1.1 GENERAL DESCRIPTION

The [redacted] FC 3110 printer shown in figure 1-1 is a serial printer which operates at a maximum rate of 30 characters per second, and can print a maximum of 132 characters per line. The character repertoire consists of the 64 alphanumeric characters shown in Appendix A. The 63 character symbols and one space are located on the outer surface of a print wheel which rotates continuously at 1800 revolutions per minute. A character is printed whenever a print solenoid is activated by the control logic, causing a print hammer to strike the back of the paper. This forces the paper against the inked print wheel causing the character impression. At the maximum printing speed, one character is printed for each revolution of the print wheel, allowing a print rate of 30 characters per second.

In addition to the 64 printable characters, the FC 3110 printer also recognizes six control characters: Carriage Return (CR), Back Space (BS), Line Feed (LF), Form Feed (FF), Vertical Tab (VT), and Motor Control (DC3).

The printer electronics described in this manual is contained on two printed circuit cards: the Control, Data and Decode card and the LVPS Regulator and Driver card. The logic circuitry, contained on the Control, Data and Decode card, performs the following basic functions:

a. It provides an interface to a terminal controller, which allows data to be transmitted to the printer.

b. It converts the data received from the terminal controller and from switches on the control panel into low level solenoid drive signals, indicator drive signals and a motor drive signal.

The LVPS Regulator and Driver card, located at the rear of the printer enclosure, contains the +5 VDC and +48 VDC low voltage power supply, a power sequencer, and the solenoid and lamp drivers.

OPERATION

3.1 CONTROLS AND INDICATORS

All printer controls available to the operator are listed and described in table 3-1. All indicators are covered in table 3-2.

TABLE 3-1

FC 3110 PRINTER OPERATOR CONTROLS

Control Designation	Function
Power On (located under the control panel)	Activating this rocker switch applies 115 VAC to the printer
REMOTE	Pressing this switch changes the printer mode from local to remote, if the printer is not out of paper, the window is not open, and the printer was not in local mode as a result of low motor speed.
LOCAL	Pressing this switch causes the printer to enter the local mode.
TEST	If the printer is in local mode, pressing this switch prints all 64 characters (including the space) on a single line. All 64 characters are printed twice, in the order in which they appear on the print wheel. The remainder

TABLE 3-1

FC 3110 PRINTER OPERATOR CONTROLS (Cont)

Control Designation	Function
	of the line is filled with spaces. When the end of the line is reached, the test ends with an automatic carriage return and line feed.
SPACE	If the printer is in local mode, pressing this switch allows the operator to position the print wheel anywhere along the line. The print wheel moves only while the switch is pressed. When the right end of the line is reached, an automatic carriage return and line feed occurs.
LINE FEED	If the printer is in local mode, pressing this switch causes one line feed to occur.
FORM FEED	If the printer is in local mode, pressing this switch moves the paper so that the top of the next form is in printing position.
MOTOR BYPASS	Pressing this switch keeps the motor running and disables the automatic motor control feature of the printer.
DC RESET	Pressing this switch causes a master reset of all the logic control circuitry and sets top of form.
PHASE CONTROL	This control potentiometer is used to adjust the print hammer delay, in order to compensate for varying paper thicknesses.

TABLE 3-2

FC 3110 PRINTER INDICATORS

Indicator Designation	Function
PWR	This light goes on when the printer is receiving power from the 115 VAC input.
ATTN	This light goes on when a printer fault condition is detected (i.e., window open, out of paper, or motor not up to speed).
REMOTE	This light goes on when the printer is ready to receive a character from the printer interface.
LOCAL	This light is on when the printer is in local mode.

3.2 OPERATING PROCEDURES

3.2.1 TURN-ON

a. Turn on the POWER ON switch. This initializes the control logic, turns the motor on, enables the front panel switches, and places the unit in local mode.

b. Insert paper and use the DC RESET switch to adjust the paper to the top of the form.

c. Run the internal test (TEST switch) to ensure proper setting of the PHASE CONTROL potentiometer.

d. Place the printer in remote mode by pressing the REMOTE switch on the front panel. The printer is now ready to receive data from the interface.

3.2.2 TURN OFF

a. Turn off the POWER OFF switch.

THEORY OF OPERATION

INTRODUCTION

The Control, Data and Decode card contains the control logic for interfacing between the Buffered Printer Interface card and the mechanical and control panel portion of the printer.

When receiving a data or control character from the interface card or a switch closure indication from the control panel, this control logic responds by activating the appropriate solenoid in the printer. This causes the specified function to be performed (i.e., character print, line feed, carriage return etc.). The control logic also: 1) generates Busy/Ready and Fault indications to both the interface and printer controls, 2) controls the motor drive in the printer, and 3) converts fault indications and status conditions into drive signals for the indicator lights.

Referring to the functional block diagram in figure 4-1, printer operation begins once the power switch is turned on. This turns on the low voltage supply providing +5 VDC to the logic circuitry and +48 VDC to the sequencer and power-on (PWR) indicator. The logic circuitry then executes a DC reset (approximately 0.3 sec) which initializes the system. After the DC Reset, the logic circuitry sends a motor-on signal to the sequencer. This energizes the relay coil, causing the motor to turn on and applying power to the solenoid drivers. The motor drives the print wheel, lead screw and timing disk. The movement of the timing disk causes timing signals to be generated on the

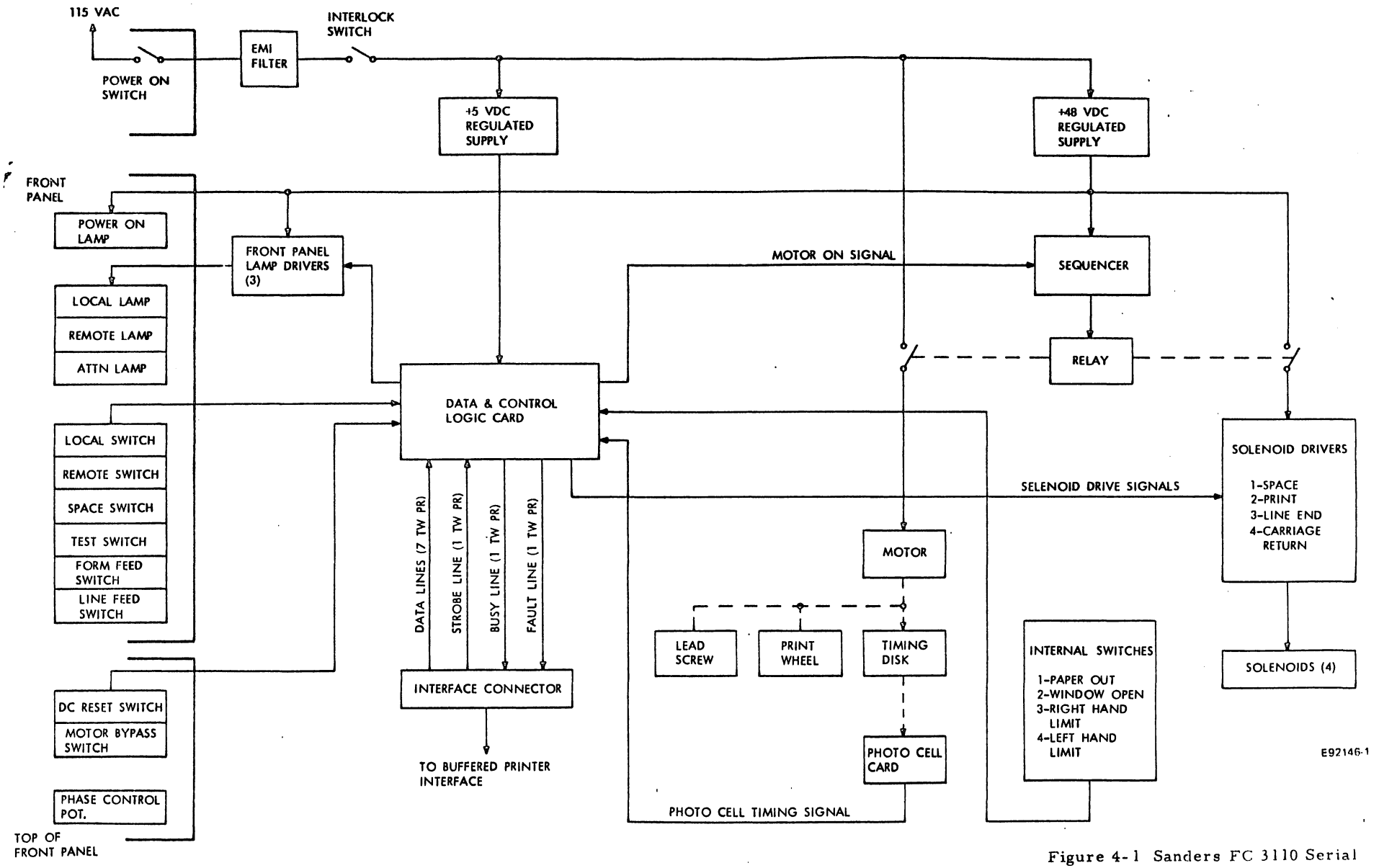


Figure 4-1 Sanders FC 3110 Serial Printer Functional Block Diagram.

photocell card. The unit is now idling in the local mode with all front panel switches enabled. The operator can now insert paper, adjust to top of form and run the internal test (TEST switch) to ensure proper setting of the PHASE CONTROL potentiometer.

Remote mode is entered by pressing the REMOTE switch on the front panel. All data is then received from the interface, with the printer logic controlling the solenoids and motor, to convert the data signals to hard copy print.

Most mechanical operations in the printer are controlled by four solenoids:

a. Print Solenoid - causes the print hammer to strike the print wheel. This action causes the impression of one of the 63 characters contained on the print wheel to be transferred onto the paper form.

b. Space Solenoid - causes the print wheel and print hammer to move from left to right along the printed line to accomplish character spacing. The action of this solenoid causes a pin, contained on the print wheel assembly, to engage a lead screw which rotates in synchronism with the print wheel. When characters are printed incrementally, the pin is engaged once per character. In the synchronous (continuous) printing mode (30 cps) the pin remains engaged in the lead screw until the last character on the line has been printed. It should be noted that it takes one full character time (33.3 ms) to set the pin before printing can begin.

c. Carriage Return Solenoid - causes the print wheel assembly and print hammer to return quickly to the left hand margin stop. The action of this solenoid causes a pawl to retract from a ratchet bar. The pawl and ratchet arrangement is used to maintain the position of the print wheel assembly whenever the space pin is disengaged. There is one detent on the ratchet bar for each column of the printed form. A backspace is accomplished by supplying a single pulse to the carriage return solenoid, causing the pawl to release momentarily and then engage the previous detent on the ratchet bar.

d. Line Feed Solenoid - causes the paper feed tractor to advance the form upward one line. The solenoid receives a single pulse which causes a pawl to retract from a ratchet wheel which is mechanically linked to the paper feed tractors. The pawl is held out long enough for the ratchet wheel to advance one detent, after which the pawl is re-engaged. Each detent on the ratchet corresponds to one line on the form. A form feed is accomplished by executing multiple line feeds.

The description of the printer logic and power supplies contained in this section is organized as follows:

a. Introduction
b. Idle State Timing
c. Data Character Printing
d. Control Characters
e. Printer Switch and Indicator Logic
f. Serial Interface
g. Printer Interface Signals
h. Low Voltage Power Supply Regulator and Drivers

In addition, paragraph 4.9 contains a description of all integrated circuits used in the Control, Data and Decode card and not used in the basic PDS system.

NOTE

All signal mnemonics appearing on the schematic drawings and referred to in this section follow the following rule: The fourth letter in the mnemonic always indicates the active state of the signal (i.e., STBLIN is an active low signal and RDYHLD is an active high signal).

4.2 IDLE STATE TIMING

As long as power is applied to the printer but no data has been received from the interface card, the printer is in the idle state and the timing signals shown in figure 4-2 are continuously generated.

Basic timing for the printer control logic is derived from a timing disk mounted on the same shaft as the print wheel, as shown in figure 4-3. Slots are cut into the outer circumference of the timing disk. As the disk rotates, when a portion of the timing wheel interrupts the light to a phototransistor, a high Photo Cell Input (PCIH) pulse is generated. When light passes through the slot in the disk, a low PCIH pulse occurs.

The circumference of the disk is subdivided into 72 5^{o} segments: eight segments for the wide slot, and 64 segments for the 64 characters.

Since the wheel rotates at 1800 RPM (30 revolutions per second), the frequency of the character pulses (5^{o} segments) is 2160 Hz. The character pulse width is approximately 460 microseconds.

4.2.1 PHOTO CELL INPUT (PCIH, PCIR)

Each revolution of the timing disk causes the photocell circuit to produce 64 character timing pulses, and one wide pulse.

These Photo Cell Input pulses are shaped by a Schmitt trigger circuit on the Control, Data and Decode card. The output of this circuit (CLKH) provides the system clock for the printer logic circuitry.

4.2.2 PRINT WHEEL POSITION ENCODER (PWPE)

The Print Wheel Position Encoder (PWPE) consists of a 6-stage binary counter and decoder. This PWPE counter is incremented by each CLKL pulse from the timing disk and keeps track of the current position of the print wheel. A clear pulse (CLRL) generated by the 64th character position resets the counter and each subsequent CLKL pulse increments it by one. The three MSB and three LSB outputs of the 3 x 8 decoder are enabled by $\overline{\text{CLKH}}$, and outputs from these two decoders are further combined to generate pulses:

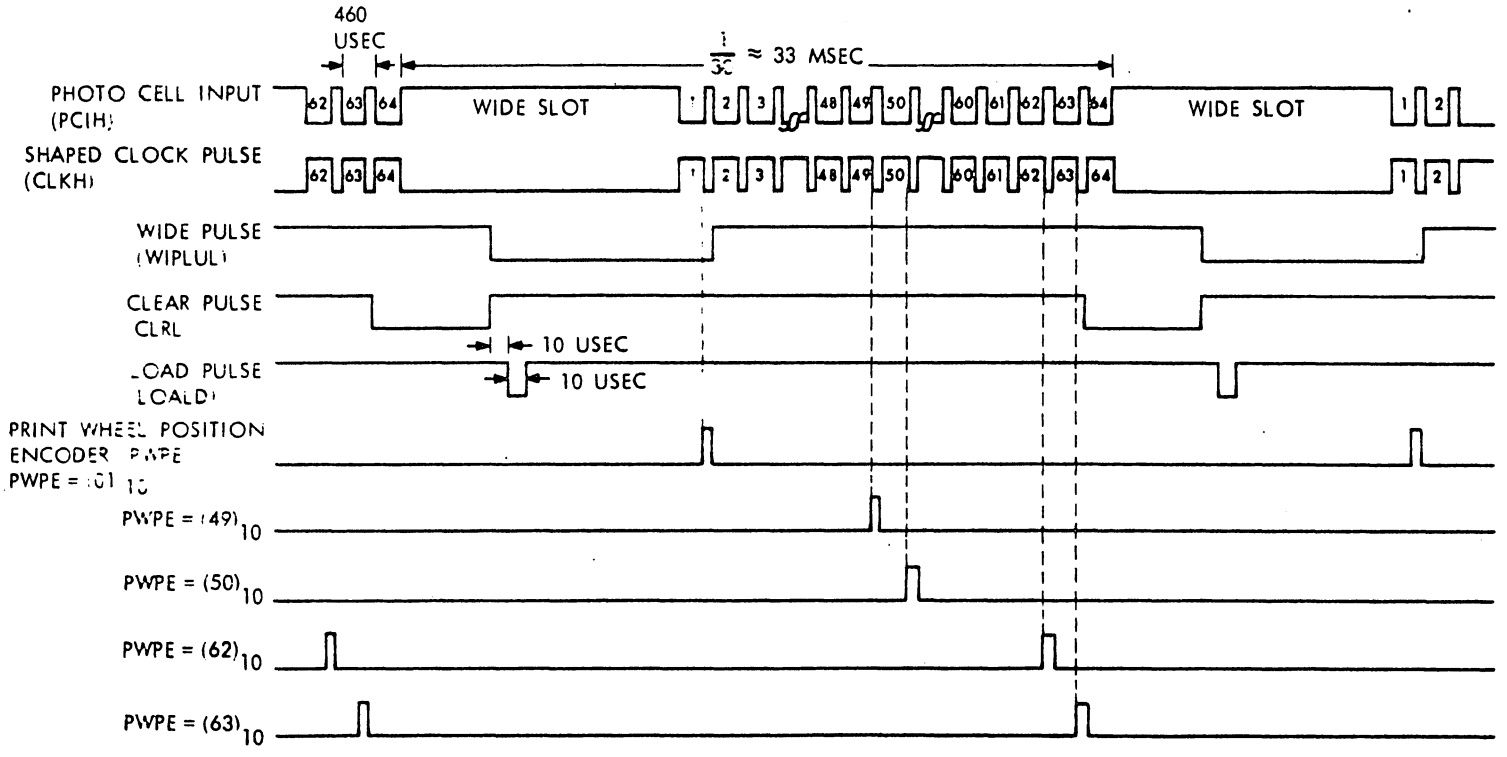
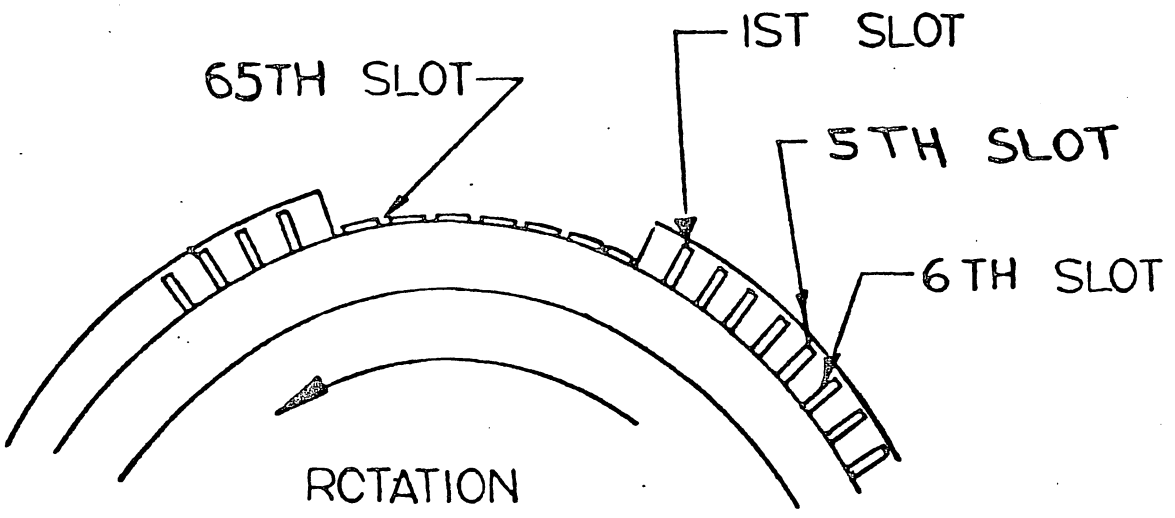


Figure 4-2 Idle State Timing.

E92146-2



TIMING WHEEL
LOOKING FROM LEFT SIDE

Figure 4-3

PWPE = 01, 61_8 (49_{10}), 62_8 (50_{10}), 76_8 (62_{10}) and 77_8 (63_{10}). These timing pulses perform such functions as resynchronize the print wheel logic (CLRL), gate the print enable circuitry, etc.

4.2.3 WIDE PULSE (WIPLUL)

As shown in figure 4-3, the timing disk contains a wide (40°) slot. The high PCIH pulse generated by this slot is used to synchronize the print wheel with the control logic.

Each shaped Photo Cell Input pulse (CLKL) is applied to a Wide Pulse Detector circuit. During the 64 character pulses, the low CLKL pulse causes a low level into gate U95-12. Between character pulses, CLKL goes high for a short interval, forward-biasing CR8. Capacitor C89 holds the input to gate U95-12 low during these short intervals. As a result, the Wide Pulse flip-flop (U84-9) is normally reset and the Wide Pulse signal WIPLUL is normally high.

However, when the wide slot on the timing disk is reached, CLKL goes high for a longer interval. This allows C89 to charge to the positive threshold voltage of gate U95-12. This produces a low at the preset input to Wide Pulse flip-flop (U84-9) setting the flop-flop and generating a low (active) WIPLUL signal. During the following CLKL pulse, C89 discharges removing the low preset input to U84-9. The following CLKL pulse clocks the flip-flop reset, ending the WIPLUL pulse.

4.2.4 LOAD PULSE (LOALD)

The leading edge of the Wide Pulse (WIPLUL) fires a 10 μsec one-shot (U79-9). To initiate a delay, the trailing edge of this one-shot output then fires another 10 μsec one-shot (U79-7) which generates the Load pulse (LOALD) used by the control logic. This pulse transfers data from the Input Data Register/ Test Counter and the Bit Six Converter to the Print Pulse Counter.

4.2.5 CLEAR PULSE (CLRL)

The trailing edge of the PWPE = 63_{10} pulse clocks the Clear Pulse Generator flip-flop U82-9 set. This generates a low CLRL pulse which remains active

until the flip-flop is reset by the leading edge of Wide Pulse WIPLUL. This CLRL pulse re-initiates the control logic for the next revolution of the print wheel.

4.3 CHARACTER PRINTING

The Control, Data and Decode card synchronizes the buffered printer interface with the printer. An active strobe signal (STRHIN) from the interface causes the printer control logic to generate 64 Print Enable pulses (PRIHEN) in synchronism with the 64 character positions on the print wheel. When the print wheel reaches the character position specified by the interface data (DATH1-7), a Printer Solenoid pulse (PRSLOL) is generated causing the print hammer to strike the print wheel. Also during this print wheel revolution, a Space Pin Solenoid signal (PISLOL) is generated causing the print wheel to move to the next character position. When the end of the line is reached, an automatic line feed and carriage return operation is executed.

The timing involved in this printing operation differs somewhat depending on whether a single character or a string of characters is being printed. The interval between successive characters (and strobes) from the interface card determine which printing operation is taking place.

The first revolution of the print wheel (from one wide pulse to the next wide pulse) following the detection of the first strobe is used to synchronize the control logic with the printer. The specified character is actually printed during the second revolution of the print wheel, following the strobe. During the first revolution, a Busy signal (BUSLY) to the interface card prevents new data from being sent to the Control, Data and Decode card. During the second revolution (33 milliseconds), if no strobe is received from the interface, the control logic must be completely re-initialized whenever the next character is received. In the following description, this is referred to as <u>incremental printing</u>. If, however, a new character and strobe is received during this second revolution, the control logic does not have to be completely re-initialized

and that character is printed during the next revolution of the print wheel. This will be referred to as continuous printing.

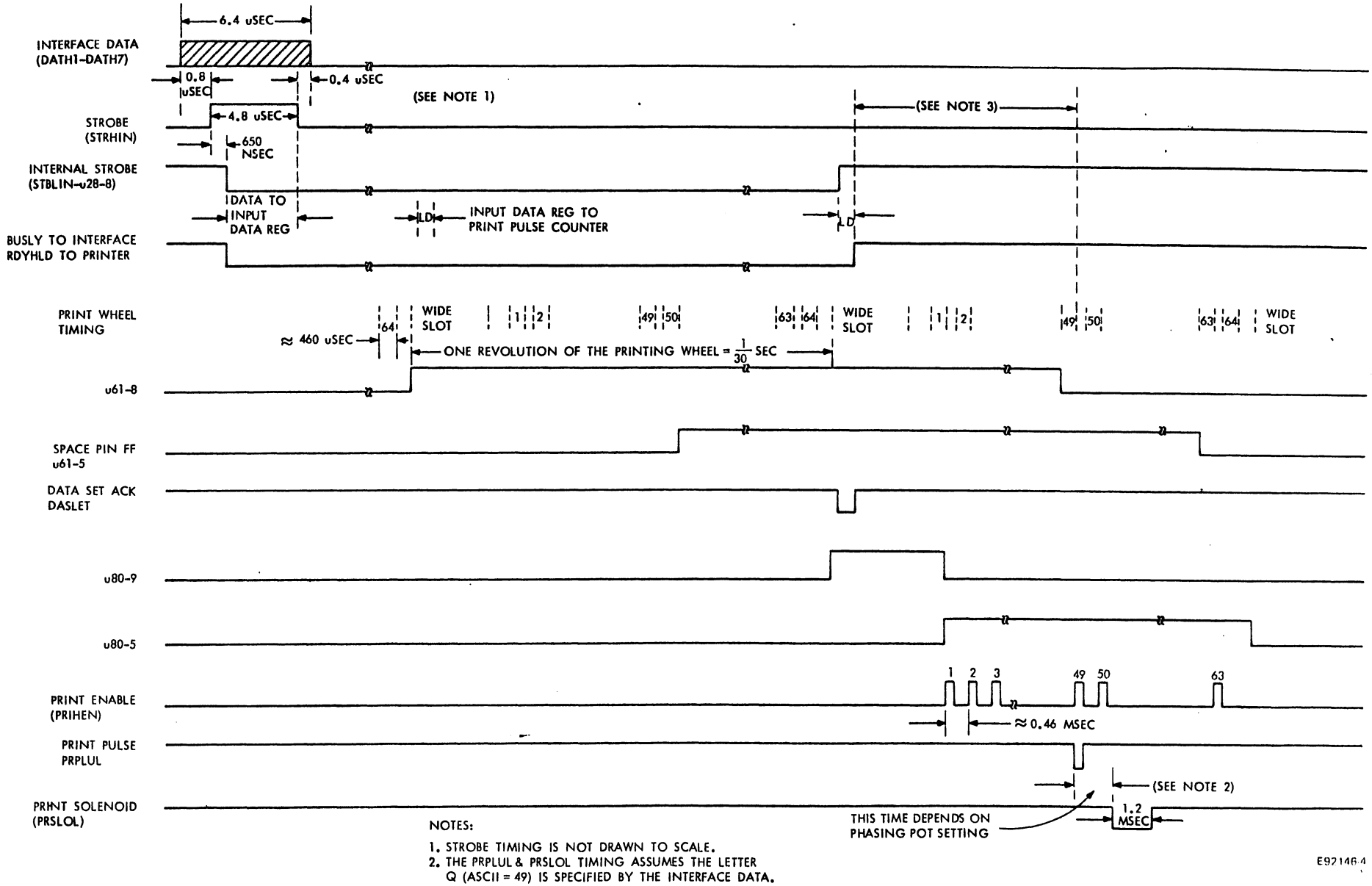
4.3.1 INCREMENTAL PRINTING

A high level on the Strobe line (STRHIN) from the interface card initiates the print enable timing. As shown in figure 4-4, reception of a strobe causes the following sequence of events:

a. Some 650 nanoseconds after the leading edge of the strobe (one-shot U7 generates the delay): a) data is transferred from the interface data lines (DATH1-DATH7) to an Input Data Register, and b) flip-flop U28-8 is clocked set generating an Internal Strobe (STBLIN) and a Busy signal (BUSLY) to the interface card. The Busy signal prevents the interface card from generating another strobe until the control logic is ready to accept new data.

b. The Input Data Register (IDR) is constantly monitored for a control code. Detection of a ZERO in both data bits 6 and 7 while the printer is not in local mode indicates that a control character has been received. This generates an Ignore Code level (CODLIG) which: a) causes a Data Set Acknowledge (DASLET) signal to be generated during the next Load Pulse (LOALD) resetting flip-flop U28-8 and terminating the Busy signal to the interface card, and, b) enables the Control Character Decode to determine if any of the following control characters is specified: VT(013_8), BS(010_8), LF(012_8), FF(014_8), CR(015_8), or DC 3 (023_8). Detection of one of these characters activates the appropriate logic and causes the printer to perform the specified function. This control character logic is described in paragraph 4.4. If the received logic does not specify a control character, no special action is taken and the logic functions described in this papagraph are performed.

c. When the next wide pulse is detected (WIPLUL) indicating that the print wheel is starting the next revolution, a Load pulse (LOALD) is generated. This pulse loads the inverted outputs of IDR 1-5 into the Print Pulse Counter (PPC) stages 1-5, and the Bit Six Converter output into stage 6. The binary count preset into this Print Pulse Counter is the ONES complement of the



NOTES:

1. STROBE TIMING IS NOT DRAWN TO SCALE.
2. THE PRPLUL & PRSLOL TIMING ASSUMES THE LETTER Q (ASCII = 49) IS SPECIFIED BY THE INTERFACE DATA.
3. INCREMENTAL PRINTING OCCURS IF NO STROBE IS RECEIVED DURING THIS INTERVAL.

Figure 4-4 Incremental Printing.

character position on the print wheel. For example, the letter A which has an ASCII code of 1000001, is the 33rd character on the print wheel. This corresponds to a binary count of 100001 (or decimal 33). Therefore, when the letter A is specified, the Load pulse presets the number 011110 (or 30_{10}) into the Print Pulse Counter. The counter is then incremented by each CLKL pulse, so that 33 pulses later, an all ONES count is reached. This all ONES condition ANDed with a Print Enable pulse (PRIHEN) initiates a pulse to the Print solenoid (PRSLOL), as described later in this paragraph.

d. The Bit Six Converter converts data bits 6 and 7 into an appropriate input to stage 6 of the Print Pulse Counter. During a normal printing operation when one of the allowable data characters shown in Appendix A is specified, IDR bit 6 is transferred, non-inverted, into stage 6 of the counter. As a result, if for example a Space is specified (ASCII code 0100000), all ONES are inserted into the Print Pulse Counter by the Load pulse. The first low-going edge of CLKL after the wide pulse, increments the counter to all ZEROS. During each PRIHEN pulse, the counter is monitored for an all ONES condition. Each successive CLKL pulse increments the counter until an all ONES condition is detected, at which time a Print Pulse (PRPLUL) is generated. Since there are 64 low-going CLKL edges but only 63 PWPE pulses, an all ONES condition does not occur for a Space character and, therefore, the print hammer will not be activated.

If a lower case character is specified (bits 6 and 7 are both ONES), the Bit Six Converter changes it to an upper case character by inverting IDR_6 into the counter and ignoring IDR_7. Also, if either the SPACE or TEST switch is pressed while the printer is in local mode (TOSL), the converter inverts IDR_6 into the Print Pulse Counter. This generates a space character for the start of a Test cycle or during a manual space operation.

e. The print enable timing is initiated at the start of the first wide pulse following the strobe. Referring to figure 4-4, WIPLOL sets flip-flop U61-8. When the Print Wheel Position Encoder decodes a count of 50_{10}, if a control character has not been received (CODLIG) and an automatic carriage return is not taking place (ATOLCR), Space Pin flip-flop U61-5 is set (PINH). Providing neither a line

feed nor carriage return operation is taking place, PINH causes a low signal to the Space Pin Solenoid driver (PISLOL). As long as PISLOL remains low, both the print wheel and print hammer are moved from left to right at the rate of one character position each print wheel revolution. (Note: The pin actually engages the shaft at PWPE = 61.) In single character printing, PISLOL is activated once. In continuous printing, PISLOL remains active until the last character on the line has been printed.

f. During the next revolution of the print wheel, the leading edge of the Wide Pulse sets flip-flop U80-9. The Load pulse then generates a Data Set Acknowledge (DASLET) signal which deactivates the Busy signal to the interface card. When the print wheel reaches the first character position, flip-flop U80-5 is set and U80-9 is reset enabling the following 64 CLKH pulses to generate 63 Print Enable pulse (PRIHEN).

g. An all ONES condition in the Print Pulse Counter allows the next PRIHEN pulse to generate a Print Pulse (PRPLOL). This pulse initiates a delay (one shot U89), which varies with the PHASE CONTROL potentiometer setting. The trailing edge fires one-shot U88, generating a 1.2 millisecond PRSLOL pulse to the print solenoid driver.

h. If another strobe has not been received by the time the Print Wheel Position Encoder reaches a count of 49_{10} during this second revolution, flip-flop U61-8 is reset. At the end of this second revolution, flip-flops U61-5 and U80-5 are also reset as shown in figure 4-4. Reception of another strobe at the end of this time requires re-initiating all the events described in the preceding paragraphs.

4.3.2 CONTINUOUS PRINTING

If a new character and strobe are received from the buffer interface during the interval between BUSLY going inactive at the start of a print wheel revolution, and the print wheel reaching the 49th character position (approximately 26 milliseconds), then continuous printing occurs. Receiving the strobe initiates the same sequence of events as described in steps a through d on incremental printing (see paragraph 4.3.1).

However, when data is received before the print wheel rotates to the 49th character position, flip-flops U61-8 and U61-5 remain set from the previous character timing and do not have to be re-initialized. As shown in figure 4-5 when the wide slot is detected at the start of the next print wheel revolution, a CLRH pulse resets flip-flop U80-5, and the leading edge of Wide Pulse (WIPLUL) sets flip-flop U80-9 When the print wheel reaches the first character position, flip-flop U80-5 is set and flip-flop U80-9 is reset to allow the next 64 CLKH pulses to generate 63 Print Enable pulses (PRIHEN).

As in incremental printing (see step g) one of these PRIHEN pulses (as determined by an all ONES condition in the Print Pulse Counter) will generate a pulse to the print solenoid driver (PRSLOL).

Note that while the character specified by data in the Print Pulse Counter is being printed, the Input Data Register is available to receive the next character from the buffer interface card.

4.4 CONTROL CHARACTERS

The printer control logic recognizes six control characters from the interface card. These control characters, their associated ASCII code and function are listed in table 4-1.

The six control characters are decoded by a Control Character Decode circuit. When bits 6 and 7 of the received code in the Input Data Register are both ZEROES and the printer is in Remote mode, a low Ignore Code signal, (CODLIG) is generated. This enables the Control Character Decode to check the received character. Detection of a control character causes a high at the appropriate VT, BS, LF, etc. output.

The specific actions following the reception of a control character are described in following paragraphs.

4.4.1 LINE FEED

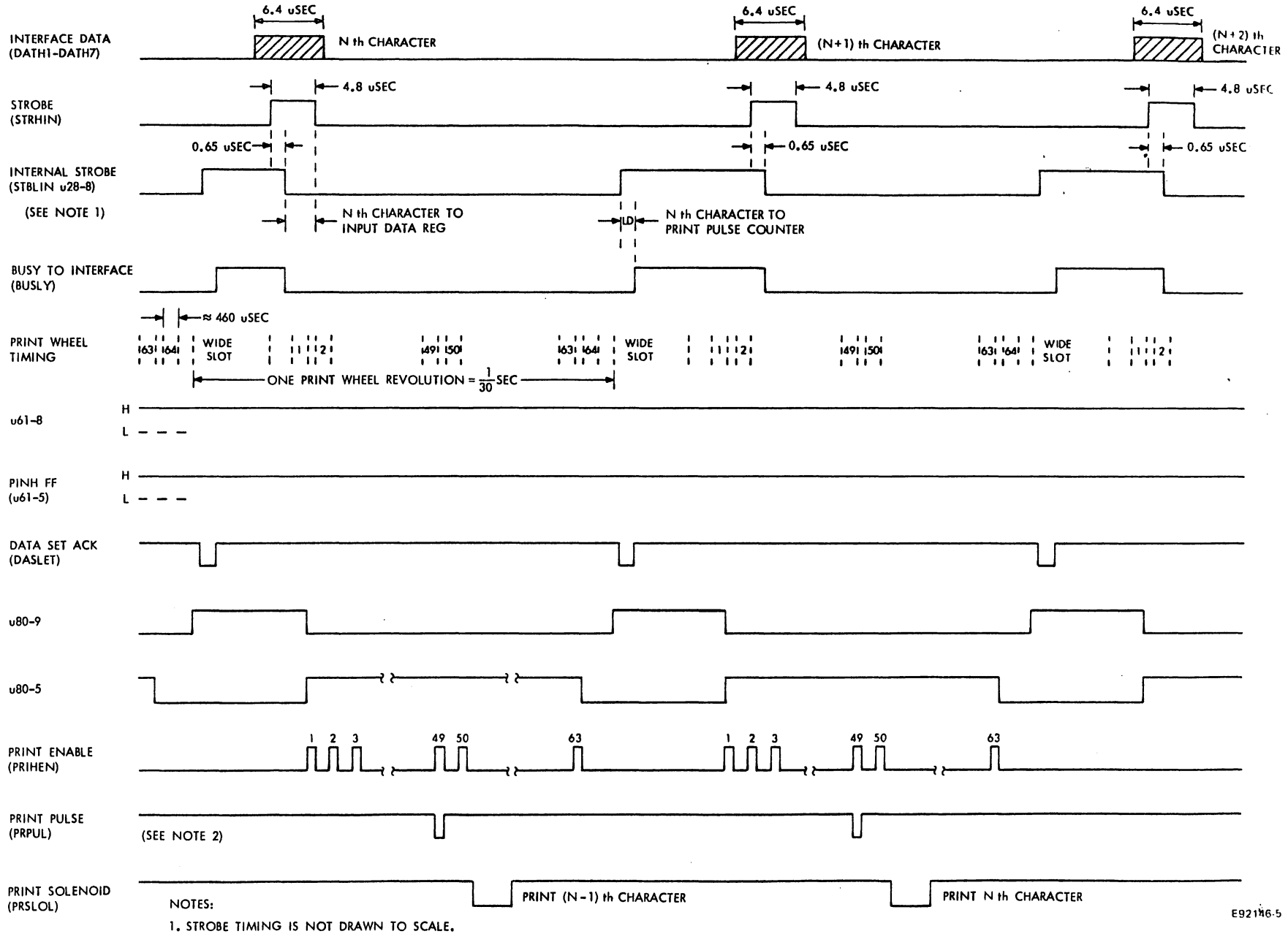
As shown in the timing diagram of figure 4-6, the first Wide Pulse (WIPHUL) following reception of a Line Feed character, activates (resets)

flip-flop U61-9. The Load pulse (LOALD) generated during this wide pulse generates a Clock Control Character pulse (CCCHLK) which clocks Line Feed flip-flop U46-6 reset. The trailing edge of WIPHUL then clocks flip-flop U46-8 reset generating Line Feed Signal LFSH. LFSH, in turn, generates a low 2.8 millisecond signal (LFSLOL) to the line feed solenoid driver.

TABLE 4-1

CONTROL CHARACTERS

Control Character	ASCII Code b7 – b1	Function
Line Feed (LF)	0001010	Causes the paper to advance one line.
Back Space (BS)	0001000	Causes the print wheel to return one space.
Carriage Return (CR)	0001101	Causes the print wheel to return to the left hand margin stop.
Form Feed (FF)	0001100	Causes the print wheel to return to the left hand margin stop and the paper to advance to the top line of the next form.
Vertical TAB (VT)	0001011	If the printer contains a Vertical Format Unit, a vertical tab causes the paper to advance the number of lines specified by the unit.
Motor Control (First character received)	Any code	Causes the motor to turn on if it is off. If the motor is on, there is no effect.



NOTES:

1. STROBE TIMING IS NOT DRAWN TO SCALE.
2. PRINT TIMING ASSUMES THE LETTER Q IS SPECIFIED BY THE INTERFACE DATA.

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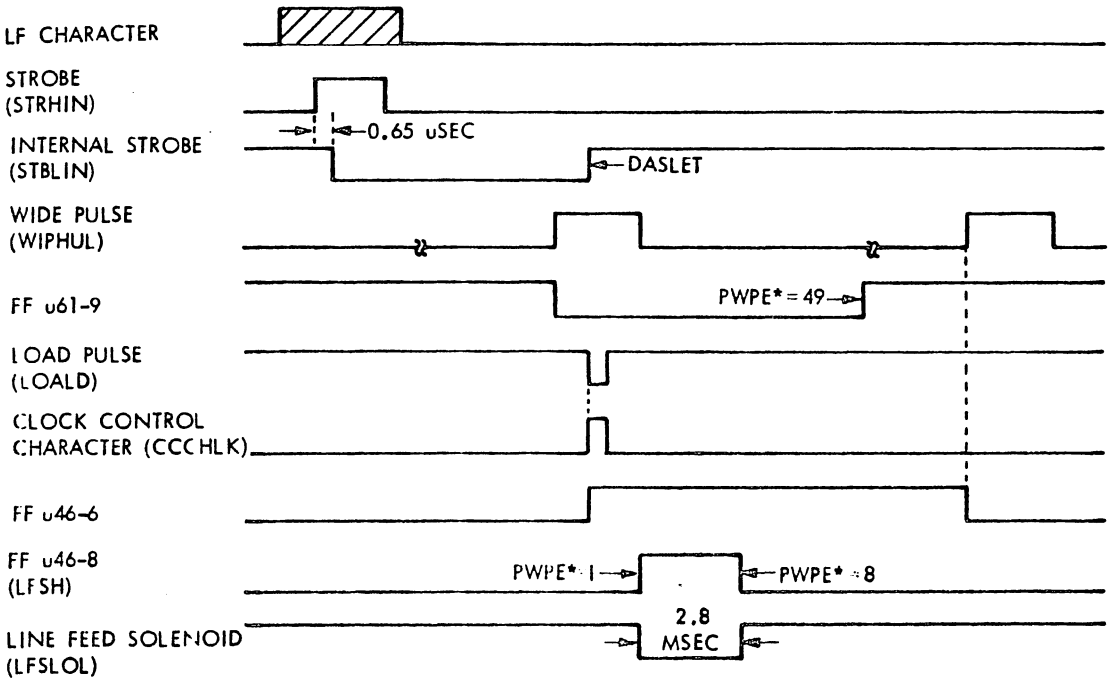
Figure 4-5 Continuous Printing.



