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# **spinwriter<sup>TM</sup>**

## **THEORY OF OPERATION MANUAL**

023-6003

**NEC**  
**NEC Information Systems, Inc.**

Doc. No. 10001  
2-79



**spinwriter<sup>TM</sup>**

**THEORY OF OPERATION  
MANUAL**

**NEC**  
***NEC Information Systems, Inc.***

Doc. No. 10001

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## PREFACE

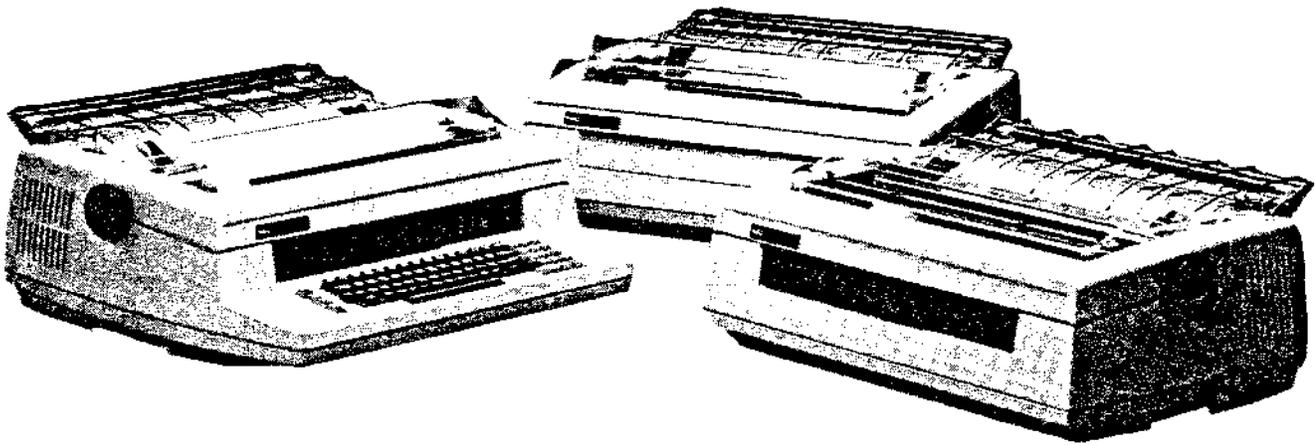
This manual provides the information necessary to understand NEC SPINWRITER printer machine operations. Comments to this manual are solicited. Please address comments and corrections to:

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## HOW TO USE THIS MANUAL

This manual is organized into eight chapters. Chapter 1 offers a general description while Chapters 2 through 7 describe in detail the operation of each logic board on a signal line basis. Chapter 8 presents a description of SPINWRITER mechanical systems. Block diagrams, circuit diagrams from schematics in the maintenance manual, timing diagrams and flow charts are employed to further illustrate subjects discussed. Note that all memory addresses are hexadecimal unless otherwise noted.



# CHAPTER 1

## GENERAL DESCRIPTION

This manual provides service personnel with SPINWRITER printer operation sequence and circuit description information. Block diagrams, and timing diagrams illustrate subjects discussed. Refer to the SPINWRITER Maintenance Manual, Doc. No. 10000, for logic diagrams, electrical schematics, wiring diagrams, and illustrated parts breakdowns.

The SPINWRITER Models 5500/5510/5520 are high-performance, serial, full character printers. An 8080A microprocessor-based control system sequences the printer functions. Several types of interfaces are provided for installation in standard EIA systems, 8080 Bus Interface Systems, or for compatible replacement in existing systems.

