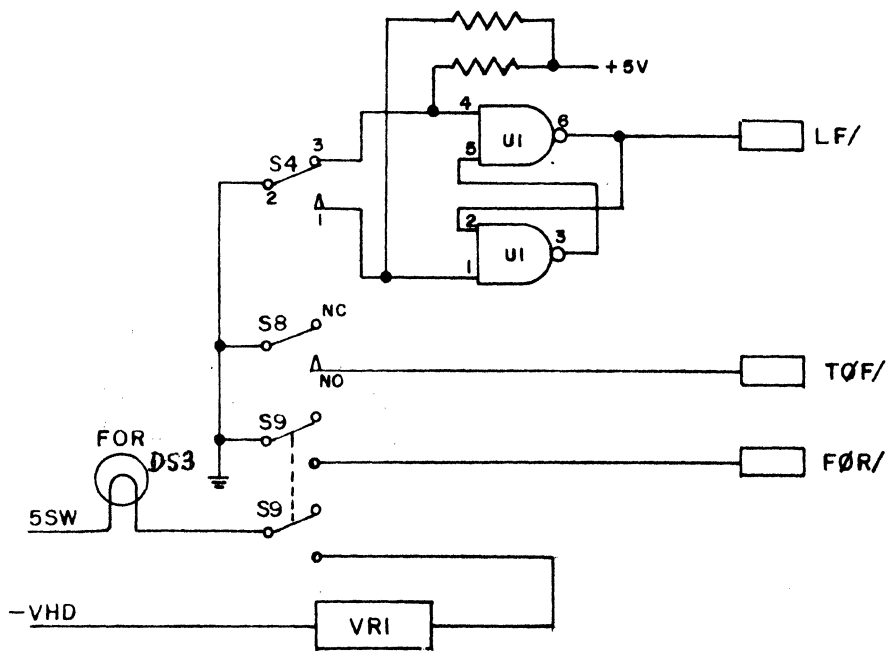


Figure 5-49. TEST/FPF, Form Feed, and Forms Override Switches

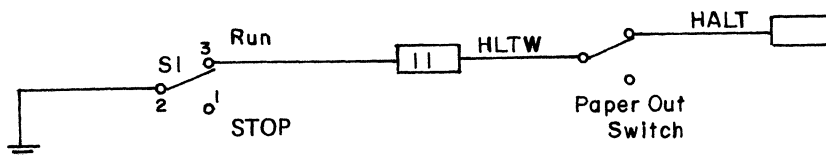


Figure 5-50. RUN/STOP Switch Circuitry

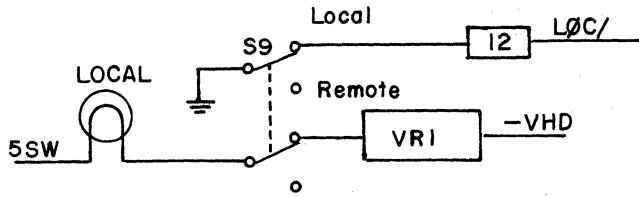


Figure 5-51. LOCAL/Remote Switch Circuitry

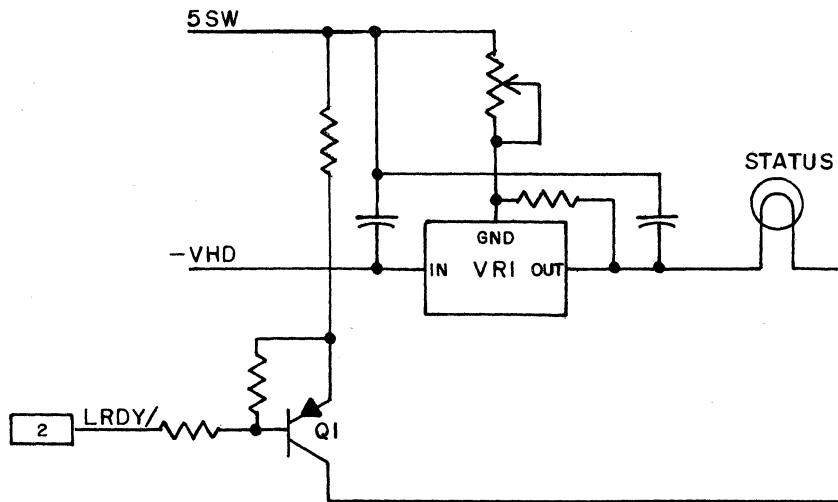


Figure 5-52. STATUS Lamp Circuitry

The indicators provided when the serial I/O board is installed are as follows:

On--The printer is in the LOCAL mode or in REMOTE mode and both RSCB and RSSB signals are active.

Off--The answer back (HERE IS) logic is active (HRT/ is low) or in REMOTE mode and either of RSSB or RSCB signals are inactive.

Flashing--The STATUS lamp flashes in synchronism with the supervisory receive data (RSSB) and clear to send (RSCB) signals. The relative brightness of the lamp is controlled by the state and frequency of these two signals (see Figure 5-53).

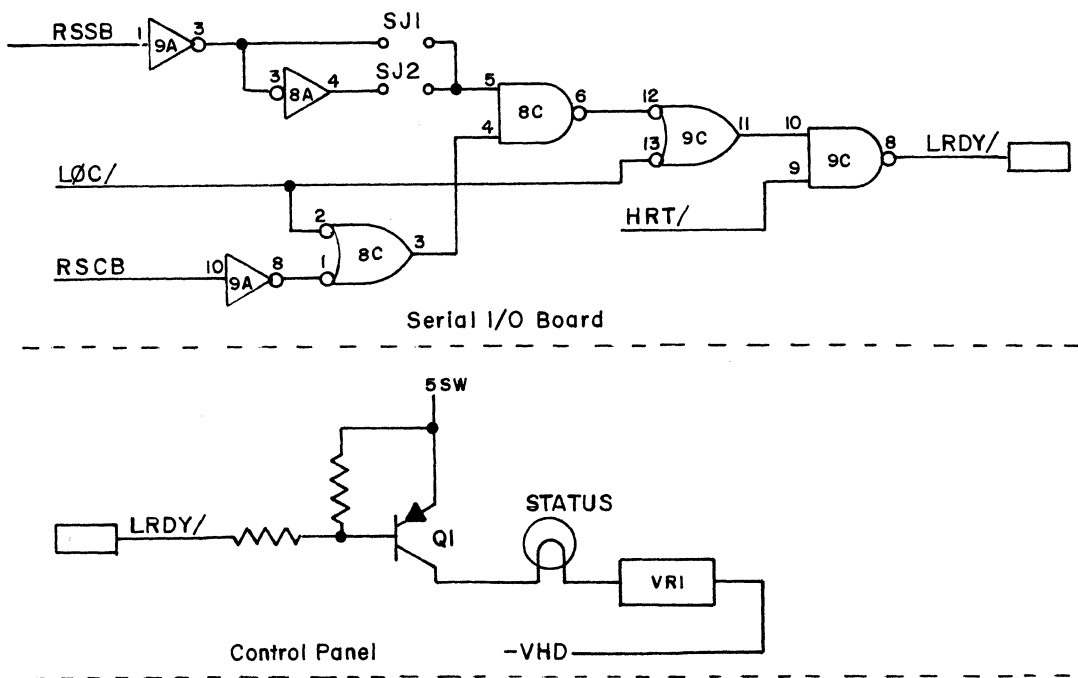


Figure 5-53. STATUS Logic Serial I/O Board

Communication Control Switches

The four switches that affect operations of the serial I/O board are presented in Figure 5-54. Switch S2 selects HALF or FULL duplex (HD/FD) operation. The ECHO/ line is active (low) when the HALF duplex mode is selected.

Switch S3 selects baud rates of 110, 300 or 1200. The state of these three lines, high or low, is used for the programmed count in the baud rate clock circuit on the serial I/O board. Activation of the break (BK) switch, S7, causes a momentary break or pause in serial transmission whenever it is activated.

The HERE IS switch (S5) can cause activation of the HERE IS logic on the serial I/O board. This circuitry outputs a 31 character response to an external device, usually in answer to the receipt of an enquire (who are you) code.

PAPER MOVEMENT AND PAPER OUT SWITCH

Paper is advanced by a 3-phase stepper-motor that is under the control of the microcomputer on the printer CPU board. Each time the NE555 one-shot is triggered, tractor hold (THD/) goes high for approximately ten milliseconds and releases the tractor drive circuits. The paper tractor moves up or down under the control of the OT0 through OT3 signals (see Figure 5-55).

Paper Out Switch Circuitry

The routing of the STOP circuit is shown in Figure 5-56. During normal operation, STOP is low. Placing the RUN/STOP switch in the STOP position, or opening the paper out switch, causes the STOP signal to go active (high).

The STOP line is routed to the printer CPU board where it inputs to the microprocessor as IN3/, and to the parallel interface board, where it affects the ready and on line signals.

Paper Feed Tractor Motor Circuitry

The entire tractor motor circuitry is shown in Figure 5-57. When the tractor is not moving, THD/ is low and a holding current of approximately 0.5A is supplied to the fields of the tractor motor. When THD/ is low, transistor Q18 is forward biased, supplying emitter current to transistor Q23. Transistor Q23 forward biases when the drop across R50 is approximately 0.7V. The collector current of Q23 then absorbs part of the base drive to transistors Q20, Q22 and Q24, holding the output current to the motor to approximately 0.5A.