*PWPE = PRINT WHEEL POSITION ENCODER.

E92146-6

Figure 4-6 Line Feed Timing.

LFSH also: 1) causes a low Print Inhibit (PRILIN) signal which disables the Print Pulse Detector and 2) inhibits the PLSLOL signal to the space pin solenoid driver preventing the print wheel from advancing to the next character position.

When the Print Wheel Position Encoder reaches a count of 8, signal DDEHEL sets flip-flop U46-8 terminating the LFSH and LFSLOL pulses. If no other Line Feed character has been received, when the Print Wheel Position Encoder reaches 49_{10}, flip-flop U61-9 is deactivated (set), and the next wide pulse sets flip-flop U46-6. If another Line Feed character has been received, however, flip-flop U61-9 remains reset and the trailing edge of the next wide pulse generates another 2.8 millisecond pulse (LFSLOL) to the line feed solenoid.

4.4.2 BACK SPACE

As shown in the timing diagram of figure 4-7, the First Wide Pulse (WIPHUL) following reception of a Back Space character activates (resets) flip-flop U61-9. The Load pulse (LOALD) generated during this wide pulse generates a Clock Control Character pulse (CCCHLK) which clocks Back Space flip-flop (U36-5) set. The trailing edge of the wide pulse (WIPHUL) then clocks flip-flop U36-9 set activating signal BSDH. With BSDH high, when the Print Wheel Position Encoder reaches a count of 16_{10}, a low CRSLOL pulse is generated for the carriage return solenoid driver. This pulse causes the print wheel to back up one space. Approximately 3.7 milliseconds later, a count of 24 in the Print Wheel Position Encoder resets BSDH and terminates the CRSLOL pulse. If no other Back Space character has been received, when the Print Wheel Position Encoder reaches 49_{10}, flip-flop U61-9 is deactivated (set) and the next wide pulse sets flip-flop U36-5. If another Back Space character has been received, however, flip-flop U61-9 remains reset and the trailing edge of the next wide pulse generates another 3.7 millisecond pulse to the carriage return solenoid (CRSLOL).

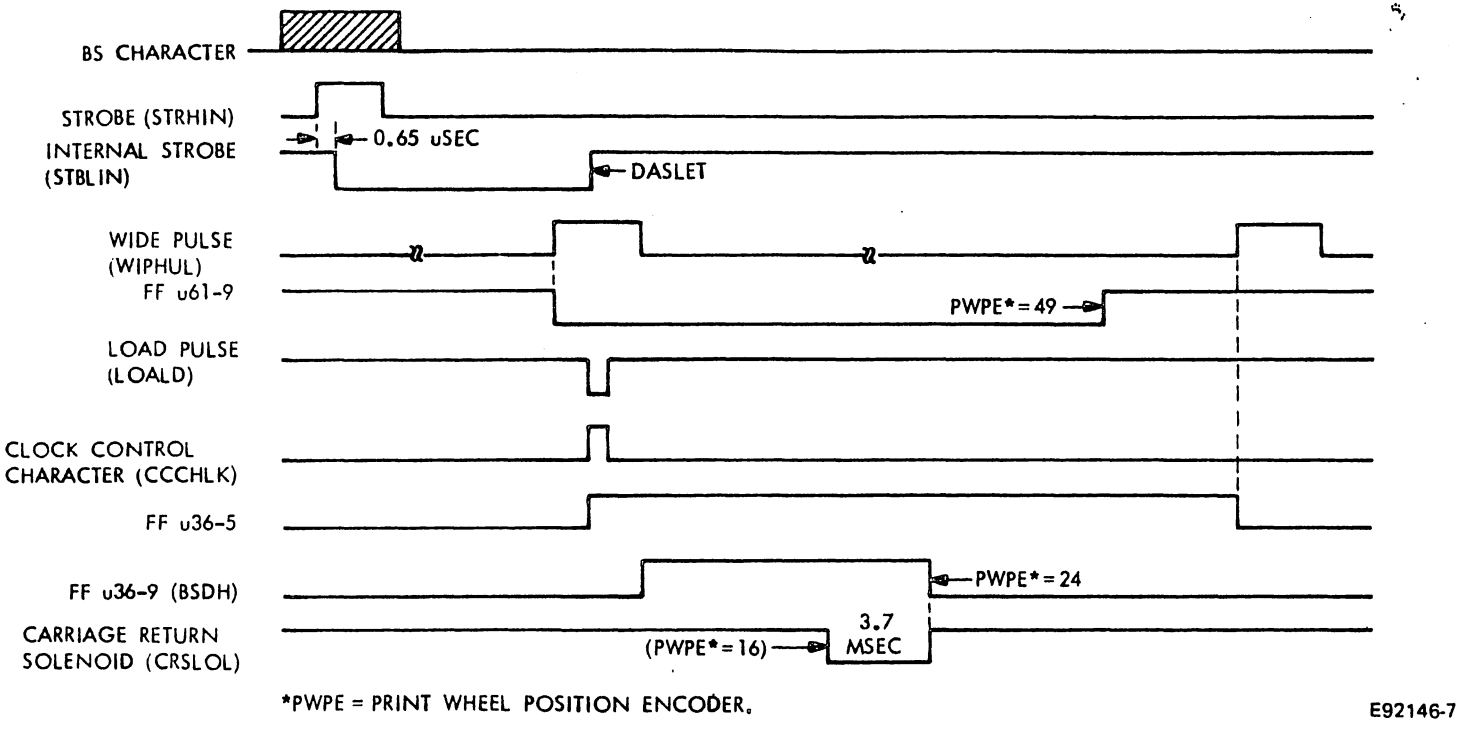


Figure 4-7 Back Space Timing.

4.4.3 CARRIAGE RETURN

As shown in the timing diagram of figure 4-8, the first wide pulse (WIPHUL) following reception of a Carriage Return character activates (resets) flip-flop U61-9. The Load pulse (LOALD) occurring during this wide pulse generates a Clock Control Character pulse (CCCHLK) which clocks Carriage Return flip-flop U56-6 reset. The resulting high CRSH signal performs the following functions:

a. If any character except a Line Feed character is received from the buffer interface, CRSH inhibits the generation of an Internal Strobe (STBLIN) signal. As a result, during a carriage return, the printer control logic recognizes only a Line Feed character.

b. CRSH generates a low Print Inhibit pulse (PRILIN) which disables the Print Pulse Detector.

c. CRSH also inhibits the PISLOL signal to the space pin solenoid driver. This prevents the print wheel from advancing to the next character position.

d. As long as CRSH is active, a low CRSLOL signal is sent to the carriage return solenoid driver which forces the print wheel to return to the beginning of the line.

When the print wheel reaches the left hand margin stop, a switch is activated in the printer which sends a low Carriage Return End signal (CRELND) to the control logic. This deactivates (sets) the CRSH flip-flop and then terminates the carriage return operation.

4.4.4 FORM FEED

If the printer contains an optional Vertical Format Unit, the printer then keeps track of the current line position on the form, and informs the Control, Data and Decode card when the last line on a form is reached. If the printer does not contain this option, the Control, Data and Decode card must keep track of the current line position.

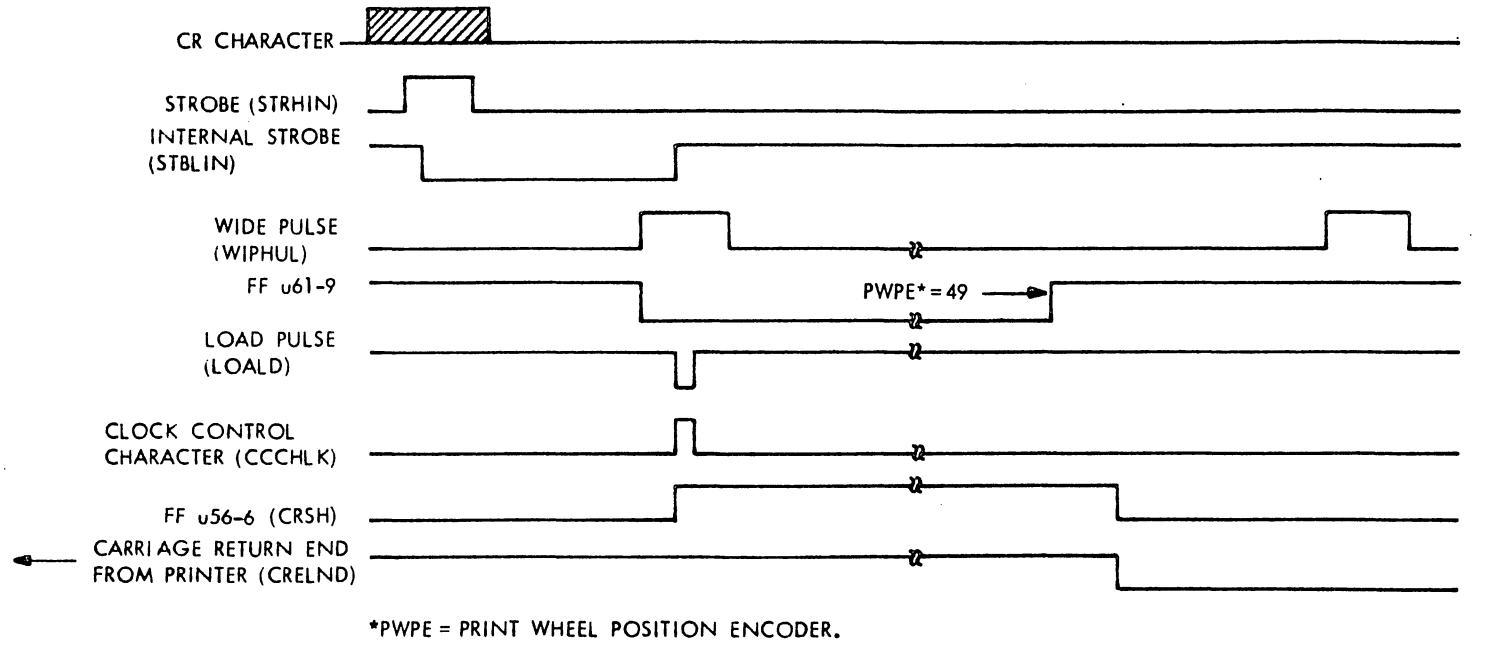


Figure 4-8 Carriage Return Timing.

The timing diagram shown in figure 4-9 illustrates the timing associated with the Control, Data and Decode card when the printer does not contain the Vertical Format Unit. The form feed operation consists of a carriage return and consecutive line feeds. As shown in the timing diagram, the first wide pulse (WIPHUL) following reception of a Form Feed character activates (resets) flip-flop U61-9. The Load pulse (LOALD) occurring during this wide pulse generates a Clock Control Character pulse (CCCHLK) which clocks the Form Feed flip-flop (U56-9) reset and the Carriage Return flip-flop (U56-5) reset. The carriage return operation then takes place as described in paragraph 4.4.3. Consecutive Line Feed (LFSH) pulses, each 3.2 milliseconds wide, are generated during each revolution of the print wheel. The action initiated by each of these LFSH pulses is described in paragraph 4.4.1.

During a form feed operation each LFSH pulse is generated as follows: As long as the Form Feed flip-flop (U56-9) is reset, the trailing edge of wide pulse WIPHUL clocks flip-flop U46-9 reset. This action: 1) activates LFSH which in turn sends a low (active) level to the line feed solenoid driver (LFSLOL), and 2) increments a counter (U15/U26) in the Form Feed Generator which keeps track of the present line position. Approximately 3.2 milliseconds later, the Print Wheel Position Encoder reaches a count of 8 activating signal DDEHEL. This directly sets flip-flop U46-9 terminating the LFSH and LFSLOL pulses.

As long as the Form Feed flip-flop (U56-9) is reset, these LFSH and LFSLOL pulses are generated again by each wide pulse. When the counter in the Form Feed Generator reaches a predetermined count (as specified by pre-wired jumper connections) indicating the last line on the form has been reached and CLRL is true, a decoder output (U17-8) goes low resetting the counter and deactivating (setting) the Form Feed flip-flop (U56-9). This completes the form feed operation.

If the printer contains a Vertical Format Unit, the Control, Data and Decode card does not generate a series of LFSH and LFSLOL line feed pulses. Instead, a constant high LFSH and low LFSLOL level to the printer is generated. When the end of the form is reached, a low Vertical Format Unit (2) level

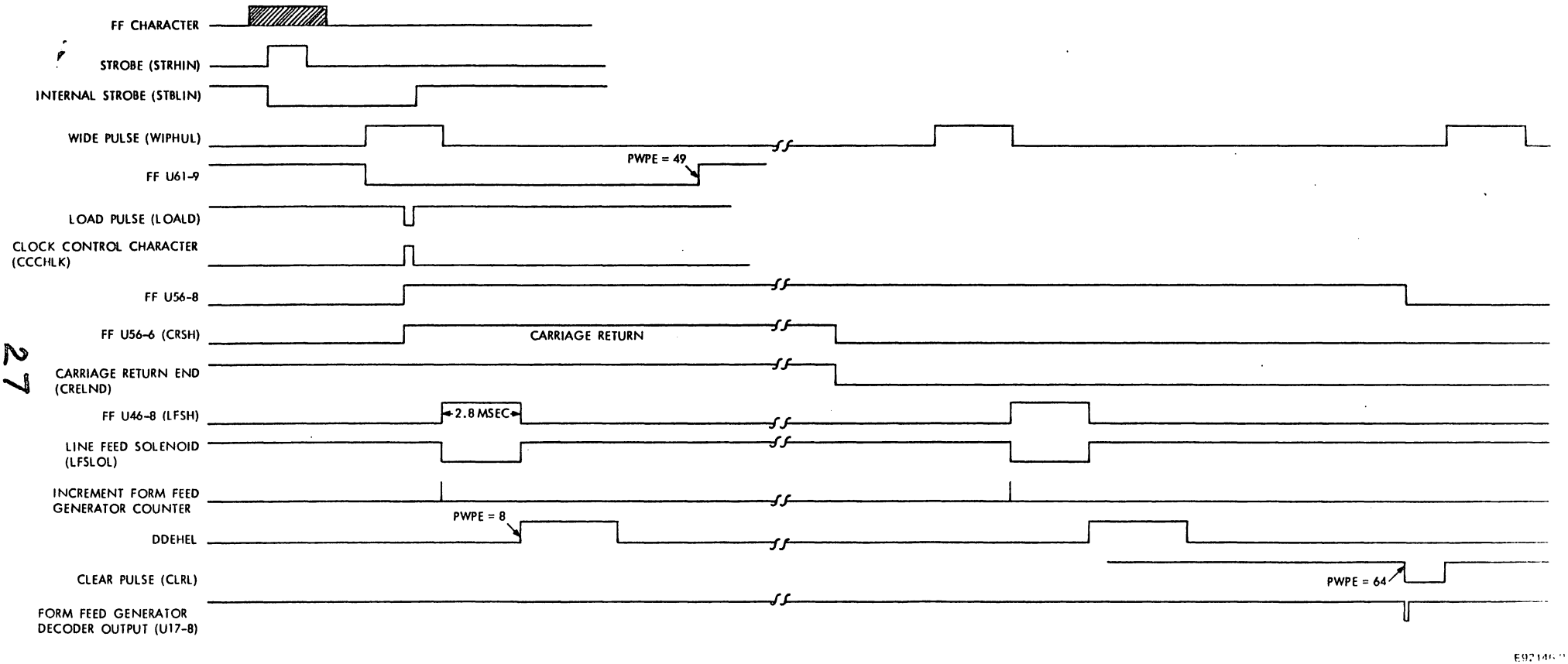


Figure 4-9 Form Feed Timing (Without Vertical Format Unit)

(VFUL2) and a low Line Count Generator pulse (LCGL) generated by the VFU bead chain on the printer deactivates (sets) the Form Feed flip-flop (U56-9) terminating the operation. The Control, Data and Decode card, however, still initiates the carriage return operation.

4.4.5 VERTICAL TAB

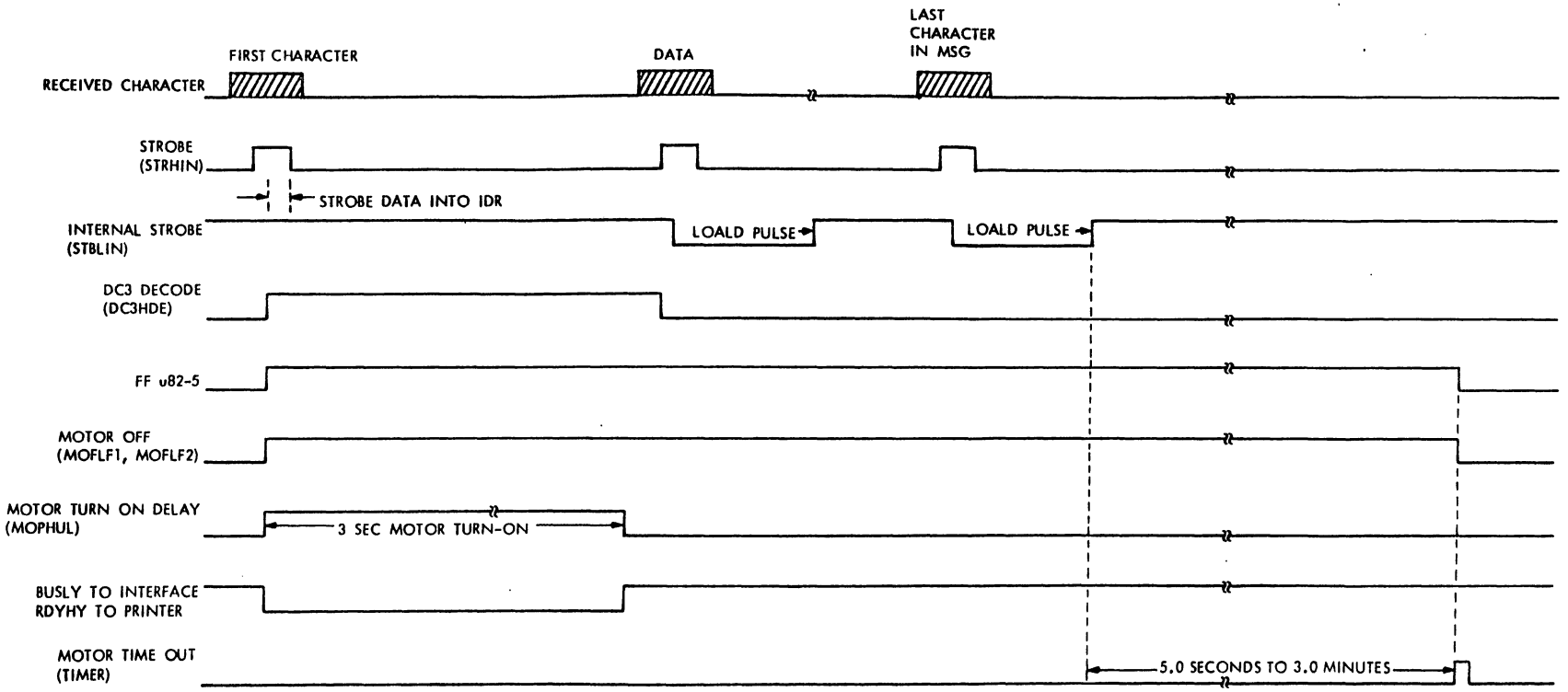
Reception of a Vertical Tab character by the Control, Data and Decode card affects the printer only if the printer contains the optional Vertical Format Unit. During the first wide pulse following the reception of a Vertical Tab character, a Clock Control Character pulse (CCCHLK) activates (sets) Vertical Tab flip-flop U58-5. If the Vertical Format Unit and associated jumper connections are included in the printer, the following action occurs.

The Vertical Tab flip-flop activates a constant high LFSH and a low LFSLOL level, which causes continuous paper feeding until the printer sends a low Vertical Format Unit (1) level (VFUL1) and a low Line Count Generator Pulse (LCGL) to the Control, Data and Decode card. This resets Vertical Tab flip-flop U58-5 ending the operation.

4.4.6 MOTOR TURN-ON

The motor control feature, which operates only when the printer is in the remote mode, automatically turns off the motor after 5 seconds to 3 minutes (adjustable) after data transfer from the interface has stopped. With this motor control feature, the motor turns on when the first character is received from the interface. The feature can be disabled by pressing the MOTOR BYPASS switch on the printer.

As shown in the timing diagram of figure 4-10, reception of the first character sets Motor Control flip-flop U82-5. If no motor faults exist, if the plexiglass window is closed and if a DC reset is not taking place, then Motor Off signals MOFLF1 and MOFLF2 go high. A high MOFLF1 signal to the power sequencer when the POWER ON switch is on, applies 115 VAC to the



NOTES:

1. TIMING IS NOT DRAWN TO SCALE.
2. STBLIN IS INHIBITED DURING THE FIRST CHARACTER, BY THE LOW MOTOR OFF SIGNAL MOFLF2.

E92146-10

Figure 4-10 Motor Control Timing.

motor and +48 VDC to the solenoid drivers. The positive-going edge of MOFLF2 fires a 3 second one-shot generating a Motor Turn-On delay (MOPHUL). During this 3-second delay: 1) motor faults are ignored by inhibiting the clock input to the Motor Fault flip-flop, 2) an active low BUSLY signal is sent to the interface card to prevent the transfer of new data, and 3) an inactive low RDYHLD signal is sent to the printer. Following this 3-second delay, each time new data is received from the interface card, a low Internal Strobe STBLIN pulse is generated. This pulse ends (goes high) during the first wide pulse following the strobe. Each time STBLIN goes high, and the motor is on (MOFLF2 is high) and the printer is in remote mode (LOCLAL is high), a Motor Time-Out circuit is activated. As shown in sheet 1 of the schematic drawing (No. 7100426L001), this condition back-biases diode CR2 and allows the +5 VDC supply to charge capacitor C92 through R24 and R28. Each time STBLIN goes low (when new data is received), capacitor C92 discharges through CR2 to ground. After the last character in a message is received, STBLIN goes high and remains high allowing C92 to charge without interruption. When the positive voltage across C92 reaches a threshold level, Q1 turns on, Q2 turns on, and the TIMER output goes high. Potentiometer R24 is used to adjust this TIMER interval from 0.5 and 3.0 minutes.

The positive-going edge of the TIMER output clocks flip-flop output clocks flip-flop U82-5 reset, which activates Motor Off signals MOFLF1 and MOFLF2 (low). A low MOFLF1 signal causes the power sequencer to remove the 115 VAC from the motor and the +48 VDC from the solenoid drivers.

4.5 PRINTER SWITCH AND INDICATOR LOGIC

The manual controls and indicators located on the printer are grouped into the following categories:

a. External Operator Controls - POWER ON/OFF, LOCAL, READY, SPACE, TEST, LINE FEED, and FORM FEED.

b. Internal Controls - MOTOR BYPASS, PHASE CONTROL, and DC RESET.

c. Internal Switches - Paper Out switch, Window Open switch, Right Hand Limit switch, and Left Hand Limit switch.

d. External Indicators - POWER ON, LOCAL, REMOTE, and ATTN.

e. Power Reset - Circuit breaker on the rear panel for ac protection.

The logic operations associated with each of these controls and indicators is described in the following paragraphs.

4.5.1 EXTERNAL OPERATOR CONTROLS

4.5.1.1 POWER ON/OFF Switch

This switch connects/disconnects the 115 VAC to the printer.

4.5.1.2 LOCAL and READY Switches

Flip-flop U72-9 on the Control, Data and Decode card is used to indicate the local/remote status of the printer. This flip-flop is reset (LOCLAL goes low), indicating local mode, by any of the following conditions:

a. A dc reset (DCRLST)

b. A printer fault - FALHLD (i.e., motor fault, window open, or out of paper).

c. Pressing the LOCAL switch (LOCLSW) on the printer.

Capacitor C94 causes a slight delay between detecting the condition and actually resetting the flip-flop.

The flip-flop is set indicating remote mode whenever the READY switch (PRILSW) on the printer is pressed and none of the above three conditions (i.e., dc reset, printer fault, pressing the LOCAL switch) is present.

4.5.1.3 SPACE Switch

The SPACE switch is enabled only while the printer is in local mode. This switch allows the operator to position the print wheel anywhere along the line. The print wheel moves as long as the switch is depressed. When the

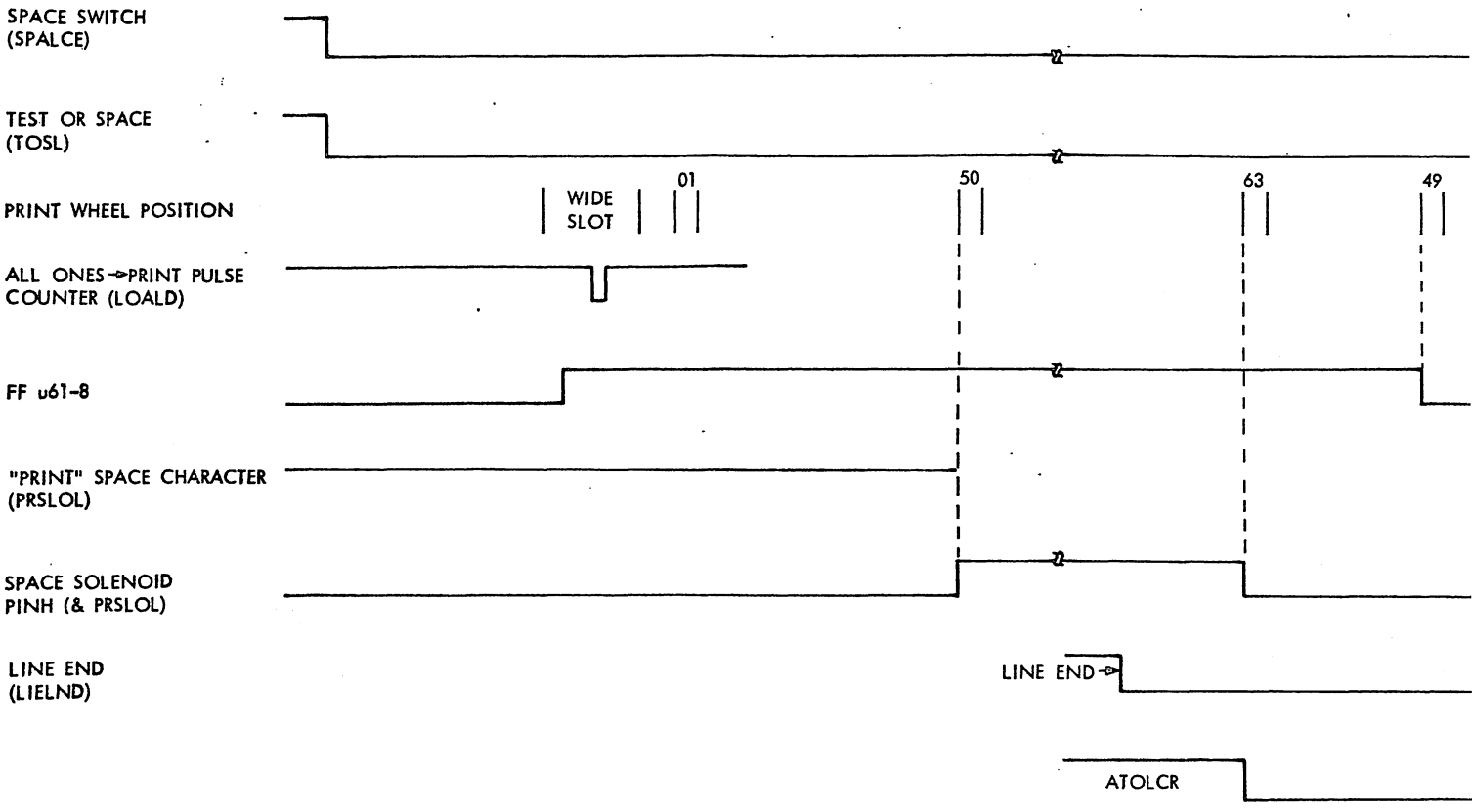
extreme right end of the line is reached, an automatic line feed and carriage return takes place.

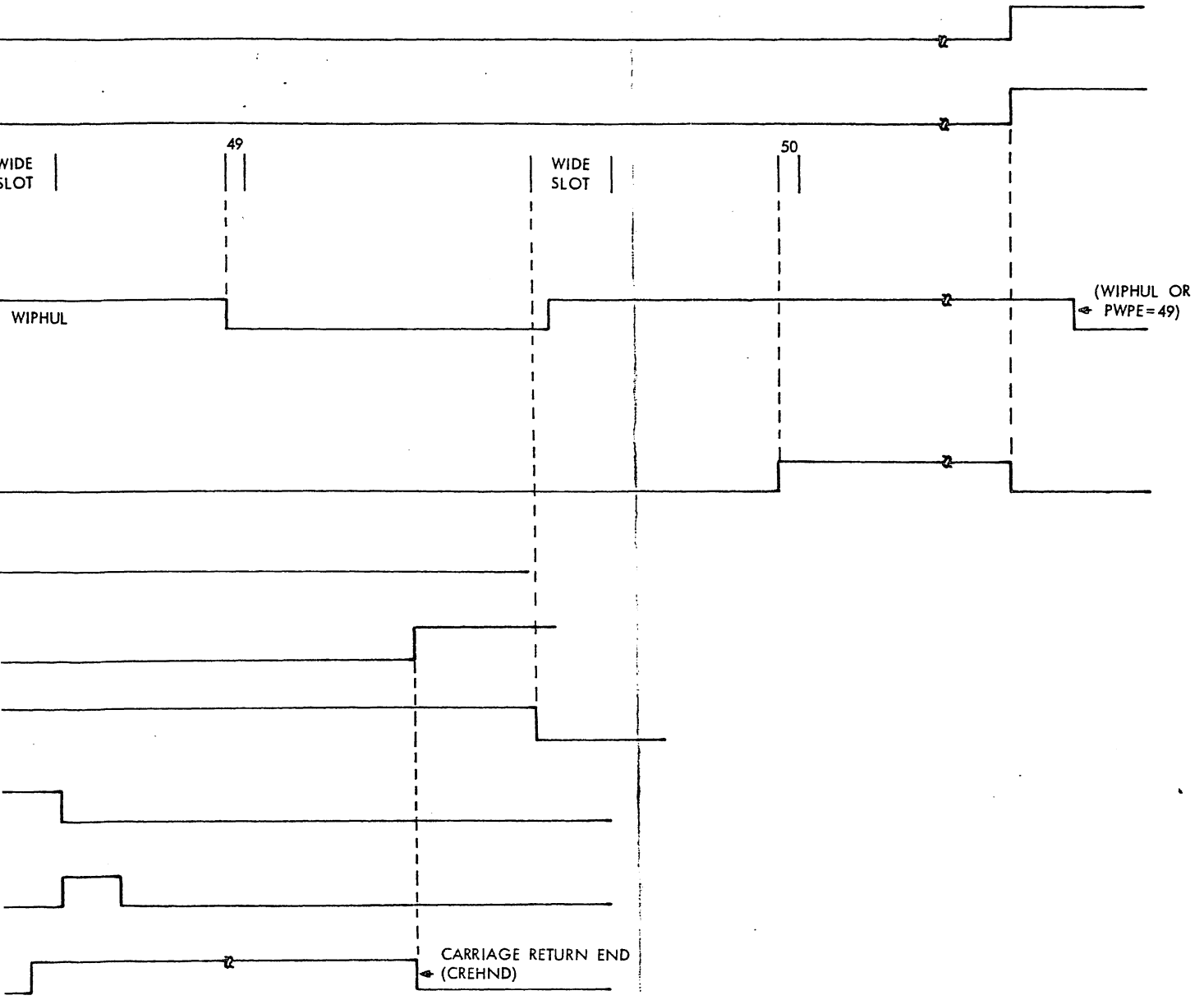
Referring to the timing diagram of figure 4-11, pressing the SPACE switch (SPALCE) while the printer is in local mode (LOCLAL) activates Test Or Space signal TOSL. A low TOSL signal activates the Internal Strobe STBLIN, for as long as the SPACE switch is pressed (except during an automatic carriage return). A low TOSL signal also causes a high output from the Bit Six Converter resulting in an all ONES count to the Print Pulse Counter during each LOALD pulse. This causes the carriage to advance one space during each revolution of the print wheel as described in paragraph 4.3 (Character Printing). The space pin solenoid (PISLOL) is activated by setting the Space Pin (PINH) flip-flop, same as in normal character printing.

When the print wheel reaches the right end of the line, the printer sends a low Line End signal (LIELND) to the Control, Data and Decode card. When the Print Wheel Position Encoder (PWPE) reaches a count of 63_{10}, the Auto Carriage Return (ATOLCR) flip-flop (U58-9) is clocked reset. A low ATOLCR immediately deactivates (resets) the PINH flip-flop and the next PWPE count of 49_{10} deactivates (sets) flip-flop U61-8. During the next wide pulse, flip-flop U29-8 is clocked reset by a CLRL pulse causing flip-flop U42-9 to set. The Clock Control Character pulse (CCCHLK) then clocks the Line Feed flip-flop (U46-6 → High) and the Carriage Return flip-flop (U56-6 → High). The resulting line feed and carriage return operations are described in paragraphs 4.4.1 and 4.4.3, respectively.

When the print wheel reaches the left margin stop, a Carriage Return End (CREHND) from the printer terminates the carriage return operation and deactivates (sets) the Auto-Carriage Return (ATOLCR) flip-flop (U58-9). If the SPACE switch is still depressed, the "printing" of spaces is resumed on the next line.

When the switch is released, SPALCE and TOSL both go high. The high TOSL immediately resets the PINH flip-flop which deactivates the space


SPACE SWITCH
(SPALCE)
TEST OR SPACE
(TOSL)
PRINT WHEEL POSITION
WIDE
SLOT
01
50
63
49
ALL ONES→PRINT PULSE
COUNTER (LOALD)
FF u61-8
"PRINT" SPACE CHARACTER
(PRSLOL)
SPACE SOLENOID
PINH (& PRSLOL)
LINE END
(LIELND)
LINE END
ATOLCR
FF u29-8
FF u42-9
LINE
(LFSI
CARRIAGE R
(CRSH)



E92146-11

Figure 4-11 Manual Space Switch Timing.

solenoid (PISLOL). During the next wide pulse or PWPE count of 49_{10} (whichever comes first), flip-flop U61-9 is deactivated (set).

4.5.1.4 TEST Switch

The TEST switch is enabled only while the printer is in local mode. This switch causes all 64 characters (including the space) to be printed on a single line, in the order in which they appear on the print wheel. The test prints the 64 characters twice, then continues to print spaces until the end of the line is reached. At this time an automatic line feed and carriage return is executed.

Pressing the TEST switch (TESLT) while the printer is in local mode sets Print Test flip-flop (U29-6) and activates Test Or Space signal TOSL. The active TOSL signal causes the same printing action as described in paragraph 4.5.1 (Space Switch). The Print Test flip-flop (U29-6), however, allows each CLRL pulse (which is generated once every print wheel revolution at the start of the wide slot) to increment the Input Data Register (or Test Counter). This Test Counter starts with an all ZEROES count (a low PINH while the printer is in local mode resets the counter). A count of 50 then sets PINH, after which, the counter gets incremented by CLRL. The active TOSL signal causes the Bit Six Converter to invert bit six from the Test Counter into the Print Pulse Counter. As a result, the first count preset into the Print Pulse Counter at load time is an all ONES count, except for a ZERO in bit 1. This makes the first printed character an exclamation point.

Subsequent characters are printed in the order they appear on the print wheel. After the 64th character is printed (space), bits 1-6 of the Test Counter recycle to ZEROES and the same 64 characters are printed again.

After the 128th character has been printed, a ONE out of Test Counter stage 8 allows the trailing edge of the wide pulse to reset the Print Test and Manual Space flip-flop U42-5. This flip-flop then resets the Test Counter and holds it reset until after the automatic line feed and carriage return has been executed. Signal TOSL causes spaces to be printed on the remainder of the line as described in paragraph 4.5.1.3.

This continues until the print wheel reaches the right end of the line, causing the printer to send a low Line End signal (LIELND) to the Control, Data and Decode card. This causes an automatic line feed and carriage return operation as described in paragraph 4.5.1.3.

4.5.1.5 LINE FEED Switch

Pressing the LINE FEED switch (LFSLW) while the Printer is in local mode and a print test or manual space operation is not in progress (TOSL is high), causes the printer to perform a single line feed operation. The first CLRL pulse after the switch is pressed clocks flip-flop U29-8 reset, which in turn clocks flip-flop U42-9 set. The Clock Control Character (CCCHLK) pulse then resets Line Feed flip-flop U46-6 and the trailing edge of the wide pulse (WIPHUL) resets flip-flop U46-8, activating Line Feed signal LFSH. A high LFSH directly resets flip-flop U42-9 to prevent any subsequent line feed until after the LINE FEED switch is released and pressed again. The actual line feed operation caused by a high LFSH signal is described in paragraph 4.4.1.

4.5.1.6 FORM FEED Switch

Pressing the FORM FEED switch (FFSLW) while the printer is in local mode and a print test or manual space operation is not in progress (TOSL is high), causes the printer to perform a single form feed operation. The first CLRL pulse after the switch is pressed clocks flip-flop U29-8 reset, which in turn clocks flip-flop U42-9 set. The following Clock Control Character (CCCHLK) pulse then resets Form Feed flip-flop U56-9 and Carriage Return flip-flop U56-5 (activating CRSH). The trailing edge of wide pulse WIPHUL resets flip-flop U46-8 activating Line Feed signal LFSH. This high LFSH signal directly resets flip-flop U42-9 to prevent any subsequent form feed operation until after the FORM FEED switch is released and pressed again. The actual form feed operation caused by activating the Form Feed and Carriage Return flip-flops is described in paragraph 4.4.4.

4.5.2 INTERNAL CONTROLS

4.5.2.1 MOTOR BYPASS Switch

Pressing this switch disables the automatic motor control feature and keeps the motor on. A low Motor Always On (MAOLSW) signal from the printer has the same effect as receiving a DC3 character from the interface card. If the printer window is not open and a dc reset is not taking place, a low MAOLSW keeps Motor Off signals MOFLF1 and MOFLF2 constantly high, keeping the motor turned on.

4.5.2.2 PHASE CONTROL Adjustment

The PHASE CONTROL potentiometer is used to adjust the print hammer delay, in order to compensate for varying paper thicknesses.

4.5.2.3 DC RESET Switch

Either one of two conditions will generate a dc reset signal (DCRLST), which in turn resets most of the logic on the Control, Data and Decode card. The two conditions are: 1) pressing the DC RESET switch on the printer, or 2) power turn-on. When the +5 VDC supply turns on, initially 0 volt across C47 in the DC Reset circuit generates an active (high) DCRHST signal. The +5 VDC, however, forward-biases diode CR4 and back-biases CR3, allowing a positive voltage to develop across C47 (via R29). As a result, after the initial turn-on, the junction of CR3 and C47 remains high except for when the DC RESET switch on the printer is pressed.

4.5.3 INTERNAL SWITCHES

4.5.3.1 Paper Out Switch

This microswitch is held reset whenever a form is positioned in the paper feed tractors. It remains reset until approximately 4 inches remain on the last form. Setting the switch sends a low PAOLUT signal to the logic.

4.5.3.2 Window Open Switch

This microswitch is held reset whenever the plexiglas window is closed. If the window is lifted, this switch sets, sending a low WIOLP signal to the control logic causing the unit to go to local mode and the motor to turn off.

4.5.3.3 Right Hand Limit Switch

This magnetically activated reed switch sets, sending a low LIELND signal to the logic, whenever the print wheel assembly is at the right hand margin stop. In the local mode, activating this switch causes a carriage return and line feed. In remote mode a carriage return with no line feed occurs.

4.5.3.4 Left Hand Limit Switch

This magnetically activated reed switch sets, sending a low CRELND signal to the control logic, whenever the print wheel assembly is at the left hand margin stop. This switch signals the end of a carriage return.

4.5.4 EXTERNAL INDICATORS

4.5.4.1 PWR Indicator

The PWR indicator lights when the printer is receiving power from the 115 VAC line.

4.5.4.2 LOCAL Indicator

The LOCAL indicator lights when the printer is in local mode. The inverted Q output of Local/Remote Control flip-flop U72-9 (LOCHLD) is used to control the lamp driver. Paragraph 4.5.1.2 describes how the printer can be placed in local mode.