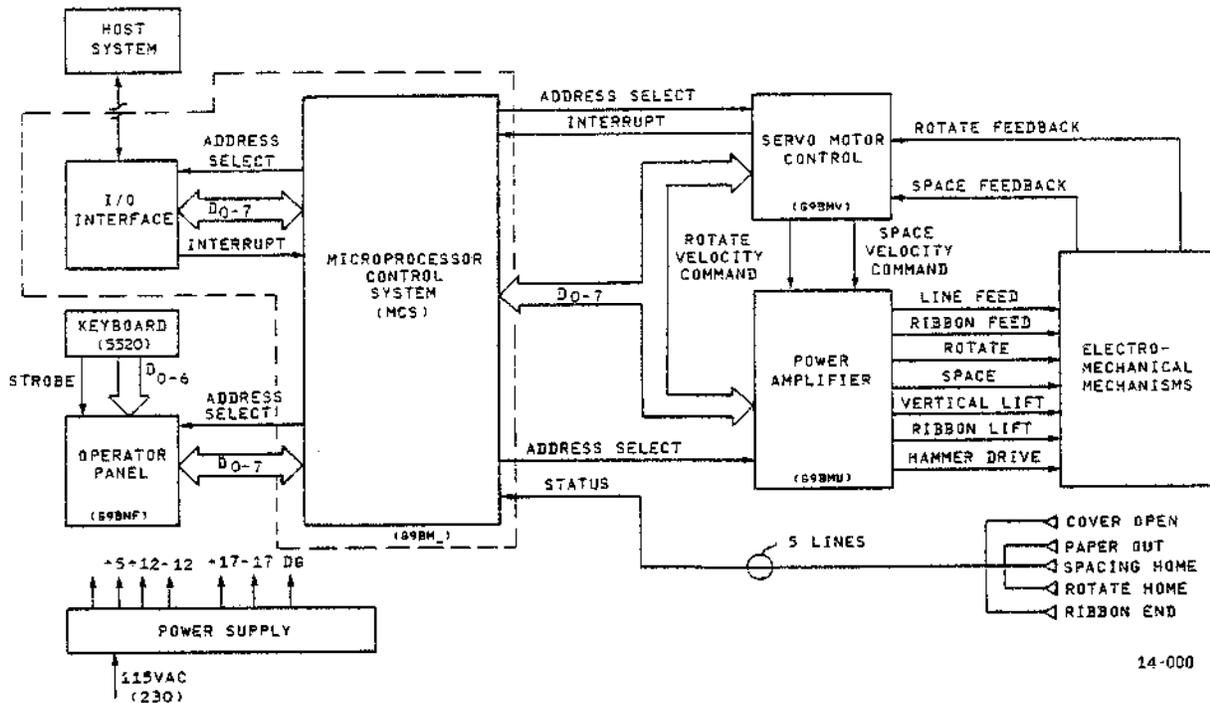
The SPINWRITER logic (Figure 1-1) consists of the processor board, servo board, driver board, and a power supply. Models 5510R/5520R also have an operator control panel logic board and, in addition, Model 5520R has keyboard logic.

### 1.1 PROCESSOR BOARD

The processor board consists of two sections: controller interface circuitry and the microprocessor system (MPS). The interface circuitry matches host system data and control signals to the SPINWRITER, while the MPS provides system control for all SPINWRITER operations via the machine control Input/Output (I/O) ports.

There are nine types of interfaces: seven are incorporated on individual kinds of processor boards; the eighth interface, current loop type, is packaged on a separate logic board (G9BMY) and is used with the EIA standard RS-232-C type processor board (G9CUR); and the ninth interface, Centronics-type, is packaged on a separate logic board (G9BNA) and is used with the output device adapter (ODA) type processor board (G9BNB).

In Model 5520 units, the MPS portion of the processor board controls all printer functions including selection, status, data transfer, and timing. These functions are carried out by an internal program which periodically scans the operator control panel and interface and performs other "housekeeping" functions. When an input signal is received from either the communications link or the control panel/keyboard, the main



14-000

Figure 1-1 SPINWRITER Block Diagram

program is interrupted and jumps to a service routine. Incoming data is temporarily stored in memory, and then program control is restored to the main program where processing is executed, monitoring the data stored in memory. User data received for printing is stored in a buffer until the processor converts the data characters into print thimble position information and sends commands to the servo control system to start the print cycle.

Feedback signals from SPINWRITER electromechanical units are also stored in temporary memory for use by the main instruction program. Control signals to SPINWRITER subassemblies and resulting feedback signals are routed via several I/O ports. The data transmission process is serviced periodically by the controller. The SPINWRITER firmware instructions located in memory initiate and control all these operations.

## 1.2 SERVO BOARD

The servo board logic circuits receive positional and control information from the processor to control the carriage drive (spacing) motor, the print thimble (rotate) motor and the vertical position (print thimble lift) coil. The servo board receives rotate and spacing servo data signals from the processor

board in digital form, and converts them to analog signals representative of the direction and distance to be moved. The servo board combines these analog signals with feedback signals from the servo position transducers to provide input to the driver board power amplifiers. The servo board also contains the sense circuit for the vertical print thimble lift coil signal. This signal is returned to the MPS.

### 1.3 DRIVER BOARD

The driver board contains the power amplifiers which supply print drive voltages to the spacing and rotate motors, and the vertical print thimble coil. The driver board also contains decoding logic and drive circuits to control the remaining printer mechanisms: the line feed motor, hammer coil, ribbon color change coil, and ribbon feed motor.