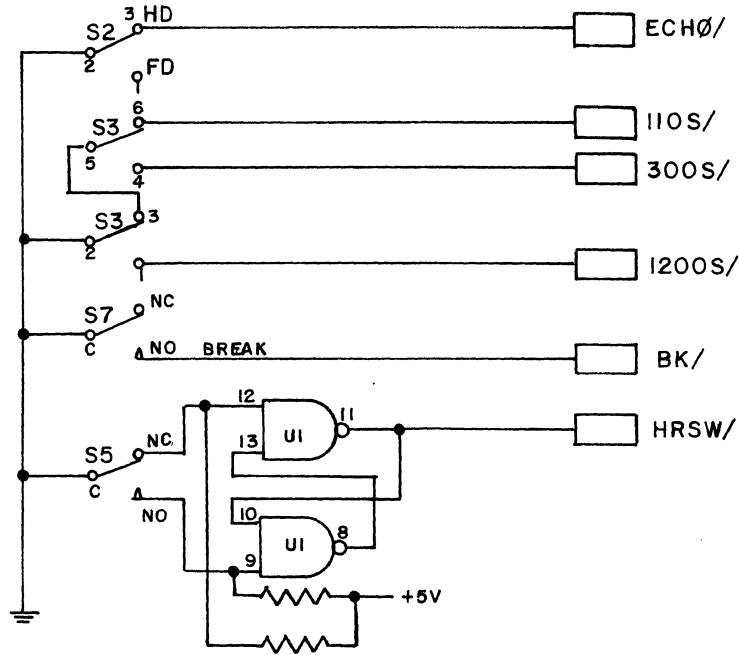


Figure 5-54. Communications Control Switches Control Panel

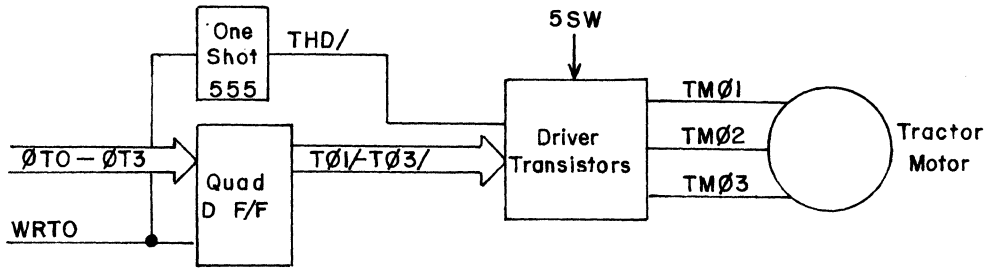


Figure 5-55. Paper Movement Block Diagram

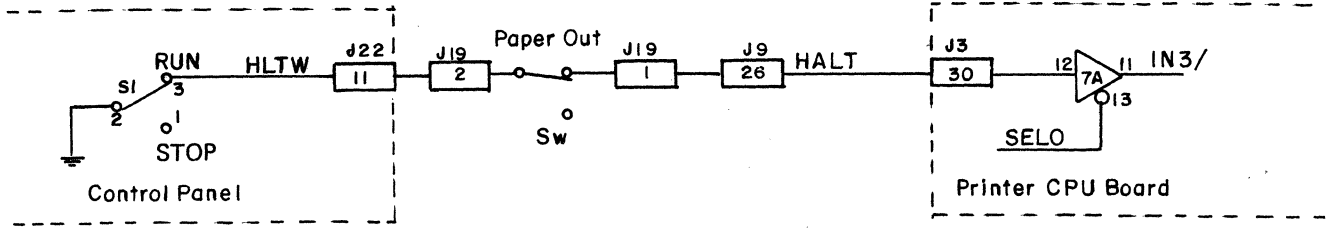


Figure 5-56. Paper Out Circuit

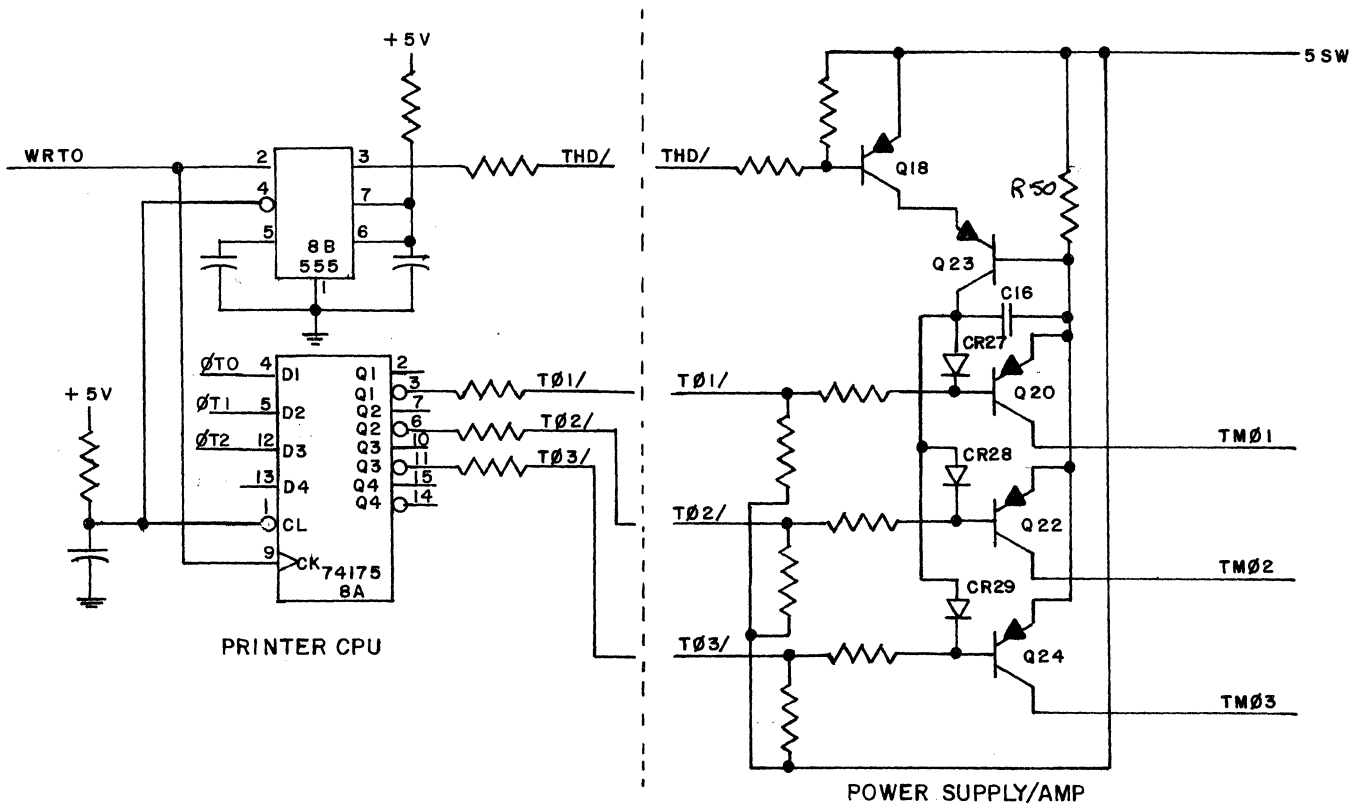


Figure 5-57. Tractor Motor Circuitry

When the paper is to be moved, the microprocessor activates OT0/, OT1/ and OT2/ in the desired sequence, along with the WRTO line. WRTO clocks the condition of the three OT signals into 8A and triggers the one-shot, 8B, causing THD/ to go high for ten milliseconds. It also removes the holding current from the tractor motor. Assuming T01/ is low, Q20 will be driven into saturation, supplying approximately 1.4A of drive current to phase 1 of the motor.

Paper Feed Mechanism

The paper feed mechanism is assembled as an integral part of the chassis. The left and right hand supports for the mechanism are each composed of a pair of stamped parts. The fixed portion of the support fits the platen shaft. The platen is secured to the chassis by an adjustable right-hand and left-hand platen support assembly. Since the paper feed is referenced to the platen, it is adjusted relative to the platen. Two tractor guide shafts, one round and the other square, are located between the left-hand and the right-hand supports.

RIBBON CONTROL

The circuitry involved in controlling ribbon motion is presented in Figure 5-58. The two motors are not interchangeable. The left motor revolves clockwise, the right motor revolves counterclockwise. There are two distinct phases to the ribbon operation. One is the nonmoving operation, where a torque is applied by both drive motors to maintain ribbon tension. During the second phase, current to one drive motor is removed and the second motor receives drive current, causing the ribbon to move left or right.

Maintaining Ribbon Tension

Both ribbon motors apply torque and keep the ribbon tensioned whenever ribbon control (RBC) is low. In order for RBC to go low, the carriage must be a zero position (ZPOS is high) and the paper tractor must not be busy (TBSY is low). This causes 6A-8 to output a high, which removes the reset from timer 6B and triggers it into action. After the NE555 one-shot times out, the output on pin 3 goes low.

Moving The Ribbon

Ribbon motion is activated whenever the carriage is not at zero position (ZPOS is low) or the paper tractors are moving (TBSY is high). Either action causes gate 6A to output a low and hold flip-flop 7C-5 in the set condition, keeping RBC high. The low out of 6A-8 also holds the timer, 6B, in the reset condition.

The ribbon motor to be energized is controlled by the state of the ribbon switch latch, Z4-3 and Z4-6. If the right ribbon switch was the last to activate, Z4-3 outputs a high and Z4-6 outputs a low. When RBC goes high, Z4-11 outputs a low and turns triac Q9 on, while Q8 is disabled when Z4-8 outputs a high. This makes the left ribbon