4.5.4.3 REMOTE Indicator

The REMOTE indicator lights when the printer is ready to receive a character from the interface card. The lamp driver is activated by a high Ready (RDYHLD) signal from the Control, Data, and Decode card. Signal RDYHLD goes low, turning off the light, under any of the following conditions:

a. From a Data Strobe (STRHIN) from the interface card while the motor is on (NOFLF2 is low) to the completion of the Data Set Acknowledge pulse (DASLET).

b. Whenever the printer is in local mode ($LOCLAL_L$).

c. During the 3-second motor turn-on interval (MOPHUL).

4.5.4.4 ATTN Indicator

The ATTN indicator lights whenever a fault condition exists in the printer. A high FALHLD signal on the Control, Data and Decode card turns the indicator on. Signal FALHLD goes high under any of the following conditions:

a. The plexiglas window is open causing a low WIOLP signal from the printer.

b. The printer is out of paper causing a low PAOLUT signal from the printer.

c. The Motor Up To Speed Detector in the Control, Data and Decode card detects a drop in the synchronous speed of the motor.

The Motor Speed Detector operates as follows: During each print wheel revolution, a count of 49_{10} in the Print Wheel Position Encoder (PWPE) fires one-shot U48 generating a 3.1 millisecond pulse. When PWPE reaches a count of 50_{10} the one shot output is clocked into flip-flop U64-8. If the one-shot pulse is still high, flip-flop U64-8 is clocked set indicating no motor speed failure. However, if the one-shot pulse has gone low, flip-flop U64-8 is clocked reset indicating a speed failure. If this happens, flip-flop U72-5 gets clocked reset by the trailing edge of the next PWPE = 49_{10} count. This activates signal FALHLD to the ATTN lamp driver, and generates low Motor Off signals MOFLF1 and MOFLF2 (if the MOTOR BYPASS switch has not been depressed). This lights the ATTN indicator and turns off the motor. After the motor speed failure is corrected, a DC Reset (DCRLST) is required to clear the Motor Speed Detector logic.

4.6 SERIAL INTERFACE

The printer can be configured to receive either serial asynchronous data or parallel data depending on pre-wired jumper connections. Schematic No. 7100426L001 (Sheet 3) lists the jumper connections required for both serial and parallel operation. The description contained in the following paragraphs assumes that all jumpers are connected for serial mode.

In the serial mode each received character is 10 bits long and consists of a Start bit, 7 data bits (bit 8 must be a ZERO (low), and a Stop bit. Data levels at the output of receiver element U1 are:

"1" Bit - +5 volts
"0" Bit - 0 volts
Start Bit - 0 volts
Stop Bit - +5 volts
Idle - +5 volts

Basically the serial to parallel operation is performed by first detecting the Start bit and then clocking the input data into a 10-stage shift register during each consecutive 6.4 μsec (or 7.0 μsec for 720/701 interface) clock interval. The 1st and 10th stages of the shift register are constantly monitored for a Start/Stop bit combination. Detection of this combination generates a strobe which clocks the received data in parallel to the Input Data Register/Test Counter, and re-initializes the serial interface logic for reception of the next character.

A timing diagram of the serial to parallel converter is shown in figure 4-12.

4.6.1 CLOCK

The reception of a start bit fires Clock Sync one-shot U5-9 generating a 3.2/3.5* μsec pulse. This low pulse immediately disables gates U4-1 and U12-10. Some 80 nanoseconds later, this same pulse appears inverted at U4-2. The result is

*3.2 μsec for PDS, 3.5 μsec for 720/701 interface

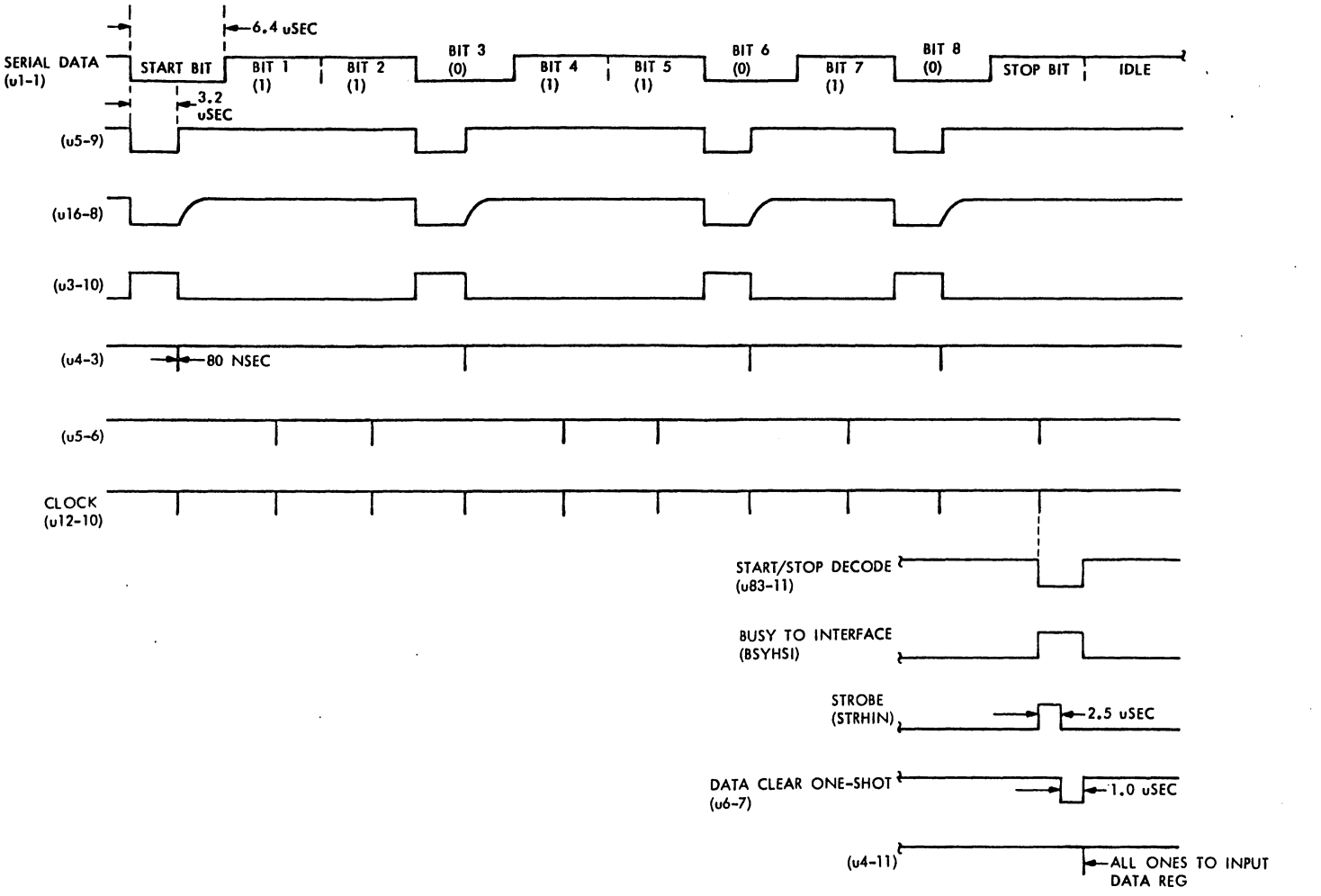


Figure 4-12 Serial Interface Timing.

an 80 nanosecond low-going pulse at U4-3, some 3.2/3.5 μsec after the start bit is received.

This 80 nanosecond pulse performs two functions: 1) it clocks the start bit into the Serial Input Data Register and 2) it retriggers the Clock One-Shot (U5-6), resynchronizing the clock output to the incoming data.

Until the next high-to-low transition is detected on the DATHSI line (i.e., a "1" to "0" transition), Clock One-Shot U5-6 clocks the data into the Serial Input Data Register. This one-shot operates as follows: After an initial DC Reset (DCRLST), input pin U5-4 to the one-shot goes high firing the one-shot. Output U5-7 then goes low for 6.4/7.0 * μsec disabling input U5-4. At the trailing edge of the pulse, the high U5-7 output is delayed by gates U4-6, U3-2 and the one-shot input, causing a 50 nanosecond delay before retriggering the one-shot. The resulting low-going 50 nanosecond pulse at U5-6 is used to clock the Serial Input Data Register. In this free-running mode, a 50 nanosecond clock pulse is generated every 6.4/7.0 μsec.

When a high to low transition is detected on the DATHSI line, however, the Clock Sync One-Shot circuit generates an 80 nanosecond pulse (in exactly the same manner as when a Start bit was detected), and this pulse, is used to clock data into the Serial Input Data Register. This pulse also resyncs the Clock One-Shot.

4.6.2 SERIAL INPUT DATA REGISTER

The Serial Input Data Register consists of a 10-stage shift register with preset inputs (elements U8 and U9). During a DC Reset or if a printer fault (FALLT) is detected, the preset (P) input to the Serial Input Data Register goes high forcing all ONES into the register.

When the Start bit is received, the Clock One-Shot is synchronized with the incoming data and the following ten consecutive bits are clocked into the register (as described in paragraph 4.6.1). Detection of a 0 in the first stage

---

*6.4 μsec for PDS, 3.5 μsec for 720/701 interface

and a 1 in the tenth stage causes a low output from U83-11 which: 1) inhibits the clock to the Serial Input Data Register, 2) generates a high Busy (BSYHY) signal to the interface card, and 3) initiates a strobe (STRHIN) pulse to the control logic.

4.6.3 STROBE

If the printer is not busy (BUSLY is high), an active low output from the Start/Stop Bit Decoder (U83-11) fires one-shot U6-10, generating a 2.5 μsec STRHIN strobe pulse. This strobe delayed by 0.65 μsec strobes data from the Serial Input Data Register (SDIH1-SDIH7) in parallel, into the Input Data Register/Test Counter. This transfer initiates the character printing operations described in paragraph 4.3.

The trailing edge of STRHIN fires Data Clear One-Shot generating a 1.0 μsec pulse out of U6-7. This pulse activates a circuit similar to the Clock Sync circuit, and the trailing edge generates an 80 nanosecond low-going pulse at the output of U4-11. This pulse presets the Serial Input Data Register to all ONES, which deactivates the Start/Stop Bit Decoder and makes the serial interface logic ready to receive the next character.

4.7 PRINTER INTERFACE SIGNALS

Table 4-2 contains a list and brief description of all interface signals connected to the Control, Data and Decode card.

4.8 LVPS REGULATOR AND DRIVER CARD

The LVPS (Low Voltage Power Supply) Regulator and Driver card (Schematic 7100387 - old) (7100551 - new) contains the following components and circuits:

a. +5 VDC Power Supply Regulator
b. +48 VDC Power Supply Regulator
c. Sequencer
d. Solenoid Drivers
e. Lamp Drivers

TABLE 4-2

INTERFACE SIGNALS

(A) Interface Card to Control Card

Signal Mnemonic	Connector - Pin	Description
DATH1, R*	J3-15, 33	Parallel Data Bit 1 (LSB), and Return*
DATH2, R	J3-16, 34	Parallel Data Bit 2 (LSB)
DATH3, R	J3-17, 35	Parallel Data Bit 3 (LSB)
DATH4, R	J3-18, 36	Parallel Data Bit 4 (LSB)
DATH5, R	J3-8, 27	Parallel Data Bit 5 (LSB)
DATH6, R	J3-11, 30	Parallel Data Bit 6 (LSB)
DATH7, R	J3-13, 31	Parallel Data Bit 7 (MSB)
STRHIN, R	J3-19, 37	Parallel Data Strobe
DATHSI, LSI	J3-10, 9	Serial Data Input

(B) Control Card to Interface Card

Signal Mnemonic	Connector Pin	Description
BUSLY, BUSY	J3-2, 21	Busy/Ready Line for Parallel Interface
BSYHSI, LSI	J3-4, 3	Busy/Ready Line for Serial Interface
FALLT, R	J3-7, 26	Printer Fault Line for Parallel Interface
FLTHSI, LSI	J3-6, 5	Printer Fault Line for Serial Interface

*All interface lines are twisted pair and the second mnemonic always refers to the return.

TABLE 4-2

INTERFACE SIGNALS (Cont)

(C) Printer to Control Card

Signal Mnemonic	Connector-Pin	Description
CRELND, R	J2-A2, B14	Carriage Return End from internal Left Hand Limit switch
EXTLRST, R	J1-8, 7	External reset from DC RESET switch
FFSLW, R	J1, 2, 9	FORM FEED switch
LCGL, R	J2-A12, B7	Line Count Generator pulse
LFSLW, R	J1-30, 10	LINE FEED switch
LIELND, R	J21-B12, A8	Line End from internal Right Hand Limit switch
LOCLSW, R	J1-16, 14	LOCAL switch
MAOLSW, R	J1-24, 23	MOTOR BYPASS switch
PAOLUT, R	J2-B13, A5	Paper Out indication from internal Paper Out switch
PCIH, R	J2-A13, B8	Photo Cell Input
PRILSW, R	J1-22, 13	READY switch
SPALCE, R	J1-20, 12	SPACE switch
TESLT, R	J1-4, 11	TEST switch
VFUL1, R	J2-A16, B10	Vertical Format Unit output for terminating vertical tab operation

TABLE 4-2

INTERFACE SIGNALS (Cont)

(C) Printer to Control Card (Cont)

Signal Mnemonic	Connector-Pin	Description
VFUL2, R	J2-A14, B11	Vertical Format Unit output for terminating form feed operation
WIOLP, R	J1-28, 27	Window Open indication from internal Window Open microswitch

(D) Control Card to Printer

Signal Mnemonic	Connector-Pin	Description
CRSLOL	J1-25	Input to carriage return solenoid driver
FALHLD	J1-29	Printer Fault signal to ATTN indicator lamp driver
LFSLOL	J1-18	Input to line feed solenoid driver
LOCHLD	J1-19	Local Mode signal to LOCAL indicator lamp driver
MOFLF1	J1-21	Motor Off signal to power sequencer
PISLOL	J1-17	Input to space pin solenoid driver
PRSLOL	J1-15	Input to print solenoid driver
RDYHLD	J1-1	Ready signal to REMOTE indicator lamp driver

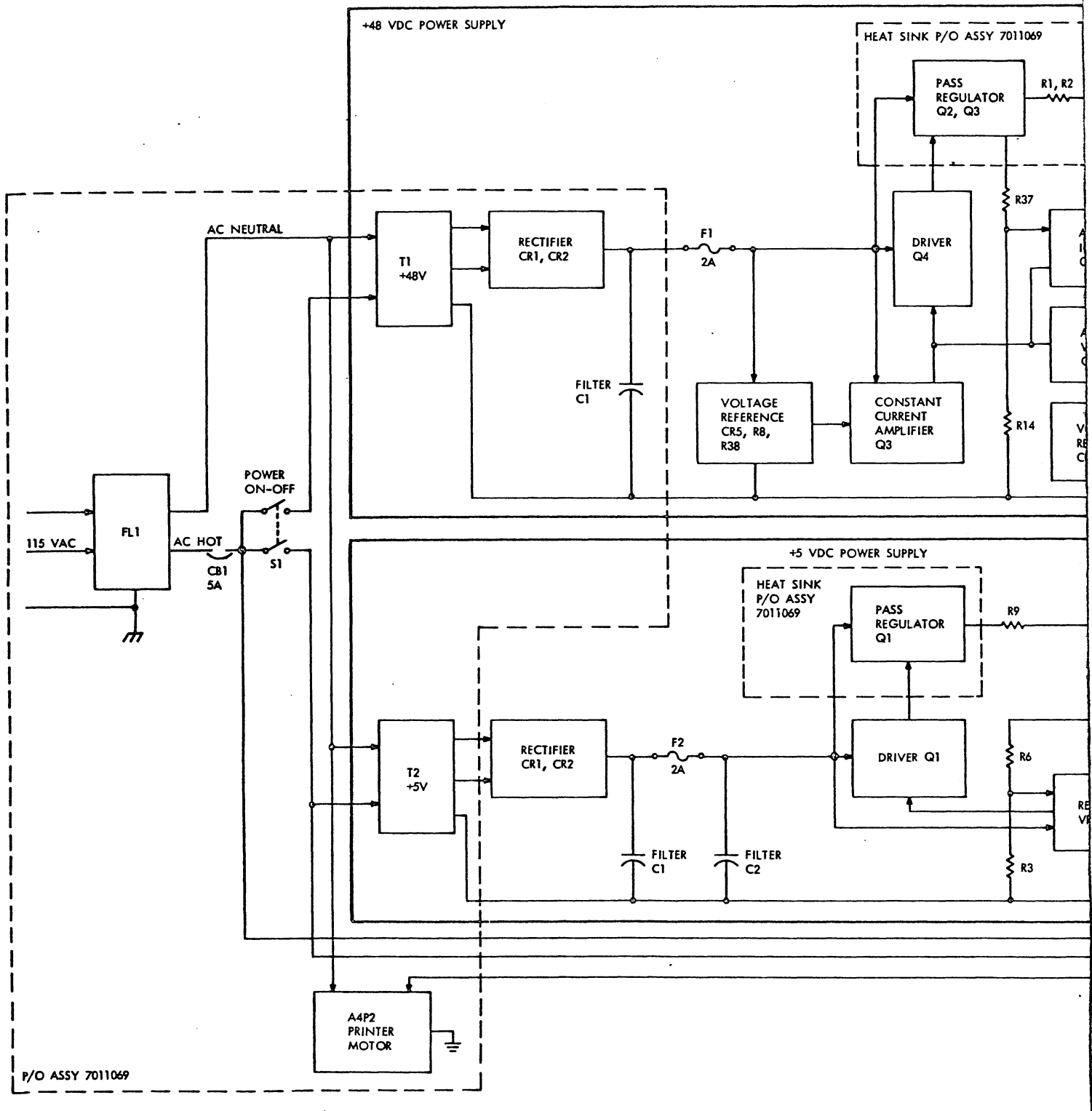
The function of the two power supplies is to provide power to the logic circuits, photocell amplifier and solenoids via the solenoid driver circuitry. The sequencer ensures that the power supplies are turned on and off in the proper sequence and controls power to the printer motor. Figure 4-13 shows a block diagram of the Low Voltage Power Supply.

4.8.1 GENERAL (Schematic Nos. 7011069, 7100387 and 7100551)

The printer is turned on by applying 115 VAC through RFI filter FL1 and circuit breaker CB1. This allows switch S1, POWER ON-OFF switch, to apply AC power to the power supplies. Placing S1 to the ON position energizes the two power supplies. A +5 VDC is applied to the Control, Data and Decode card and to the Photocell Amplifier. The +5 VDC power supply output allows the Sequencer to apply +48 VDC to the solenoid drivers and 115 VAC to the printer motor. The motor becomes operational in 0.5 seconds. The solenoid drivers are controlled by logic signals PISLOL, PRSLOL, LFSLOL, and CRSLOL from the Control and Data Decode card.

4.8.2 +5 VDC POWER SUPPLY

The input power is applied to transformer T2, to the LVPS Regulator and Driver board where it is rectified by diodes CR1 and CR2 and filtered by capacitor C1. Through fuse F2, the input power (nominally at 9 VDC) is applied to the collector of linear regulator pass transistor Q1, the emitter of driver A1, the integrated circuit voltage regulator VR1 and input filter capacitor C2. Voltage regulator VR1 generates its own 1.7 volt internal voltage reference and compares it with the output voltage at pin 6. An internal high-gain amplifier in VR1 generates an error signal at pin 2 which is applied to the base of driver Q1. The output of Q1 controls the linear regulator pass transistor Q1 which maintains a constant output voltage despite fluctuations in input voltage and load current.


+48 VDC POWER SUPPLY
HEAT SINK P/O ASSY 7011069
PASS REGULATOR Q2, Q3
R1, R2
R37
AC NEUTRAL
T1 +48V
RECTIFIER CR1, CR2
F1 2A
DRIVER Q4
FILTER C1
VOLTAGE REFERENCE CR5, R8, R38
CONSTANT CURRENT AMPLIFIER Q3
R14
POWER ON-OFF
115 VAC
FL1
AC HOT
CB1 5A
S1
+5 VDC POWER SUPPLY
HEAT SINK P/O ASSY 7011069
PASS REGULATOR Q1
R9
T2 +5V
RECTIFIER CR1, CR2
F2 2A
DRIVER Q1
R6
FILTER C1
FILTER C2
R3
A4P2 PRINTER MOTOR
P/O ASSY 7011069

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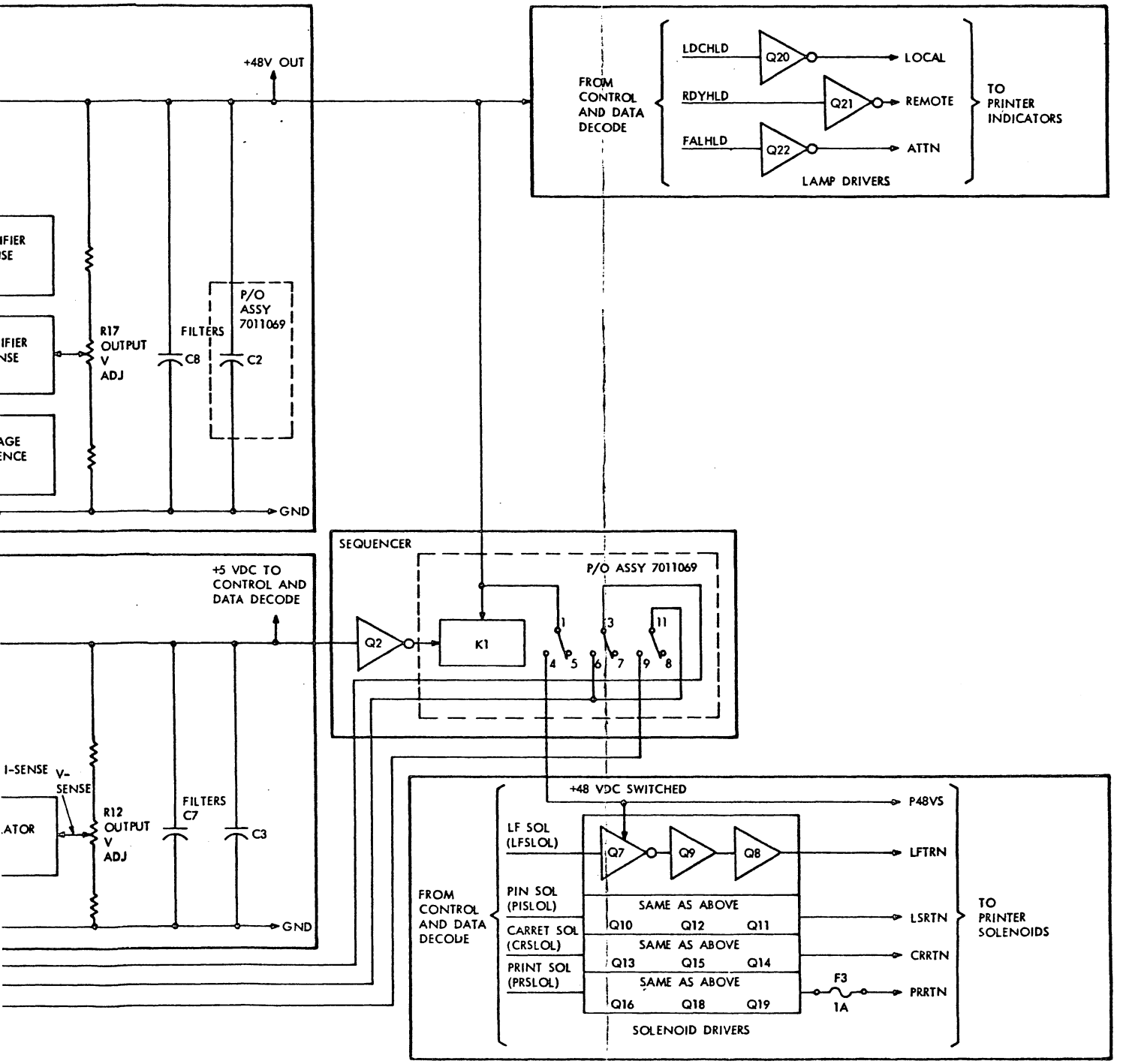


Figure 4-13 LVPS Regulator and Driver Card Block Diagram.

Current sensing is accomplished by resistor R4 in conjunction with VR1 and voltage divider R6 and R3. VR1 senses the voltage drop across R4, but some of this voltage is cancelled by the voltage divider R6 and R3. Current fold-back occurs when approximately 0.35 volts is sensed across terminals 1 and 8 of VR1. In this condition, an error signal is generated by VR1, through pin 2, to transistor Q1 which drives transistor Q1 and provides a high impedance to the output current. In the event of a prolonged short circuit, the linear regulator pass transistor Q1 is protected by folding-back the current to less than 50% of its nominal value.

4.8.3 +48 VDC POWER SUPPLY

The input power is applied through transformer T1, rectified by diodes CR1 and CR2, and filtered by capacitor C1 which supplies a nominal 62 VDC to the LVPS Regulator and Driver card. This 62 VDC input is applied to the collectors of parallel pass transistors Q2 and Q3 and Darlington driver Q4. Zener diode CR5 (2.4V), R8 and R38, and Q3 form a constant current source for driver Q4 and amplifiers Q5 and Q6.

The output voltage is sampled by resistors R16 and R18 as adjusted by R9. This voltage is compared to the reference voltage generated by zener diode CR6 (5.6V). The difference between the voltage on the base and emitter of amplifier Q5 determines the amount of Q5 collector current which is shared by transistor Q4. Q4 becomes a current amplifier which drives pass transistors Q2 and Q3. Thus a closed loop is formed to regulate the output voltage.

Current sensing is accomplished by resistors R1 and R2, in conjunction with the voltage divider formed by resistors R37 and R14. In normal operation the voltage at the base of Q6 is slightly higher than its emitter by Q6 is not driven into conduction. When excess current is drawn from the regulator, the drop across resistors R1 and R2 (which equalizes the current through Q2 and Q3) causes Q6 to become forward biased and drains the constant current source which normally is supplied to driver Q3. This drives Q1 and Q2 toward cutoff and decreases the output voltage in proportion to the excess current drawn.

The voltage divider formed by R14 and R37 provides fold-back of the voltage-current relationship during overload conditions which reduces the dissipation of Q2 and Q3 during short circuit conditions.

Due to the transient nature of the load, a large output capacitor C8 is provided in the output. Peak currents of 8 amperes for one millisecond are accommodated in this manner by the regulator whose output under steady state condition is approximately 2 amperes.

4.8.4 SEQUENCER

The Sequencer consists of relay K1 and driver Q2 which control the application and removal of power (+5V and +48V). When power is turned on through switch S1 both supplies (+5V and +48V) are energized. When the +5V supply is energized and, the Motor Off signal (MOFLF) is inactive (high) driver Q2 conducts applying ground to one side of relay K1. When +48V supply output is present, relay K1 is energized and the +48V is switched through contacts 1 and 4 of relay K1 which energizes the solenoid drivers. Contacts 11 and 9 of relay K1 provide AC return to the printer motor allowing the motor to come up to speed. Therefore the +5V and +48V supply is energized before the solenoid drivers and motor B1, to prevent erroneous activation of the solenoids. If Motor Off (MOFLF) goes active (low), driver Q2 is reversed biased de-energizing K1 which removes the +48V to the solenoid drivers and turns off motor B1.

The turn-off sequence of the power supplies may be accomplished logically by the MOFLF signal (as described above) or manually by the main power switch S1. When S1 is switched to the OFF position, AC power to the +48 VDC power supply is removed. AC power to the +5 VDC power supply is maintained through contacts 3 and 6 of relay K1 until such time (0.5 seconds maximum) as the +48 volta output decays to the drop-out voltage (7.2 VDC), of relay K1. When K1 drops out, the AC power to the +5 VDC power supply is removed and its output decays.

4.8.5 SOLENOID DRIVERS

The solenoid driver circuits consist of four similar circuits which buffer and amplify an active low logic signal from the Control, Data and Decode card to drive the +48 VDC solenoids in the printer. Each circuit is basically identical except for its power handling capability. The inputs, outputs and load for each driver are as follows:

Input Signal-Pin	Output	Current (Approx.)	Solenoid
PRINT SOL (PRSLOL)-13	A10-P48VS A12-PRRTN	0.5A	Print
PIN SOL (PISLOL)-19	A14-P48VS A9-LSRIN	0.2A	Space
CARRET SOL (CRSLOL)-17	A3-P48VS A5-CRRTN	0.2A	Carriage Return
LF SOL (LFSLOL)-20	A13-P48VS A1-LFRTN	0.2A	Line Feed

Since all circuits are functionally identical, only the Line Feed is described as a typical example. When the LFRTN is active (low), current for the 48 volt bus is drawn through R16 and CR13 causing Q7 to turn off. The voltage on the collector of Q7 and the base of Q9 increases, forward biasing Q9. This causes Q8 to be forward biased placing a return path to ground for the +48 VDC across the coil. This energizes the selected solenoid performing the indicated operation. It should be noted that the solenoids draw substantial current but their duty cycles are relatively small, minimizing their steady state power dissipation.

4.8.6 LAMP DRIVERS

Three identical Lamp Driver circuits are used to light the LOCAL, REMOTE and ATTN lamps on the printer. The Local (LOCHLD), Ready

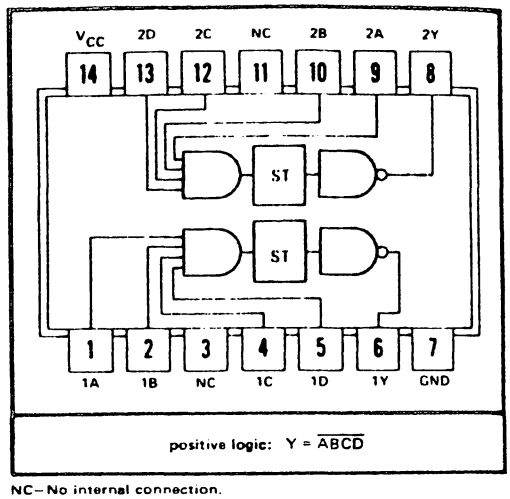
(RDYHLD), and Fault (FALHLD) signals, from the Control, Data and Decode card, when active (low) are inverted by the drivers which provide a return path to ground for the lamp current, lighting the indicator lamp.

4.9 INTEGRATED CIRCUIT DESCRIPTIONS

Most of the integrated circuits used in the FC 3110 printer are described in the PDS-804 Theory of Operation manual (Publication No. SDS-800-01). The following paragraphs describe only the additional integrated circuits used in the printer, which are not described in that manual.

4.9.1 SN7413 DUAL NAND SCHMITT TRIGGERS

This element shown in figure 4-14 contains two identical Schmitt Trigger circuits. Logically, each circuit functions as a 4-input NAND gate with Schmitt Trigger action. Because of the Schmitt Trigger action, the gate has different input threshold levels for positive- and negative-going signals. The difference between these two threshold levels is typically 800 mv.



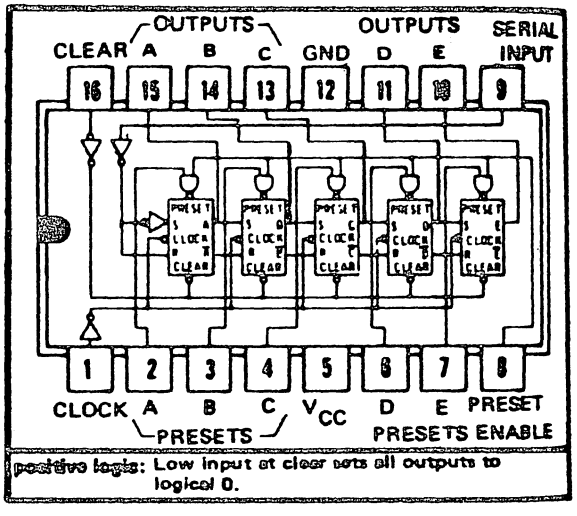
NC–No internal connection.
[1]Pin assignments for these circuits are the same for all packages.

E92146-14

Figure 4-14 SN7413 Dual NAND Schmitt Triggers.

4.9.2 SN7496 5-BIT SHIFT REGISTER

This element shown in figure 4-15, contains five R-S master-slave flip-flops connected serially. Both the PRESET and CLEAR inputs and the Q-output to all flip-flops are accessible permitting any combination of serial/parallel operation. A low CLEAR input simultaneously resets all flip-flops. A high PRESET ENABLE combined with a high PRESET input to a specific flip-flop (i.e., A, B, C, etc.) sets that flip-flop. Both clear and preset inputs are independent of the clock. When shifting data through the register, transfer of information to the output pins occurs on the positive-going transition of the CLOCK input.

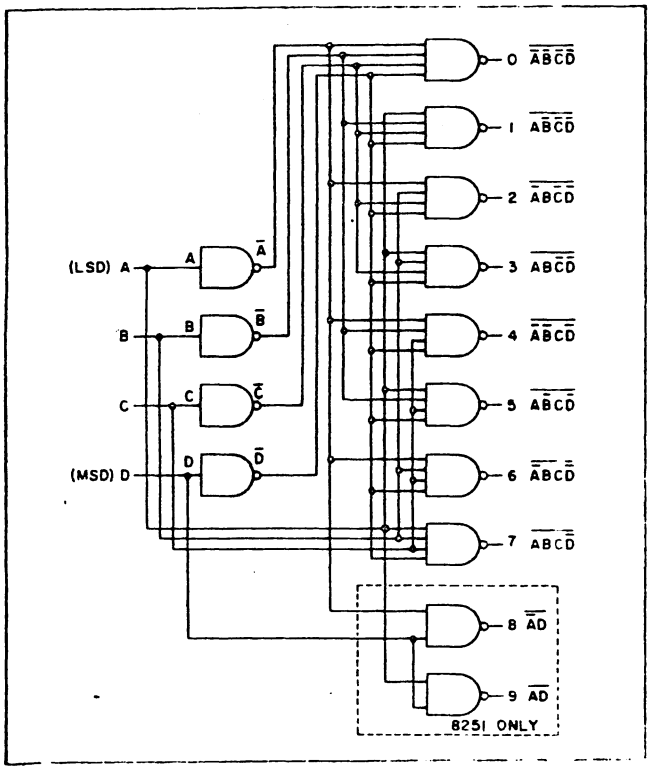


E92146-15

Figure 4-15 SN7496 5-Bit Shift Register.

4.9.3 8250 BINARY-TO-OCTAL DECODER

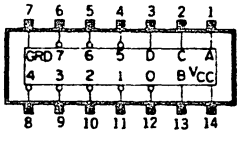
This element shown in figure 4-16 converts a 3-bit input (A, B, C) to a one-out-of eight output (0-7). The fourth input (D) is used to enable/disable the decoder when it is used as part of a larger decoding network. The truth table shown in figure 4-16 lists the output states resulting from each of the 16 possible input conditions.



TRUTH TABLE

Input State				8250 Output States							
A	B	C	D	0	1	2	3	4	5	6	7
0	0	0	0	0	1	1	1	1	1	1	1
1	0	0	0	1	0	1	1	1	1	1	1
0	1	0	0	1	1	0	1	1	1	1	1
1	1	0	0	1	1	1	0	1	1	1	1
0	0	1	0	1	1	1	1	0	1	1	1
1	0	1	0	1	1	1	1	1	0	1	1
0	1	1	0	1	1	1	1	1	1	0	1
1	1	1	0	1	1	1	1	1	1	1	0
0	0	0	1	1	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	1	1	1	1
0	1	0	1	1	1	1	1	1	1	1	1
1	1	0	1	1	1	1	1	1	1	1	1
0	0	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

A PACKAGE

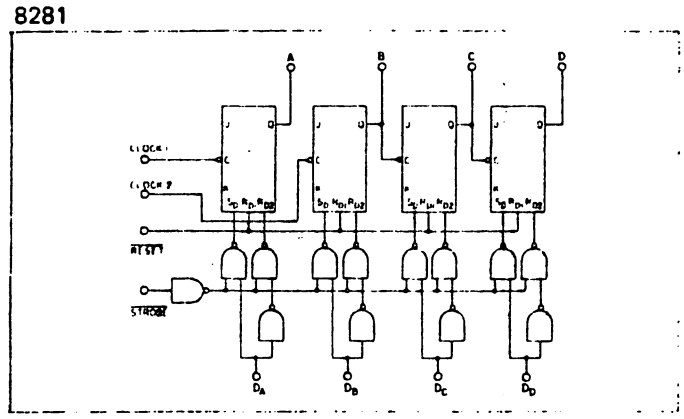


E92146-16

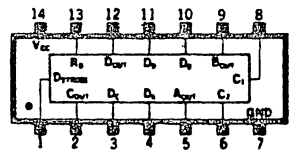
Figure 4-16 8250 Binary-to-Octal Decoder.

4.9.4 8281 BINARY COUNTER

This element shown in figure 4-17 may be used as a divide-by-two, divide-by-eight, or divide-by-sixteen counter, depending on external connections. The element contains a 1-stage (A) and a 3-stage (B, C, D) binary counter each with a separate clock input (CLOCK1 and CLOCK2). When used as 4-stage counter, the A output is connected to the CLOCK2 input. Data (D_A-D_D) can also be strobed in parallel into the four flip-flops by a low $\overline{\text{STROBE}}$ input.



A PACKAGE



E92146-17

Figure 4-17 8281 Binary Counter.

4.9.5 9601 MONOSTABLE MULTIVIBRATOR (ONE-SHOT)

This element shown in figure 4-18 generates a high and low pulse at the Q and $\overline{Q}$ outputs respectively, whenever the inputs are activated. There are four DC level-sensitive inputs, two are active high and two are active low. Each time the input conditions for triggering are met, the external capacitor is discharged and a new cycle is started. The output pulse width can vary from 50 nsec to 10 sec, as determined by the selectable circuit components R_X and C_X.

Applying a low to either Reset input (pin 9 or 10) prevents the one-shot from triggering.

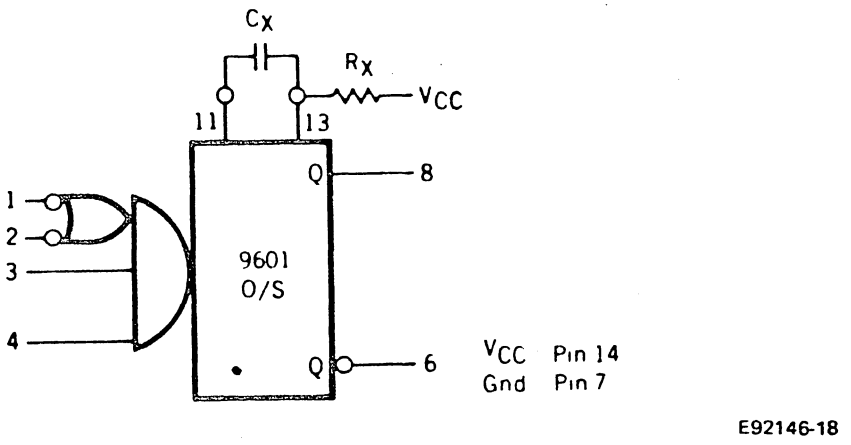


Figure 4-18 9601 Monostable Multivibrator (One-Shot).

4.9.6 9602 DUAL MONOSTABLE MULTIVIBRATORS (ONE-SHOTS)

This element shown in figure 4-19 contains two one-shots similar to the one described in paragraph 4.9.5. The only difference is that each one-shot on the 9602 element contains one active high and one active low input and a single active low Reset input.

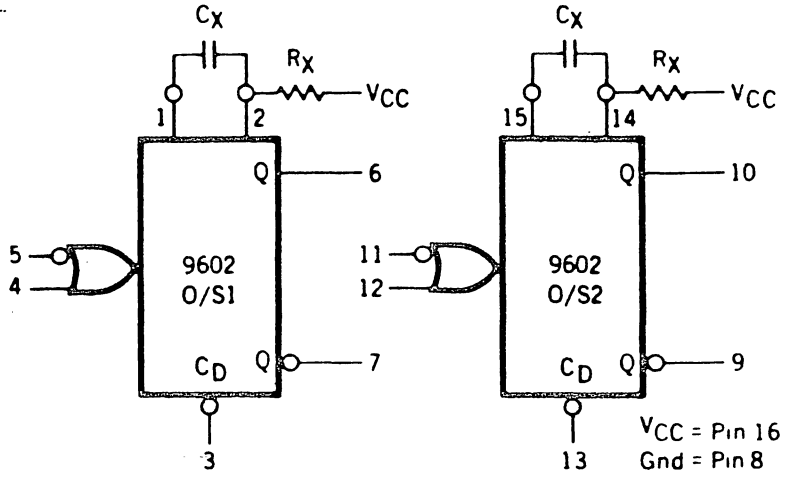
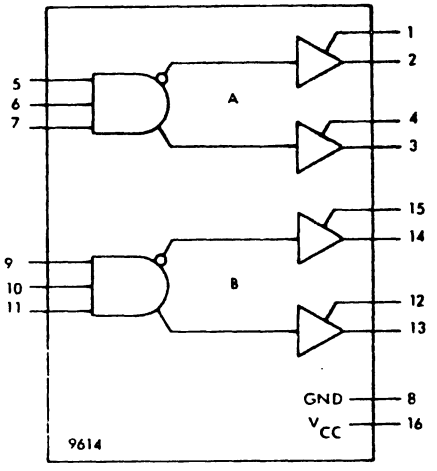


Figure 4-19 9602 Dual Monostable Multivibrators (One-Shot).