### 1.4 OPERATOR CONTROL PANEL LOGIC BOARD

This logic board provides access to the processor for selection of impression, parity, speed, line feed, spacing, form length, and form feed commands. Keyboard signals are routed to the MPS via the control panel data bus.

### 1.5 KEYBOARD LOGIC

The keyboard logic circuit board enables access to the processor via the control panel to provide input of control, numeric, and alphanumeric information and commands. User data from the keyboard is transmitted, one character at a time, as the keys on the keyboard are depressed.

There are two types of SPINWRITER keyboards. One has an ASCII key set, the other both ASCII and APL character sets. The ASCII characters are engraved on the top of the key caps. The APL characters and symbols are engraved on the front of the key caps. Selection of the ASCII or APL character set is accomplished by either the "ASCII/APL" switch on the accompanying control panel or by program control.

### 1.6 POWER SUPPLY

The power supply provides five dc regulated output voltages: +5V, +12V, -12V, +17V, and -17V. It is a compact, lightweight, built-in power supply containing four printed circuit boards: P1, P2, P3, and G9BMT. The power supply consists of an ac voltage regulator and a dc voltage regulator. The switching and control circuits of the ac regulator provide input current to a constant voltage transformer (CVT). The regulated dc outputs are derived from stepped-down, regulated ac voltage supplied by the CVT.

## 1.7 RELATED DOCUMENTS

The following documents provide supplemental information on the SPINWRITER series of printers and terminals:

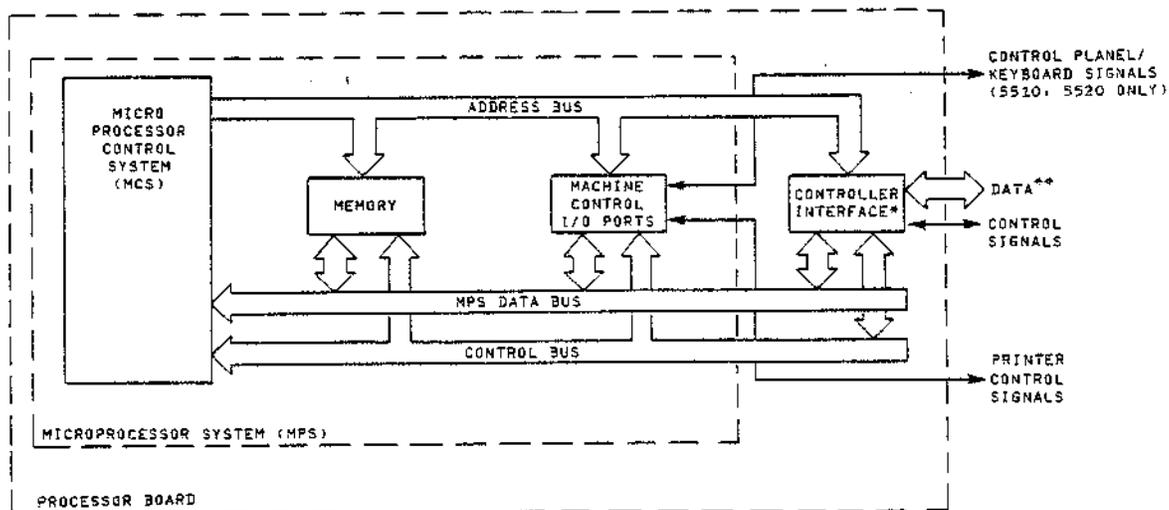
10000	SPINWRITER Maintenance Manual
10002	Model 5500 Operator's Guide
10003	Models 5510 and 5520 Operator's Guide
10004	Model 5500 Product Description
10005	Models 5510 and 5520 Product Description

## CHAPTER 2

### PROCESSOR/INTERFACE BOARD

The processor board (Figure 2-1) contains the microprocessor system (MPS) and the controller interface circuitry. The processor board is numbered according to the type of interface employed:

- G9CUR, G9DWH, G9DWJ EIA Standard RS-232-C
- G9CUP Diablo-Compatible
- G9CUQ 8080 Bus Line
- G9CUT Qume-Compatible
- G9BNB ODA
- G9BNA Centronics-Type Signal Conversion
- G9BMY Current Loop Signal Conversion



\*INTERFACE LOCATED ON SEPARATE PCB FOR CURRENT LOOP AND CENTRONICS-TYPE MODELS

\*\*SOME MODELS HAVE UNIDIRECTIONAL DATA INPUT LINES

14-001

Figure 2-1 Processor/Interface Board Block Diagram

The microprocessor systems are virtually identical except for the SPINWRITER firmware programs stored in read only memory (ROM) and for the respective machine control input/output (I/O) port allocations. Two SPINWRITER models, Current-loop type and Centronics-type, require further controller signal conversion which is supplied by the G9BMY and G9BNA circuit boards, respectively.