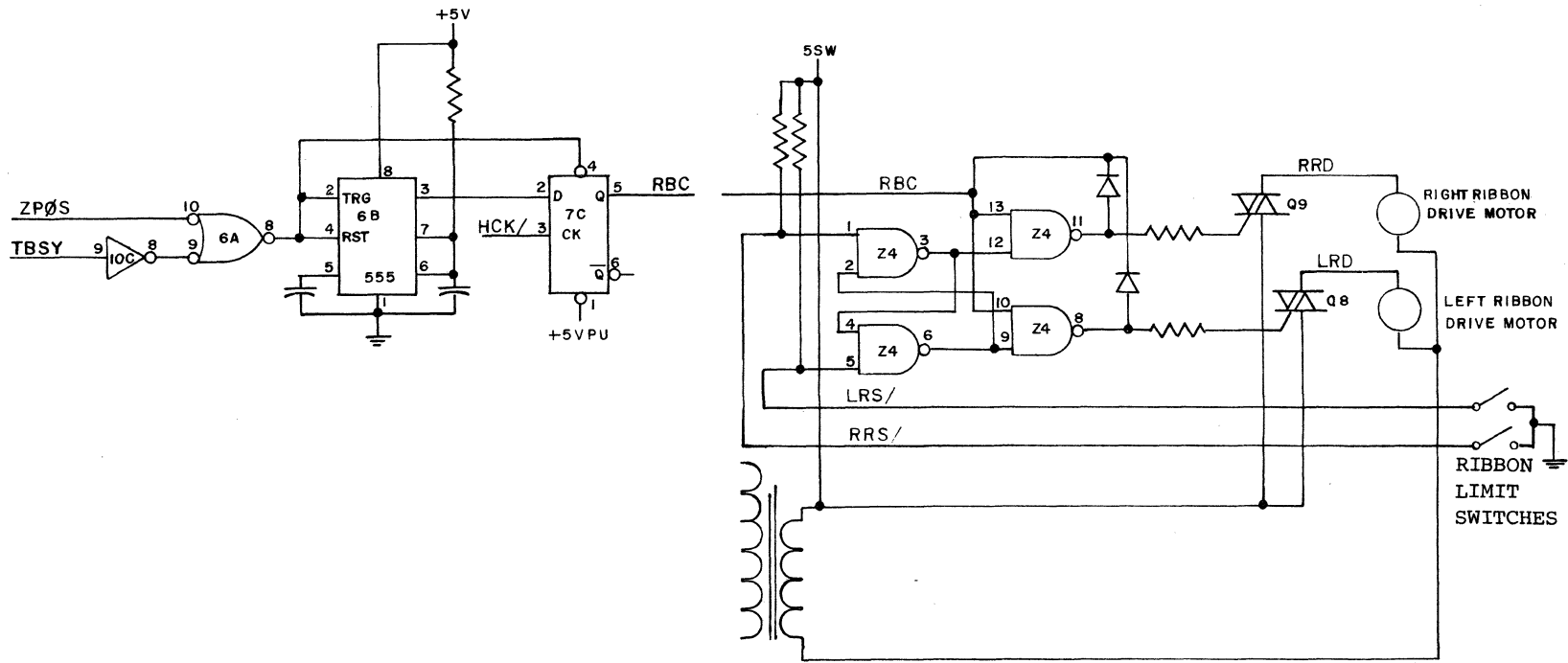


Figure 5-58. Ribbon Drive Circuit

Driver motor become a follower, allowing the right ribbon drive to wind the ribbon.

KEYBOARD LOGIC

A block diagram of the keyboard logic is provided in Figure 5-59.

Keyboard entry is in a matrix that produces a hex code output. Keystrokes from the keyboard are encoded by the ROM and the generated signal is translated into a 7-bit character. This is transferred to the interface board as KB0 through KB7. Transfer of each character is effected by a strobe pulse (KBSTB), which is generated by the same keystroke generating the character. The hex code values generated are shown in the Operating Manual, Figure 1-10.

Keystrokes from the matrix are used to address the encoder ROM. As an example, if key 47 is activated, a hex code value of 6B is generated and the ASCII code for lowercase k is output via KB0 through KB7.

Uppercase and ContRoL Logic

Uppercase k is derived by pressing the shift key (either 57 or 68) followed by activation of key number 47. Holding either of the shift keys down causes the shift input to the encoder ROM to go true. Activation of the shift lock key (39) has the same effect, except that a latch is set and will remain set until the shift lock key is released.

Activation of the ContRoL key (56) causes a non-printable code to be generated by an otherwise printable character key. Using the "k" as an example again, simultaneous activation of the ContRoL key and the "k" key will cause the ROM to output the hex code of 0B for a vertical tab (VT). This code is the same as the ASCII code.

Repeat Key

Activation of the repeat key (69) causes the keyboard to repeatedly output the hex code for the keyswitch activated within the keyboard matrix.

Uppercase Alpha

The UC ALPHA key (38) is used to force the uppercase mode of operation. If bit 6 out of the ROM is true, as in the case of lowercase letters, activation of the UC ALPHA key forces it to appear false at KB6, thereby converting a lowercase letter into an uppercase letter. This only has an effect on alphabetic keys.

Keyboard Strobe

The strobe (KBSTB) necessary to effect a character transfer is available in either a positive or negative active state. The strobe width is a minimum of 10 milliseconds and becomes active 30 to 50 milliseconds after data is put on the interface.

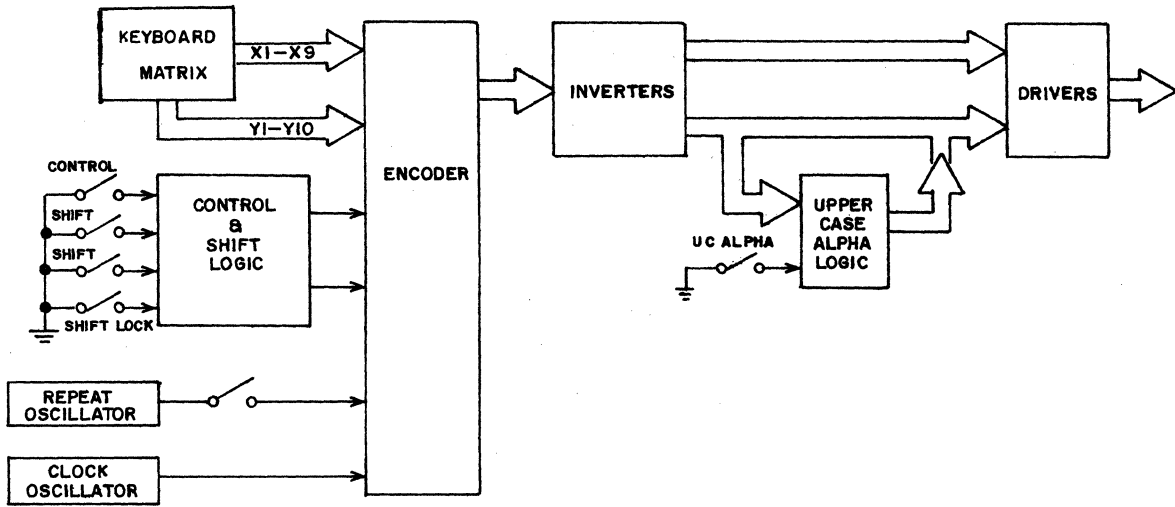


Figure 5-59. Keyboard Logic Block Diagram

SECTION 6 MAINTENANCE

INTRODUCTION

This section deals with prescribed preventive and corrective maintenance for the Matrix Printer. Printer maintenance is limited to checkout and corrective procedures that can be performed on-site. Other than replacing the printhead and ribbon, maintenance should be performed only by qualified service personnel.

For qualified personnel, fault isolation may be performed to the printed circuit board level and to the replacement of the faulty board as a unit. For the horizontal motion and paper movement, faults may be isolated to the assembly and component level.

PREVENTIVE MAINTENANCE

Preventive maintenance is based on a schedule of periodic inspection (refer to Table 6-1). During inspection, note marginal operation or physical conditions that could lead to serious operational failure (if left undetected) of the printer. In addition to the normal regular monitoring of printout by the operator, routine inspection of moving parts and internal cabling should be performed to detect wear or faulty parts. This should include a daily check of the general performance and a monthly visual inspection of all moving parts. Inspection should also verify that all characters are printed, character spacing is uniform, and tabulation is operating correctly.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of troubleshooting and fault isolation in the event of printer malfunctions, and the replacement of the defective part or assembly. Replacement procedures are in this section under Removal and Replacement.

Troubleshooting

Malfunctions can arise from faults in the electronic, electromechanical, and mechanical units of the printer. The symptoms of a malfunction should be analyzed in terms of the following areas:

Printout--Includes loss of character print, improper spacing, loss of some characters, unacceptable print quality or improper tabulation.

Paper feed--Symptoms are paper bunching, torn paper or incorrect line spacing.

Communications loss--Printer does not function correctly when operating with a host system or the keyboard.

Printer stop--Printer fails to operate or operates marginally.

Part or Function	Frequency	Action
Printout	Daily	<p>Inspect for clarity.</p> <p>(a) If weak, change ribbon.</p> <p>(b) If uneven density, perform impression adjustment.</p> <p>(c) If impression adjustment does not improve quality, replace printhead.</p> <p>(d) If character spacing is uneven or characters are missing, refer to Table 6-2.</p>
Printhead and driver board	Monthly	Check for loose connections and proper adjustment.
Controls/Indicators	Monthly	Verify proper action and indications.
Paper feed belts and mechanism	Monthly	Check for wear and correct operation.
All mechanical parts	Monthly	Clean with vacuum cleaner.
Cabinet	Monthly	Clean with mild household detergent and dry cloth.
All moving mechanical parts and electrical connections	Monthly	Inspect for wear damage, obstructions, dust, worn insulation, broken wiring and loose connections.
Ribbon	As necessary	Replace or turn over (Reference Operation Section, Ribbon Installation).
Lead screw	Annually	Lubricate with light coating of TRI-FLON.

1. Fault Analysis

The troubleshooting chart, Table 6-2, is not a comprehensive list of all possible printer troubles and remedies. It is a guide to isolating faults and correcting malfunctions. Maintenance should be performed only by personnel familiar with electronic troubleshooting and fault isolation techniques.

2. Fault Isolation

In many cases of printer malfunction, a visual check may find faults that preclude complex troubleshooting procedures. During visual inspection, check the following:

Switch positions and panel indicators for correct settings and indications.

Wiring, connectors, and cabling for secure connection.

Moving parts for obstruction, wear, or damage.

During power and/or electronics checks, inspect the following:

Power source and main fuse.

DC voltage outputs at the power supply.

All power distributions and voltage levels throughout the printer.

Printed circuit boards for proper seating in the mother board.

ADJUSTMENTS

Some adjustments on the Matrix Printer may be required. A description of these adjustments and recommended procedures are presented in this section.

Impression Adjustment

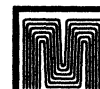
The printhead to platen distance adjustment is explained in the Operation Section.

Paper Feed Tractors to Platen Distance

This adjustment may be required if many different forms are used. Its necessity is indicated by line bunching (uneven spacing between lines), torn paper feed holes and/or elongated paper feed holes in the forms.