4.9.7 9614 DUAL DIFFERENTIAL LINE DRIVER

This element shown in figure 4-20 contains two identical differential line drivers. Each driver can drive transmission lines either differentially or single-ended, back-matched or terminated. The active pull-up and pull-down outputs are split and brought out to adjacent pins. The two pairs of outputs are complementary providing "NAND" and "AND" functions of the input. The active pull-up output is short-circuit protected.

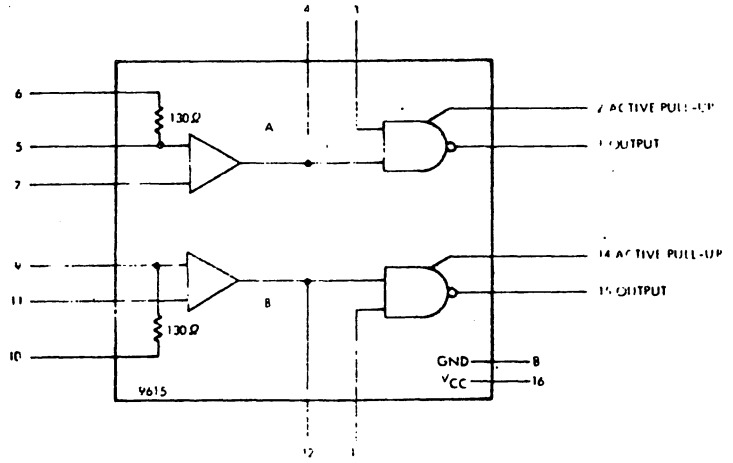


E92146-20

Figure 4-20 9614 Dual Differential Line Driver.

4.9.8 9615 DUAL DIFFERENTIAL LINE RECEIVER

This element shown in figure 4-21 contains two identical differential line receivers. Each receiver is designed to receive ±500 mv of differential data (usually from a 9614 line driver) in the presence of high level common mode voltages (±15V), and still deliver an undisturbed output voltage. The response time is controlled by adding an external capacitor at the response control terminal.



E92146-21

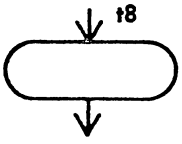
Figure 4-21 Dual Differential Line Receiver.

MAINTENANCE

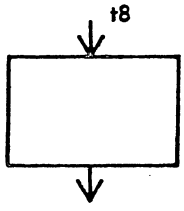
5.1 INTRODUCTION

This section contains maintenance flow charts on the control logic circuitry. Removal and replacement procedures for the major mechanical assemblies are covered in the vendor manual. All logic circuit adjustments are specified on schematic drawing No. 7100426 L001 (sheet 3).

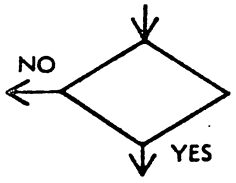
Each of the flow charts is generated from the logic diagrams and each contains information on specific logic events, the time of each event, and signal locations. The following symbol blocks are used throughout the flow charts:



Indicates that the logic condition described in the block does exist (i.e., the logic function is active) at this time (t8). Used primarily to indicate what logic condition is required to enter a flow chart.

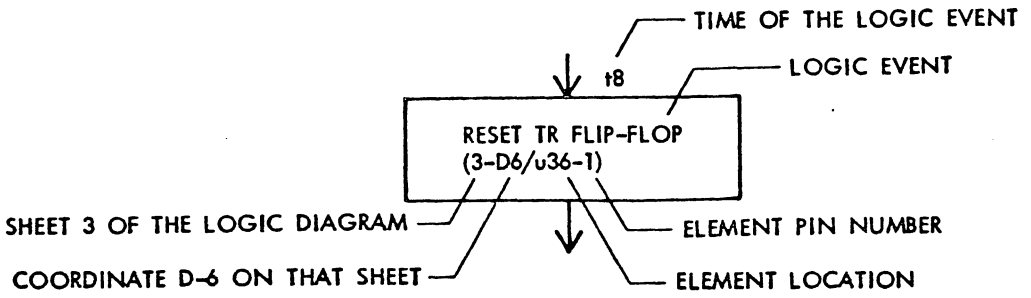


Indicates that the logic action (e.g., setting a flip-flop, generating a pulse, etc.) described in the block occurs at the indicated time (t8).



Indicates a logic decision, based on whether the condition described in the block exists or not.

At the top of each block is indicated the time during which the specified logic condition, action or decision occurs. Inside the block is a description of the logic event, and the location of the logic circuit involved. For example, the following block provides the following information:



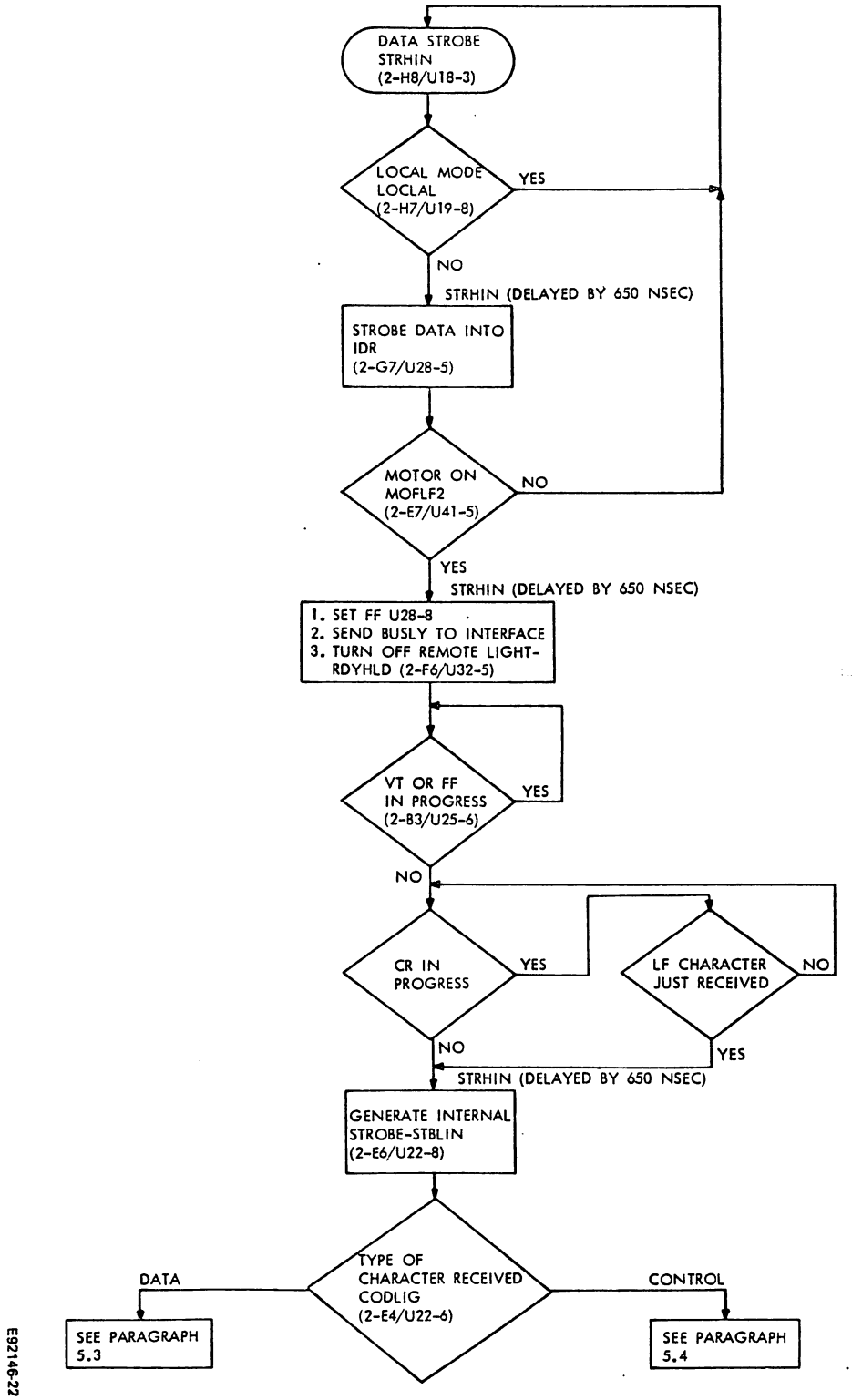
a. The TR flip-flop gets reset.

b. The resetting occurs at t8 time.

c. The logic element involved in resetting the flip-flop is gate U36-pin 1 (on the circuit card indicated on that flow chart) and this element is located on sheet 3, coordinate D-6 of the indicated logic diagram.

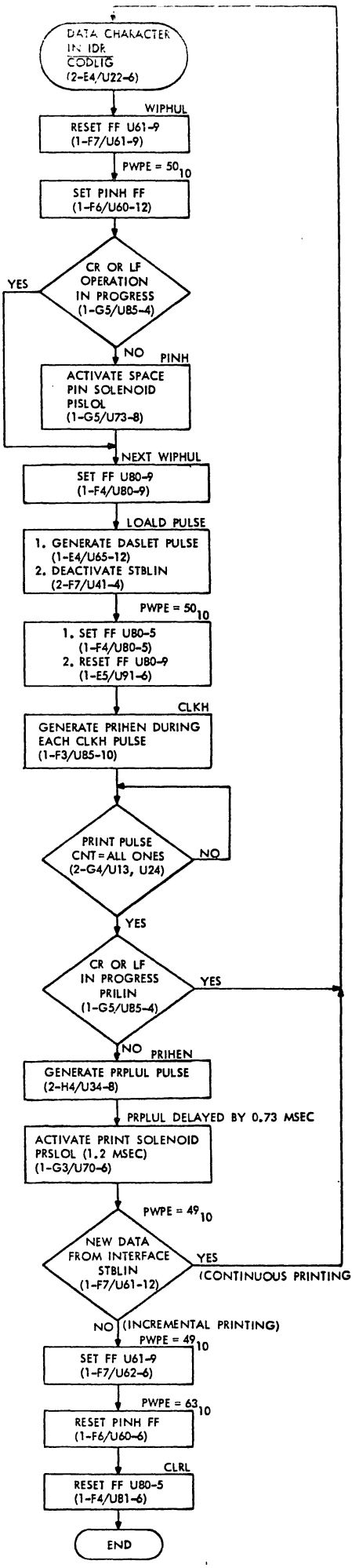
The maintenance flow charts contained in this section are organized as follows:

Paragraph	Flow Chart
5.2	Data Reception from Interface
5.3	Data Character Received
5.4	Control Character Received
5.4.1	Line Feed (LF)
5.4.2	Back Space (BS)
5.4.3	Carriage Return (CR)
5.4.4	Form Feed (FF)
5.4.5	Vertical Tab (VT)
5.4.6	Motor Control (DC3)



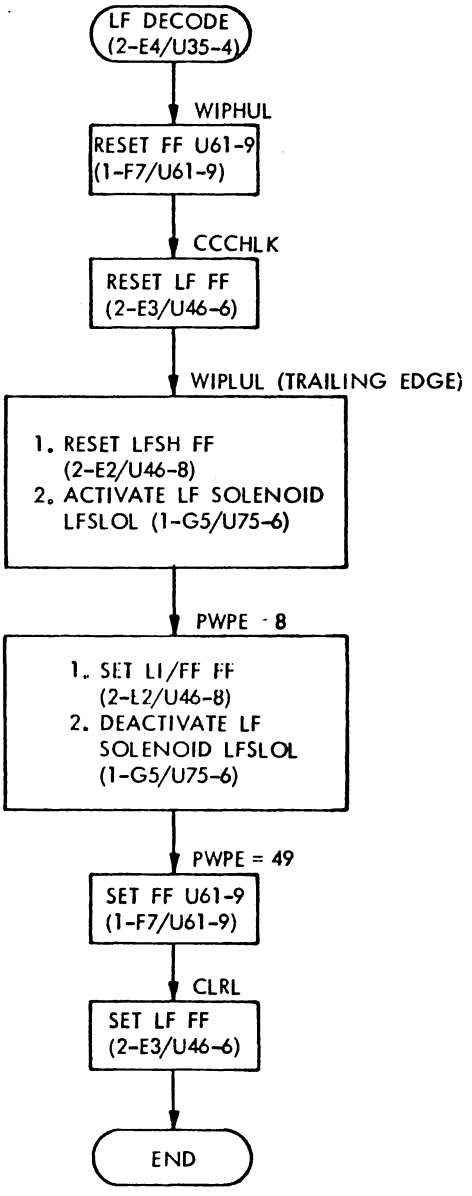
E92146-22

5.2 Data Reception From Interface.


DATA CHARACTER IN IDR
CODLTG
(2-E4/U22-6)
WIPHUL
RESET FF U61-9
(1-F7/U61-9)
PWPE = 50 10
SET PINH FF
(1-F6/U60-12)
CR OR LF OPERATION IN PROGRESS
(1-G5/U85-4)
YES
NO
PINH
ACTIVATE SPACE PIN SOLENOID PISLOL
(1-G5/U73-8)
NEXT WIPHUL
SET FF U80-9
(1-F4/U80-9)
LOALD PULSE
1. GENERATE DASLET PULSE
(1-E4/U65-12)
2. DEACTIVATE STBLIN
(2-F7/U41-4)
PWPE = 50 10
1. SET FF U80-5
(1-F4/U80-5)
2. RESET FF U80-9
(1-E5/U91-6)
CLKH
GENERATE PRIHEN DURING EACH CLKH PULSE
(1-F3/U85-10)
PRINT PULSE CNT = ALL ONES
(2-G4/U13, U24)
NO
YES
CR OR LF IN PROGRESS PRILIN
(1-G5/U85-4)
YES
NO
PRIHEN
GENERATE PRPLUL PULSE
(2-H4/U34-8)
PRPLUL DELAYED BY 0.73 MSEC
ACTIVATE PRINT SOLENOID PRSLOL (1.2 MSEC)
(1-G3/U70-6)
PWPE = 49 10
NEW DATA FROM INTERFACE STBLIN
(1-F7/U61-12)
YES
(CONTINUOUS PRINTING
NO
(INCREMENTAL PRINTING)
PWPE = 49 10
SET FF U61-9
(1-F7/U62-6)
PWPE = 63 10
RESET PINH FF
(1-F6/U60-6)
CLRL
RESET FF U80-5
(1-F4/U81-6)
END

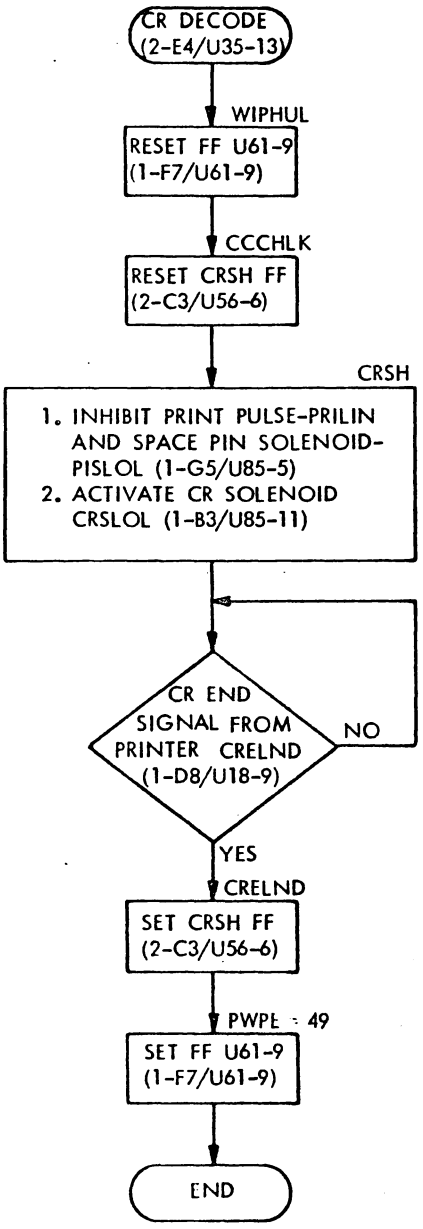
E9214G-23

5.4.1 Line Feed Character (LF).



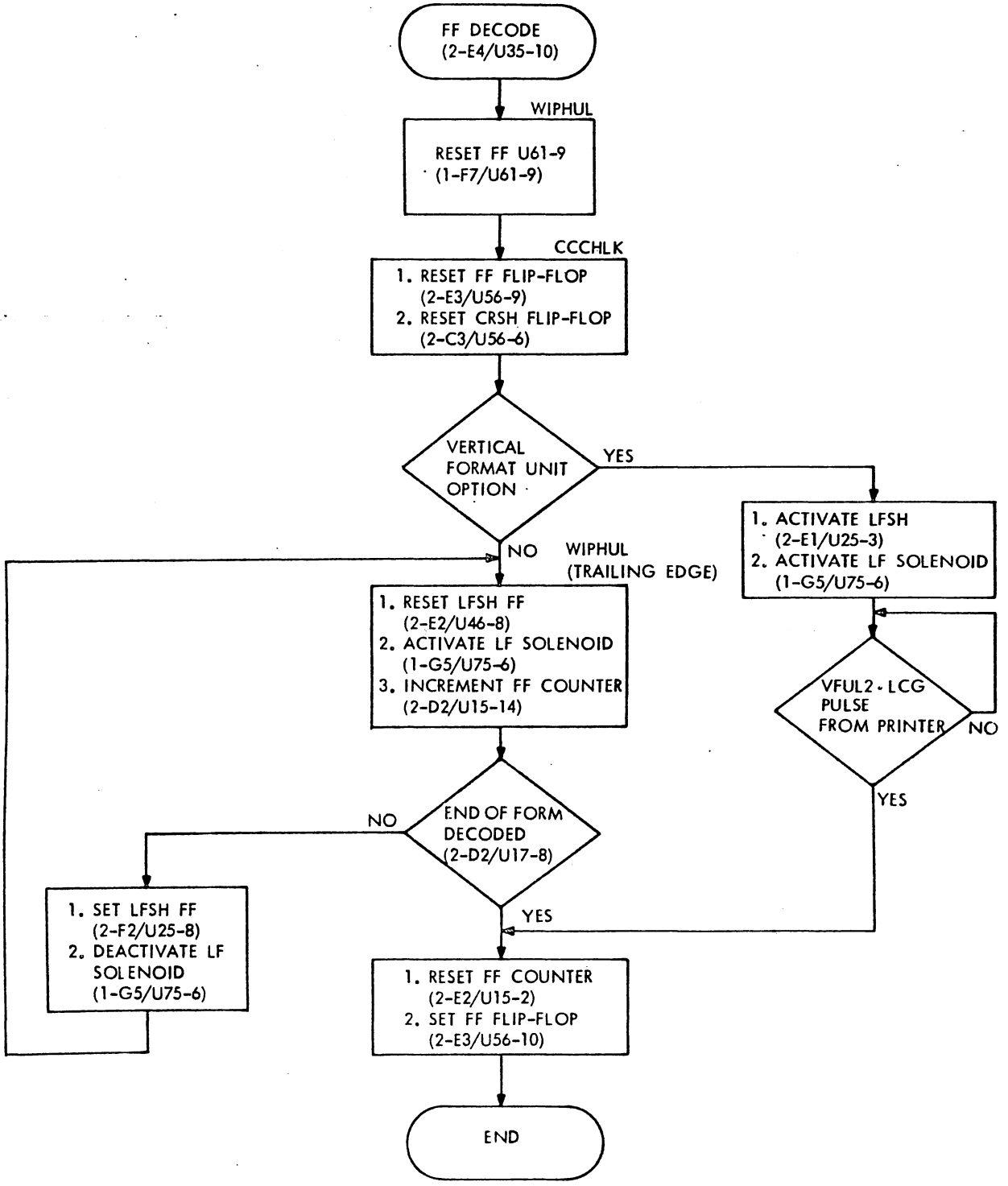
E92146-25

5.4.3 Carriage Return Character (CR).



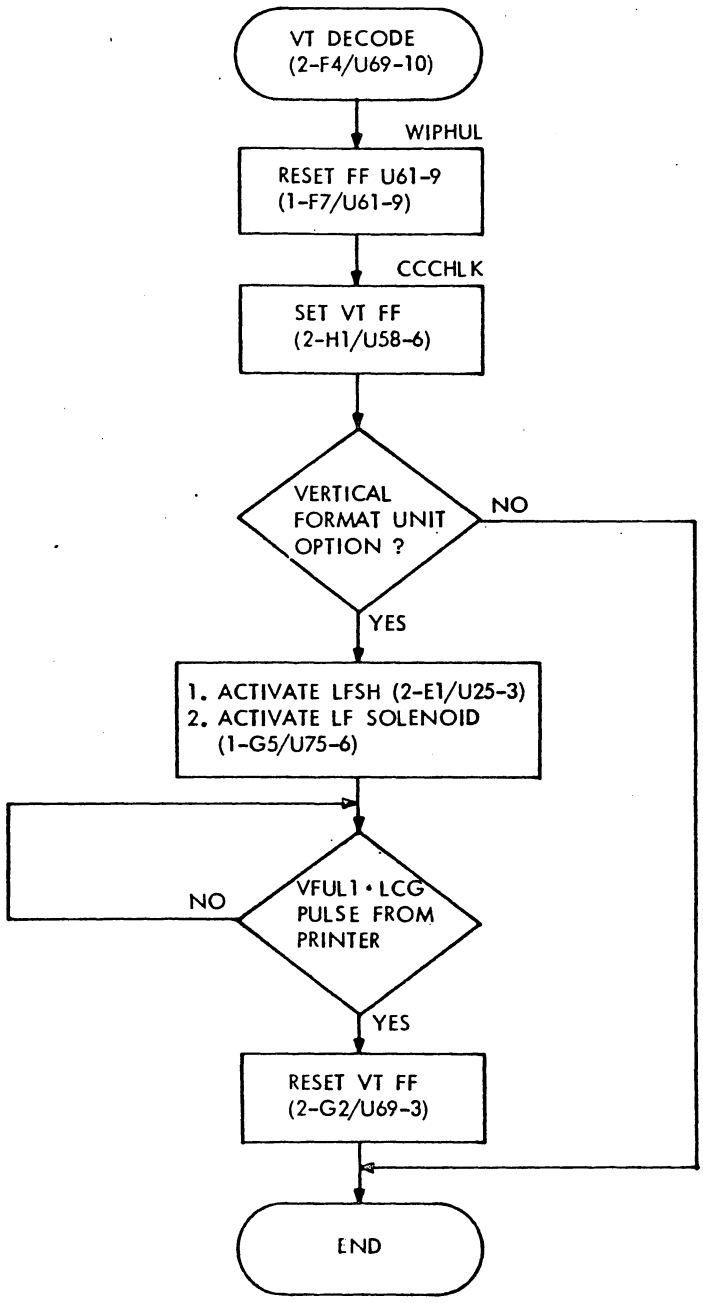
E92146-27

5.4.4. Form Feed Character.

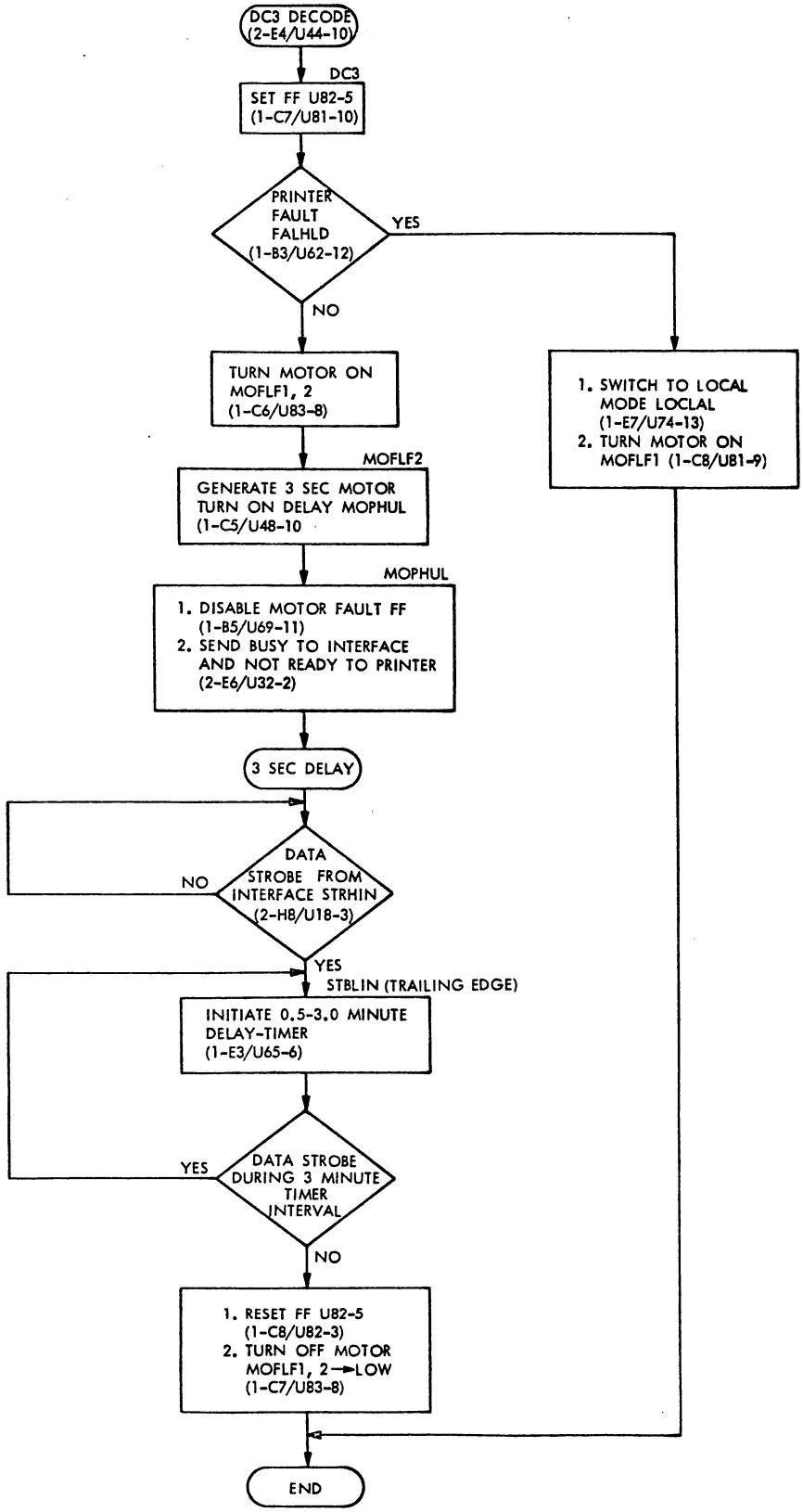


E92146-28

5.4.5 Vertical Tab Character (VT)



E92146-29


DC3 DECODE (2-E4/U44-10)
DC3
SET FF U82-5 (1-C7/U81-10)
PRINTER FAULT FALHLD (1-B3/U62-12)
YES
NO
TURN MOTOR ON MOFLF1, 2 (1-C6/U83-8)
1. SWITCH TO LOCAL MODE LOCLAL (1-E7/U74-13)
2. TURN MOTOR ON MOFLF1 (1-C8/UB1-9)
MOFLF2
GENERATE 3 SEC MOTOR TURN ON DELAY MOPHUL (1-C5/U48-10
MOPHUL
1. DISABLE MOTOR FAULT FF (1-B5/U69-11)
2. SEND BUSY TO INTERFACE AND NOT READY TO PRINTER (2-E6/U32-2)
3 SEC DELAY
DATA STROBE FROM INTERFACE STRHIN (2-H8/U18-3)
NO
YES
STBLIN (TRAILING EDGE)
INITIATE 0.5-3.0 MINUTE DELAY-TIMER (1-E3/U65-6)
DATA STROBE DURING 3 MINUTE TIMER INTERVAL
YES
NO
1. RESET FF UB2-5 (1-C8/UB2-3)
2. TURN OFF MOTOR MOFLF1, 2→LOW (1-C7/UB3-8)
END

E92146-30

APPENDIX A

USASCII CODE FOR FC 3110 PRINTER

b_7 →					0	0	0	0	1	1	1	1
b_6 →					0	0	1	1	0	0	1	1
b_5 →					0	1	0	1	0	1	0	1
BITS	b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	COLUMN → / ROW ↓	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
	1	0	1	1	11	VT	ESC	+	:	K	[	k	{
	1	1	0	0	12	FF	FS	,	<	L	\	l	/
	1	1	0	1	13	CR	GS	-	=	M	]	m	}
	1	1	1	0	14	SO	RS	.	>	N		n	~
	1	1	1	1	15	SI	US	/	?	O	_	o	DEL

APPENDIX B
DICTIONARY OF MNEMONICS

Mnemonic	Definition
ATOLCR	Automatic Carriage Return - Generated when the print wheel reaches the extreme right hand margin.
BSDH	Back Space flip-flop output.
BSYHSI	Busy/Ready Line for serial interface.
BUSLY	Busy/Ready Line for parallel interface.
CCCHLK	Clock Control Character pulse.
CLKL	Clock Pulse - Basic timing signal derived from the photo cell pulses.
CLRL	Clear Pulse - Generated once during each revolution of the print wheel, just prior to the wide pulse.
CODLIG	Code Ignore - Generated when control character is received and printer is in remote mode.
CRELND	Carriage Return End from internal Left Hand Limit Switch.
CRRLST	Carriage Return Reset - ORed function of DC Reset and Carriage Return End.
CRSH	Carriage Return flip-flop output.
CRSLOL	Carriage Return Solenoid driver input.
DASLET	Data Set Acknowledge pulse - Coincident with Load pulse when data has been received from the interface.
DATH1-7	Input Data Bits 1-7.
DATHSI	Serial Data Input.

APPENDIX B

DICTIONARY OF MNEMONICS (Cont)

Mnemonic	Definition
DC3HDE	DC3 Decode Output.
DCRLST	DC Reset.
DDEHL	Signal used to terminate Line Feed pulse.
EXTLRST	External Reset from DC RESET switch.
FAILHLD	Printer Fault (ATTN) lamp driver input.
FAILLT	Printer Fault Line for parallel interface.
FFSLW	FORM FEED switch.
FLTHSI	Printer Fault Line for serial interface.
LCGL	Line Count Generator - Output pulse from Vertical Format Unit,used in Form Feed and Vertical Tab operations.
LFSH	Line Feed signal.
LFSLOL	Line Feed Solenoid driver input.
LFSLW	LINE FEED switch.
LIELND	Line End from internal Right Hand Limit switch.
LOALD	Load Pulse - Used to load Print Pulse Counter.
LOCHLD	LOCAL Lamp Driver input.
LOCLAL	Local/Remote flip-flop output.
LOCLSW	LOCAL switch.
MAOLSW	MOTOR BYPASS switch.
MOFLF1, 2	Motor Off signal.

APPENDIX B

DICTIONARY OF MNEMONICS (Cont)

Mnemonic	Definition
MOPHUL	3 Second Motor Turn On Delay.
PAOLUT	Paper Out indication from internal Paper Out switch.
PCIH	Photo Cell Input.
PINH	Space Pin flip-flop output.
PISLOL	Space Pin Solenoid driver input.
PRIHEN	Print Enable pulse - Consists of 64 consecutive pulses corresponding to the 64 character positions on the print wheel.
PRILIN	Print Pulse Inhibit - Inhibits pulse to the print solenoid driver.
PRILSW	READY switch.
PRPLUL	Print Pulse - Initiates pulse to the print solenoid.
PRSLOL	Print Solenoid driver input.
RDYHLD	REMOTE indicator lamp driver input.
SPALCE	SPACE switch.
STBLIN	Internal Strobe.
STRHIN	Input Strobe pulse - Minimum of 2 microseconds in duration.
TESLT	TEST switch.
TIMER	Output from Motor Time Out Circuit - 0.5 to 3.0 interval (adjustable) initiated by the reception of each character.

APPENDIX B

DICTIONARY OF MNEMONICS (Cont)

Mnemonic	Definition
TOSL	Test Or Space - Activated by pressing either TEST switch or SPACE switch on the printer.
VFULI	Vertical Format Unit Level 1 - Output from Vertical Format Unit used to terminate Vertical Tab operation.
VFUL2	Vertical Format Unit Level 2 - Output from Vertical Format Unit used to terminate Form Feed operation.
WIOLP	Window Open indication from internal Window Open microswitch.
WIPLUL	Wide Pulse - Corresponds to wide slot on the timing disk.

1.0 GENERAL

This specification describes a serial alphanumeric electro-mechanical printing device, final assembly number 1008670, model HSP-30, which is suitable for use in Data Communications Terminals, Billing/Accounting Systems and limited Data Origination applications. The machine has a single helical type wheel with 63 characters plus space, and prints with wheel in motion. The printer will print at a maximum rate of 30 characters per second and has a writing line length of 132 positions. It can be used in a work station and can be operated from a keyboard, reader, etc. Frame is constructed so printer mounting tilts printer back 18° for better visibility of the writing line.

2.0 FUNCTIONAL DESCRIPTION

2.1 Principle of Operation:

The printing device employs a helical print wheel which is driven along the writing line by a lead screw. The print wheel and the lead screw operate constantly and in exact synchronism with one another.

The constantly rotating lead screw is engaged to initiate letter spacing. The constant lateral movement of the print wheel when engaged with the lead screw is compensated for by the helical arrangement of the characters on the wheel so that the character font appears to stand still horizontally with the print position.

Slots in a timing wheel on the print wheel shaft identify each character position. A print signal initiates the firing of the print hammer, which strikes the back of the paper forcing it against the print wheel.

2.2 Graphics:

2.2.1 Speed

Normal synchronous speed is 30 characters/second. This includes space, letterspace and tab speeds.

Normal synchronous speed for backspace is 15 characters/second.

Asynchronous speed: Average speed per line up to 30 characters/second. Asynchronous operation occurs when information is given to the printer at a lower rate than synchronous speed.

Carrier return time is 385 ms max for Maximum Writing Line, at ambient temperatures above 60°F.

2.2.2 Character Font Repertoire

Sixty three (63) characters plus space placed serially on the print wheel by USASCII code.

2.2.3 Type Font - Friden Style "Systems 6410" modified
Character Height: .096 inches (except some symbols).
Character Width (nominal): .067 inches.

2.2.4 Format: 10 characters per inch horizontal
6 lines per inch vertical
132 characters per line.

2.2.5 Inking: Direct inking of print wheel by direct supply ink roller.

2.3 Print Quality:

The printer device is capable of meeting the following alignment for all characters.

2.3.1 When printing at 30 characters per second on either a single sheet or an original with five carbon copies or when printing incrementally at a rate no less than 15 characters per second the following alignment tolerances will be maintained consistently for 200 hours of running time:

2.3.1.1 Vertical line spacing: Six characters per inch with a character tolerance of ± .015 inch non-accumulative with reference to the average or nominal center line.

2.3.1.2 Vertical character alignment: Adjacent characters must not vary from each other by more than ± .010 inch.

2.3.1.3 Horizontal character alignment: Centerlines of adjacent characters must not vary more than ± .010 inch. The distance between the vertical character center lines of any two characters in a 132 character writing line must not vary more than ± .020 inch.

2.3.1.4 The maximum allowable character skew is 1-1/2 degrees.

2.3 Print Quality (Continued)

2.3.2 Last carbon copy legibility will be maintained. "Legibility" is defined as normal visual perception of a particular character (the 5th, 17th, 28th, etc.) in a line consisting of random alphanumerics, dollar sign and decimal symbols from a distance of twenty-four (24) inches.

2.4 Paper

2.4.1 Number of copies:

Original plus five carbons maximum. The printing mechanixm must be capable of feeding and printing single part forms of 14 to 20 pound paper, and up to six part forms (5 carbons) with a paper combination of 10 pound original, 10 pound intermediate and 12 pound last copy. Interleaved carbon paper will be 5 pounds.

Input media specifications which comply with printer forms requirements for acceptable printing quality are shown in Appendix I.

2.4.2 Paper Configuration:

Paper form width is 14-7/8 inches overall maxiumu. Paper must be punches for tractor feed according to IBFI standards.

2.5 Horizontal Format Control Features:

The basic printer device will perform the following horizontal format functions: Space, Backspace and Carrier Return.

Left and right hand tractors are continuously adjustable to a minimum of 3 inches between pin, horizontally. The left hand margin is adjustable. The first print position can be no closer than 5/8" (approx.) from the centerlines of the tractor feed holes.

Horizontal tab must be accomplished by continuous spacing at letter spacing speed (3 inches per second). There is no other horizontal slew mechanism in the basic device.

There is a manual horizontal vernier adjustment which moves the entire paper feed assembly, and the paper, horizontally for precise location of the print position. This is not useable when printing on maximum width paper (14-7/8"). A right limit sensor and a horizontal drive disengaging mechanism are provided to prevent interference between carrier parts and the right hand tractor.

2.0 FUNCTIONAL DESCRIPTION (Continued)

2.6 Vertical Format Control Features:

2.6.1 Paper forms are normally advanced by power delivered by the main motor through an electro-mechanical clutch. Line index time: 20 ms. Form slew feed: 16 inches per second.

2.6.2 A manual, bidirectional, paper advance knob is provided for full space positioning. The knob may be manipulated to adjust the line to approximately 8 positions within a normal line space.

2.6.3 Line Count Generator

A device is provided which gives a 5 volt signal for each print line advanced by power. The signal occurs for each line in a vertical slew operation as well as for individual line indexing, and it can be used to terminate a slew operation.

2.6.4 Format Control Mechanism - Optional Feature

A format control device using dual channel bead chain, is available to furnish vertical position information to using systems. Maximum form length is 17 inches. This is a field installable option. It will not preclude the use of a vertical electronic control.

2.7 Print Selection:

The heart of the device is the photo-sensor mounted on the left side of the printer near the timing wheel. Each revolution of the timing wheel causes the amplifier to produce 64 pulses. The timing wheel is connected to the same drive shaft as the print wheel. The drive shaft is rotating at 1800 RPS or 30 RPS. The resultant printing time is 30 characters per second based on one character printed per revolution. When a portion of the timing wheel blocks the light to the photo transistor an output pulse occurs. Each pulse on the timing wheel represents 5° of space on the perimeter of the wheel. The wide slot represents 8 X 5° or 40° of the space. There are 72 increments (360/5) around the perimeter of the wheel. Since the timing wheel is rotating at 30 RPS, then the frequency of the character pulses will be 30 X 72 or 2160 Hz. Therefore the period is 1/2160 or 463 microseconds.

3.0 SIGNAL DEFINITIONS:

3.1 Input - 4 Electro-mechanical Transducers. Refer to Appendix III for current wave forms and typical circuits.

3.1.1 Letter Space Solenoid: +48 V, 2.1 ohms.

3.1.2 Carrier Return/Back Space Solenoid: +48 V, 14.8 ohms.

3.1.3 Line Feed Clutch Actuator: +48 V, 24.5 ohms.

3.1.4 Hammer Actuator: +48 V, 2.75 ohms.

3.1.5 +5 V power to photosensors.

3.2 Output - 3 Sensor Switches, 2 Photosensors.

3.2.1 Paper Out - switch closure when paper is absent about 9 print lines below last printed line.

3.2.2 Left Hand Margin (Carrier Return Complete). Switch closure when carriers are at the left margin. Switch should open before reaching second print position.

3.2.3 Right Hand Limit - Switch closure when carriers have moved too close to the right hand tractor assembly

3.2.4 Photocell In-Signal from print shaft timing disc + 5 V.

3.2.5 Line Count - Signal from line feed actuation + 5 V.

3.3 Signal Delays - All input signals must be delayed .500 sec. after motor turn-on, to allow time for the motor to reach correct operating speed.

3.4 Print Coil Timing - An adjustment of 1 ms. must be built into the circuit which controls firing of the print coil to allow "copy control" compensation for changed impact time when different thickness forms are used.

4.0 TIMING DIAGRAM - Refer to Appendix VI.

5.0 POWER REQUIREMENTS:

5.1 Motor: 115 V A.C., 60 Hz, 3.1 Amp
230 V A.C., 50 Hz, 1.6 Amp optional

5.2 Electro-Mechanical Transducers: +48 V D.C., 7% Regulation
Average current: 1.2 Amp
Peak currents: Letter space coil 3.25 Amp surge,
Hammer Coil 4.50 Amp for 1.2 ms., repeatable after 5 ms.