Section 2.1 provides an outline of operation for a serial interface processor board. Also discussed are the circuits and signals common to all types of processor boards. Sections 2.2 through 2.6 discuss the individual processor board controller interface circuitry, interface signals and timing. Sections 2.7 and 2.8 discuss the signal conversion boards used with the current loop and Centronics-type models.

## 2.1 OUTLINE OF OPERATION

There are two basic types of SPINWRITER interface systems, serial and parallel. In serial systems the processor controls the machine control I/O port and the Universal Synchronous/Asynchronous Receiver/Transmitter (USART), upon interruption, by executing the microprocessor unit (MPU) instructions stored in ROM. In parallel interface systems the controller commands processor operations via "handshaking" signals while the processor controls machine functions via the machine control I/O ports.

The serial interface processor board controls the machine control I/O Port and the USART by reading out and executing MPU instructions stored in ROM. The proper execution of these firmware instructions by the MPU enables the SPINWRITER to send and receive data, convert data into the printer's internal print code and generate control commands to the printer's mechanical units.

The random access memory (RAM) buffer is used for MPU processing, for the receive and transmit data and also as an information buffer for the mechanical position data of the SPINWRITER subassemblies. The firmware instruction program stored in ROM controls the operator control panel/keyboard. The mechanical parts and the processing of data to and from the EIA interface are controlled by interrupts.

The main functions of the printer monitor program (i.e., the SPINWRITER firmware) are to periodically scan the operator control panel/keyboard data port, perform the output commands to the operator control panel indicators and USART. When an input signal is received from the communications link (via the USART), the MPU is interrupted by the interrupt controller and jumps to an interrupt service subroutine. During this service

subroutine, the input data is stored in the buffer (RAM). Then the program returns to the same point in the main routine where it was interrupted and it continues processing.

The input data is received by the interrupt subroutine and processed by the main routine. The firmware converts the received data in the buffer into internal codes to make logical decisions concerning character selection, spacing, line feed, etc. For example, if the data is representative of a print code, the MPU compares the type and position of the character to be printed to the current position of the mechanical parts stored in the RAM. Then the MPU calculates (1) the shortest direction and distance to be moved for print thimble rotation, (2) vertical print thimble plane to be selected and (3) any spacing or line feed required to print the new character. Next the MPU outputs the applicable commands via the MPS machine control I/O ports (Figure 2-1). Then servo board and driver board drive the mechanical parts in accordance with the information from the I/O port(s).

The feedback signal(s) from the mechanical parts in operation initiates the event counter(s) of the I/O port(s). When a mechanical movement stops, the I/O port sends an interrupt to the MPU.

Sections 2.1.1 through 2.1.3.9 discuss circuits and functions common to all SPINWRITER models. Diagrams and data, from G9CUR schematics, are used as an example to enhance descriptions where needed. Section 2.1.3.10 describes the G9BNF operator control panel/keyboard interface. This information is similar to other control panel/keyboard interfaces.

### 2.1.1 Microprocessor Control System (MCS)

The MCS (Figure 2-2) consists of an 8-bit microprocessor unit (MPU), an 8224 system clock generator, and the 8228 system bus controller.

The 8080 MPU (Figure 2-3) is an 8-bit microprocessor contained in a single 40-pin integrated circuit (IC) package. It has an 8-bit wide, bidirectional data bus used for both input and output, and a 16-bit address bus capable of directly addressing up to 65K bytes of memory or I/O locations. MPU instructions in the form of a microprogram are located in memory, from where they are sequentially read out and executed. The MPU contains the instruction register (IR), the program counter (PC), the memory address register (MAR) not shown in Figure 2-3, the stack pointer (SP), other registers and the logical operation circuit.