Procedure	Correct Response	Incorrect Response	Cause/Check	Probable Fault
1. Turn power on	The printhead should move slowly to the right side to establish the right margin, then to the left side to establish the left margin.	No movement	<ol style="list-style-type: none"> 1. Power (refer to Procedure 9) 2. Connections to servo motor 3. Electronic drawer plugged in properly 4. Boards plugged in properly 5. Servo (refer to Procedure 10 or 11) 6. Check Fuses F3 and F4 	P/S board CPU board Servo board Fuse F3 Fuse F4
		Erratic movement	<ol style="list-style-type: none"> 1. Power (refer to Procedure 9) 2. Connections to: <ol style="list-style-type: none"> a. electronic drawer b. tachometer c. disc sensor board 3. Servo (refer to Procedure 10 or 11) 	P/S board Disc sensor board CPU board
2. Enter data	Characters should print at the speed the data is entered up to the designated speed of the printer.	No data prints and no carriage movement	<ol style="list-style-type: none"> 1. Correct switch settings on front panel 2. Paper out switch on tractor 3. Keyboard and keyboard connection or data from host source and connection 4. Servo (refer to Procedure 10 or 11) 	CPU board I/O board (if self test works)

Procedure	Correct Response	Incorrect Response	Cause/Check	Probable Fault
2. Enter data	(cont'd)	No data prints but carriage moves	<ol style="list-style-type: none"> 1. Connection to printhead 2. Front panel switch setting 3. Paper out switch 4. Servo (refer to Procedure 10 or 11) 5. Power (refer to Procedure 9) 6. Connections to head driver board 	Data board CPU board I/O board Head driver board
		Wrong data prints	<ol style="list-style-type: none"> 1. Data input 2. Connections 3. Servo (refer to Procedure 10 or 11) 	I/O board Data board CPU board
		Good data prints but dots missing over the complete character across the full page	<ol style="list-style-type: none"> 1. Servo (refer to Procedure 10 or 11) 2. Impression adjustment 3. Connections to head driver board and printhead 	Printhead Head driver board Data board
3. Enter self test-enter ESC? AF1 or via TEST switch. NOTE: To stop self test, place RUN/STOP switch in STOP position.	The printer should print "This is a self test program," a series of ASCII characters, and the speed in characters per second along the left margin. Reference Operation Section, Self-test Procedure for Print-out sample.	No printing	<ol style="list-style-type: none"> 1. Data entered 2. Switches on front panel 3. All connections 4. Servo (refer to Procedure 10 or 11) 	CPU board I/O board (if self test works, but cannot communicate with host)
		Good data but missing dots on one side of the page only	Platen adjustment Adjust platen to be parallel to the carriage travel	Platen adjustment (factory adjustment)
		Good data but missing dots along the top or the bottom of the characters	Platen adjustment Adjust platen height relative to the printhead	Platen adjustment (factory adjustment)
		Good data but constantly missing dots from a particular wire	<ol style="list-style-type: none"> 1. Printhead solenoid 2. Connection to head driver board and to the printhead 	Printhead Head driver board Data board Loose connection or faulty cable
		Ribbon smudge	Impression adjustment	Impression adjustment
4. With no horizontal tabs set, do a tab and a CR	The carriage should slew to the right margin, then return to the left margin.	No movement Movement but carriage overshoots	<ol style="list-style-type: none"> 1. Data entered 2. Servo (refer to Procedure 10 or 11) Servo (refer to Procedure 10 or 11)	CPU board Servo board



Procedure	Correct Response	Incorrect Response	Cause/Check	Probable Fault
5. Turn paper knob by hand (POWER On)	You should feel a positive stepping action from stepper motor holding current.	Turns free	1. Loose pulleys 2. Connections to tractor drive motor 3. Power (refer to Procedure 9)	P/S board CPU board Tractor motor
6. Enter LF	The paper should advance 1 line (1/6 inch)	No movement or erratic movement	1. Loose pulleys 2. Connections 3. Power (refer to Procedure 9)	P/S board CPU board Tractor motor
		Irregular spacing between lines	Paper tension around platen and paper tractors	Paper tractor adjustments
7. Enter data	Ribbon should move	No ribbon movement	1. Ribbon mounted properly 2. Connections to ribbon motor, interconnect board, and switches. 3. Power (refer to Procedure 9)	P/S board Ribbon motor Direction switches Ribbon hubs Interconnect board
8. Trip a ribbon direction switch, enter a character then repeat for other direction switch.	Ribbon should move first in one direction then the opposite direction	Moves only in one direction	1. Connections to ribbon motor in-operative 2. Direction switch 3. Drive motor	Drive motor P/S board Direction switch
9. Turn POWER on	Power indicator on front panel ON	No power (indicator OFF)	1. Main power switch 2. AC plug 3. Main power fuse 4. AC power 5. Power supply fuses 6. Connections 7. Voltages a. +5V b. -10V c. +12V d. +5 sw e. +5 com f. VHD (>+) g. MV+ (>15V) h. MV- (>15V)	P/S board Transformer
10. Turn POWER On	Margin search	No movement	1. Connections to servo motor 2. Servo board installed properly 3. CPU board installed properly 4. Power (refer to Procedure 9) 5. Check fuses F3 and F4	Servo board CPU board P/S board Fuse F3 Fuse F4
11. Enter data	Carriage movement	No movement	1. Connections to servo motor 2. Servo board installed properly 3. CPU board installed properly 4. Power (refer to Procedure 9)	Servo board CPU board P/S board

Procedure	Correct Response	Incorrect Response	Cause/Check	Probable Fault
11. Enter data	(cont'd)	Erratic movement	<ol style="list-style-type: none"> 1. Connection to servo motor and disc sensor board 2. Connection to tachometer 3. Tachometer installed properly 4. Servo and CPU boards installed 5. Power (refer to Procedure 9) 6. Printing speed 7. Tachometer producing noisy signals 8. Disc dirty or bent 	Servo board CPU board P/S board Disc sensor board Tachometer
12. Set control panel switches to RUN, HD, LOCAL, then type data	The data should print	No printing	<ol style="list-style-type: none"> 1. Connections to I/O board and keyboard 2. Data from keyboard 3. Connections to control panel 4. Control panel switches 	I/O board Cable or connections Control panel board
13. Set LOCAL switch to remote and type data	The data should print	No printing	<ol style="list-style-type: none"> 1. I/O board 2. Cable or connections 	I/O board Cable or connections
14. Disconnect RS-232 connection to external equipment. Jumper pins 2 to 3 and 5 to 8 to 20 on connector J8. Set front panel switches to remote, FD and RUN. Enter a character through the keyboard. Try at 110, 300 and 1200 baud	The character should print	No character prints or the wrong character prints	Connections to I/O board and keyboard	I/O board Cable or connections
15. Disconnect connection to external data source and plug in keyboard. Set front panel switches to RUN, LOCAL, HD, then enter data	Character should print	No printing	<ol style="list-style-type: none"> 1. Connections to I/O board 2. Data from keyboard 3. Front panel switches 	I/O board Keyboard Front panel switches

The distance between the platen and the paper feed tractor may be adjusted as follows:

- (a) Select the forms that will have the greatest number of parts (multi-part). See Operator's Manual, Section 4.
- (b) Loosen the four screws on the paper feed assembly end plates at both ends of the assembly.
- (c) Adjust the tractor-to-platen distance so that the forms are taut. The paper feed holes should be lined up over the tractor pins such that pressure is not exerted that would elongate the holes.
- (d) Tighten the screws and check the alignment.
- (e) Try the different forms that will be used while checking the alignment. If a happy medium cannot be accomplished with all of the different forms used, different settings will have to be established for the different forms.

Platen Drive Belt

This adjustment may become necessary due to the tractor-to-platen adjustment, or when a replacement of the belt, tractor, or platen is requested. To accomplish the adjustment, perform the following (see Figure 6-1):


- (a) Loosen the two screws that hold the platen drive belt tensioner plate to the right end plate of the paper feed assembly.
- (b) Adjust the tensioner plate to maintain sufficient belt tension.
- (c) Tighten the two screws holding the platen drive belt tensioner.

Note: Excessive tension transmitted throughout the system will cause premature failure of components, i.e., bearings.

Platen Alignment

This alignment will become necessary due to replacement of the platen, platen drive belt, or a tractor. The alignment requires a special tool (platen alignment tool, Microdata part number TA20019348). The alignment is performed as follows as (see Figure 6-2):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.