5.0 POWER REQUIREMENTS (Continued)

5.3 Photosensors: +5 V D.C., 5% Regulation
Average current: .150 Amp

6.0 ENVIRONMENTAL REQUIREMENTS - Refer to Friden Specification S-035, except temperature in area of ink roller should not exceed 105°F.

7.0 OUTLINE AND MOUNTING

7.1 Outline Dimensions - Refer to Appendix II.

7.2 Mounting and Weight

7.2.1 Machine can be mounted at discretion of user or use Friden brackets for tilting machine at 18° as shown in Appendix II.

7.2.2 Machine weighs approximately 41 lbs. Weight on bracket nearest motor is approximately 17.6 lbs. and 9.1 lbs on other three brackets.

8.0 TEST, ADJUSTMENT AND LUBRICATION SPECIFICATIONS

8.1 Test Specification - will be defined at a later date.

8.2 Adjustment and Lubrication Specification - Refer to Appendix IV.

9.0 MAINTENANCE CRITERIA

9.1 Printer Operator Responsibilities:

9.1.1 Maintain supply of paper and ink roller (4003055). The ink roller can be reversed to obtain maximum usage.

9.1.2 Printer area should be clean from foreign materials.

9.1.3 The operator should occasionally, (about once a month) remove caked ink and accumulated dust particles from the print wheel, using typewriter type cleaning tools and techniques.

9.2 Service Personnel Responsibility:

9.2.1 Clean all shafts and relubricate per lubrication specifications.

9.2.2 Readjust print wheel keys and guide bearings. Check for worn parts.

9.0 MAINTENANCE CRITERIA (Continued)

9.2.3 Maintenance period should be every four months.

10.0 REFERENCE DOCUMENT LISTING AND APPENDICES

10.1 Appendix I - Input Media Specifications

10.2 Appendix II - Outline Dimensions

10.3 Appendix III - Current Wave Forms and Typical Circuits

10.4 Appendix IV - Adjustment and Lubrication Specifications

10.5 Appendix V - Cable Diagram

10.6 Appendix VI - Timing Diagram

10.7 Appendix VII - Printer Schematic

APPENDIX I

INPUT MEDIA SPECIFICATIONS

For optimum printer performance in terms of print quality the following items are specified:

Paper and Carbon - Single part form
20 pound white bond

Multiple part form
Use Standard Register form or equivalent.
Original will be 12 pound white bond.
Intermediate sheets will be 10 pound white stancote.
Last sheet will be 12 pound white bond.
Carbon will be #512, full width, both sides crimped.

Ink Roller - Purchased part
"Porelon" ink roll
Part #4003055 or #1010545
From S. C. Johnson & Son, Inc., Racine, Wisconsin or Elastolabs Corporation, 20 Grand Avenue, Brooklyn, New York, 11205, Formula Micro-Well EL 500-2X.

APPENDIX III

CURRENT WAVE FORMS AND TYPICAL CIRCUITS

1.0 CARRIER RETURN

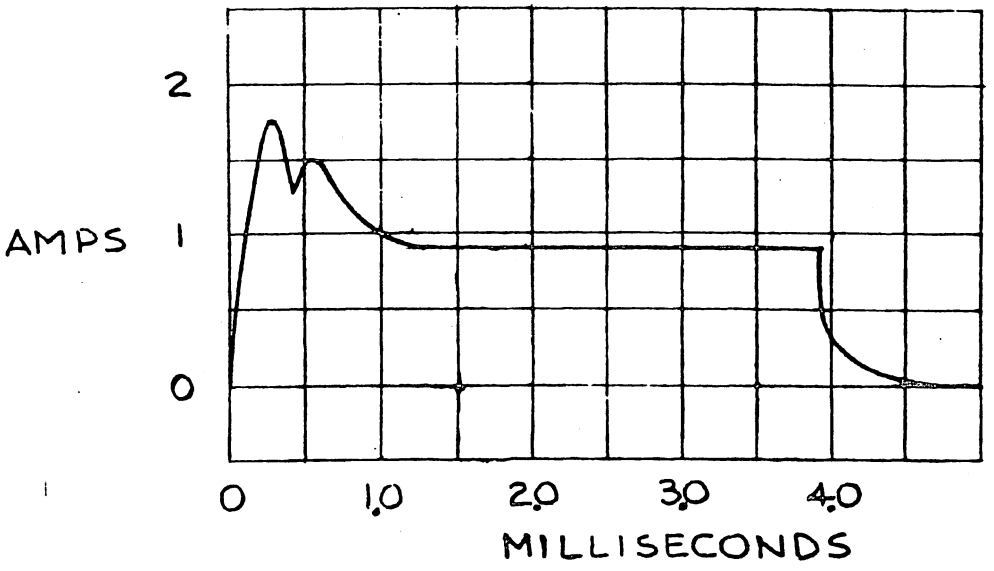
Surge Current: 1.75 A

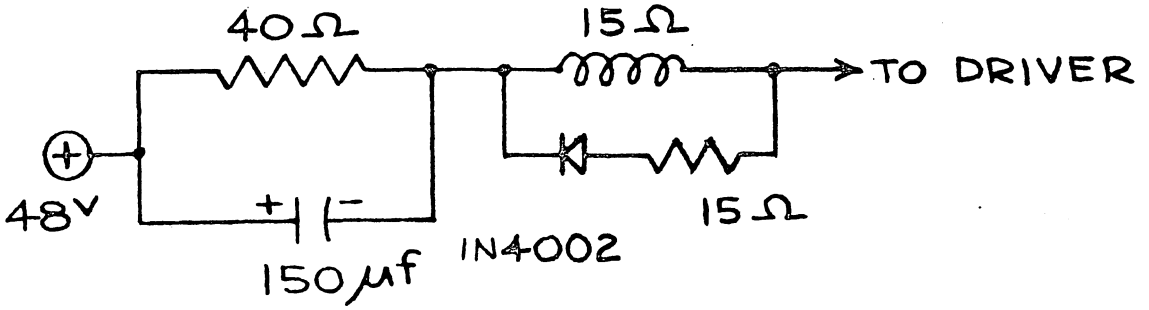
Holding Current: 0.90 A

TOLERANCE SPECIFICATIONS

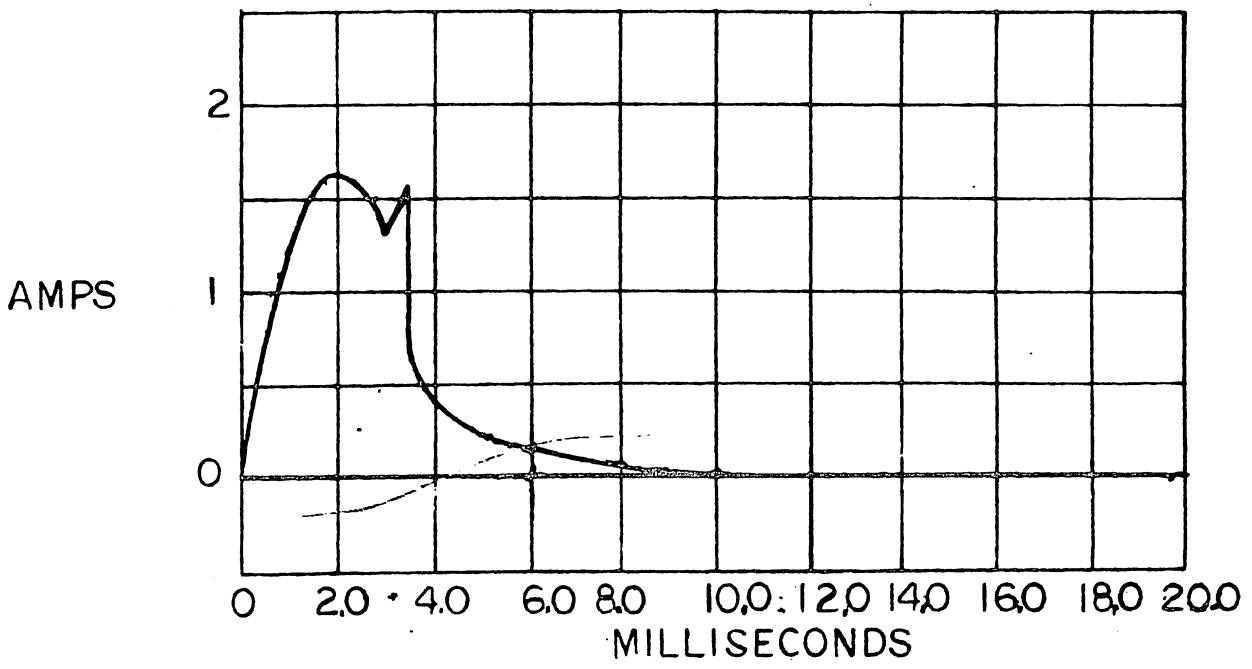
Surge Current: 1.4 to 2.0 A

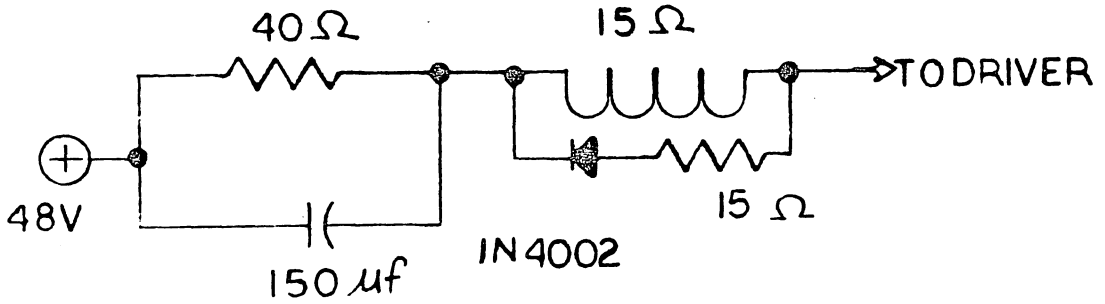
Holding Current: 0.8 to 1.0 A





2.0 BACK SPACE CURRENT WAVE FORM
Pulse Length: 3.7 ms.
TOLERANCE SPECIFICATIONS:
Peak Current: 1.4 to 2.0 A
Pulse Length: 3.6 to 5.4 ms.





3.0 PRINT COIL CURRENT WAVE FORM

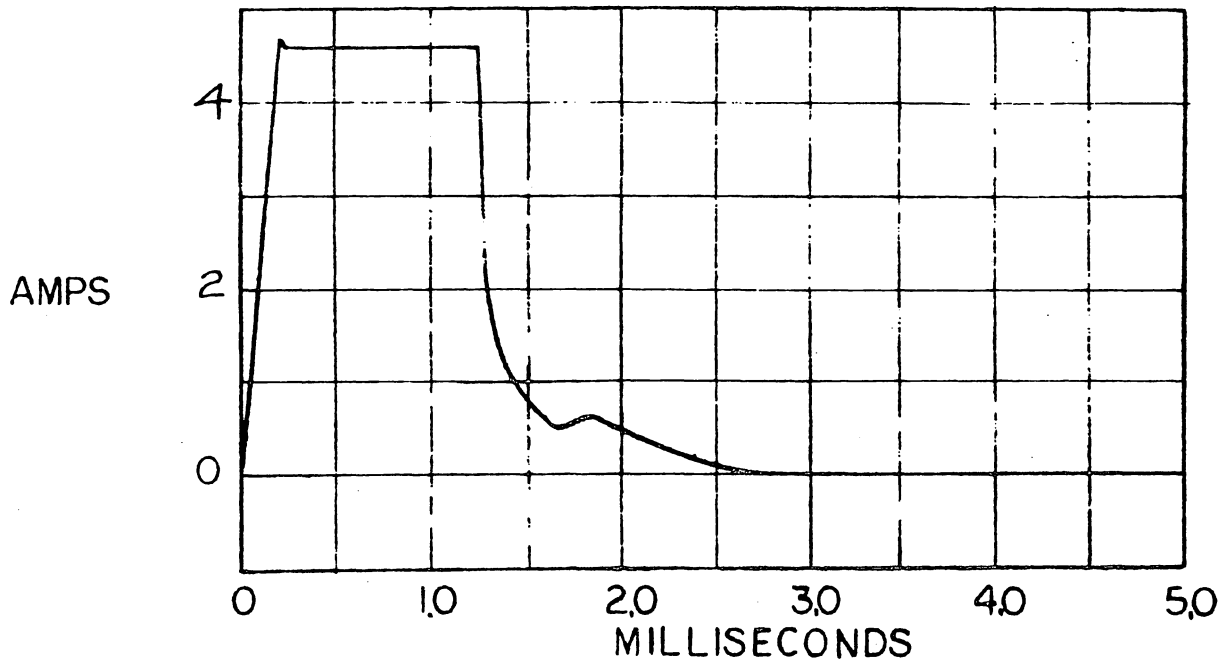
Peak Current: 4.5 Amps

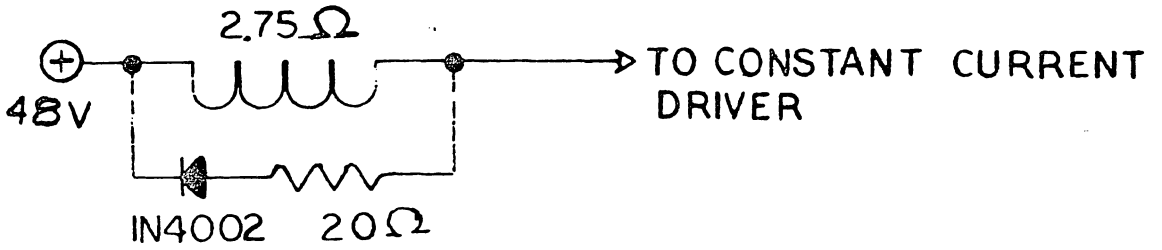
Pulse length: 1200 Usec

TOLERANCE SPECIFICATIONS

Current: 4.5 ± .5 A

Pulse Length: 1200 ± 50 Usec



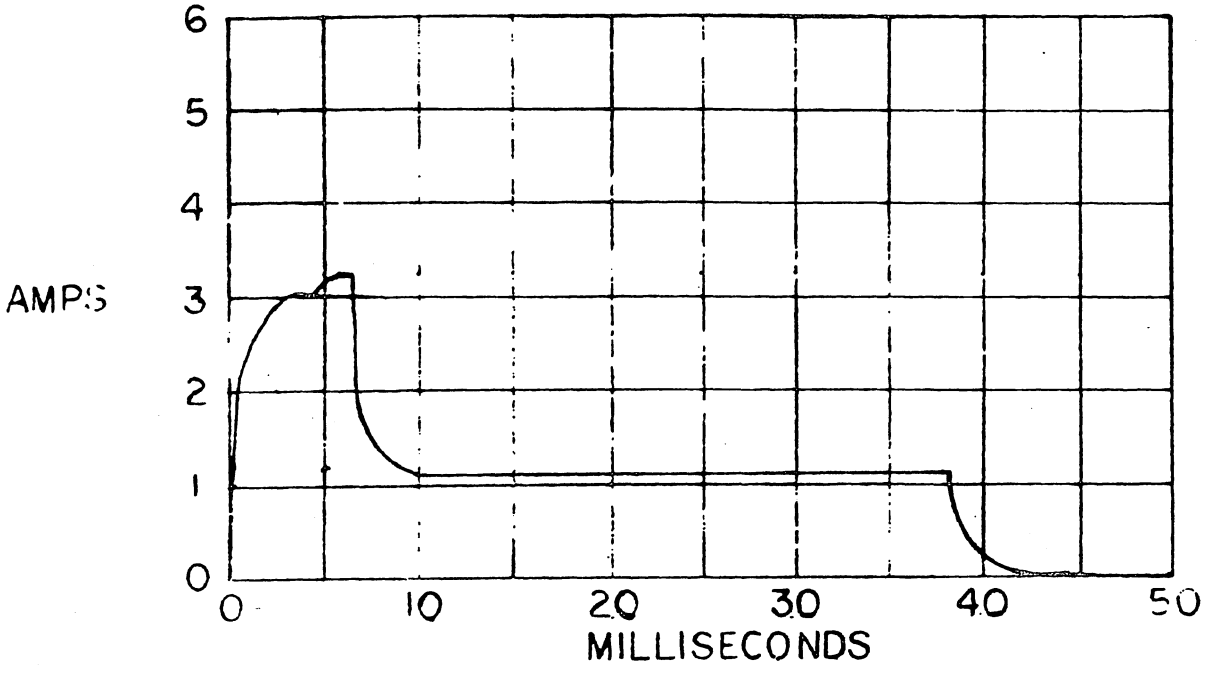


4.0 LETTER SPACE CURRENT WAVE FORM

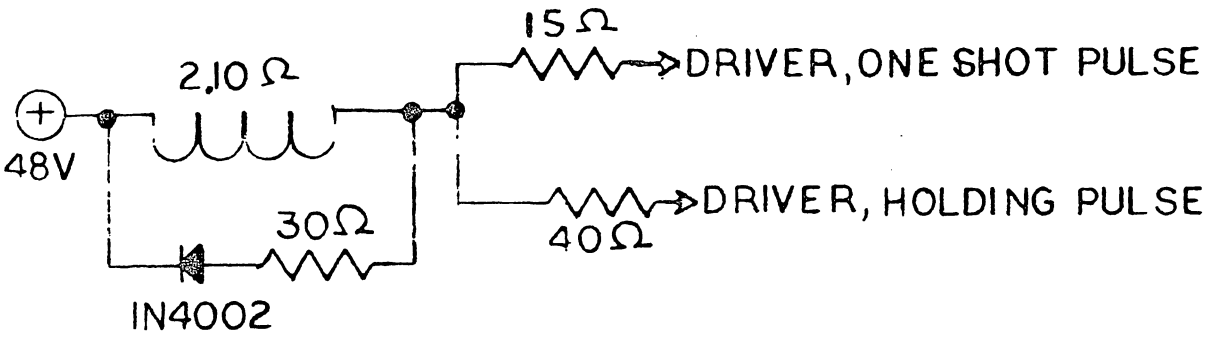
Peak Current:	3.25 A Nominal	
Holding Current:	1.15 A	
Surge Pulse Length:	7.0	ms.

TOLERANCE SPECIFICATIONS

Surge Pulse Length	6.3	to 7.7	ms.
Peak Current:	3.0	to 3.5	A



NOTE: The wave shows letter space current for one letter space operation. The time for one letter space operation is 39.8 ms. That is, the solenoid is energized from count 49 of machine clock of first cycle to count 63 of second cycle.



5.0 LINE FEED COIL CURRENT WAVE FORM

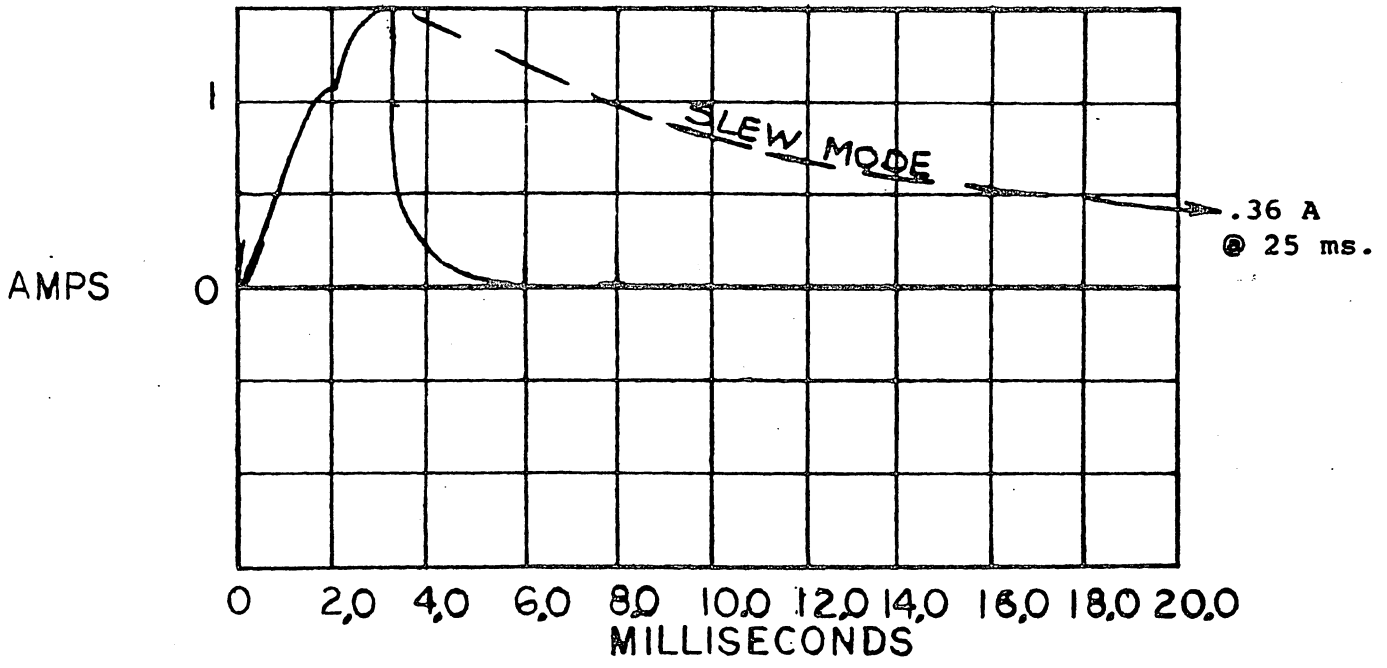
Peak Current: 1.5 A

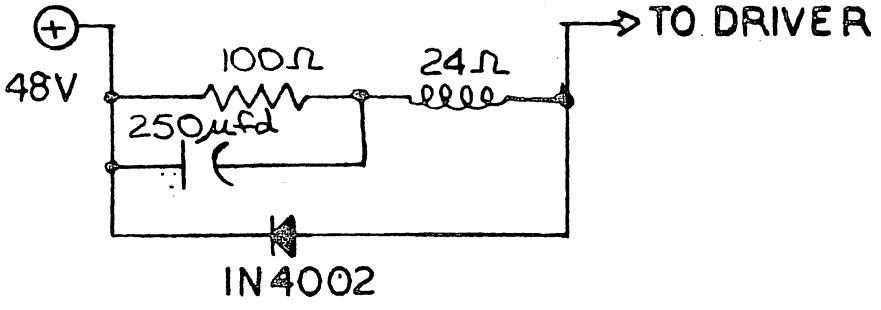
Pulse Length: 3.2 ms

TOLERANCE SPECIFICATIONS

Current: 1.5 ± 0.2 A

Pulse Length: 2.6 to 3.8 ms.





MECHANICAL OPERATION

The following paragraphs describe the mechanical operation of the Helical Serial Printer, Model HSP-30. The discussion is limited to those components whose function is most relevant to an understanding of the printer operation.

Print Wheel

The 63 printable characters are located on the outer surface of the print wheel. The print wheel continuously rotates at a rate of 1800 revolutions per minute. Since a single character is printed for each revolution of the wheel, printing occurs at a maximum rate of 30 characters per second. When the desired character is in the proper position for printing, the print solenoid is energized, causing the print hammer to strike the paper. The force of the hammer presses the paper against the inked print wheel, printing the desired character.

The character printing operation occurs while the print wheel is rotating, and the print wheel carrier is moving horizontally along the writing line. The combination of these two movements of the print wheel dictates a special helix arrangement of the character positions on the print wheel. (See Figure 1-1.) This arrangement is necessary to assure proper horizontal character alignment in the writing line.

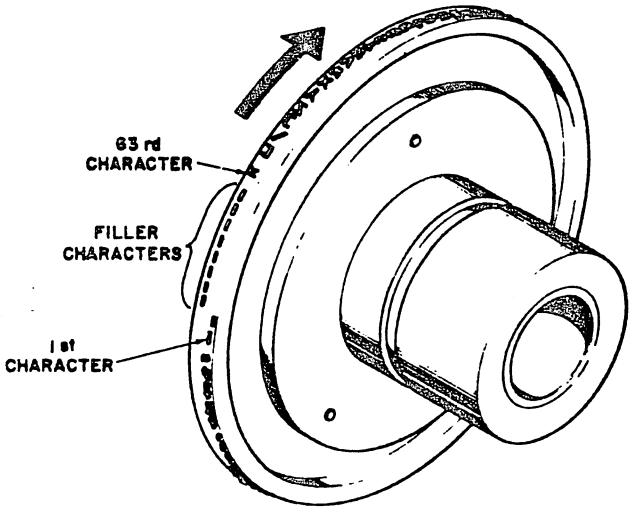


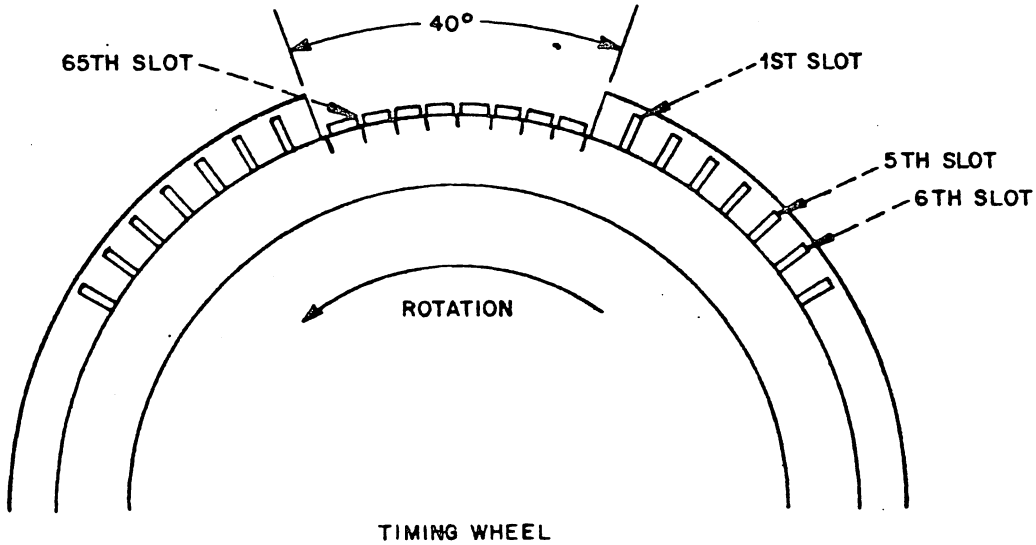
Figure 1-1. Print Wheel

The "filler" characters between the last and the first character on the wheel are used to prevent ink roller vibration, and to assure balance of the print wheel.

Timing Wheel

A timing wheel (see Figure 1-2) is attached to the left end of the print wheel shaft. Slots cut into the wheel are used to control the sequence of printer operation. Sixty-four, segments, separated by narrow slots cut in the wheel correspond to the 63 characters (plus space) on the print wheel. The slots are spaced at 5°. The 40° wide slot is used for printer synchronization during each print cycle.

To assure continuous synchronization between the user's system electronics and the HSP-30 printer, it is advisable that the wide slot timing pulse developed by the HSP-30 printer be used by the user's system logic to develop applic: ble timing signals for data handling and printer control circuits.



TIMING WHEEL
LOOKING FROM LEFT SIDE

Figure 1-2. Timing Wheel

The segments spaced at 5°, indicated by narrow slots underneath the wide slots, are necessary for adjustment purposes only. They are used to arbitrarily count the 5° slots while adjusting the printer timing.

Main Carrier Assembly

The main carrier assembly is composed of the following sub-assemblies. (See Figure 1-3.)

- Letter space solenoid assembly.
- Carrier return/backspace solenoid and associated assemblies.
- Print wheel yoke.
- Switch assembly to indicate the end of the carrier return function. This signal can also be used to monitor the position of the carrier.
- Plunger assembly to cushion the impact of the carrier return.
- Ink roller cartridge assembly.
- Mechanical disengagement assembly.
- Front paper guide.

The primary purpose of the main carrier assembly, with its associated sub-assemblies, is to control the horizontal motion of the print wheel. When the letter space solenoid is energized, the letter space roller engages the threads of the continuously rotating helical screw shaft, causing the carrier assembly to move from left to right.

The carrier return solenoid and its associated assemblies serve a dual purpose and are mounted on the underside of the main carrier. Primarily, its purpose is to allow the main carrier to return all the way to the left hand margin position when the carrier return is initiated. It is also energized when the back space function is initiated, allowing the main carrier to back space one character position at a time.

The print wheel yoke mechanically connects the print wheel to the main carrier to maintain the print wheel alignment with the main carrier, and to assure proper horizontal character alignment in a writing line.

A reed switch assembly (Left Hand Margin Switch S3) is mounted at the left side of the main carrier assembly. Closure of this switch generages a signal

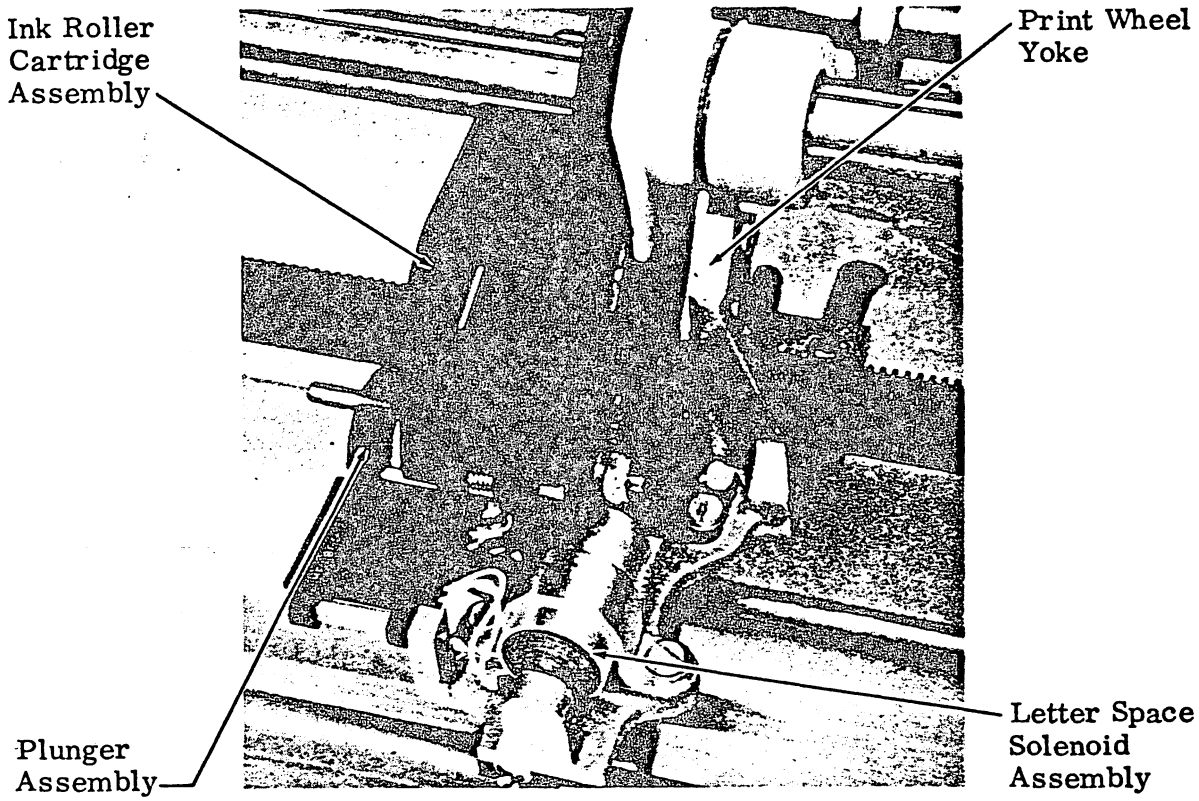


Figure 1-3. Main Carrier Assembly

to the left hand margin sensor circuit indicating that the carrier is at the first column position. The switch opens as the carrier moves to the second column position and will not close again until another carrier return function is performed.

The system control logic pertinent to printer control should be designed in such a manner that the carrier return function could be monitored. Provisions should be made to resume data flow upon receipt of the left hand margin signal ($\overline{\text{LHMSW}}$ at pin P2A2).

The carrier return plunger is mounted at the lower left hand side of the main carrier assembly. Its floating properties assure proper insertion of the plunger into the dash pot every time the printer performs a carrier return function. Compressed air cushions the impact of the carrier return; therefore, smooth noise-free operation is assured.

The lower ink roller cartridge assembly is mounted on the top side of the main carrier assembly to house the ink roller. The spring-loaded upper ink roller cartridge can be pulled back for easy ink roller replacement.

NOTE: The ink roller cartridge assembly is not installed when the printer is shipped. The ink roller cartridge is part of the accessory package and it is the customer's/user's responsibility to install the ink roller cartridge at the time the printer is unpacked.

The mechanical disengagement lever is mounted to the right side of the main carrier assembly and when operated will mechanically disengage the letter space roller from the screw shaft. Under normal conditions, it will be operated only when the 132-character writing line is exceeded. This is to avoid mechanical breakdowns if for some reason the carrier return function did not occur.

The carrier assembly is designed for electro-mechanical operation: however, the assembly can be moved manually to the left by releasing the carrier return pawl located under the carrier assembly. Manual movement to the right can be accomplished by pushing the carrier from left to right.

> CAUTION
>
> DO NOT use the ink roller cartridge assembly for a handle when manually moving the carrier. Damage to to the ink roller cartridge assembly can occur if this practice is followed.
>
> Manual movement of the carrier assembly can cause damage to the carrier return mechanism if not performed properly. In order to avoid unnecessary damage to the mechanism, it is recommended that the operator be properly trained in this operation.

Print Hammer Carrier

The print hammer carrier is comprised of the following assemblies. (See Figure 1-4.)

- Hammer coil assembly.
- Hammer armature.
- Hammer housing and associated parts.
- Impression, copy controls, and adjustments.

- Permanent magnet assembly for activation of the line length limit switch (right-hand limit switch).

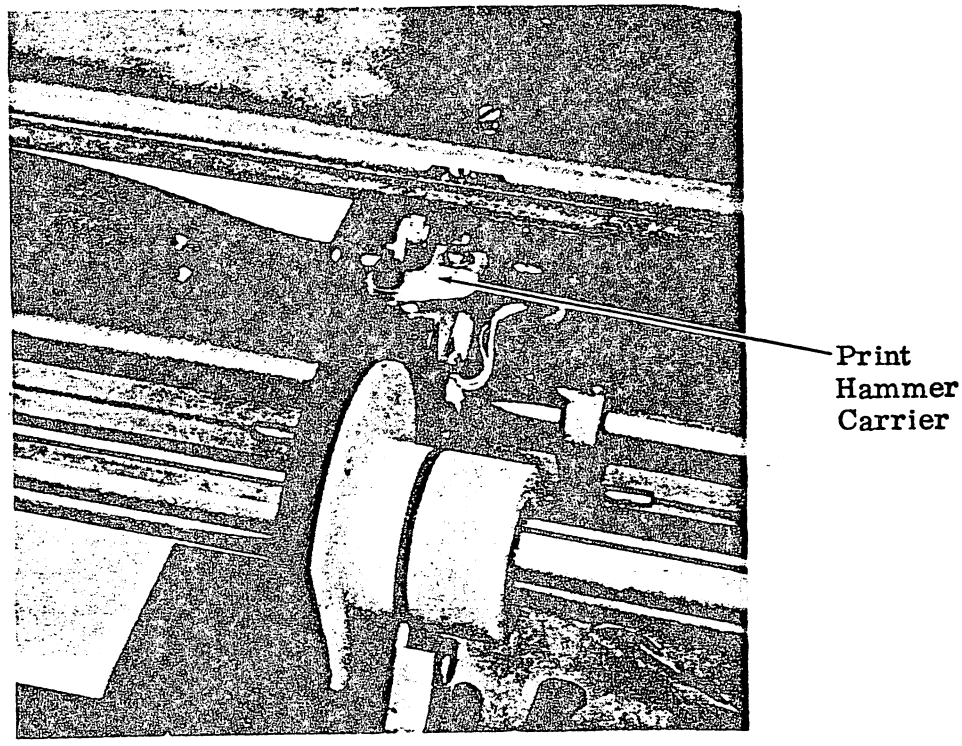


Figure 1-4. Print Hammer Carrier Assembly

The main function of the print hammer carrier is to keep the print hammer constantly aligned with the print wheel. The assembly is cable-connected to the print hammer drum which in turn is connected to the main carrier return mechanism. The assembly position is adjustable for proper alignment with the print wheel by adjusting the associated cable drum at the carrier return shaft.

Print Wheel Shaft/Helical Screw Shaft Drive

The print wheel shaft and the helical screw shaft (see Figure 1-5) are mounted between the two side plates by means of high-quality ball bearings at both ends. These shafts are synchronized and are driven together by means of a separate pulley and drive belt and a drive belt between the two. The speed ratio is 1:2, which assures horizontal motion by one character position to each print wheel revolution.

The print wheel shaft extends through the left side plate where the special timing wheel and flywheel are mounted.

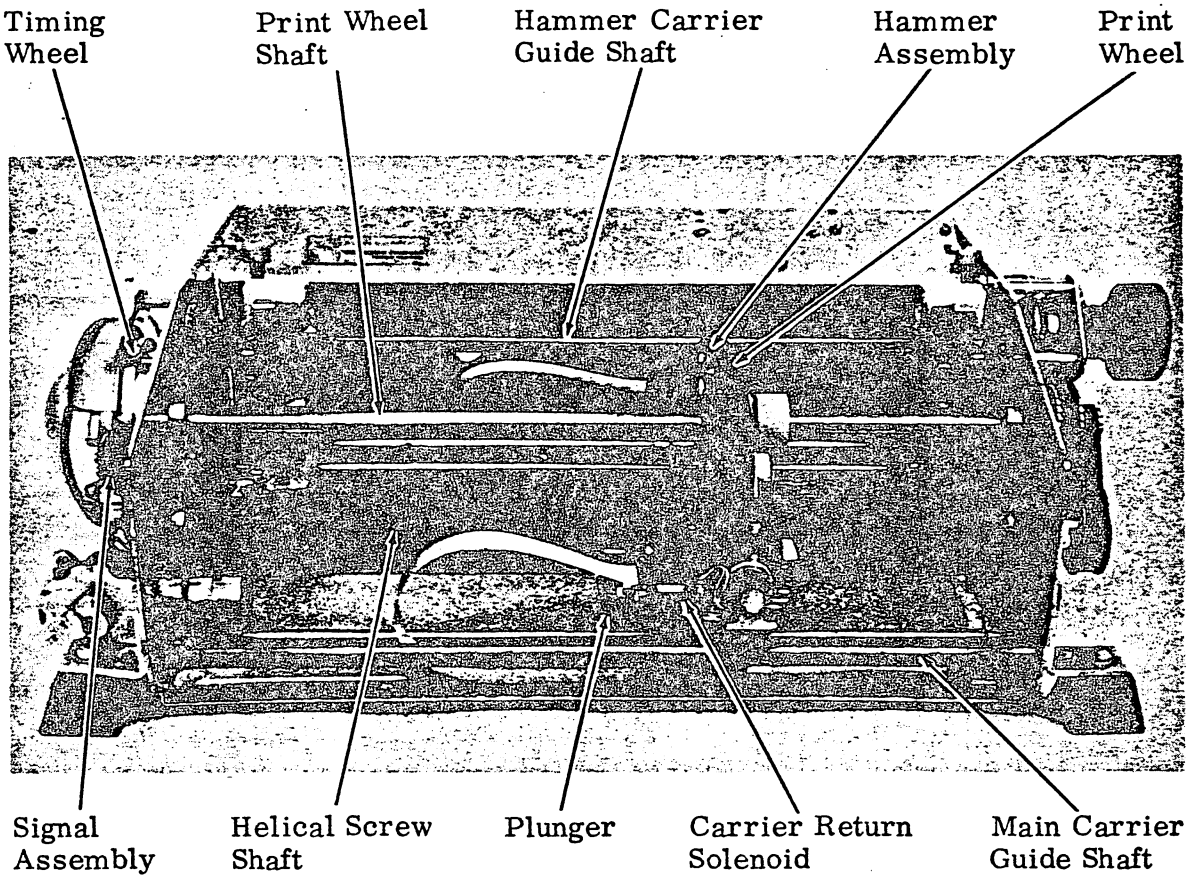


Figure 1-5. Print Wheel Shaft/Helical Screw Shaft Drive

ASCII Code Chart

The HSP-30 is capable of printing the characters in columns 2 through 5 of the ASCII code chart (See Table 1-1.) The function codes such as: BS, LF, CR, and SP must be decoded in the system's logic and the decoded output used as strobe lines to activate the driver circuits associated with the electro-mechanical functions in the printer. (Refer to Appendix.)