The 8080 MPU is driven by the 2.048 MHz, two-phase clock from the 8224 Clock Generator, (Figure 2-2). The 8228 System Controller and Bus Driver performs two functions as it's name



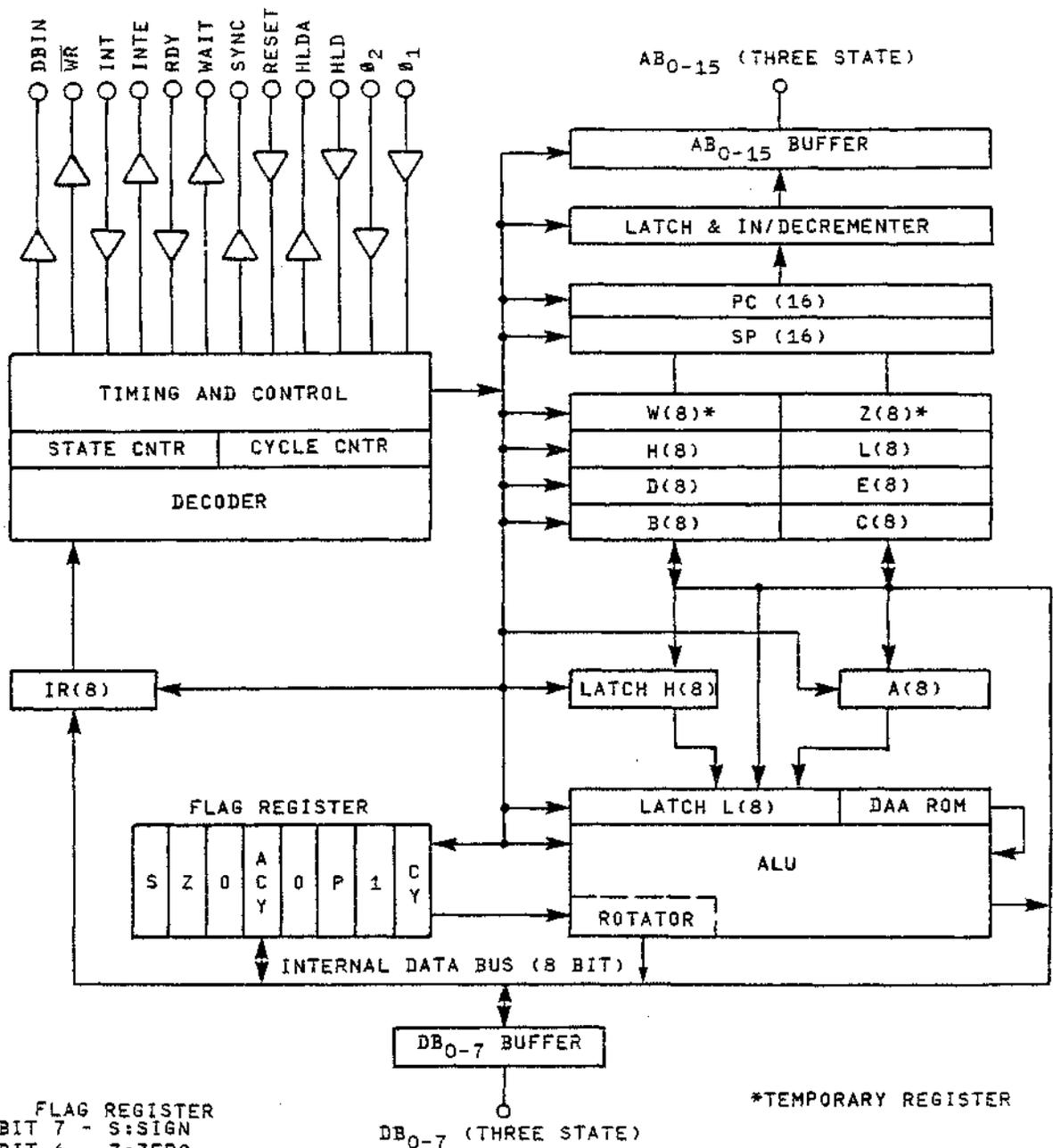


Figure 2-3 MPU Block Diagram

implies. The eight bit, bidirectional bus driver provides buffering between the MCS data bus and the MPS data bus. On the processor side minimum input voltage requirements (3.0V) are exceeded. On the system side, the driver is capable of adequate drive current (10 ma) for connection of a large number of memory and I/O devices to the bus. The data bus output lines can be forced into a high impedance state by use of the BUSEN input. MPU status signals on the data lines are latched by the 8228 at the beginning of each MPU machine cycle by the STSTB signal. These latched signals generate "active low" control signals for direct interfacing to system components when gated with MPU control signals.

- Memory Read (MEMR)
- Memory Write (MEMW)
- I/O Read (I/O R)
- I/O Write (I/O W)
- Interrupt Acknowledge (INTA)

### 2.1.2 Memory

The firmware program stored in the Read Only Memory 458D erasable type EPROM chips (Figure 2-4) controls SPINWRITER machine operations. The RS-232-C board contains eight of these 1K x 8 ROM's (Z1 - Z8). These ROM's have been assigned a 16 bit hexadecimal(H) address range from 0000H to 1FFFH. Decoders develop ROM Chip Select signals ROMCS0 through ROMCS7 to enable one of the eight ROM's while the lower 10 address bus lines (AB0-9) are used to select one of the selected chip's 1024 memory locations.