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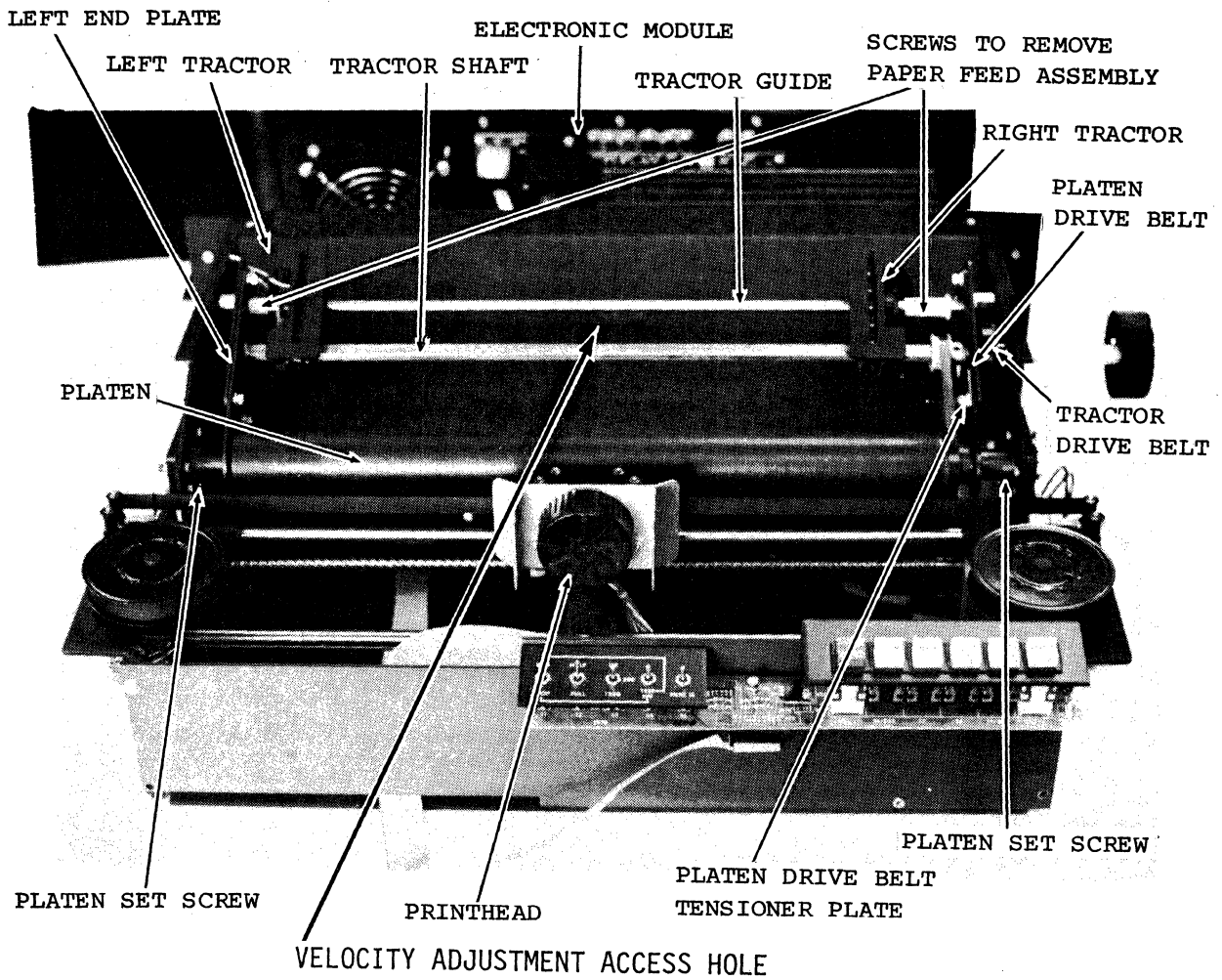


Figure 6-1. Chassis, Front View

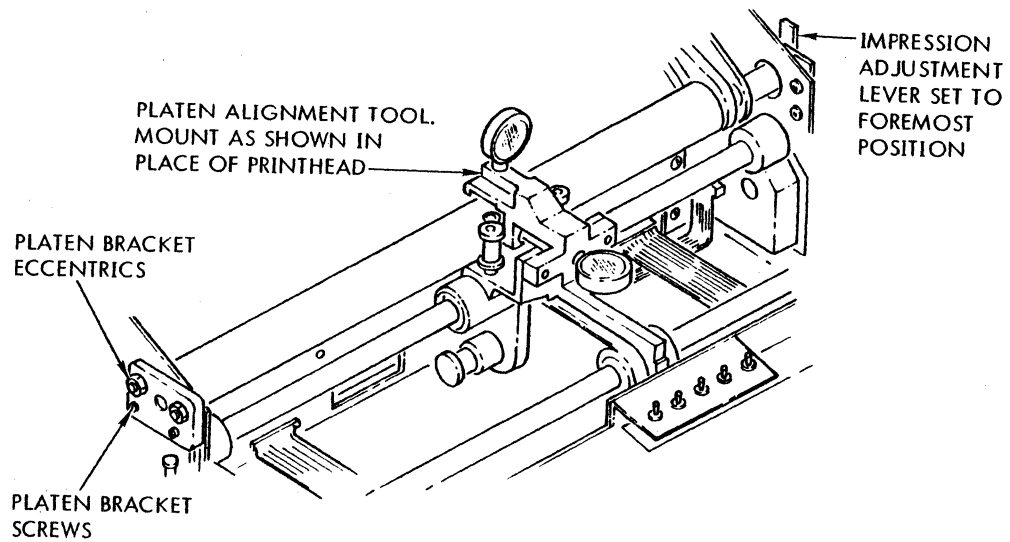


Figure 6-2. Platen Alignment

- (C) Remove the entire chassis from the lower cover by removing the four feet on the bottom side of the lower cover and the two screws at the rear of the printer. These connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Remove the printhead from the carriage (see Printhead Replacement, this section).
- (e) Remove the ribbon (see Ribbon Installation, Operator's Manual Section 4).
- (f) Remove the heat sink from the carriage, using a 5/64-inch ball-end Allen driver.
- (g) Calibrate the platen alignment tool as follows:
 - (1) Acquire a block with one flat surface.
 - (2) Set the flat surface of this block on the vertical reference surface of the tool.
 - (3) Check the dial indicator reading of the horizontal indicator, and adjust the dial setting of the indicator to zero.
 - (4) Repeat steps 1, 2, and 3 for the vertical indicator.
- (h) Mount the platen alignment tool to the printhead carriage.
- (i) With the carriage in the far left position, loosen all four platen bracket screws.
- (j) Using a 7/16-inch wrench, adjust the left rear platen eccentric to a horizontal position reading of -0.010.
- (k) Using a 7/16-inch wrench, adjust the left front platen eccentric to a vertical position reading of -0.004.
- (l) Move the carriage to the far right position and adjust the right platen eccentrics for the same readings as the left platen bracket.
- (m) Check the readings on both ends and readjust as necessary until both ends give the proper readings.
- (n) Tighten the platen bracket screws and make certain that the readings are still correct.
- (o) Remove the platen alignment tool and reverse steps (a) through (f).

Servo Adjustments

Velocity (R25) may be adjusted on the servo PCB. This adjustment affects the speed of the carriage. While running selftest (reference Operator's Manual, Figure 4-13), the first three numbers printed at the beginning of each cycle give the speed of the printer. If this number is less than 165, adjust the velocity pot (R25) on the servo board until the speed is 165. This may be accomplished as follows:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Unscrew the four screws that fasten the rear panel (electronic module) to the chassis. Remove the electronics module by pulling the strap on the rear panel (see Figure 6-3 and 6-4).
- (c) Plug in the extender cable (PN A20019243) between the electronics module and the interconnect board.

An alternate procedure to (a), (b), and (c) on new 165 CPS Printer only, is to locate the velocity adjustment access hole (refer to Figure 6-1). Remove the cover from the hole closest to the right side. Locate velocity pot with tool and make adjustment.

- (d) Load paper in the printer. Plug the power cord into the power outlet and turn POWER on.
- (e) Upon completion of the POWER on cycle, execute the self-test and adjust the velocity pot on the servo board (clockwise increases speed; counterclockwise decreases speed). If using the access hole, adjustment tool must be placed under the paper. Do not cause a paper jam if using this method.
- (f) When a speed of 165 has been attained, reverse steps (a) through (e).

Position (R40) is adjusted if the servo oscillates when trying to turn the lead screw by hand when power is applied to the printer (an audible tone occurs if the servo is oscillating). The procedure for this adjustment is as follows:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Unscrew the four screws that fasten the rear panel (electronic module) to the chassis. Remove the electronics module by pulling the strap on the rear panel (see Figures 6-3 and 6-4).
- (c) Plug in the extender cable between the electronics module and the interconnect board.

An alternate procedure to (a), (b), and (c) is to locate the position adjustment access hole (refer to Figure 6-1). Remove the cover from the hole closest to the left side. Locate the position access hole and make adjustment.

- (d) Plug the power cord into the power outlet and turn POWER on.
- (e) Upon completion of the POWER on cycle, grasp the lead screw and gently, but firmly, attempt to turn it. If a chattering or oscillation is felt or heard, adjust the position pot (R40) until the oscillation stops.
- (d) Reverse steps (a) through (d).