Wheel Position/Character Assignments

Table 1-2 indicates the print wheel position assignments for the character set used by the HSP-30.

b7 → / b6 → / b5 → / BITS					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4	b3	b2	b1	Column / Row	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	¦
1	1	0	1	13	CR	GS	-	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

Table 1-1. ASCII Code Chart

WHEEL POSITION	CHARACTER	WHEEL POSITION	CHARACTER	WHEEL POSITION	CHARACTER	WHEEL POSITION	CHARACTER
1	!	17	1	33	A	49	Q
2	"	18	2	34	B	50	R
3	#	19	3	35	C	51	S
4	$	20	4	36	D	52	T
5	%	21	5	37	E	53	U
6	&	22	6	38	F	54	V
7	'	23	7	39	G	55	W
8	(	24	8	40	H	56	X
9	)	25	9	41	I	57	Y
10	*	26		42	J	58	Z
11	+	27	;	43	K	59	[
12		28	<	44	L	60	\
13		29	=	45	M	61	]
14		30	>	46	N	62	^
15	/	31	?	47	O	63	
16	0	32	@	48	P	64	SP

Table 1-2. Wheel Position/Character Assignments

Paper Feed/Format Control

The feeding of paper journal through the printing station is accomplished by using a single pair of paper guide assemblies (one on each side of the printer). The guides are mounted on the paper guide shaft (lower end of the guide assemblies) and are individually adjustable along the shaft to accommodate the various paper widths from 3" to 14-7/8".

The upper belt bearing is mounted on the paper drive shaft (square shaft). The right-hand end of the paper drive shaft extends through the right side plate on which the line feed clutch and the line count generator (LCG) are assembled.

Horizontal vernier adjustment for proper paper positioning is accomplished by adjusting the paper guide shaft horizontally for the desired position. The adjustment is performed with the thumb disc mounted on the left-hand side plate. The bead chain drives the lower pulley mounted on the paper guide shaft. The paper guide shaft is threaded at the left end on which the pulley is mounted (see Figure 1-6).

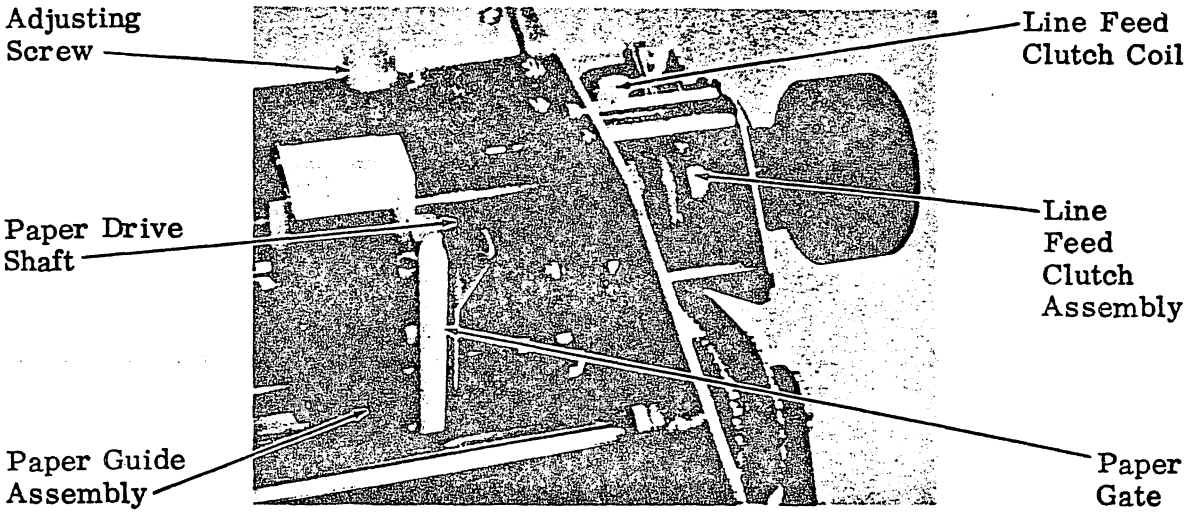


Figure 1-6. Paper Guide Assembly and Clutch

The paper feed clutch mounted on the right-hand side plate drives the paper drive shaft. When the clutch is energized, the shaft is engaged to the drive hub, and the tractors will feed the paper through the printing station.

Manual document feed and precision format positioning in the printer is accomplished by manually turning the document feed knob mounted on the line feed clutch assembly. Precision paper positioning can be performed by manually pulling the knob outward. When the knob is rotated in this position, the vertical paper positioning may be adjusted within one line feed increment. This is to permit the operator to fine-tune the forms to the printing station. When the knob is released, it will lock itself into the selected position and the printer will line-feed from that newly selected position.

Escapement Drum Assembly/Carrier Return Mechanism

The escapement drum assembly (see Figure 1-7) is mounted on the outside of the left-hand side plate. The escapement drums and the carrier return spring assembly are mounted on the carrier return shaft. The carrier return shaft is constantly under return-spring tension. The two carrier return cables are attached to their respective drums, which in turn provide the proper alignment to the print hammer and the print wheel when the two carrier assemblies are moved from the left to the right while the characters are being printed.

The carrier return (CR) solenoid and the associated pawl and linkage are mounted underneath the main carrier. When the printer is operating, the detent pawl is moving along the escapement shaft. When the carrier stops, the pawl assembly is engaged in the escapement shaft tooth, preventing the carrier return function from taking place.

The carrier can be returned to the left-hand margin by manually disengaging the pawl or by energizing the CR solenoid. (NOTE: See warning on page 1-5 regarding manual movement of the carrier assembly.) When the carrier reaches the left-hand margin, the impact is cushioned by the plunger and dash pot, where the momentary air compression absorbs the impact.

If for some reason the letter space roller does not disengage when the carrier passes the 132nd column (see paragraph above) a mechanical disengagement occurs. The mechanical disengage retractor lever will operate when the 133rd column is reached, by striking against the right paper tractor striker plate. When this occurs, the letter space roller is disengaged and the carrier is held in the last position by the pawl.

Adjustable Left-Hand Margin

The adjustable left-hand margin set is mounted on the escapement shaft and guide shaft (see Figure 1-8). The assembly can be repositioned on the escapement shaft by lifting the spring-loaded margin set lever. When the desired position is established, the margin control assembly can be locked into its

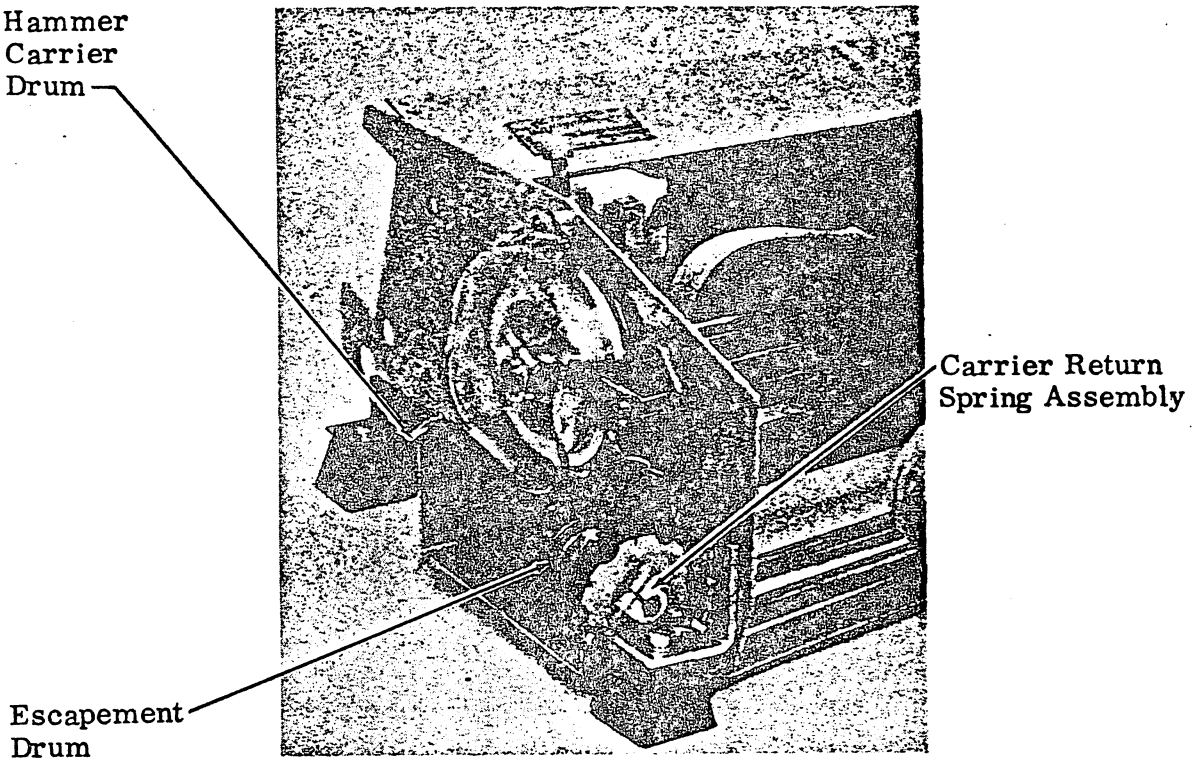


Figure 1-7. Escapement Drum Assembly

position by releasing the lever, locking the assembly into the column position. The left-hand margin cannot be positioned to the left of the left-hand tractor. A safety tab mounted on the left hand paper tractor assembly prevents this condition.

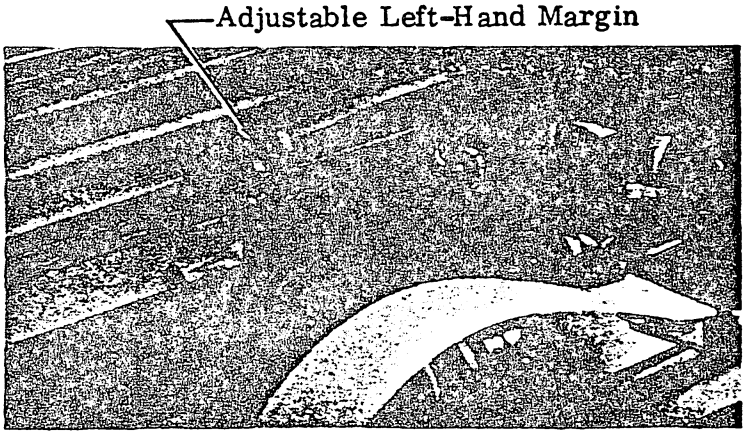


Figure 1-8. Margin Control Assembly

Drive Belts and Pulleys

A total of four timing belts provide the necessary power transfer to the drive shafts (see Figure 1-9). The pulleys have been carefully selected to achieve the precise speed ratio necessary to maintain synchronous printer operation. The main timing belt tension is adjustable by positioning the idler pulley assembly higher or lower, respectively tightening or loosening the belt. Also the line-feed-belt drive tension is adjustable by repositioning the compound idler pulley assembly on the right hand side plate by loosening the locknut on the inner side of the side plate.

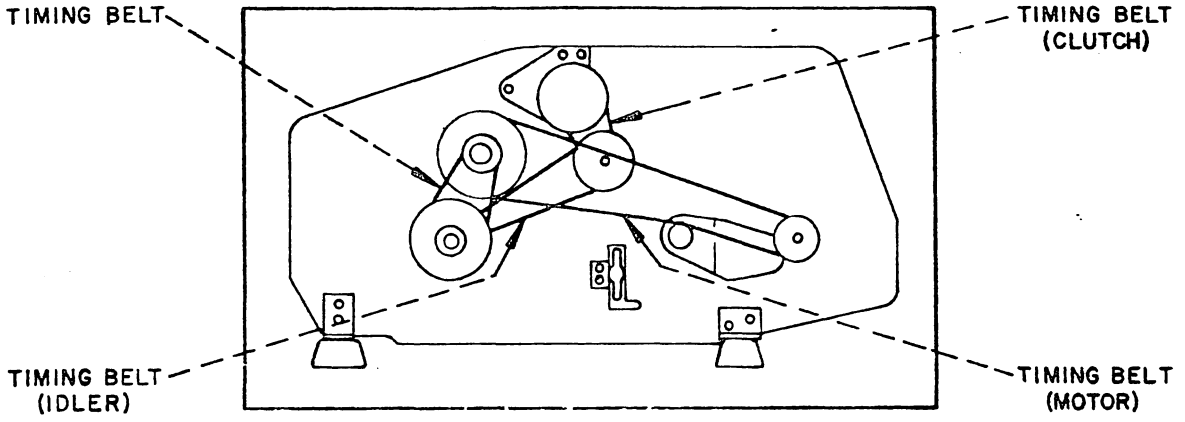


Figure 1-9. Drive Belts and Pulleys

ELECTRO-MECHANICAL OPERATION

The electro-mechanical devices used in the HSP-30 are described in the following paragraphs. This discussion includes the location, the assigned function description, the circuit, and the current waveform (applicable) for each of these devices.

Letter Space Solenoid/Roller Pin Assembly

The letter space solenoid/roller pin assembly is located on the top side of the main carrier. It is designed to engage the main carrier to the rotating screw shaft when a printing character or space is called for. When the solenoid energizes, the pushrod will push the roller pin assembly towards the rotating screw shaft. The mechanical delay required for this operation is obtained by a special timing arrangement, so that the pin will always be engaged at the proper time.

Right-Hand Limit Switch

The right-hand margin switch is a reed switch PCB assembly mounted on the right hand tractor assembly. Its purpose when activated, is to generate an output signal to the user's system indicating that the maximum line length has been reached and that the carriers are too close to the right hand tractor assembly.

NOTE: The actual function of the pulse generated by closing of the right-hand limit switch is up to the systems design engineer. The switch was designed as an emergency limit indicator. Its use for other functions should be fully analyzed before implementation.

Left-Hand Margin Switch

The left-hand margin sensor is a reed switch assembly mounted on the left side of the main carrier assembly. The purpose of the switch is to acknowledge the return of the main carrier to the home position at the left-hand margin. The switch is activated by an adjustable permanent magnet assembly which is mounted on the left-hand margin control assembly. The distance between the magnet and the reed switch is adjusted so that the switch closes at the home position (first column) and opens before the carrier moves to the second column position when the printer resumes printing following a carrier-return function.

Motor and Motor Start Circuit

The 3600 revolutions per minute, 120V AC, 60 Hz synchronous motor is mounted on the support bracket at the rear of the printer. The AC power is not switch controlled; therefore, the motor turns on when the power connections are made and the system power is switched on.

When power is applied to the motor, the start winding will energize the start relay KM. When the motor reaches operating speed (approximately 500 milliseconds), the KM contacts 2 and 4 will close and keep the motor running. The AC circuit for the printer is not fused because the printer is designed to be part of a system, utilizing the system power facilities. The motor and start relay wiring is shown in the wiring diagram in the Appendix of this manual.

Printer Timing Signal Assembly (See Figure 1-14)

The timing signal assembly is mounted on the left hand side plate of the printer. The assembly consists of a LED (Light Emitting Diode) board assembly and a sensor assembly, separated by spacers. The assembly is mounted in such a way that the timing disc can freely rotate between the sensor and the emitter. When the emitter output is blocked by a segment in the timing disc the sensor output is low, and conversely, when the light shines through the timing disc, the output is high. The DC power requirement for the assembly is +5V.

NOTE: Users who design their own electronics and power supply must connect the +5V DC to pin P2A3 through a 56 ohm 1/2 watt resistor in order to provide proper biasing to the LED. The same applies to pin P2B15 for LCG.

Since the output of this timing device is synchronous with the print wheel, it is the "heart" of the printer, and the main timing signal for various functions of the HSP-30 printer. The system's control logic must utilize this timing signal.

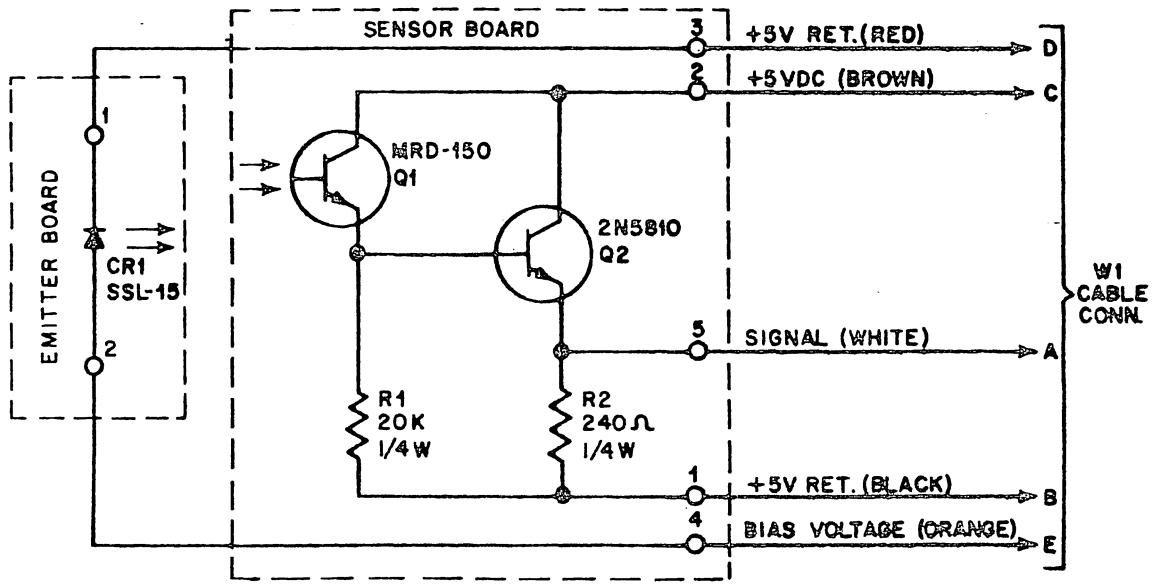
NOTE: OEM customers refer to sequential timing diagram in Appendix section of this manual.

Line Count Generator (LCG)

The Line Count signal assembly is mounted on the clutch assembly support bracket at the right side of the printer. Electrically the signal assembly is identical to the timing signal assembly described in the preceding paragraph. The mounting bracketry is designed so that the assembly, when mounted, can be adjusted for proper output signal.

The purpose of the LCG is to generate a pulse for each line feed performed, so that the system's logic can monitor form handling by utilizing this signal.

The assembly should be adjusted so that the pulse occurs approximately 15 ms after the line feed coil is energized. The duration of the LCG pulse is app. 1.8 ms.



SCHEMATIC – SIGNAL ASSEMBLY
(ALSO APPLIES TO LCG)

NOTE: BIAS VOLTAGE IS OBTAINED BY INSTALLING 56 OHM 1/2W RESISTOR IN SERIES WITH +5V SUPPLY TO CONNECTOR E.

LUBRICATION

The following lubricants should be used on the HSP-30:

Lubricant	Part Number	Equivalent Lubricant and Source	
Number 2	T-18194	Mobile DTE 797	Mobile Oil Co.
Number 10	T-18269	Aero Lubriplate	David Holland
Number 14	T-18862	A-210-58	Ultrachemicals. Inc.

These lubricants have been tested by Singer Business Machines and have been found to be best for the HSP-30; substitution of other lubricants may result in poor printer performance.

The applicators listed below are approved for use on the HSP-30 and can be ordered from Singer Business Machines Service Materials. Rochester. New York.

Applicator	Part Number
Oiler (Plastic)	T-18185
Brush (Number 5)	T-18070
2-oz. can	T-18423

Shafts

Use Number 14 lubricant on the print wheel shaft. Wipe off any excess, leaving a thin film of lubricant on the shaft.

Lubricate all other shafts with Number 10 lubricant. Wipe off any excess, leaving a thin film of lubricant on the shafts.

Hubs

Lubricate both hubs of the paper feed tractors with Number 2 lubricant, as indicated in Figure 4-1.

Paper Feed Shaft Bearings

Lubricate both oilite bearings on the paper feed shaft (see Figure 4-2), carrier return shaft. and letter space roller with Number 2 lubricant.

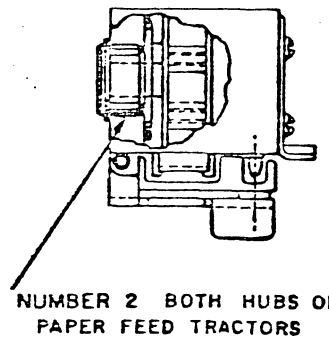


Figure 4-1. Paper Feed Tractor Hubs

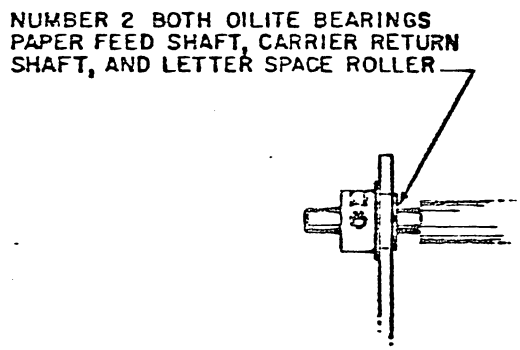


Figure 4-2. Paper Feed Shaft Bearings

Paper Feed Clutch Springs

Lubricate both ends of the paper feed clutch springs with Number 10 lubricant as indicated in Figure 4-3. Lubricate ratchet teeth and the armature tip with Number 14 lubricant as indicated in Figure 4-3.

Idler Pulley

Lubricate the idler pulley with Number 2 lubricant as indicated in Figure 4-4.

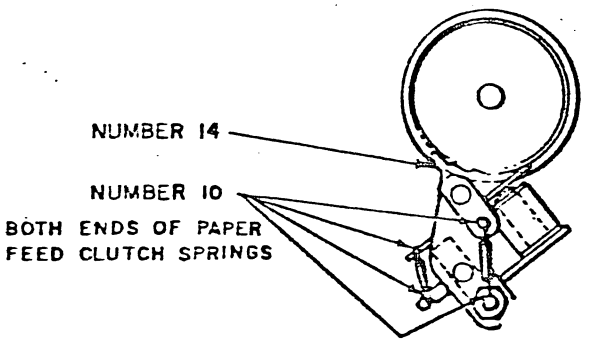


Figure 4-3. Paper Feed Clutch Springs

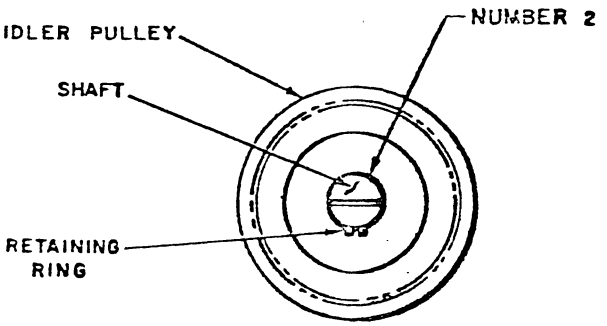


Figure 4-4. Idler Pulley

Ink Cartridge Spring

Lubricate both ends of the ink cartridge spring (see Figure 4-5) with Number 10 lubricant.

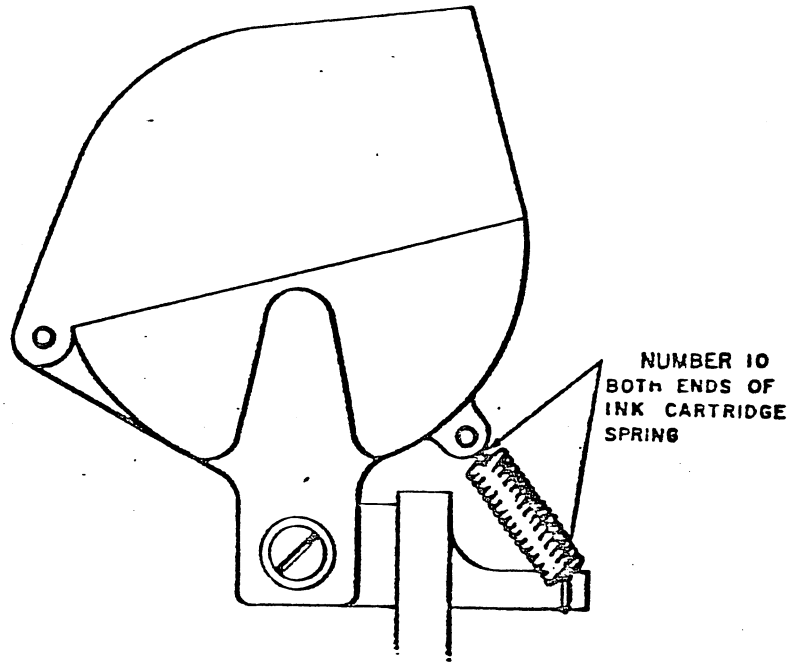


Figure 4-5. Ink Cartridge Spring

Print Wheel Hub and Carrier Yoke

Apply a small amount of Number 10 lubricant to the tip of the yoke assembly which rides in the guide groove of the print wheel hub assembly (see Figure 4-6).

Carrier Return Solenoid Linkage and Detent Pawl

Apply Number 2 lubricant and Number 10 lubricant as shown in Figure 4-7.

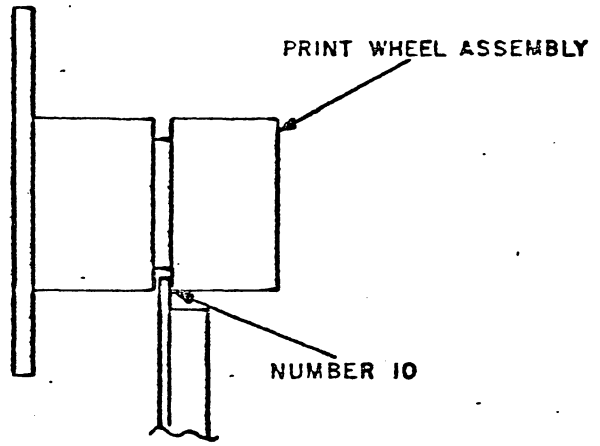


Figure 4-6. Print Wheel Hub/Carrier Yoke

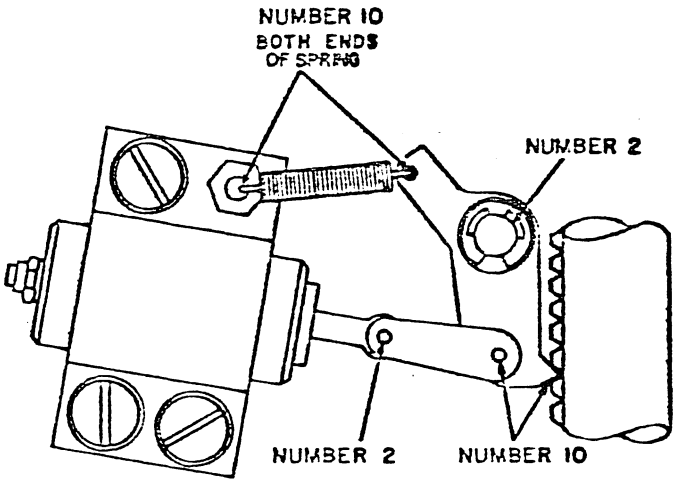


Figure 4-7. Carrier Return Solenoid Detent Pawl

ADJUSTMENTS

General

The following safety rules should be carefully observed.

1. If the printer is down for maintenance or adjustments, check to make sure that the AC power is disconnected.
2. Do not operate the machine under power until it is completely adjusted.
3. To prevent accidental injury by the timing disk, always replace the cover over the timing disk before power is applied to the printer.
4. Do not energize the print hammer unless there is paper between the print hammer and the print wheel.
5. Do not operate the printer without an ink roller installed in the ink cartridge.

Spring Washer on Helical Screw Shaft

The spring washer must maintain a clearance of .040 to .080" between the two thrust washers located on the left-hand side of the helical screw shaft. Adjustment is made by reversing the inside thrust washer to place the washer hub inside the gap. Refer to Figure 4-8.

Spring Washer on Print Wheel Shaft

The spring washer must maintain a clearance of .040 to .080" between the two thrust washers located on the right-hand side of the print wheel shaft. Adjustment is made by reversing the inside thrust washer to place the washer hub inside the gap. (The same procedure as used for the washer on the helical screw shaft, above, except that the washers are mounted on the right-hand side of the shaft.)

Bottom Guide Bearing on Main Carrier

Adjust the eccentric screw on the bottom guide bearing of the main carrier so that the bearing fits the guide shaft with a clearance of .0005 to .0015" and allows a smooth movement of the guide shaft the full length of the machine. (NOTE: The top guide bearing is stationary and cannot be adjusted. Refer to Figure 4-9.)

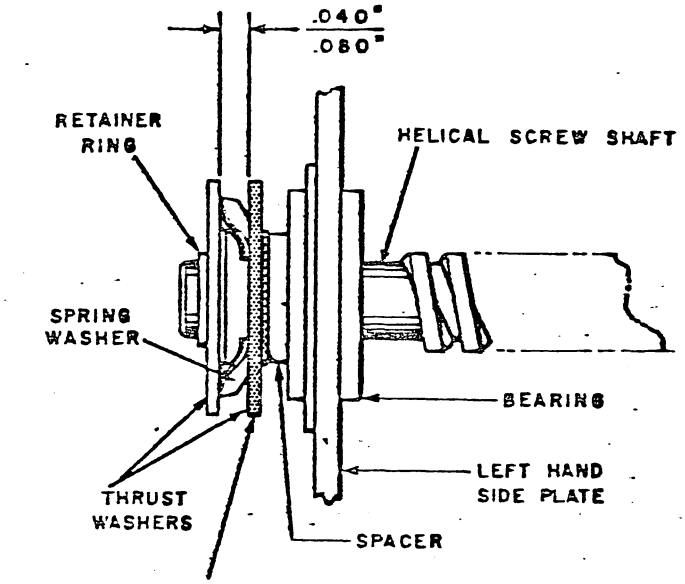


Figure 4-8. Spring Washer - Helical Screw Shaft

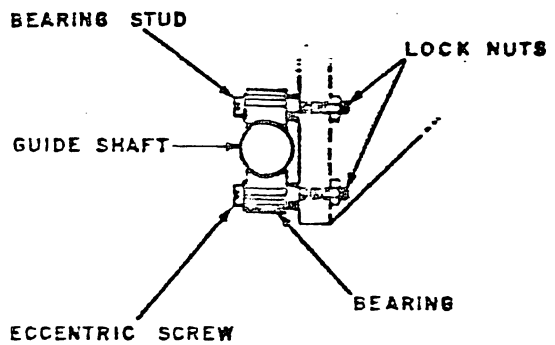


Figure 4-9. Guide Bearing - Main Carrier

Back Guide Bearing on Hammer Carrier

Adjust the rear eccentric screw on the back guide bearing of the hammer carrier so that the bearing fits the guide shaft with a clearance of .0005 to .0015" between the bearing and the guide shaft for full length of the machine. (NOTE: The front bearing is stationary and cannot be adjusted. Refer to Figure 4-9.)

Hammer Carrier Cable Tension

Attach the eyelet end of the cable to the right-hand side of the carrier and thread the cable around the plastic pulley. Position the carrier against the right end plate. (See Figure 4-10.)

With the cable drum loose on the shaft, wind 3-1/2 turns of cable around the drum, beginning at the rear flange. (NOTE: Do not overlap the cable on the drum.)

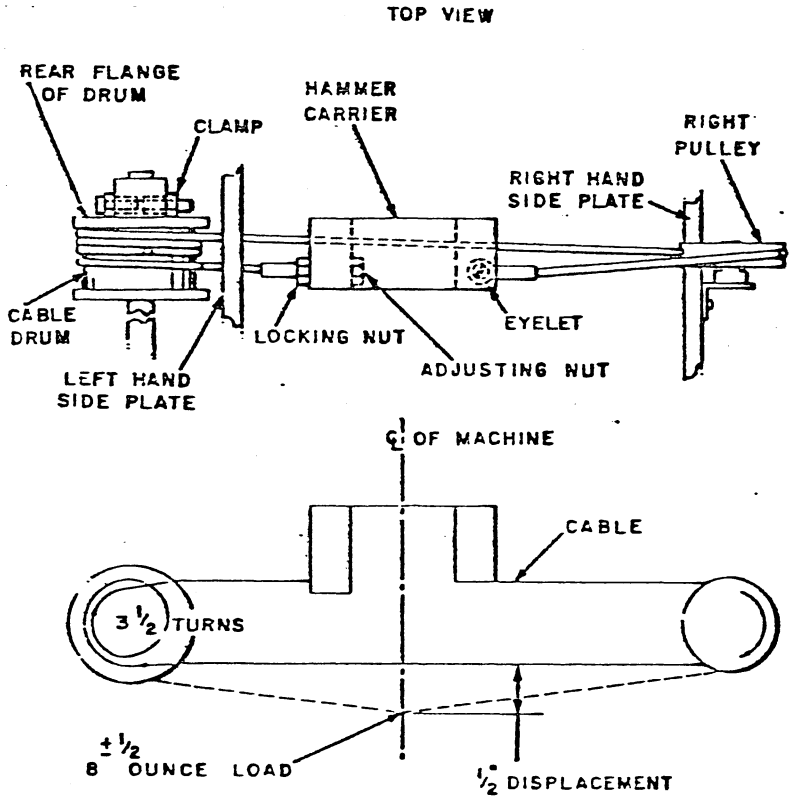


Figure 4-10. Hammer Carrier Cable Tension

Slip the ball into the slot of the drum and attach the cable to the left-hand side of the carrier as shown in Figure 4-10.

Turn the adjusting nut and the locknut so that the hammer carrier can be deflected .5" at the center of the machine with a load force of 8.0 ± .5 ounces. Tighten the locknut.

Print Wheel Hub Key Adjustments

To perform this adjustment, disconnect the print wheel from the main carrier by removing the print wheel yoke and position the print wheel to the left of the carrier.

Loosen the two screws on both print wheel keys and set keys to obtain a minimum running fit between the key and the keyway of the shaft. The sides of the hub key must be parallel with the sides of the keyway in the print wheel shaft. Tighten the mounting screws. Repeat this adjustment for the other key. See Figure 4-11.

The main purpose of this adjustment is to obtain a running fit between the key and the keyway of the shaft, and also to maintain the 385 millisecond maximum carrier return time for the maximum writing line (132 characters).

Print Wheel Yoke

Slightly loosen the two screws that secure the print wheel yoke. Adjust the yoke so that it provides maximum engagement, but does not contact the base circumference of the slot in the hub during the 360° rotation of the hub. Tighten the screws.

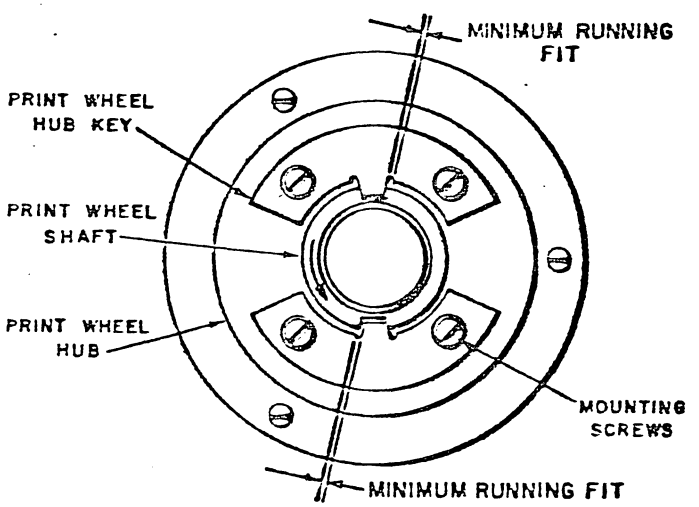


Figure 4-11. Print Wheel Hub Key

Carrier Return Adjustment

Initial Set-Up

1. Position the dash pot to the extreme left-hand position with the margin set lever firmly engaged in the tooth of the rack.

2. Position the main carrier to the left, so that the dash pot plunger on the carrier is against the stop in the dash pot housing.

3. Loosen the screw on the clamp on the main carrier cable drum, and position the hub of the return spring to allow .015 to .025" end play of the carrier return shaft. Wind the clock spring five turns and tighten the clamp screw. (NOTE: The clock spring should not be wound more than ten turns. Exceeding ten turns could result in permanent deformation of the spring.)

4. Loosen the screw on the clamp on the hammer cable drum and align the hammer carrier with the main carrier. so that the print hammer is aligned with the print wheel. Tighten the screw on the clamp. with .015 to .025" clearance between the hammer carrier cable pulley and the bearing.

5. Manually traverse the main carrier the full length of the machine. Adjust the cables so that the cables do not contact the left-hand end plate where the cables go through the end plate.

Determining Carrier Return Time

NOTE: The carrier return time from the extreme right-hand position (132nd column) should be 385 milliseconds maximum. Time and temperature should be considered.

The carrier return time can be determined by the time interval that the carrier return solenoid is energized. To determine the carrier return time, use an oscilloscope (Tektronix 453 or equivalent) or any equivalent pulse-measuring device. Use the following test points to connect the test equipment:

1. Connect the probe lead to P1 A3 or to the carrier return driver output of the device control electronics. Refer to Schematic Diagram in the Appendix.

2. Trigger, if necessary. The carrier return pulse should be that shown in Figure 4-12.

3. If the carrier return time is greater than 385 milliseconds. check for binds.

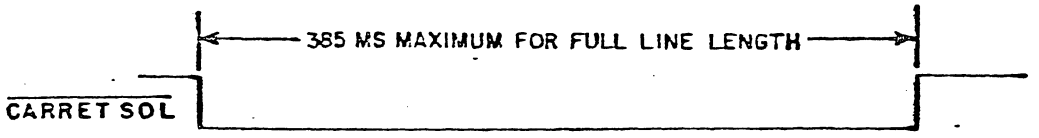


Figure 4-12. Carrier Return Pulse

Dash Pot Plunger Adjustment

Position the dash pot plunger against the stop in the dash pot housing.

1. Using the two thin nuts, position the dash pot plunger so that the main carrier is about .1" from the dash pot housing. Also, check to see that the hammer carrier is not in contact with the left-hand paper guide assembly.
2. Adjust the two thin nuts so that the detent pawl is fully engaged in the nearest tooth on the detent shaft. (Refer to Figure 4-13.) check to see

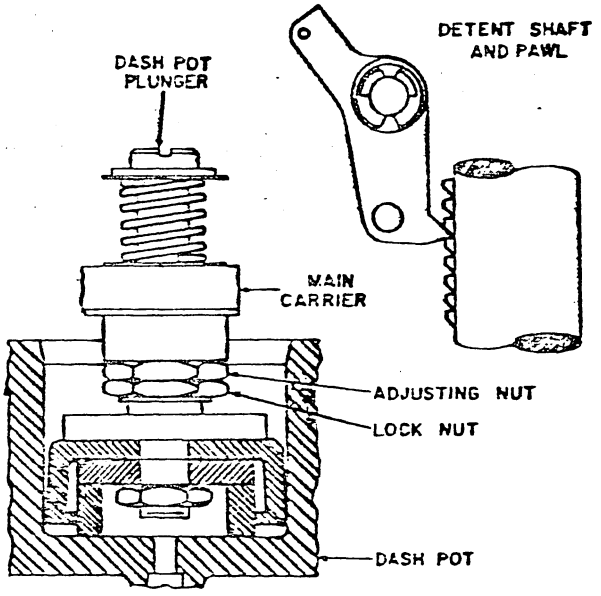


Figure 4-13. Dash Pot Plunger

that the left-hand margin control is fully detented in its selected position. To check the correctness of above adjustments, release the carrier return pawl. the carrier should not move and when pawl is released, it should engaged fully to the detent tooth.

End of Carrier Return Switch

With the main carrier positioned so that the detent pawl is fully engaged with the tooth on the detent shaft, adjust the magnet screw on the dash pot to a minimum air gap of .035" between the magnet and the reed switch. The switch should be closed at this setting, and should open before the next tooth on the detent shaft.

To check the accuracy of the carrier return switch setting, connect a meter across the reed switch and check to see that the switch opens as stated above. Readjust the magnet if necessary to maintain a consistent left-hand margin. Refer to Figure 4-14.

Dash Pot Adjustment

Adjust the orifice opening screw in the dash pot to stop the carrier as quickly as possible with no bounce after full travel of the carrier. Refer to Figure 4-14.

For the dynamic functional check, operate the printer to see that the left-hand margin is maintained when the printer is carrier returning from various column positions (from .10 to 13.2" line length).

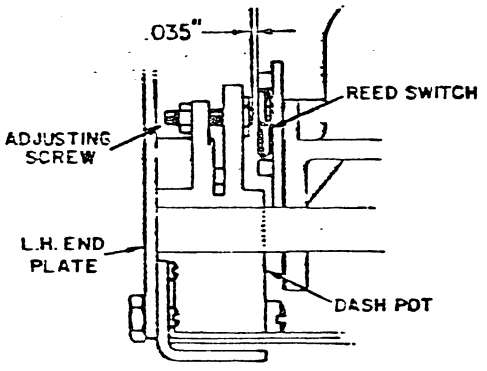


Figure 4-14. End of Carrier Return Switch

Letter Space Roller Positioning

Place the main carrier in the approximate center of the machine or where the maximum amount of bow in the helical screw shift occurs. Rotate the shaft so that the bow is convex as viewed from the front of the machine.