The main program, which is stored in ROM, is normally sequenced in ascending memory address order. Interrupts and jump commands can vector MPU operations to subroutines located in other areas of ROM or to data stored in RAM. In any event, program control is eventually restored to the next main program address. Incoming data, machine position, and status information are temporarily stored in Random Access Memory 2111 type RAM chips. RAM has been assigned an address range of 2000H through 21FFH. AD2000, coupled with AB8, provides chip select to one of the two pairs of 256 x 4 RAM'S (Z9,Z12 or Z10,Z11), while the lower eight address lines (AB0-7) select one of the 256 memory locations.

### 2.1.3 Machine Control Input/Output Ports

There are two types of processor I/O ports; machine control ports described here and controller interface ports discussed in Sections 2.2 to 2.8. Machine control ports transfer command

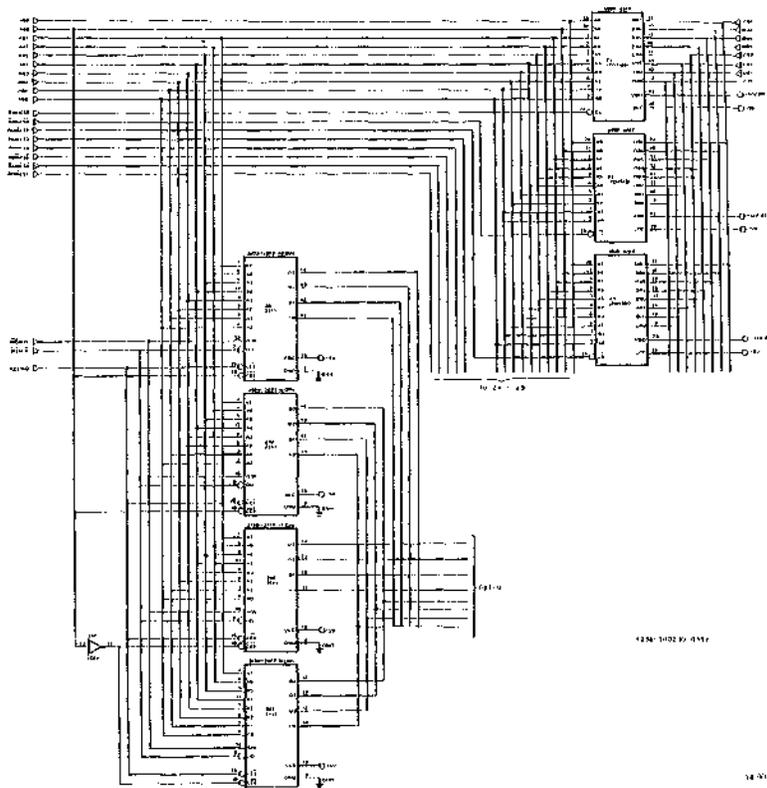


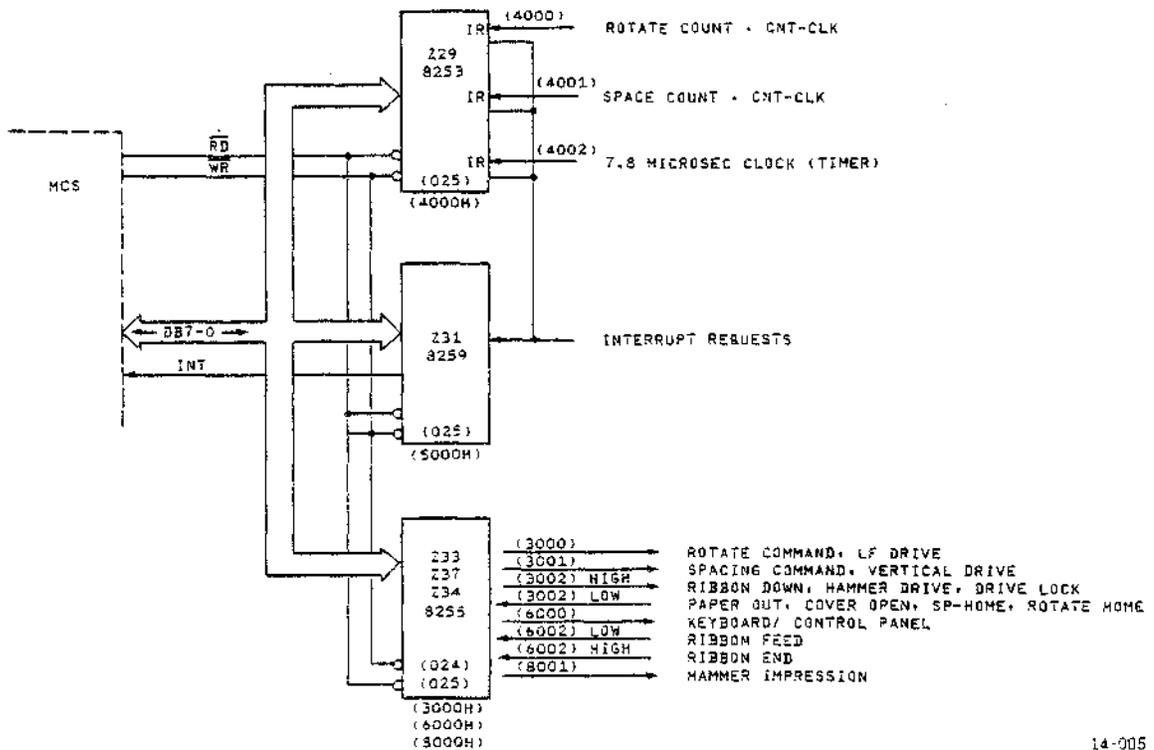
Figure 2-4  
SPINWATER Memory

and status signals to/from the SPINWRITER mechanisms. Printer control I/O consists of 8255 Programmable Peripheral Interfaces, an 8259 Programmable Interrupt Controller, and the 8253 Event/Counter Timer (Figure 2-5).

The 8255 Programmable Peripheral Interface (PPI) transfers control commands to/from the printer mechanisms. These control commands include velocity and direction of print thimble rotation, velocity and direction of carriage spacing, print thimble plane, length of paper feed, ribbon feed, and hammer impression commands.

The 8259 Programmable Interrupt Controller informs the MCS when a peripheral device or servo system wants program attention. If the MCS wants to accept the interrupt, the controller will place a 3-bit code on the data bus that specifies to the MCS the ROM memory address location of the appropriate control program.

The 8253 Event/Counter Timer informs the MCS that a particular event has or has not been completed in a specified time frame. For example, at the start of a space operation, the space timer is loaded with a time interval measured in milliseconds. A start command is issued to the carriage to initiate spacing. If the specified space time expires before carriage motion