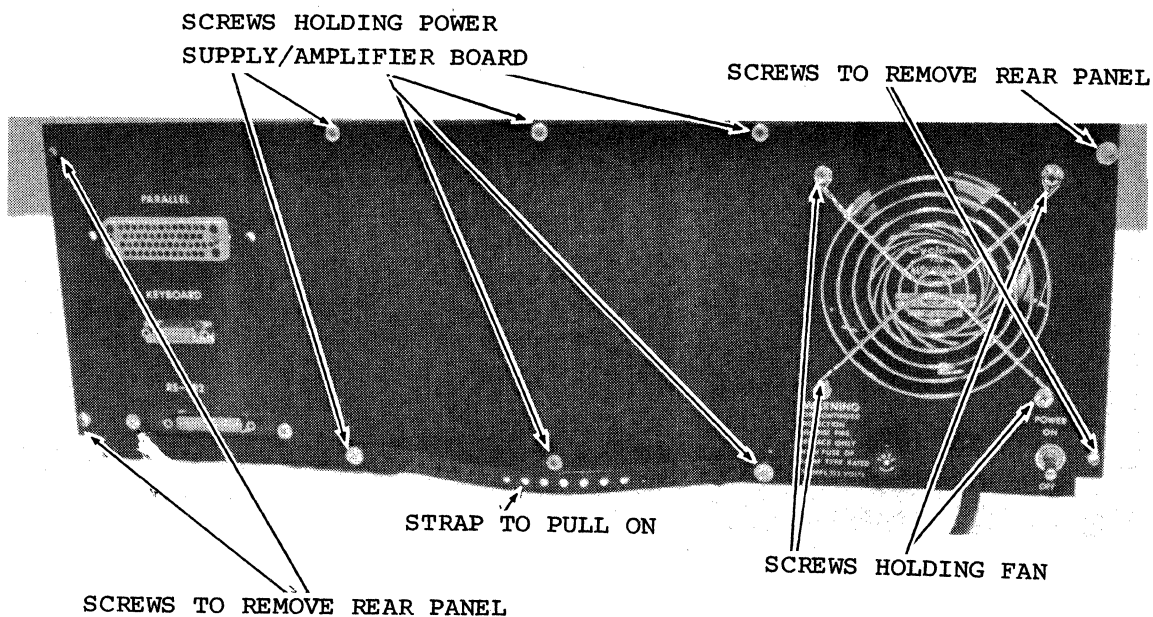


Figure 6-3. Rear Panel

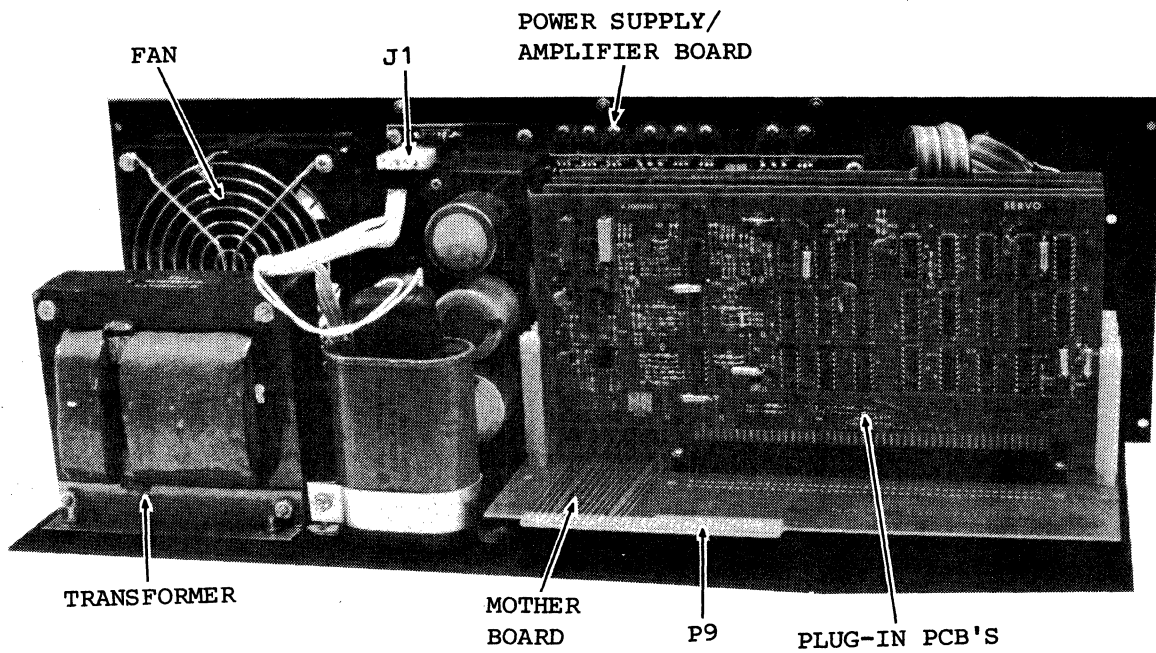


Figure 6-4. Electronic Module

REMOVAL AND REPLACEMENT

Power should be off when printed circuit boards are removed or replaced. Particular attention should be made to ensure that the boards are properly seated. All connections to the plug-in boards are bussed, so they may be inserted in any connector on the mother board provided there is only one PCB of each type.

Replacement of mechanical parts is much more critical as improper installation affects the printer performance. Their replacement is described throughout this section. The replacement of chassis-mounted electronic parts is also described.

Printed Circuit Boards

1. Plug-In PCB's

To replace any of the plugable printed circuit boards (CPU, data, servo, and I/O boards), perform the following procedures:

NOTE

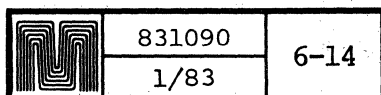
An extender cable (PN A20019243 is available for troubleshooting purposes. It can be used to maintain operation while the electrical module is separated from the mechanical module; i.e., it can be used to jumper the mother board to the interconnect board, thus allowing an operational printer while the electronic module is separated from the mechanical module.

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Unscrew the four screws that fasten the rear panel (electronic module) to the chassis and remove the electronics module, by pulling the strap on the rear panel (see Figures 6-3 and 6-4).
- (c) Remove and replace the appropriate PCB.

2. Power Supply/Amplifier Board

To replace this PCB, perform the following procedures:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Unscrew the four screws that fasten the rear panel to the chassis and remove the rear panel (see Figures 6-3 and 6-4).



- (c) Remove molex connector P1 that attaches transformer T2 leads to power supply board.
- (d) Unscrew the six screws that fasten the heat sink to the rear panel.
- (e) Remove the power supply heat sink assembly from the rear panel.
- (f) To replace the power supplies/amplifier board, reverse steps (a) through (e).

3. Head Driver Board

To replace this PCB, perform the following procedures:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the entire chassis from the lower cover by removing the four feet on the bottom side of the lower cover and the two screws at the rear of the printer. These connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Remove the four screws connecting the front panel to the chassis and lay the front panel forward.
- (e) Remove the printhead cable assembly plug from connector J21 on the head driver board (see Figure 6-5).
- (f) Remove P31 from the inductive transient suppressor board.
- (g) Remove the three screws that fasten the head driver cover and board to the front panel.
- (h) Remove the interconnect board cable assembly plug from connector J20 on the head driver board.
- (i) Remove the head driver board.
- (j) To replace the head driver board, reverse steps (a) through (i).

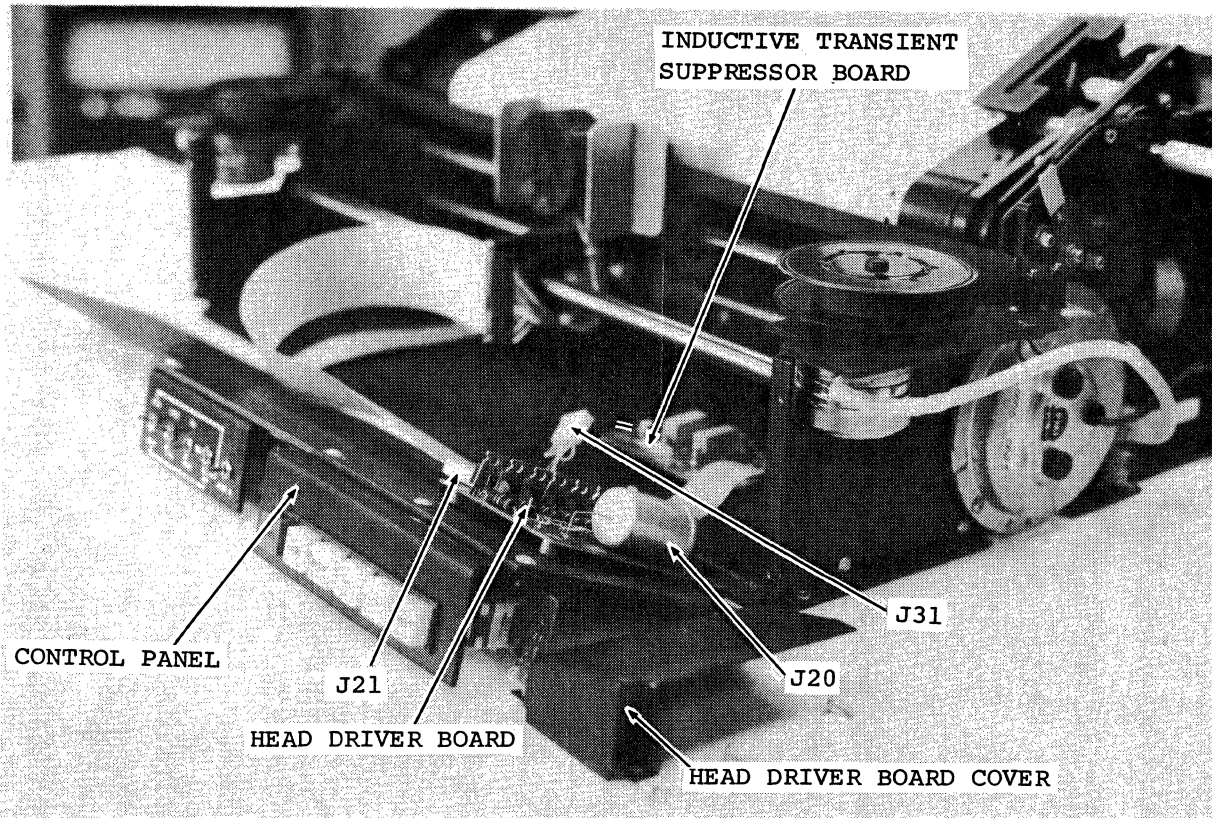


Figure 6-5. Front Panel

NOTE

When replacing the interconnect board cable (in J20), be certain the red edge of the cable is to the left when viewing from the front of the printer. If the cable has come loose from its connection in the interconnect board, reinsert it.

Also, be certain that the cable from the printhead is correctly and securely inserted into the head driver board connector J21 and the inductive suppressor board P31.

4. Inductive Transient Suppressor Board

To replace this PCB, perform the following procedures:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the two screws holding the cover and PCB in place and the two screws connecting the power transistors to the chassis.
- (d) Remove P31 from the inductive transient suppressor board.

CAUTION

The power transistors are mechanically connected to the chassis but are not electrically connected. There are mica insulators between the transistors and the chassis. The mounting screws are insulated from the transistors by nylon shoulder washers. Care must be exercised to ensure that these insulators stay in place.

- (e) To replace the inductive transient suppressor board, reverse steps (a) through (d).

5. Control Panel Board

To replace this PCB, perform the following procedures:

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Unscrew the five screws connecting the control panel assembly to the chassis. Remove right ribbon spool and use an offset screwdriver (see Figures 6-5 and 6-7).