Hold the core of the letter space solenoid (see Figure 4-15) so that it contacts the stop in the solenoid. Do not use the plastic stop-screw to perform this operation. With the solenoid in the position and the plunger housing mounting screws slightly loosened, move the plunger roller assembly with the solenoid to fully engage the thread of the screw shaft. When this position is obtained, tighten the mounting screws. (While tightening the mounting screws, align the push-rod and the plunger with the solenoid assembly.)

NOTE: While tightening the mounting screws, the roller must be fully engaged in the screw shaft thread.

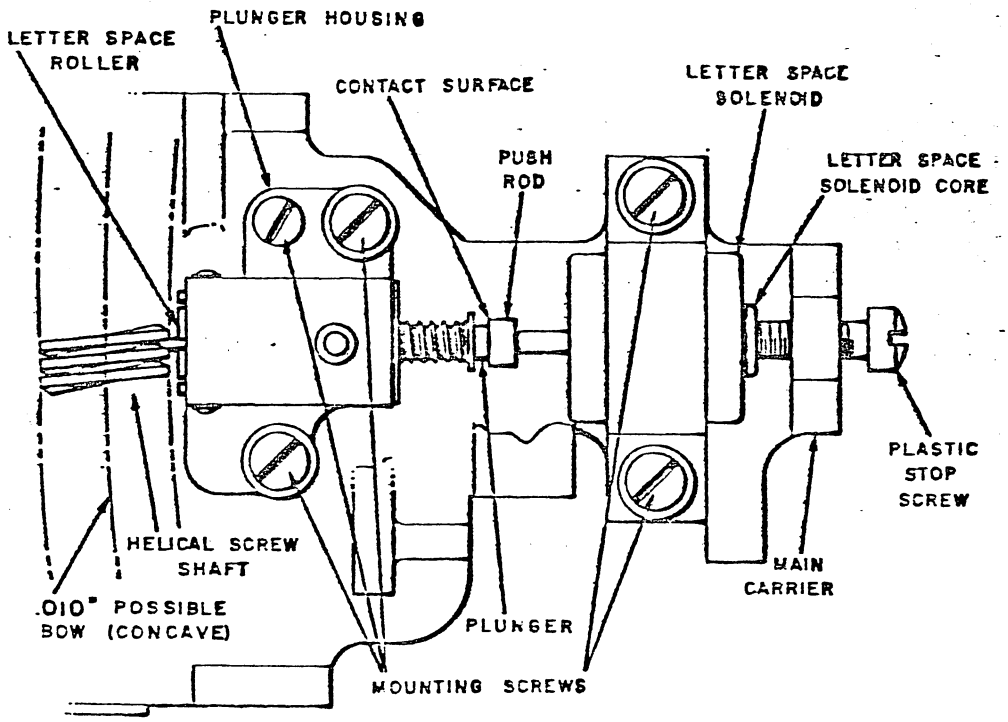


Figure 4-15. Letter Space Solenoid

Letter Space Roller Housing and Plunger Assembly

Place the main carrier in the approximate center of the machine. Rotate the shaft so that the bow is convex as viewed from the front of the machine.

Adjust the plastic stop-screw so that the clearance between the end of the letter space roller and the outside diameter of the helical screw shaft is from .003 to .005". Now, turn the screw shaft so that the roller is in line with the center line of the adjacent groove. With the armature bottom against the core of the solenoid, adjust the solenoid so that there is .058 ± .001" between the armature and the plastic stop screw. If there is no compression of the roller return spring due to tolerance build up, add a shim, Part Number 1090336, between the retainer and spring to obtain .330 ± .005" spring length. Refer to Figure 4-16.

Move the carrier the full length of the writing line, checking on several spots to assure a clearance of from .003 to .005".

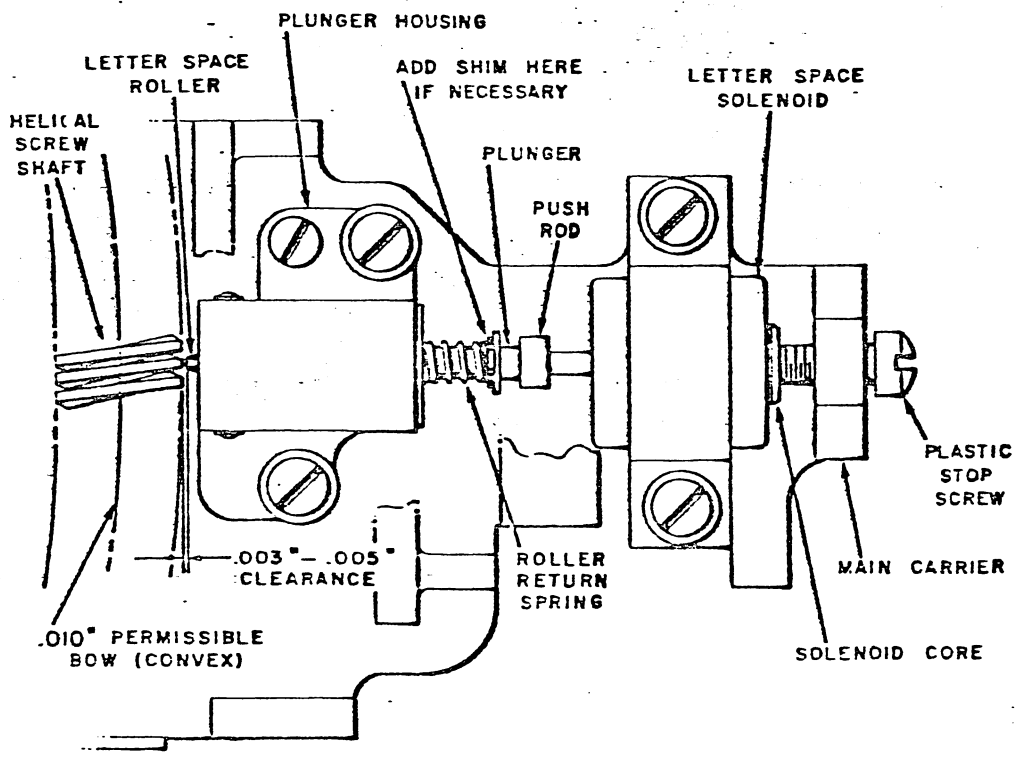


Figure 4-16. Letter Space Roller Housing and Plunger Assembly

Mechanical Disengage Check

Place the carrier to the right, so that the retractor level contacts the right-hand tractor striker plate, and the letter space roller is completely disengaged from the screw. Check for a clearance between the hammer assembly and the tractor feed pins. To verify the accuracy, manually push the letter space solenoid into the screw shaft and hold it engaged. Slowly turn the screw shaft and check to see that the roller is mechanically disengaged from the screw shaft as the disengage lever contacts the striker plate, forcing the letter space roller out from the threads of the screw shaft.

Carrier Return Solenoid and Detent Pawl Adjustment

Position the detent plate assembly so that the detent pawl fits centrally between two teeth on the detent shaft. With the core of the carrier return solenoid placed against its stop inside the solenoid, adjust the nut (4-48) at the back of the solenoid so there is a clearance of .056" ± .002" between the nut and the solenoid. See Figure 4-17. (NOTE: The .056 ± .002 clearance can be adjusted before assembly.)

Set the solenoid mounting screws so that there is a slight drag between the solenoid bracket and the detent plate. With the core of the solenoid held against the stop inside the solenoid, position the solenoid so there is a clearance of .005 ± .002" between the bottom end of the detent pawl and the teeth on the detent shaft. (To perform this adjustment, place a .056" gauge between the nut and the solenoid, and then adjust the clearance between the detent pawl and the tooth of the shaft.) Check to see that the .005 ± .002" clearance between the pawl and the shaft extends the full length of the shaft. Also check that the solenoid screw and the link are aligned as shown in Figure 4-17.

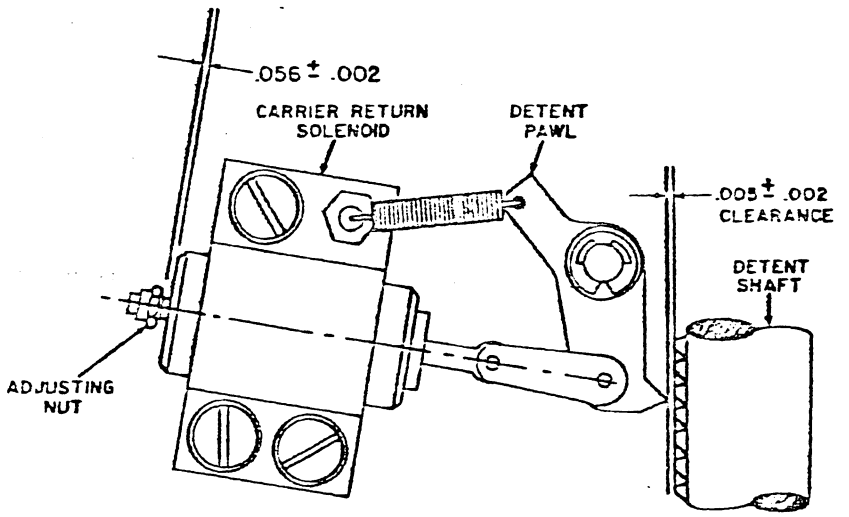


Figure 4-17. Carrier Return Solenoid and Detent

Timing Wheel and Signal Assembly Adjustment

The assembly should be aligned so that the timing disc serves the assigned shutter function by rotating freely between the Light Emitting Diode (LED) and the Sensor. If necessary, center the timing disc by moving the disc assembly as required.

Print Wheel and Timing Disc Relationship

NOTE: Either method described below is acceptable; however, the method using the oscilloscope will help to cut down the possibility of human error.

Visual Adjustment

Position the first character (!) on the print wheel in line with the print hammer. Loosen the clamp on the flywheel and rotate the timing disc counter-clockwise until the space between the fifth and sixth narrow slots is in line with the Sensor and the LED. Tighten the clamp. Refer to Figure 4-18.

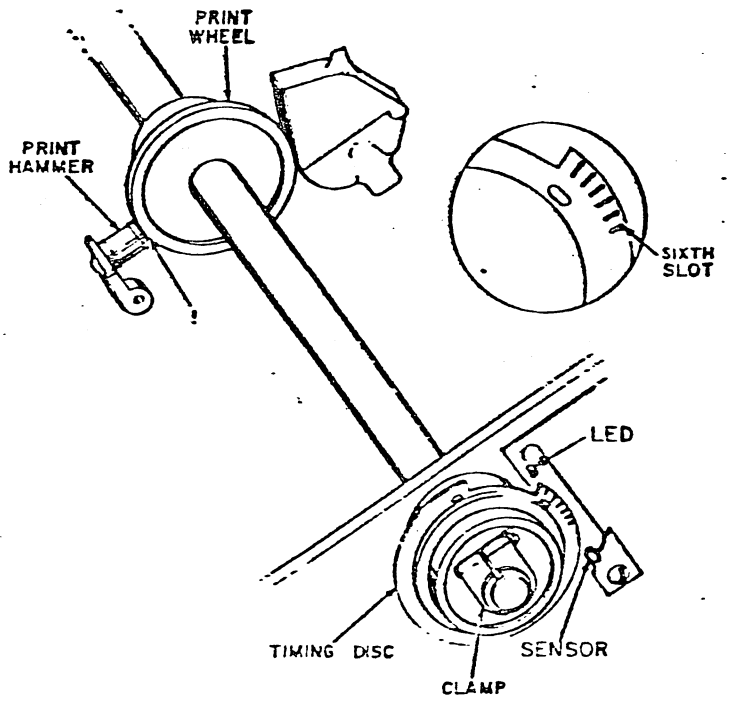


Figure 4-18. Print Wheel-Timing Disc Relationship

Adjustment - Using Oscilloscope

If the system power circuit is designed so that the +5V DC can be turned on without supplying AC power, and an oscilloscope is available, the adjustment can be performed as follows:

1. Turn the printer logic power on (+5V DC only).
2. Connect the oscilloscope probe to terminal 5 (white wire) on the signal assembly sensor board.
3. Connect the ground to terminal.
4. Line up the first character (!) on the print wheel with the print hammer and manually turn the flywheel assembly counter-clockwise until the leading edge of the space between the fifth and sixth narrow slots in the timing wheel causes the signal transition from +5 volts to ground. Find the middle point between the fifth and sixth slots, then tighten the clamp.

Timing Disc Versus Letter Space Roller Adjustments

The optimum setting of the timing disc versus letter space roller is attained by the following step-by-step adjustments.

Manually position the main carrier approximately in the center of the writing line, and place the printer on its back side so that a clear view of the carrier return pawl can be obtained.

With the carrier locked in this position, check to see that the carrier detent pawl is seated in the tooth of the detent shaft.

Manually engage the letter space roller with the aid of the solenoid armature. Slowly rotate the print wheel shaft until the letter space roller is fully engaged. Hold the roller in this position and slowly continue rotating the print wheel shaft until the carrier return pawl just drops into the next column position. Hold the print wheel in this position and check the position of the timing disc. The 65th slot should be directly in line with the LED and the Sensor.

Relocate the main carrier to the 131st column position, then repeat the above procedure and note the timing disc slot position when the carrier return pawl drops into the 132nd column position on the detent shaft. The timing disc slot reading should not be greater than slot 71.

Repeat the procedure at the first column position and note the timing disc slot position.

Due to tolerance buildup, it is permissable to deviate from the 65th slot setting a the middle of the writing line by recording the readings from the first and

132nd column positions, and selecting a midpoint for the actual setting. (NOTE: Deviation from the 65th slot reading should not be more or less than two slots.)

This fine-tuning procedure will increase the reliability of the letter space roller operation by minimizing friction of the roller with the left side of the feed screw thread during roller engagement.

Print Hammer Position and Curvature Alignment

Using T-18867. position the hammer assembly as shown in Figure 4-19, with the mounting screws. pivot screw and the adjustment screw slightly torqued. The short side of the alignment tool must be resting on the hammer housing as shown, the long end rests on the print wheel shaft and the .060" feeler of the alignment tool is between the print wheel and the hammer housing. Tighten the mounting screws. pivot screw and the adjustment screw. (NOTE: For this adjustment. the front and rear paper guides must be removed. The guides can be removed by removing their two mounting screws respectively. The rear guide is spring loaded – do not loose the spring).

Hammer Armature Core

Slightly loosen the armature core mounting screws. Adjust the core so that the armature is flush against both surfaces of the core and the print hammer protrudes beyond the block by .031 ± .001". Tighten the mounting screws. Refer to Figure 4-20. With the hammer in this position the clearance between the hammer face plate and the type wheel should be .028 to .030". Install rear paper guide.

Hammer Armature Air Gap (Initial Setting)

Position the armature against the core. Place a .020 to .025" gauge between the armature and the rubber tip of the damper screws. Adjust the damper screw until the above air gap is obtained. This setting may be revised under dynamic operating conditions. Refer to Figure 4-21.

Hammer Impression Control (Initial Setting)

Upon completion of armature core setting above. turn the impression screw clockwise until the retainer starts to move. then turn the screw additional one full turn . Refer to Figure 4-20. This setting may be changed during actual print-out of characters.

Print Hammer and Print Wheel Horizontal Alignment

Move the print wheel hub to the left against the yoke by applying a slight pressure. Hold the hub against the yoke and check to see that the print hammer is in line with the width of the print wheel.

Adjustments, if necessary, can be made by readjusting the traversing cable drums. Refer to Figure 4-21.

Tractor Guide and Belt Adjustment

Loosen the two mounting screws that secure the support plate. Place a .030 ± .005" feeler gauge between the belt and the belt guide. Position the support plate so that the tractor slides freely along the guide shaft. Tighten the mounting screws. (NOTE: The inside guide on both the right and left hand paper guide assemblies must be perpendicular to the lower guide shaft to within ± .015" in 2.5 inches. This will assure parallelism of both assemblies and assures flawless paper feeding.)

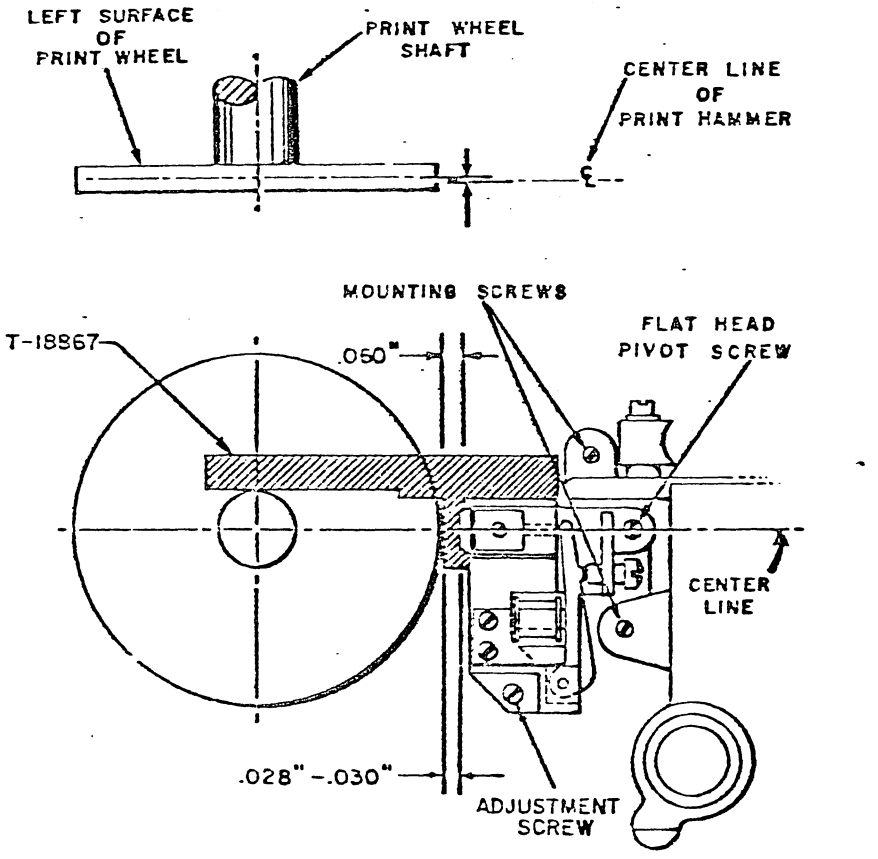


Figure 4-19. Print Hammer Position

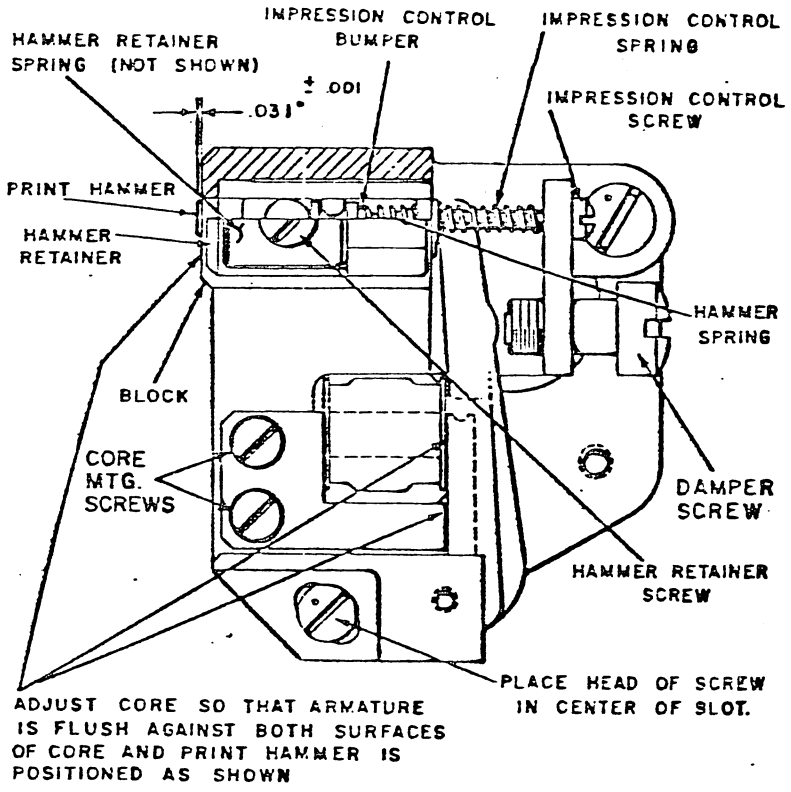


Figure 4-20. Hammer Armature Core

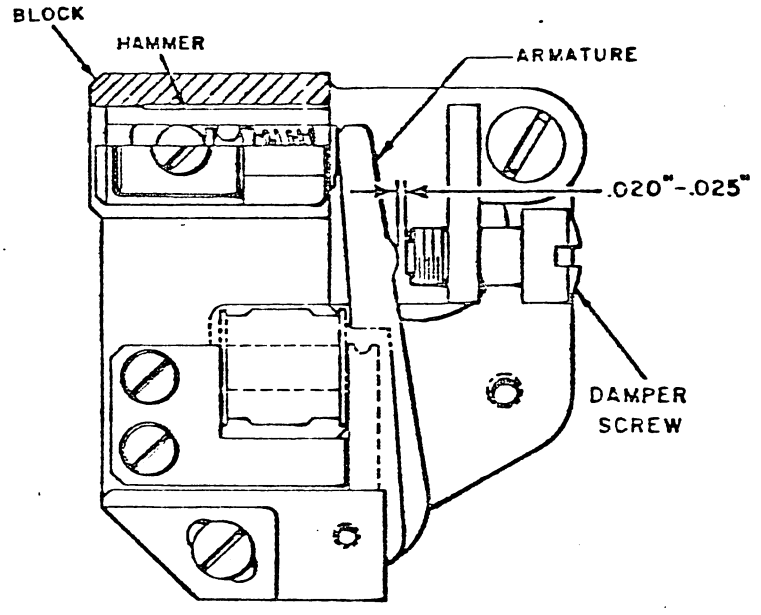


Figure 4-21. Hammer Armature Air Gap

The belt tension can be adjusted by loosening the mounting screws and sliding the plastic belt tensioner guide up or down, loosen or tighten, respectively. Check to see that both belts are of the same tautness. Tighten mounting screws.

Paper Cover Adjustments

The clearance between the upper mounting guide and the plastic cover must be set at .020" + .000" - .002". By means of the adjusting screws, maintain the same clearance between the steel cover and the plastic belt guide for the full length of the cover.

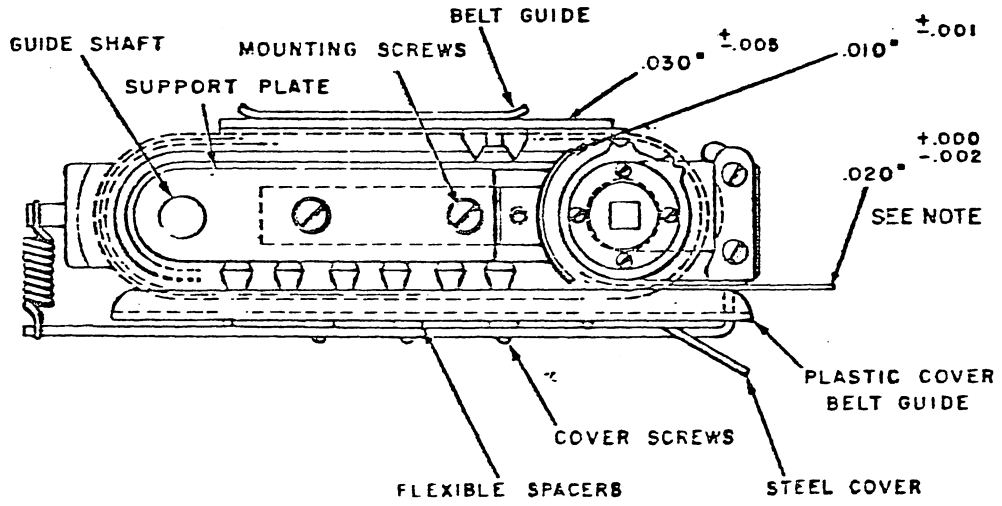
The object is to maintain the .002" allowable variance between the feed pins and the plastic belt guide for six pins against the pin guide. See Figure 4-22.

Belt Pin Alignment

Align the link pins between tractors within .005" by rotating the belt drive pulley relative to the drive hub. (NOTE: Loosen the four screws on the drive hub for this adjustment.)

Paper Feed Clutch Spring Stop Adjustment

With the clutch spring relaxed around the hub, insert a .001" feeler gauge between the clutch spring and the clutch spring stop. Move the stop against the feeler and secure the stop by tightening the screw. (NOTE: This can be done before assembly.)



NOTE:
THE RESULTANT CLEARANCE MUST NOT VARY MORE THAN .002" FOR THE SIX PINS AGAINST THE PIN GUIDE.

Figure 4-22. Paper Cover

Paper Feed Clutch Support Plate Bearing Alignment

Insert the smaller diameter (.274") end of the paper feed clutch shaft inside the clutch hub, and align the support plate so that the hub turns freely. (NOTE: The .274" diameter is for alignment purposes only and the shaft must be repositioned when the knob pin is in place and the shaft is moved to the left for collar and the end play adjustment.)

Paper Feed Clutch Shaft End-Play

Adjust the collar on the left-hand side of the machine so that the end-play of the clutch shaft is from .001 to .003".

Paper Feed Clutch Armature Mounting Block

Loosen the screws on the armature mounting block. Position the armature mounting block so that the end of the armature seats squarely between the ratchet teeth. Tighten the mounting screws.

Paper Feed Clutch Coil and Yoke Assembly

Loosen the coil and yoke assembly mounting screws. With the armature against the pole face of the core, position the coil and yoke assembly so that the clearance between the end of the armature and the outside diameter of the control ratchet is from .002 to .005". Tighten the mounting screws. See Figure 4-23.

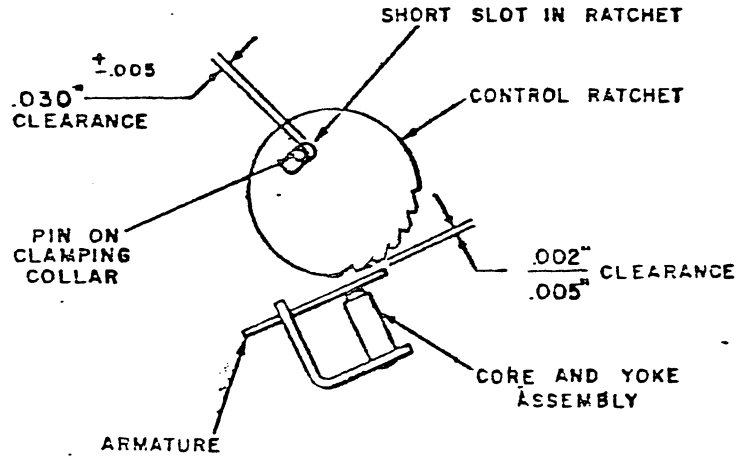


Figure 4-23. Paper Feed Clutch Coil and Yoke Assembly

Paper Feed Clutch Hub Pin

With the wrap spring relaxed, adjust the clamping collar so that its pin is .030" ± .005" from the end of the short slot in the control ratchet. See Figure 4-23. Also, when the clutch spring is in its released position, check for a clearance of .001" between the plastic stop and the clutch spring. See Figure 4-24. (NOTE: Check this only if adjustments were not made before assembly.

Paper Feed Clutch Anti-Backup Pawl

Loosen the anti-backup pawl mounting screws. Position the pawl so that the end of the pawl seats squarely between the teeth of the holding ratchet. Tighten the mounting screws.

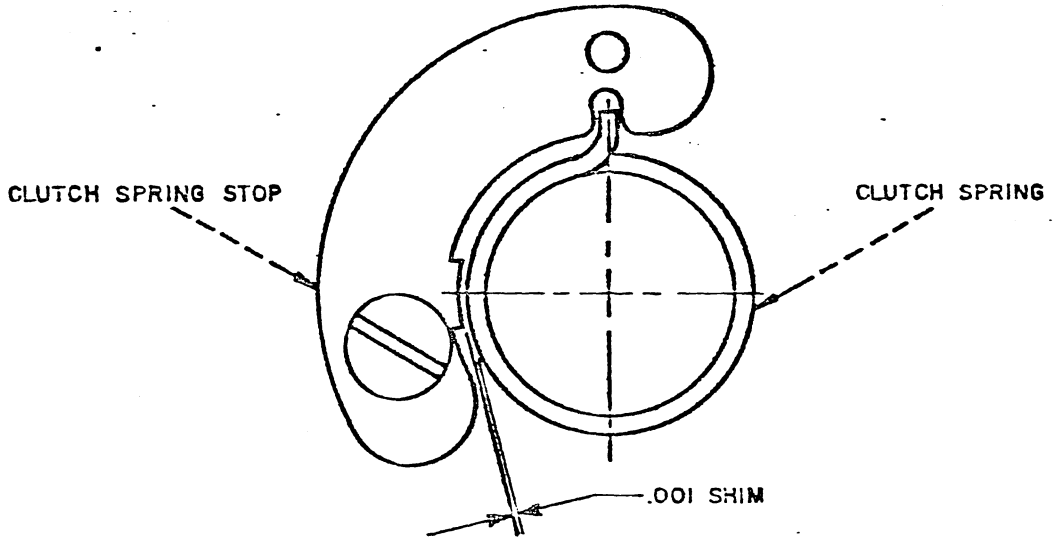


Figure 4-24. Paper Feed Clutch Hub Pin

Paper Feed Clutch Holding Ratchet

Loosen the holding ratchet mounting screws. Position the holding ratchet so that the detent pawl falls into the holding ratchet with a clearance of .002 to .007" when the armature is firmly latched in the control ratchet. At this time, the stop pin is at the end of the short slot in the control ratchet. Tighten the mounting screws. See Figure 4-25.

Right-Hand Limit Switch

NOTE: In order to perform this adjustment the horizontal vernier should be adjusted to extreme left, the left hand paper guide assembly positioned to the extreme left, and a 14-7/8 inch paper form inserted.

Position the carrier at column 133. The switch should be open. Adjust the magnet on the hammer carrier and the reed switch bracket on the right paper tractor to have the switch close between columns 133 and 134.

For this adjustment it is recommended that a meter or test light be used across the reed switch to determine the actual closing of the switch.

Paper-Out Switch

Adjust the switch lever so that the plunger in the paper-out switch is fully depressed when the contact surface of the lever is on the paper line. See Figure 4-26.

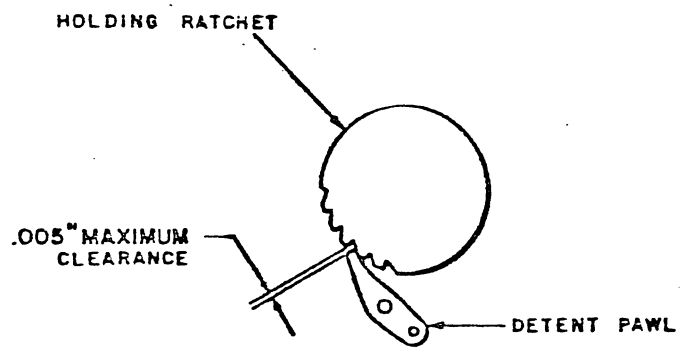


Figure 4-25. Paper Feed Clutch Coil Holding Ratchet

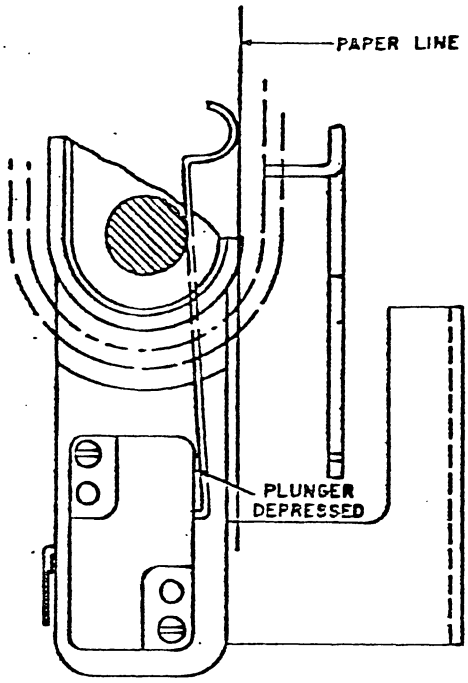


Figure 4-26. Paper-Out Switch

Motor Belt Tension

Adjust the belt tensioner so that a force of 16 ounces on the top side will deflect the belt from .28 to .34".

Clutch Belt Tension

Position the idler pulley so that a force of 4 ounces on one leg of either belt will deflect the belt from .06 to .12".

Front Paper Guide Alignment

Align the window in the front paper guide around the print hammer so that the guide opening is centrally located around the print hammer. In order to determine the proper position of the font guide the clearance between the right side of the print wheel and the front guide should be .140 ± .005". The front paper guide must be parallel with the paper. See Figure 4-27.

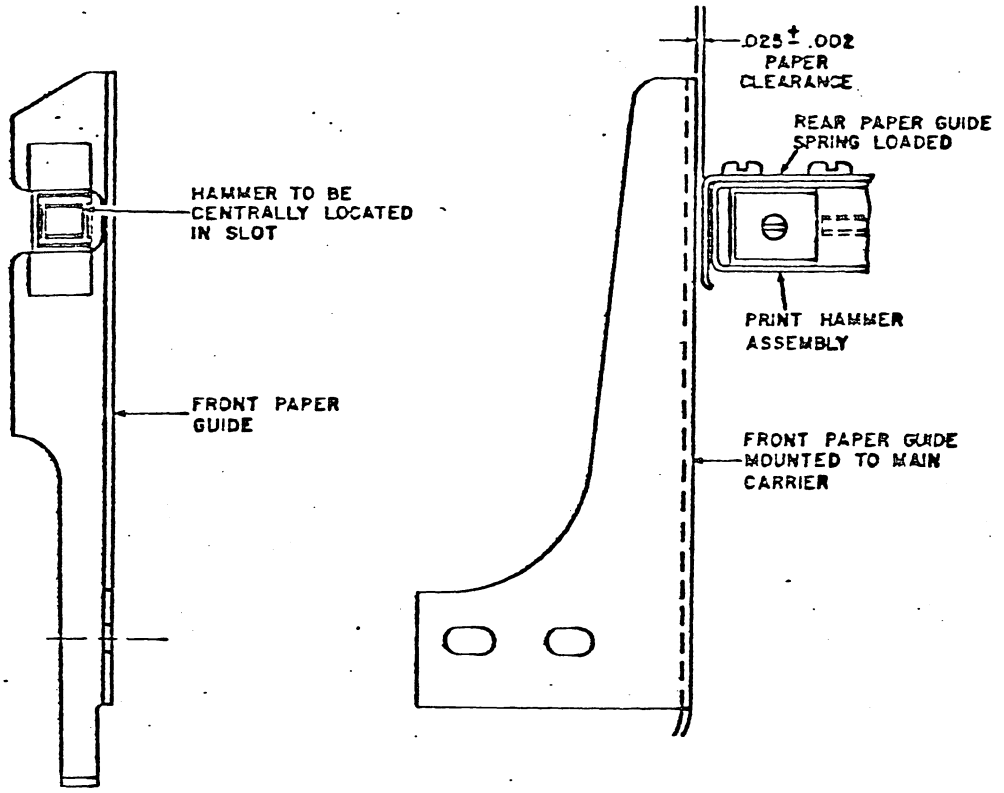


Figure 4-27. Front Paper Guide

With the rear paper guide compressed against the hammer block, position the front guide so that there is .025 ± .002" clearance between guides, for initial setting. (NOTE: If smudging is noted on the first form the front guide is too close to the print wheel. If the guide window image can be seen on the first carbon copy; the guide is too close to the hammer. In either case reposition the front guide.)

In case the rear paper guide is removed, the clearance between the working face of the front paper guide and the front edge of the hammer block should be .045 to .048". In either case, the front paper guide must be perpendicular to a line extending through the center of the print wheel shaft and the center line of the print hammer.

Print Impression Control

Multiple-Copy Form Set-Up

1. Feed a six-part, 14-7/8 inch paper form into the machine. Use Standard Register form or equivalent. Original should be 12-pound, white bond; intermediate sheets should be 10-pound white Stancote. The last sheet should be 12-pound white bond. Carbon should be No. 512, full width, and

have both sides crimped. The single-part form should be 20-pound white bond. (NOTE: Be sure that the paper is feeding freely from the paper supply to the printer. Align the paper supply rack, if necessary, to assure proper paper feeding.)

2. With paper in the machine, the plastic cover on the timing wheel, and all devices checked out, the machine is ready to print.

3. Print all the characters on the type wheel and observe for paper tear on the front pages. If paper tear on the front page is noted, decrease the hammer impression by turning the impression control screw clockwise. Do this in very small increments until the paper cutting just disappears. If there still is paper tear, decrease the air gap between the hammer core and the armature by turning the plastic damper screw counterclockwise in very small increments. If there is no paper tear and the characters are printing very light, increase the impression and the air gap between the hammer core and armature to the point just before the paper tears and slight embossing occurs on the front page (turn impression control and damper screw counterclockwise). Check the last copy to determine if it is legible. If the last copy is completely illegible, increase the amount of embossing on the front page. For adjustments refer to Figure 4-20.

4. Adjust the copy control trim potentiometer on control panel so that ghosting is minimized at the tops and bottoms of the characters.

Single (1-Part) Form Set-Up

NOTE: Before any adjustments are made tune in all characters by adjusting copy-control for proper print hammer timing.

1. Remove the 6-part form and insert a 1-part form.

2. Print all the characters on the print wheel and observe for paper tear. If there is paper tear, move the impression control retainer to the rear of the machine by turning in the spring-loaded retainer adjusting screw clockwise. Refer to Figure 4-20. Make the adjustment in small increments, just until paper tearing stops.

3. Check the first character printout. Allow the machine to idle at the left-hand margin position for 30 seconds before printing. If the first character is not printed after a delay, readjust the impression control retainer toward the front of the machine, and at the same time decrease the air gap between the hammer core and the armature by turning the damper screw clockwise.

4. Recheck the 6-part form and compare it with the first 6-part form printout. If necessary, readjust the impression control retainer very slightly to obtain good performance on the 6-part form. Recheck the 1-part form printout.

5. In case smudging appears on the first sheet, the front paper guide is too close to the print wheel. Adjust the guide away from the print wheel, still maintaining the paper clearance of .025 ± .002" paper clearance. If the guide window image is appearing on the first carbon copy, the front paper guide is too far from the print wheel.

PREVENTIVE MAINTENANCE PROCEDURES

General

Other steps and procedures necessary to assure trouble-free operation of the HSP-30 are semi-annual preventive maintenance (performed by experienced service personnel) and weekly checks (performed by the printer operators to assure trouble-free operation).

The frequency of the preventive maintenance and checks is dependent on the usage of the printer in the system.

Semi-Annual Preventive Maintenance

To assure optimum performance, at least two preventive maintenance calls per year should be performed on the HSP-30. The procedure below should be used as a guide:

1. Clean all guide shafts and the feed screw with a good cleaning solvent. Cleaning solvent (Part Number T-18375) is recommended. Re-lubricate all shafts, except the print wheel shaft, with Number 10 lubricant, and wipe off the excess grease so that there is a thin film of lubricant left on the shafts.

   The print wheel shaft should be cleaned and lubricated with Number 14 oil. (The print wheel bearing is impregnated in a special oil.)

2. Clean the entire machine and lubricate as detailed in the beginning of this section.

3. Check the print wheel and clean the characters using Type Cleaner (Part Number T-18347).

4. Check for worn parts and replace if necessary. If adjustable parts are replaced, refer to the adjustment section of this manual for proper adjustment procedures.

Printer Operator Responsibilities

1. An adequate supply of paper and ink rollers should be maintained at all times to assure uninterrupted printer operation.

   The ink rollers may be obtained from Singer Business Machines Service Materials, Rochester, New York, under Part Number 4003055 (Black Ink), or Part Number 1010545 (Dark Blue Ink). (NOTE: The life expectancy of an ink roller under normal use is approximately 10,000,000 characters, using both sides of the roller.

   The following conditions affect the life of an ink roller and should be considered when estimating an adequate ink roller supply:

   - Quality of forms (absorbent type lessens the expected ink roller life).
   - Desired print quality.
   - Environmental conditions.
   - Received data variations.
   - Writing line lengths.

   The ink roller can be reversed (turned around) to obtain maximum usage.

2. It is the operator's responsibility to keep the print area clean to prevent objects such as pencils, paper clips, hair pins, etc., from falling into the printer. This is of utmost importance in the case where the printer is operated without the top cover.

3. The operator should occasionally remove caked ink and accumulated dust particles from the print wheel. This may be accomplished by using type cleaner.