14-005

Figure 2-5 MPS Machine Control I/O Ports

stops, the timer will cause an interrupt to the MCS indicating a carriage malfunction or a physical restriction. The 8253 timer receives timing commands for the rotate and space functions.

The MCS employs memory-mapped I/O techniques to increase system throughput by allowing the MPU data registers as well as the accumulator to be utilized during I/O operations.

The following text describes machine control port functions; port addresses follow the titles. A port is defined as one to eight of eight available lines located at the hexadecimal (H) addresses indicated. Refer to SPINWRITER schematics 136-100235-036, -037, and -038 for the following discussion.

#### 2.1.3.1 Rotate Port (3000H)

The rotate port outputs the commands to the rotate servo circuitry on the servo control board. The commands consist of three lines for rotate velocity data and two lines for direction data (CW and CCW). The rotate servo can be assigned the position mode by placing both direction control lines at a high level. Table 2-1 indicates the control functions of the rotate port signals.

Table 2-1 Function of Rotate Port Signals

SIGNAL NAME	STOP	SPEED (MAX)	SPEED (MIN)
RTVELA1	-	LO	HI
RTVELB1	-	LO	HI
RTVELC1	-	LO	HI
SIGNAL NAME	STOP	CLOCKWISE	COUNTERCLOCKWISE
RTXXCW0	HI	LO	HI
RTXCCW0	HI	HI	LO

#### 2.1.3.2 Line Feed Port (3000H)

The line feed (LF) port outputs the paper feed command to the paper feed stepping motor. The driver circuit is located on the power driver board. The LF command consists of excitation phase data ( $\phi A0, \phi A1$  and  $\phi B0, \phi B1$ ) to enable the LF stepping motor and a motor control signal (LF HOLD0) to stabilize and hold the motor's present angular position.

### 2.1.3.3 Carriage Port (3001H)

The carriage port outputs commands to the spacing servo circuit located on the servo control board. The spacing command consists of three lines for velocity data and two lines for direction data (FWD or REV). The direction commands are also used to assign to the servo system the positioning mode of operation. Table 2-2 lists the control functions of the carriage port signals.