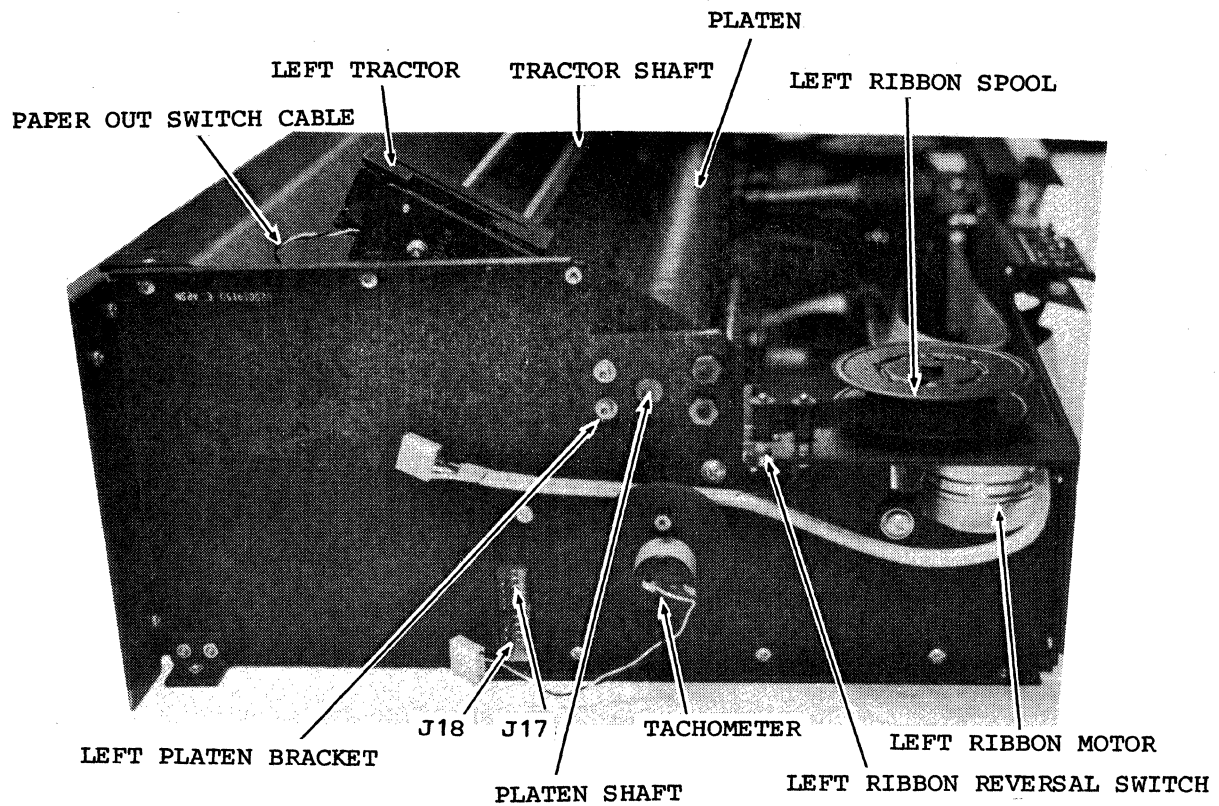


Figure 6-6. Chassis, Left Side View

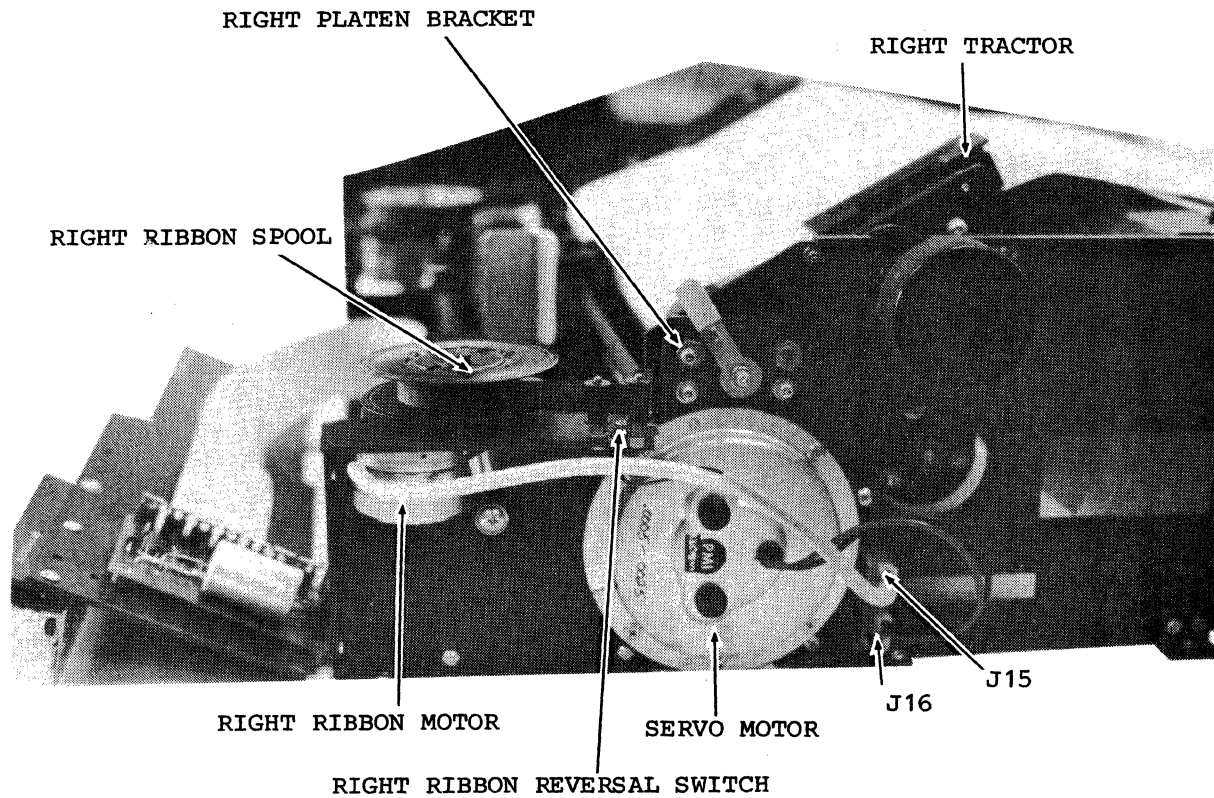


Figure 6-7. Chassis, Right Side View

Electromechanical Assemblies

Specific instructions for removal and replacement of various electromechanical assemblies will be found in this section.

1. Servo

The servo motor, disc sensor, and lead screw are removed or replaced as an assembly. The replacement procedure is as follows (see Figures 6-6 and 6-7):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) The entire chassis may be lifted from the lower cover by removing the four feet on the bottom side of the lower cover and the two screws at the rear of the printer. The four feet and the two screws connect the cover to the chassis.
- (d) Unplug the tachometer and remove it from the end of the lead screw by pulling straight out. If not pulled straight out, the tachometer shaft may break inside the lead screw.
- (e) Unplug the servo screw.
- (f) Remove the right ribbon reversal switch by unscrewing the one screw holding it in place.
- (g) Remove the disc sensor board cable where it connects to the interconnect board.
- (h) Remove the four screws holding the servo motor to the side frame.
- (i) Pull the servo motor from the right side of the chassis, just enough to remove the disc sensor board cable from the disc sensor board.
- (j) Holding the printhead, pull the servo motor from the right side of the chassis. Be sure to pull the assembly straight out so that the disc sensor assembly is not damaged.

NOTE

Steps (k), (l), and (n) are necessary only if the anti-backlash nut is being replaced. This nut should only be replaced if the nut has excessive side play.

- (k) Remove the three socket head screws that secure the anti-backlash nut (item that lead screw feeds through) to

The carriage. Remove the nut and place it on the old screw (do not discard the old anti-backlash nut).

(l) Attach the anti-backlash nut from the replacement lead screw to the carriage with the three socket head screws. Do not tighten the screws.

(m) Insert the replacement lead screw through the opening in the right side of the chassis so that it enters the anti-backlash nut. Be careful not to damage the disc sensor. When the motor is about one inch from its mounting surface, guide the lead screw journal into the bearing in the left side of the chassis. Install the disc sensor board connector to the board.

NOTE

Replacement lead screws do not require a clamp or set screw. Replace the servo motor mounting screws but do not tighten them.

(n) With the carriage at the left (home) position, tighten the screws, securing the anti-backlash nut to the carriage.

(o) Move the carriage to the right and tighten the servo motor mounting screws.

(p) Check the force required to move the carriage to the left and right. If the required force exceeds 3-1/2 pounds, repeat steps (n) and (o) after loosening the anti-backlash and servo motor screws.

(q) To replace the unit, reverse steps (a) through (g).

2. Disc Sensor Board

To remove the disc sensor board, perform the following steps:

Follow steps (a) through (j) of the servo replacement procedure.

(b) Remove the two screws holding the disc sensor board in place.

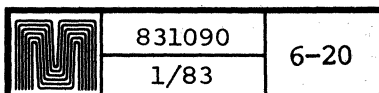
(c) Remove and replace the board.

(d) Perform steps (m) through (q) of the servo replacement procedure.

3. Tachometer

To replace the tachometer, perform the following steps:

(a) Turn off AC power and remove the power cord from the power outlet.



- (B) Remove the top cover from the printer.
- (c) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Unplug P18 and remove the tachometer by pulling straight out. The tachometer shaft could break inside the lead screw if this instruction is not carefully followed (see Figure 6-6).
- (e) Remove the rubber bracket on the old tachometer and install it on the new tachometer.
- (f) Replace the tachometer by reversing steps (a) through (d). Make certain that the black wire of the tachometer connects to the top pin of connector J18.

4. Paper Feed Tractor Motor

To remove and/or replace the tractor motor, perform the following procedure (see Figure 6-8):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the four screws that fasten the rear panel (see Figure 6-3) to the chassis and remove the rear panel.
- (d) Remove the tractor motor molex connector P14 from the interconnect board.
- (e) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (f) Remove the three hex head screws that fasten the tractor motor to the main tractor bracket.
- (g) Lift the belt from the tractor motor pulley and remove the motor from the paper feed assembly.
- (h) Loosen the Allen screw on the pulley and remove the pulley from the tractor motor shaft. Note the location of the pulley since the pulley must be located on the new motor shaft to provide proper alignment for the belt.
- (i) To replace the tractor motor, reverse steps (a) through (h).