SECTION 5 INTENTIONALLY OMITTED

6 ILLUSTRATED PARTS LIST

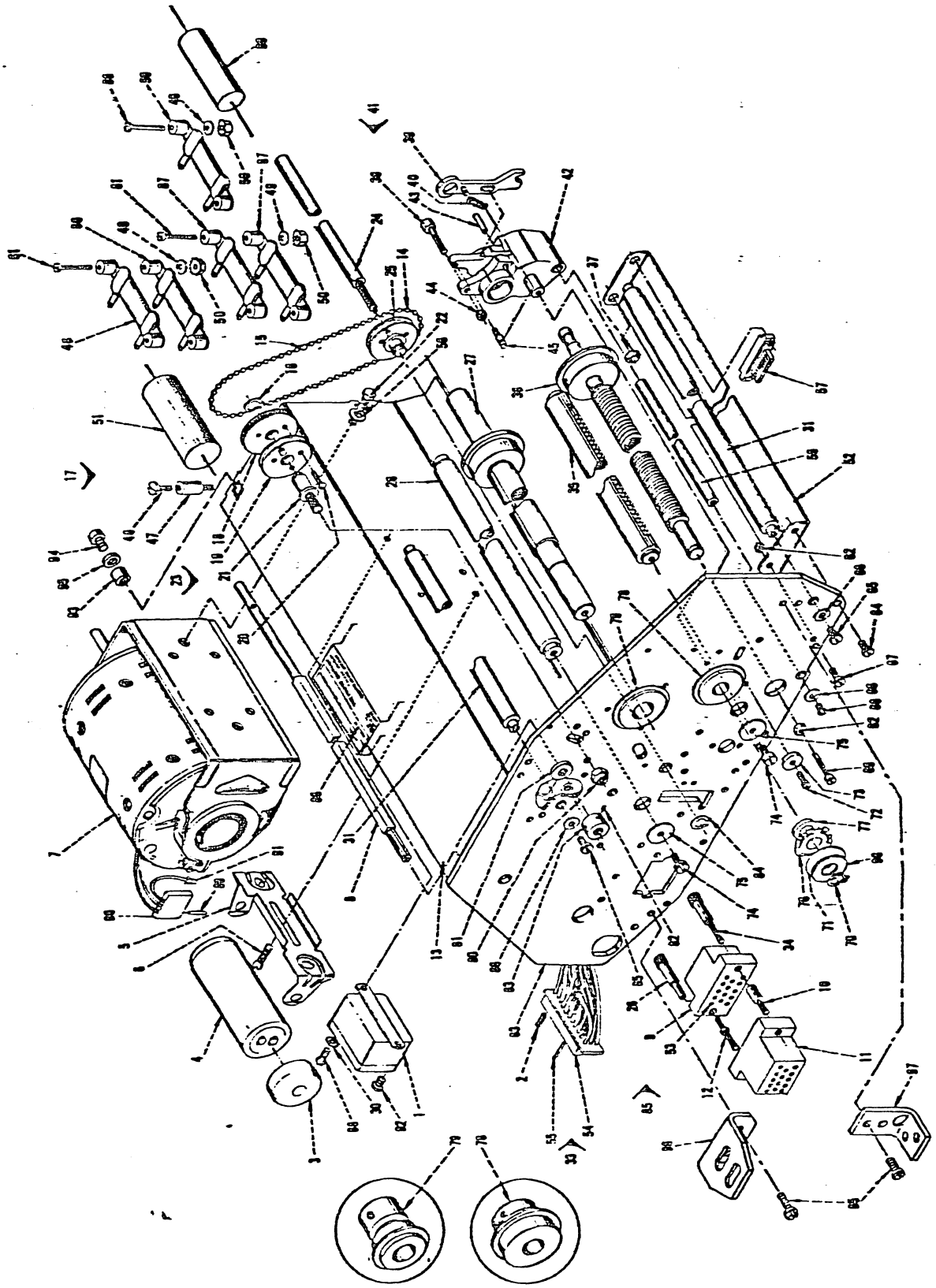


FIGURE 1 LEFT HAND SIDE PLATE

FIGURE 1 LEFT HAND SIDE PLATE

Item	Part Number	Description
1	4500447	Relay, Motor Start
2	4511182	Key, Locating
3	2002737	Cap, Capacitor
4	2002719	Capacitor, Motor (108-30 μf)
5	2002718	Bracket, Capacitor
6	89	Screw, 10-32 x 3/8" Flat Head P
7	1009945	Motor, Assembly 115V. 60 Hz (includes Items 89, 90, 91)
8	1008023	Shaft, Paper Drive
9	4500315	Connector
10	4500494	Socket Assembly (Female)
11	4500314	Connector, 14 pt (Male)
12	4500752	Socket Assembly (Male)
13	1007853	Motor Support Bracket
14	1052734	Chain, Bead
15	1058482	Connector, Bead
16	1054956	Retainer, Ring P
17	1059937	Thumbwheel Assembly Complete (includes Items 18, 19, 20)
18	1055461	Thumbwheel
19	1059960	Sprocket, Bead Belt
20	1049917	Screw, 4-40 x 1/2" Round Head P
21	1055417	Shaft, Thumbwheel
22	180894	Screw, 1/4-20 x 3/8" Hex
23	1007983	Motor Support Bracket Assembly (includes Items 1-7, 13, 22, 46-51, 56, 59-61)
24	1058230	Shaft, Paper Guide
25	1002842	Hub and Sprocket Assembly
26	4501828	Jackscrew(Female)
27	1007676	Shaft, Print Wheel (Old Models)
	1011136	Shaft Assembly, Print Wheel (New Models)
28	2014415	Rail, Hammer Guide
29	4509207	Terminal, Slip-on (not shown)
30	1056261	Lockwasher, ID 9/64" x 1/16" thick x OD 5/16" P
31	2014406	Rail, Guide (1010973 - New Rail, Guide)
32	4510499	Terminal (not shown)
33	1008504	Harness Assembly 5V (includes Items 7, 9, 26, 29, 32, 34, 53, 54, 55)
34	4501064	Jackscrew (Male)
35	2014281	Shaft, Main Escapement
36	2015017	Screw, Helical Feed (Old Models)
	1011135	Shaft Assembly, Helical Screw (New Models)
37	4510811	Grommet
38	1059813	Magnet and Screw Assembly
39	1050502	Lever, Margin Set Assembly
40	6001351	Spring, Margin Lever
41	1003136	Dash Pot and Roll Pin Assembly (includes Items 42 and 43)
42	1000019	Dash Pot

Item	Part Number	Description
43	1003137	Pin, Dash Pot
44	1003402	Nut, Magnet Screw
45	1050596	Stud, Lever Spring
46	4510091	Resistor, 5 Ohm, 40W
47	1007982	Standoff
48	4000808	Screw, 6-32 x 3/16" P
49	1040236	Washer
50	4000082	Locknut
51	4510957	Capacitor, 150μf, 150V, P
52	1002540	Tray, Ribbon Cable
53	1051786	Contact
54	4511186	Connector (32 Pin, Amp)
55	4511181	Contact
56	4000349	Lockwasher, 1/4"
57	1052814	Connector, Flat Cable (Female)
58	1051160	Guide, Dash Pot
59	4510566	Resistor, 40 Ohm, 55W
60	4510094	Resistor, 25 Ohm, 40W
61	4001131	Screw, 8-32 x 1-1/8" Fillister Head
62	1040498	Locknut, 8-32 Hex P
63	1007718	Plate, End
64	186759	Screw, 8-32 x 5/16" Binding Head P
65	28413	Screw, 10-32 x 5/16" Pan Head P (see Note 1)
66	1090047	Washer, Id 13/64" x 1/16" thick x OD 7/16" P (see Note 1)
67	34512	Screw, 8-32 x 3/8" Binding Head P
68	4001232	Screw, 6-40 x 3/16" Binding Head P
69	1050599	Screw, Dash Pot Adjustment
70	2014298	Ring, Retaining P (Old Models)
71	2014392	Washer, Thrust (Old Models)
72	1057233	Screw, 6-40 x 5/16" Fillister Head P
73	1051427	Retainer, Bearing
74	32042	Screw, 10-32 x 3/8" Binding Head P (see Note 1)
75	2014640	Washer, ID 3/16" x 3/4" OD P (see Note 1)
76	2014390	Washer, Spring P (Old Models)
77	1051881	Spacer, Screw Shaft (Old Models)
78	2014325	Bearing, Ball (Helical)
	1009564	Bearing, Ball (Helical, New Models)
79	2014326	Bearing, Ball (Print Wheel Shaft)
	1009565	Bearing, Ball (Print Wheel Shaft, New Models)
80	2015394	Locknut, 1/4-20 Hex P
81	1051216	Bearing
82	1058019	Setscrew, 8-32 x 3/16" P
83	1001368	Collar, Clutch Shaft
84	4001050	Ring, Retaining P
85	1008134	L.H. Plate Assembly Complete (includes Items 63, 72, 73, 78, 79 and 81)
86	1052791	Plate, Specification (Blank)

Item	Part Number	Description
87	4510668	Resistor, 75 Ohm, 55W
88	641	Screw, 8-32 x .750 Long
89	4509136	Pin (mates with 2010576 - not shown)
90	4510020	Connector, Mate-N-Lock (mates with 4510021 - not shown)
91	4503244	Terminal, Ring
92	1056803	Screw, Brass
93	1007899	Locknut
94	4000270	Screw, 8-32 x .5 Long
95	6004008	Washer
96	1008915	Spacer (as required) (Old Models)
97	1008661	Mounting Bracket - L.H. Front
98	1008662	Mounting Bracket - L.H. Rear (also R.H. Rear)
99	4506872	Capacitor, 280μf, 100V

NOTE 1

Units built in February 1972 and after will have "floating" hammer guide shafts; therefore, Items 65, 66, 74 and 75 are no longer used on hammer carrier guides. Item 93, No. 1008025 Spacer, shown on Figure 2 will be modified for these units.

Order Spacer, No. 1008025 Rev. A for old machines.

Order Spacer, No. 1008025 Rev. B for new machines.

FIGURE 2 RIGHT HAND SIDE PLATE

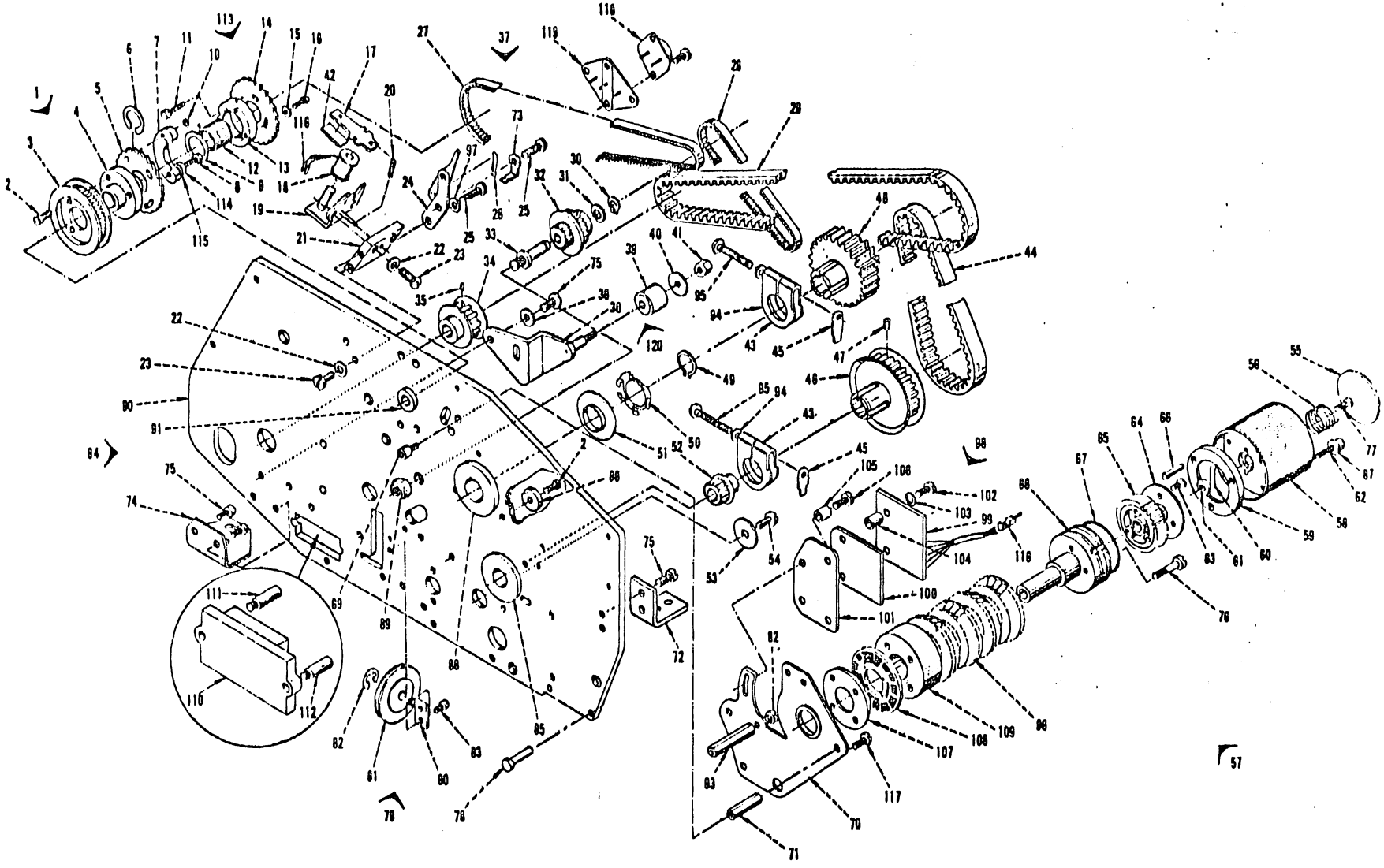


FIGURE 2 RIGHT HAND SIDE PLATE

Item	Part Number	Description
1	1001649	Hub Pulley Assembly Complete (includes Items 2 through 4)
2	1057233	Screw, 6-40 x 5 16" Fillister Head P
3	1010312	Pulley, Clutch (60T-40DP)
4	1001196	Hub, Sleeve
5	1051235	Control Ratchet Assembly
6	1051215	Ring, Retaining P
7	1000373	Stop, Spring
8	1001217	Screw, 4-48 x 11 32" Hex P
9	1000380	Spacer, Spring P
10	4000392	Ring, Retaining P
11	1000848	Screw, Hex Socket, 4-48 x .625
12	1000361	Spring, Clutch
13	1000808	Hub, Clutch Assembly
14	1000374	Ratchet, Clutch Detent
15	1090199	Washer, ID 9 64" x 1 32" thick x OD 9 32"
16	4001223	Screw, 6-40 x 23 64" Hex
17	1000701	Armature
18	1009589	Clutch Coil Assembly (including Item 116 - available in assembly only)
19	1000778	Coil Bracket Assembly
20	1002661	Spring, Clutch Armature
21	1000713	Plate, Clutch
22	1091121	Spacer, ID 3 16" x 1 16" thick x OD 3 8"
23	4000270	Screw, 8-32 x 1 2" Pan Head P
24	1009049	Pawl Plate Assembly
25	4000458	Screw
26	6001008	Spring, Clutch Detent
27	1000525	Belt, Timing-Clutch
28	1000524	Belt, Timing-Idler
29	2006591	Belt, Timing (Motor)
30	1002255	Ring, Retaining P
31	105368	Washer, ID 17 64" x 1 32" thick x OD 7 16"
32	1000473	Puller, Compound Idler
33	1052244	Shaft, Idler
34	2001553	Motor Pulley Assembly (includes Item 35)
35	4000815	Setscrew, 8-32 x 3 16" P
36	1090047	Washer, ID 13 64" x 1 16" thick x OD 7 16" P
37	1010083	Idler Pulley Assembly (includes Items 30-33)
38	1003417	Bracket Assembly
39	1001331	Bearing, Double Row
40	1090522	Washer, ID 5 32" x 3 64" thick x OD 3 3" P
41	4001031	Nut, 6-32 Hex P
42	2013161	Residual Strip
43	1050634	Clamp
44	2014471	Belt, Timing

FIGURE 2 RIGHT HAND SIDE PLATE

Item	Part Number	Description
45	2014363	Nut, Clamp
46	1051950	Pulley and Bushing Assembly (includes Item 47)
47	4000907	Setscrew, 8-32 x 1/4" Fluted P
48	1007610	Compound Pulley Assembly
49	2014436	Ring, Retaining P
50	2014390	Washer, Spring P (not on new machines)
51	2014391	Washer, Hub (not on new machines)
52	1051251	Pulley
53	2014640	Washer, ID 3/16" x OD 3/4" P
54	32042	Screw, 10-32 x 3/8" Binding Head P
55	1010374	Disc, Knob
56	1007912	Spring, Knob
57	1008177	Knob Assembly Complete (includes Items 58, 59, 62 and 87)
58	1008121	Knob
59	1059790	Ratchet
60	1057122	Pin
61	1059835	Washer, ID 17/64" x 3/32" thick x OD 25/64"
62	6002118	Screw, 4-40
63	1008157	Screw, Self-Tapping
64	1059783	Driver, Clutch
65	1008014	Spline, Clutch
66	1008013	Roller
67	1008015	Spring, Override
68	1008008	Clutch Hub and Bearing Assembly
69	1001412	Screw, 8-32 x 5/16" Hex Socket P
70	1008028	Clutch Hub Support Assembly
71	1001169	Spacer
72	1008680	Bracket, Mounting
73	1008688	Washer, Spring Tab
74	1008662	Bracket, Mounting (rear)
75	28413	Screw, 10-32 x 5/16" Fillister Head
76	1008087	Screw, 4-40 x 7/8" Fillister Head
77	1047624	Screw, 8-32 x 3/16"
78	1059812	Standoff
79	2014351	Cable Pulley Assembly Complete (includes Items 80, 81 and 82)
80	2014349	Cable Pulley Bracket Assembly
81	2014305	Pulley and Bearing Assembly
82	1002255	Ring, Retaining P
83	38262	Screw, 4-40 x 1/4" Fillister Head P
84	1008133	R.H. End Plate Assembly Complete (includes Items 2, 78, 85, 86, 88 and 90-93)
85	204325	Bearing, Ball (Helical)
86	1051427	Retainer, Bearing
87	1055821	Washer
88	2014326	Bearing, Ball (Print Wheel Shaft)
89	2015394	Locknut, 1/4-20 Hex P
90	1007718	Plate, R.H. End

Item	Part Number	Description
91	1051217	Bearing, Paper Feed
92	1008024	Screw
93	1008025	Spacer (units built in February 1972 and after, specify 1008025 Rev. B)
94	1091121	Washer, ID 3/16" x 1/16" thick x OD 3/8"
95	1008359	Screw, 10-32 x 1-1/8" Hex Head
96	1008318	Sprocket
97	1008886	Washer
98	1009599	Sensor Assembly - Line Count Generator (includes Items 99-104)
99	1007929	P.C. Board Assembly, Sensor (see Figure 5 for assembly details)
100	1007928	P.C. Board Assembly, Emitter (see Figure 5 for assembly details)
101	1008814	Nut Plate
102	1009555	Screw, 4-40
103	1008038	Spacer
104	1008040	Spacer
105	1055821	Spacer
106	1044523	Screw, 4-40 x 3/16"
107	1008104	Nut, Ring
108	1007961	Disc, Line Sensor
109	1008103	Spacer
110	4500314	Connector, 14 Point, Male
111	4500494	Socket Assembly - Female
112	4500752	Socket Assembly - Male
113	1010086	Clutch Assembly (includes Items 1-16, 63-68, 70, 76, 96, 107-109)
114	6004004	Lockwasher, No. 4
115	1866	Washer
116	1051785	Terminal
117	4000111	Screw, Flat Head, 4-40 x .25
118	4511500	Transistor
119	4508388	Mounting Kit, Transistor
120	1010078	Belt Idler Assembly (includes Items 38-41)

FIGURE 3 MAIN CARRIERS

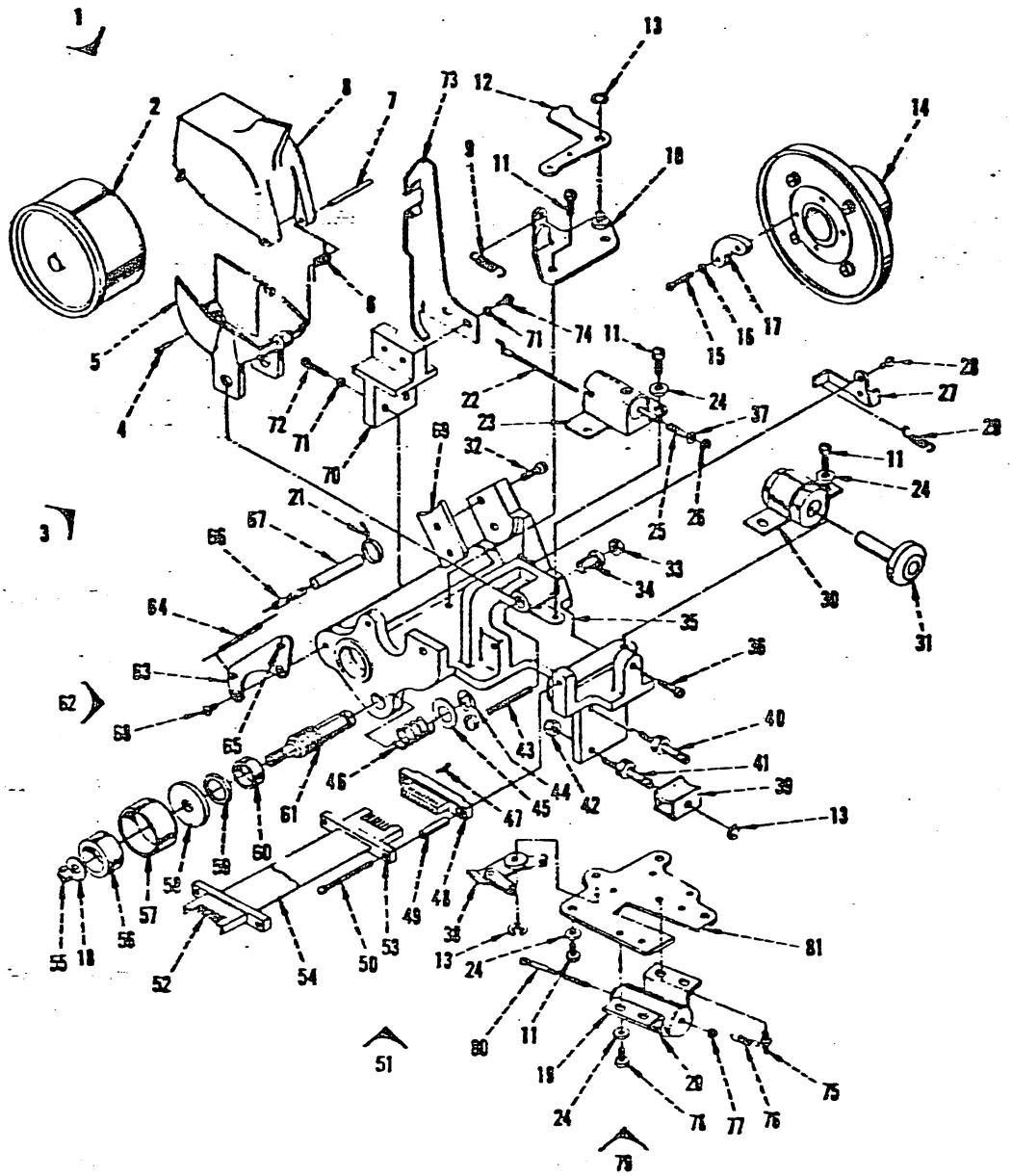


FIGURE 3 MAIN CARRIERS

Item	Part Number	Description
1	1008308	Main Carrier Assembly Complete (9-13, 18, 22-24, 27, 28, 30, 35, 36, 38-42, 55, 69, 75, 76, 78, 79, 81)
2	4003055	Roller, Ink (see Options)
3	1008288	Cartridge Ink Roller Assembly Complete (includes Items 4-8) (Cartridge Assembly without Indicator, Order 1000387)
4	1000418	Pin, Ink Roller
5	1052553	Cartridge, Ink Roller - Lower
6	1052542	Spring, Ink Roller
7	1052580	Pin, Cartridge
8	1008159	Cartridge, Ink Roller - Upper (Upper Cartridge without Indicator, Order 1052554)
9	1058956	Spring, Return
10	1059423	Lever Release Bracket Assembly
11	34512	Screw, 8-32 x 3/8" Binding Head P
12	1059410	Lever, Retractor (Old Models)
	1009281	Lever, Retractor (New Models)
13	1092125	Ring, Retaining P
14	1010053	Print Wheel and Hub Assembly Complete (includes Items 15-17)(see Options for international)
15	4000449	Screw, 4-40 x 1/2" Pan Head P
16	1866	Washer, Flat, ID 1/8" x 1/32" thick x OD 1/4" P
17	1050617	Plate, Key
18	1044507	Lockwasher
19	1007181	Solenoid Assembly (includes Item 47)
20	1008925	Residual, Carrier Return Solenoid (not shown)
21	4504028	Tie Wrap
22	1001104	Link, Retractor
23	1000749	Plunger and Housing Assembly Complete (includes Items 25, 37 and 26)
24	4000233	Washer, ID 3/16" x 1/16" thick x OD 3/8"
25	1052665	Spring
26	1056152	Ring, Retaining P
27	1000426	Bracket, Spring Anchor
28	1090003	Screw, 6-40 x 1/4" Fillister Head P
29	1004330	Spring, Ink Cartridge
30	1007291	Letter Space Solenoid Assembly Complete (includes Items 31 and 47)
31	1004647	Rod, Push Assembly
32	34512	Screw, 8-32 x 1/2" Binding Head P
33	2014643	Nut, 8-32 Hex P
34	1000428	Bushing, Ink Roller
35	1059382	Main Carrier Casting Assembly
36	1059521	Screw, Nylon Adjustment
37	1090336	Spacer (as required) ID 13/64" x 1/64" thick x OD 7/16"
38	1000768	Detent Pawl Assembly
39	1059415	Bearing Guide (Old Models)
	1010972	Bearing Guide (New Models)

Item	Part Number	Description
40	1059414	Stud, Bearing
41	2014086	Screw, Eccentric
42	2015290	Nut, Self-Locking P
43	52998	Screw, 8-32 x 1-1/2" Fillister Head P
44	1056265	Ring, Retaining P
45	1059305	Spacer, ID 11/32" x 1/64" thick x OD 5/8" P
46	4000186	Spring
47	4510499	Contact, Receptacle
48	1052814	Connector, Female
49	1000329	Spacer, OD 1/8" x 45/64"thick x OD 1/64" P
50	4001097	Screw, 4-40 x 1-1/8" Fillister Head P
51	1052792	Connector and Cable Assembly Complete (includes Items 52-54)
52	4510946	Pin, Contact
53	1052813	Connector, Male
54	1059533	Cable, Flat
55	3960	Locknut, 1/4-20 Hex P
56	1003606	Dash Pot Damper Assembly
57	1050595	Plunger, Dash Pot
58	1059306	Spacer, ID 17/64" x 1/8" thick x OD 1" P
59	1000684	Nut, Hex P
60	1001818	Spacer, OD 5/8" x 15/64" thick
61	1059290	Stud, Dash Pot
62	1008267	Block Assembly Complete (includes Items 63-65)
63	1001374	Block, Switch Mounting
64	4510873	Switch, Reed
65	1051863	Terminal
66	4504915	Wire, No. 24
67	4500240	Sleeving, A/R
68	4000111	Screw, 4-40 x 1/4" Flat Head P
69	2021802	Yoke, Print Wheel
70	1000679	Block, Paper Guide Mounting
71	1090199	Washer, ID 9/64" x 1/32" thick x OD 9/32"
72	1091029	Screw, 6-40 x 5/16" Fillister Head P
73	1003088	Guide, Front Paper
74	1057233	Screw, 6-40 x 5/8" Fillister Head P
75	1059808	Stud, Detent
76	1059830	Spring, Detent Pawl
77	1059729	Nut, 4-48 Hex (included with Item 79)
78	4000269	Screw, 8-32 x 1/4" Binding Head P
79	1004055	Solenoid and Screw Assembly (includes Items 19, 20, 47, 77, 80,)
80	2011511	Screw, Adjustment (included with Item 79)
81	1059739	Detent Stud Plate Assembly

FIGURE 4 PRINT HAMMER AND CARRIER

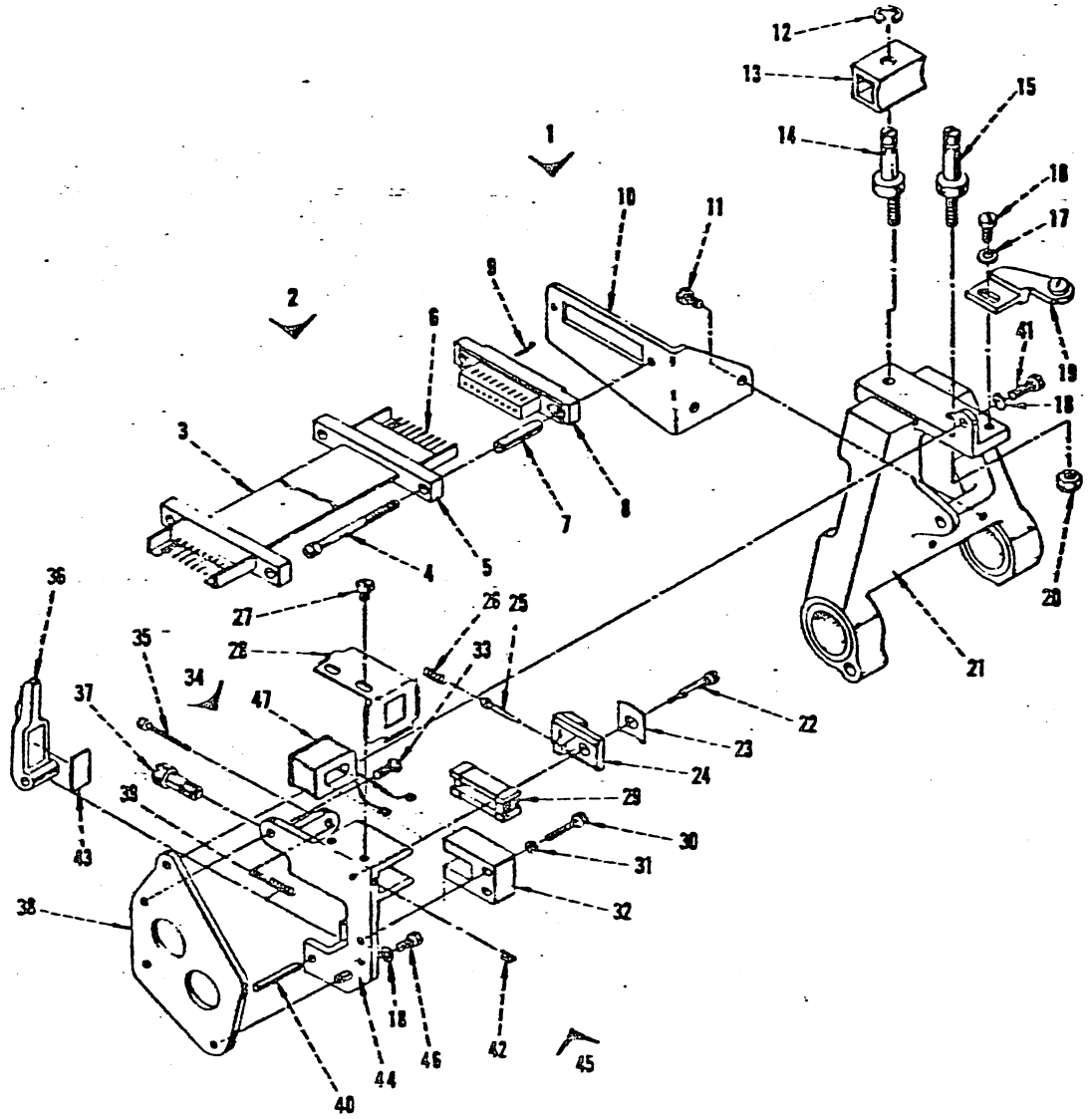


FIGURE 4 PRINT HAMMER AND CARRIER

Item	Part Number	Description
1	1001719	Hammer and Carrier Assembly Complete (includes Items 9-47)
2	1052792	Connector and Cable Assembly Complete (includes Items 3, 5 and 6)
3	1059533	Cable, Flat
4	4001097	Screw, 4-40 x 1-1/8" Fillister Head P
5	1052813	Connector, Male
6	4510946	Pin, Contact
7	1000329	Spacer, ID 1/8" x 45/64" thick x OD 11/64" P
8	1052814	Connector, Female
9	4510499	Contact, Receptacle
10	1052514	Bracket, Cable Connector
11	6002049	Screw, 6-32 x 1/4" Fillister Head P
12	1092125	Ring, Retaining P
13	1059415	Bearing, Hammer Guide
14	2014086	Stud, Hammer Guide Bearing (eccentric, rear)
15	1059414	Stud, Hammer Guide Bearing (stationary, front)
16	4000253	Screw, 4-40 x 1/4" Binding Head P
17	1866	Washer, ID 1/8" x 1/32" thick x OD 1/4" P
18	1010728	Washer
19	1001804	Magnet and Holder Assembly
20	2015290	Nut, Self-Locking P
21	1052507	Carrier, Hammer Mounting
22	1058349	Screw, Hammer Retainer
23	1052454	Spring, Hammer Retainer
24	1052424	Retainer, Hammer
25	1001936	Bumper, Impression Control
26	1052455	Spring, Hammer
27	1001567	Stud, Paper Guide Mounting
28	1001551	Guide, Rear Paper
29	1052447	Hammer Assembly
30	2009962	Screw, 4-40 x 7/16" Fillister Head P
31	6004004	Lockwasher, ID 1/8" x 1/32" thick x OD 3/16"
32	2009915	Core, Magnet
33	1041198	Screw, 6-40 x 1/4" Flat Head
34	1008602	Hammer Coil Assembly (includes Item 9 and 47)
35	1042976	Screw, 3-48 x 5/8" Fillister Head (Impression Control)
36	2009948	Hammer Armature Assembly
37	1050009	Screw and Insert Assembly
38	1052453	Plate, Mounting
39	1052456	Spring, Impression Control)
40	2013108	Pin, Pivot Hammer
41	6002940	Screw, 4-40 x 1/4" Pan Head P
42	1001552	Spring, Paper Guide
43	2013161	Strip, Hammer Magnet (anti-residual)
44	1052769	Block, Hammer Mounting
45	1000296	Hammer Assembly Complete (includes Items 22-26, 29-41, 43, 44, 46)
46	1010727	Screw, 4-40 x .31 Long
47	1008078	Coil, Hammer (available in 1008502 Assembly only - Item 34)

FIGURE 5 PAPER GUIDES, ESCAPEMENT DRUM AND TIMING

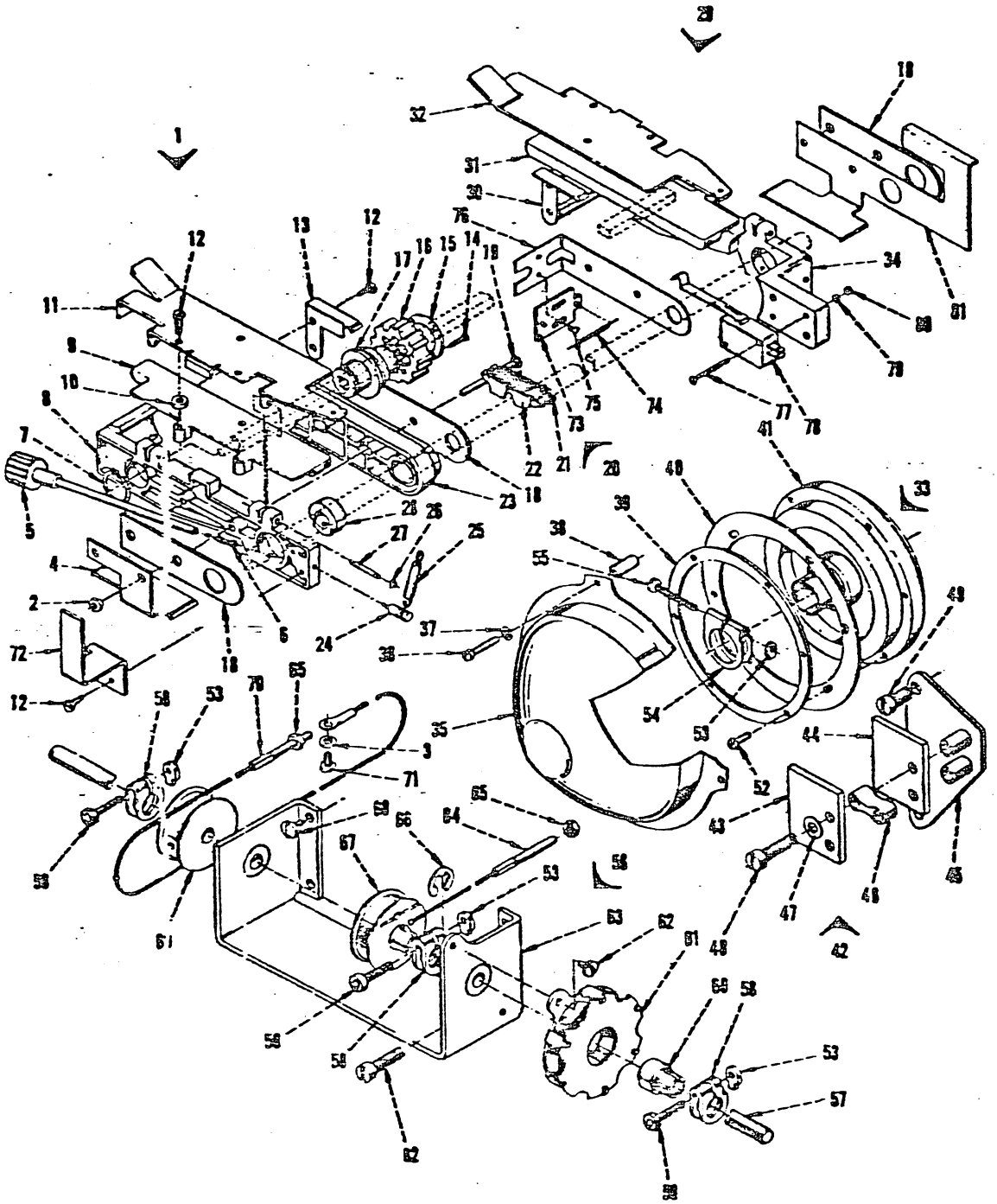


FIGURE 5 PAPER GUIDES, EXCAPEMENT DRUM AND TIMING

Item	Part Number	Description
1	1051666	L.H. Paper Guide Assembly Complete (includes Items 2, 4-23 and 72) (Old Models)
	1010759	L.H. Paper Guide Assembly Complete (New Models)
2	*4001031	Nut, 6-32 Hex
3	6004012	Washer, 9/64" x 5/16" x 1/32" thick
4	1001338	Guide, Belt, L.H.
5	*1003176	Molded Handle Assembly
6	*1003369	Clamp, Shaft
7	*2014436	Ring, Retaining
8	1051159	Guide, Mounting, L.H.
9	1051294	Guide, Paper, L.H.
10	*1050843	Spacer, 9/64" x 5/16" x 3/32" thick
11	1051337	Cover, L.H.
12	*1051958	Screw, 5/16" Pan Head Self-Tapping
13	1052232	Stripper, Paper, L.H.
14	*4000446	Screw, 2-56 x 1/4" Fillister Head
15	*1051620	Clamp, Drive Pulley
16	*1052218	Pulley, Drive
17	*1051621	Hub, Drive Pulley
18	1052235	Plate, Support
19	*4000857	Screw, 6-32 x 1-13/32" Fillister Head
20	*1000780	Belt and Link Assembly Complete (includes Items 21 and 22)
21	*1052098	Belt
22	*1052151	Link, Form Feeding
23	*1051158	Guide, Belt
24	*1051654	Pin, Spring
25	*6001423	Spring, Extension
26	*4000392	Ring, Retaining
27	*1050548	Pin, Hinge
28	*1003368	Holder, Clamp
29	1051665	R.H. Paper Guide Assembly Complete (includes Items 2, 5, 6, 7, 10, 12, 14-17, 19-28, 30-32, 34, 73, 74, 76-81) (Old Models)
	1010760	R.H. Paper Guide Assembly Complete (New Models)
30	1052231	Stripper, Paper, R.H.
31	1051295	Guide, Paper, R.H.
32	1051336	Cover, R.H.
33	1010087	Timing Disc Assembly (includes Items 39-41 and 52)
34	1051417	Guide, Mounting, R.H.
35	2015395	Cover, Protective
36	1004932	Screw, 4-40 x 13/16" Fillister Head
37	20038	Washer, 1/8" x 5/16" x 1/32" thick
38	1051688	Spacer, Plastic, 1/8" x 1/4" x 1/2" long
39	1008823	Ring, Support
40	1052232	Wheel, Timing, Character Count
41	2015332	Flywheel, Timing