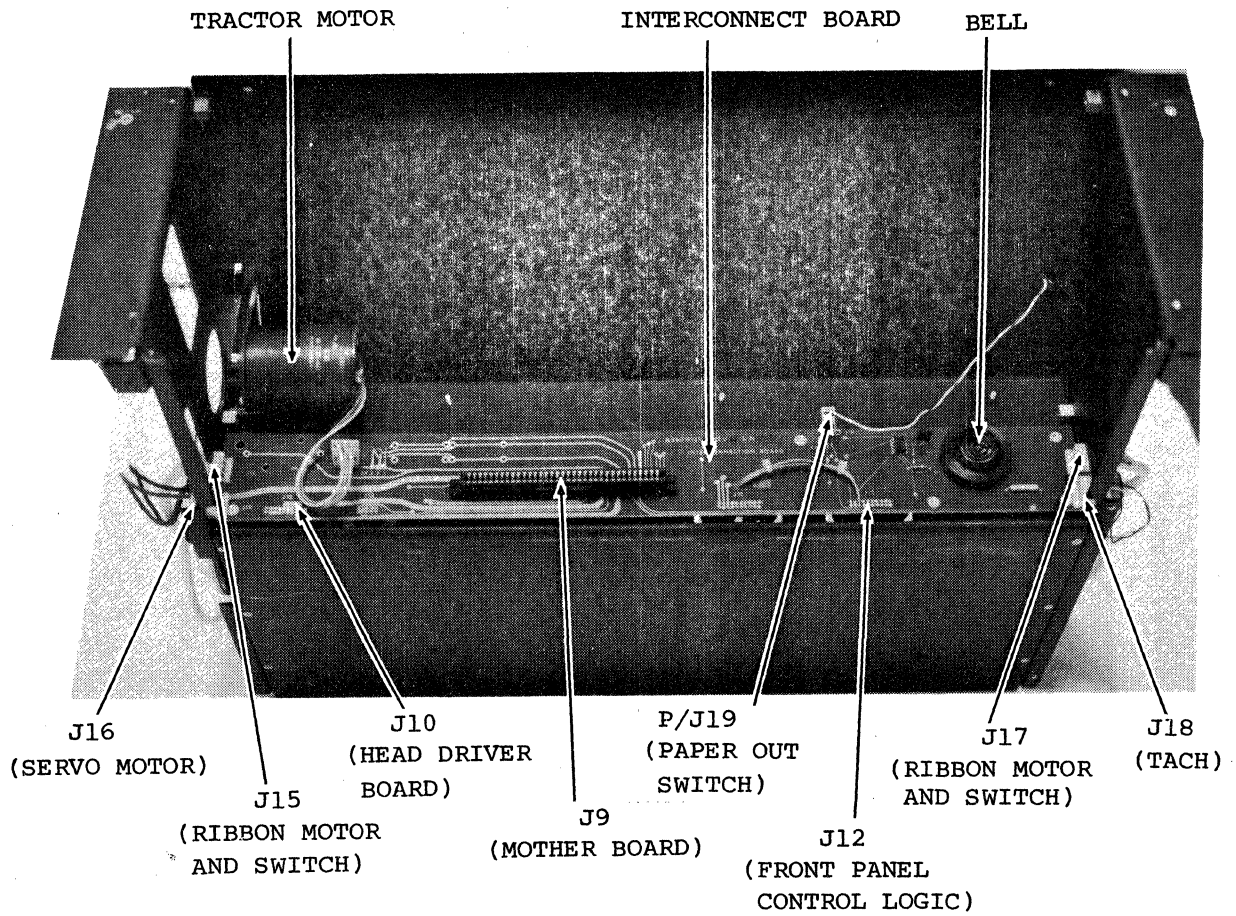



Figure 6-8. Chassis, Rear View

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5. Tractor

Tractor replacement may be necessary due to failure of the tractor itself or in case the paper-out switch becomes defective. This switch is an integral part of the left tractor. To replace a tractor, perform the following procedures (Figures 6-1, 6-6, and 6-7):

- (a) Perform the platen removal/replacement procedure.
- (b) Remove the electronic module by unscrewing the four screws that fasten the rear panel to the chassis. Pull out the rear panel (see Figure 6-3).
- (c) Remove P19 from the interconnect board (see Figure 6-1).
- (d) Remove the two screws, one from either side of the paper feed assembly, that connect the paper feed assembly to the adjustment blocks.
- (e) Remove the screw at the left end of the paper feed assembly that connects to the tractor guide.
- (f) Lift the side of the paper feed assembly and pull off the left end plate.
- (g) Slide the left tractor off the shaft and guide.
- (h) If applicable, slide the right tractor off the shaft and guide.
- (i) If the left tractor is being replaced, it will be necessary to either unsolder the wires to the paper-out switch or extract the pins from the connector (P19).
- (j) Install the new tractor by reversing steps (a) through (i). When installing the tractors, it is necessary to align the pins. This is accomplished by using the white dot on the inside of each of the tractors, located adjacent to the tractor shaft bearing. These dots must be aligned so that when the tractors are put on the tractor shaft, the dots are directly across from each other on the shaft.

NOTE

Pin 1 of P/J19 (on left when viewed from rear of printer) connects to common (bottom) terminal of the paper-out switch.

6. Platen

To replace the platen, perform the following procedure (Figures 6-1, 6-6, and 6-7):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Loosen the platen drive belt tensioner plate.
- (e) Remove the impression adjustment lever and the right platen bracket.
- (f) While holding the platen, slide the platen shaft from the platen.
- (g) Remove the platen drive belt from platen end gear.
- (h) Install the new platen by reversing steps (a) through (g).
- (i) Perform platen alignment as described under Adjustments in this section.

7. Paper Feed Belts

The platen drive belt and the tractor drive belt are the paper feed belts.

a. Platen Drive Belt

To replace the platen drive belt follow the platen removal procedure (Figures 6-1, 6-6, and 6-7).

b. Tractor Drive Belt

To replace the tractor drive belt, perform the following procedures (Figures 6-6 and 6-7):

- (1) Turn off AC power and remove the power cord from the power outlet.
- (2) Remove the top cover from the printer.
- (3) Slide the belt off of the gear at the end of the tractor shaft.

- (4) Remove the electronics module by unscrewing the four screws that fasten the rear panel to the chassis. Pull the rear panel out (see Figure 6-3).
- (5) Remove the belt from the tractor motor pulley.
- (6) Lift the belt up and around the manual feed knob at the end of the tractor shaft.
- (7) Install the new belt by reversing steps (a) through (f).

8. Ribbon Motor

To replace a defective ribbon motor, perform the following procedures (Figures 6-6 and 6-7):

- (a) Turn off AC power and remove power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Remove the ribbon spool.
- (e) Unplug connector P15 (right) or P17 (left) from the interconnect board.
- (f) Lift the ribbon spool hub from the ribbon motor shaft by exerting an upward, even pressure (i.e., place a screwdriver between hub and chassis).
- (g) Remove the wavy washer and felt washer from the ribbon motor shaft.
- (h) Remove the screw that attaches the ribbon reversal switch to the chassis.
- (i) Remove the two screws that attach the ribbon motor to the chassis.

Replace the ribbon motor by reversing steps (a) through (i).

NOTE

The ribbon motors on the right and left sides are different motors. Do not attempt to interchange them. The left side requires a motor that turns in a clockwise direction, and the right side requires a motor that turns in a counterclockwise direction.

- (4) Remove the electronics module by unscrewing the four screws that fasten the rear panel to the chassis. Pull the rear panel out (see Figure 6-3).
- (5) Remove the belt from the tractor motor pulley.
- (6) Lift the belt up and around the manual feed knob at the end of the tractor shaft.
- (7) Install the new belt by reversing steps (a) through (f).

8. Ribbon Motor

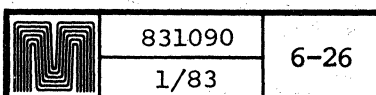
To replace a defective ribbon motor, perform the following procedures (Figures 6-6 and 6-7):

- (a) Turn off AC power and remove power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Remove the ribbon spool.
- (e) Unplug connector P15 (right) or P17 (left) from the interconnect board.
- (f) Lift the ribbon spool hub from the ribbon motor shaft by exerting an upward, even pressure (i.e, place a screwdriver between hub and chassis).
- (g) Remove the wavy washer and felt washer from the ribbon motor shaft.
- (h) Remove the screw that attaches the ribbon reversal switch to the chassis.
- (i) Remove the two screws that attach the ribbon motor to the chassis.

Replace the ribbon motor by reversing steps (a) through (i).

NOTE

The ribbon motors on the right and left sides are different motors. Do not attempt to interchange them. The left side requires a motor that turns in a clockwise direction, and the right side requires a motor that turns in a counterclockwise direction.



9. Ribbon Motor Reversal Switch

To replace a defective ribbon motor reversal switch, perform the following procedure (Figures 6-6 and 6-7):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Remove the four feet on the bottom side of the lower cover and the two screws at the rear of the printer that connect the cover to the chassis. Lift the chassis out of the cover.
- (d) Unplug connector P15 (right) or P17 (left) from the interconnect board.
- (e) Remove the screw that attaches the ribbon reversal switch to the chassis.
- (f) Replace the ribbon motor by reversing steps (a) through (e).

NOTE

The black wire should connect between pin 1 of P15 or P17 and the common contact of the switch. The blue wire should connect between pin 2 of P15 or P17 and the normally open (NO) contact of the switch.

10. Printhead

To replace a defective printhead, perform the following procedure (Figure 6-1):

- (a) Turn off AC power and remove the power cord from the power outlet.
- (b) Remove the top cover from the printer.
- (c) Disconnect the printhead cable from the head driver board (J21).
- (d) Refer to Figure 6-1. Using a 5/64-inch ball-end Allen driver, remove the two upper screws that connect the printhead to the carriage.
- (e) Remove the printhead. Install the new printhead on the carriage.

- (F) Connect the printhead cable to the head driver board connector J21. Be sure that the connector and plug pins mate on a one-to-one basis (there is no mechanical means of ensuring a proper connector-to-plug match).
- (g) Press the wire bundle on the printhead close to the printhead so that the wiring cannot snag on the head driver board.
- (h) Perform the impression adjustment as described in the Operator's Manual, Section 4.

TEST EQUIPMENT AND TOOLS

The following list includes recommended tools and test equipment for maintenance of the Matrix Printer:

Dual trace oscilloscope

Volt ohmmeter

Standard tool kit including:

#1 Phillips X 4" blade screwdriver

#2 Phillips X 4" blade screwdriver

Offset Phillips screwdriver

Offset Allen wrench set

Alignment tool (tweaker)

7/16-inch wrench (box or open end)

5/64-inch ball-end Allen driver

Special tools

Extender cable, Microdata Part No. A20019243

Platen alignment tool, Microdata Part No. TA20019348.