Table 2-2 Carriage Port Signal Functions

SIGNAL NAME	STOP	SPEED (MAX)	SPEED (MIN)
SPVELA1	-	LO	HI
SPVELB1	-	LO	HI
SPVELC1	-	LO	HI
SIGNAL NAME	STOP	FORWARD	REVERSE
SPXFWDO	HI	LO	HI
SPXRVS0	HI	HI	LO

### 2.1.3.4 Vertical Port (3001H)

The vertical port outputs the command to the vertical driver, located on the servo control board, to provide vertical drive motion (lift-down) for the print thimble. The vertical command consists of two lines, down and lift.

```

VTDWNO }
VTLIFTO } Print Thimble Vertical Drive

```

### 2.1.3.5 Hammer Drive Ports (3002H, 8001H)

The hammer drive port outputs the command to the hammer drive circuit located on the drive board. The hammer command consists of six lines for the hammer impression data and one line to control the hammer drive time.

```

HMDRIV1      Hammer Drive Time (3002H)

HMIMPA0
HMIMPB0 }
HMIMPC0 } Hammer Impression (8001H)
HMIMPDO }
HMIMPE0 }
HMIMPF0 }

```

### 2.1.3.6 Ribbon Feed Port (6002H)

The ribbon (RB) feed port outputs the command to the ribbon feed driver located on the driver board. The ribbon feed command consists of excitation phase data and a control line (RB FREE) to inhibit the phase data from reaching the ribbon feed stepping motor. The ribbon feed motor does not have a hold command.

RB FEED ØA	}	Ribbon Feed
RB FEED ØB		
RB FREE		Inhibit Ribbon Feed
RB END		End of Multistrike Ribbon Cartridge

### 2.1.3.7 Ribbon Color Change Port (3002H)

This port outputs the signal to the ribbon color change driver located on the driver board. When the command RBCDV1 is low, spring tension will raise the ribbon into the black ink position. If RBCDV1 is high, a solenoid is activated to pull the ribbon cartridge down into the red ink position.

### 2.1.3.8 Drive Lock Port (3002H)

The drive lock port outputs the signal to de-energize the power driver circuits. If the MCS has detected a malfunction in the printer mechanism, the MCS will force the signal line DVLOCK1 low. DVLOCK1 being low will cause the drive lock circuit on the power amplifier board to remove power from the printer's drive electronics.

### 2.1.3.9 Status Port (3002H)

The status port inputs the following printer mechanical system feedback signals to the MPS: Paper End, Cover Open, Space Home, and Rotate Home. These feedback signals inform the firmware program of the condition of SPINWRITER mechanical positions and interlocks.

### 2.1.3.10 Control Panel/Keyboard Port (Models 5510, 5520 Only)

This interface port provides a path for data and control signals between the G9BNF control panel/keyboard and MCS. Information is transferred to the MCS via main instruction program scanning of control panel switch selections and keyboard hexadecimal codes after a key is depressed. In this way provision is supplied on command from control panel and/or keyboard to,

(1) allow MCS control of printer mechanisms or (2) output user data and signals. Keyboard user data is transmitted one character at a time, as the keys are depressed, to a 16 character storage buffer.

#### Circuit Description (G9CUR)

Integrated circuit Z33, a three-port device, is used primarily to input operator control panel and keyboard data to the microprocessor. One port, addressed at 6001H, commands the control panel logic circuits while the second port, addressed at 6000H, inputs control panel and keyboard data signals to the microprocessor. The third port, addressed at 6002H, provides an interface between the microprocessor system and the host system output inhibit commands. Refer to 5510/5520 Microprocessor Logic Schematic - G9CUR, drawing 136-100235-036.

Operator control panel switches and keyboard keys are read from address 6000H after a command word is sent to address 6001H. When reading this data, three bits (bit 0 through 2) should be set in address 6001H depending upon the type of data to be read. Table 2-3 lists address assignments for operator control panel and keyboard functions.

The ports on the command address 6001H are as follows:

<u>Address 6001</u>	<u>Port</u>
Bit 0	INPUT BIT 0
1	INPUT BIT 1
2	INPUT BIT 2
3	KEYBOARD - RESET
4	ALARM - LAMP
5	BUZZER

## 2.2 EIA STANDARD RS-232-C INTERFACE (G9CUR)

This serial interface is fully implemented and contained on the G9CUR processor board (see Figure 2-6 and SPINWRITER logic diagram 136-100235-036). This section describes the controller interface circuitry, refer to Section 2.1 for machine control circuitry.

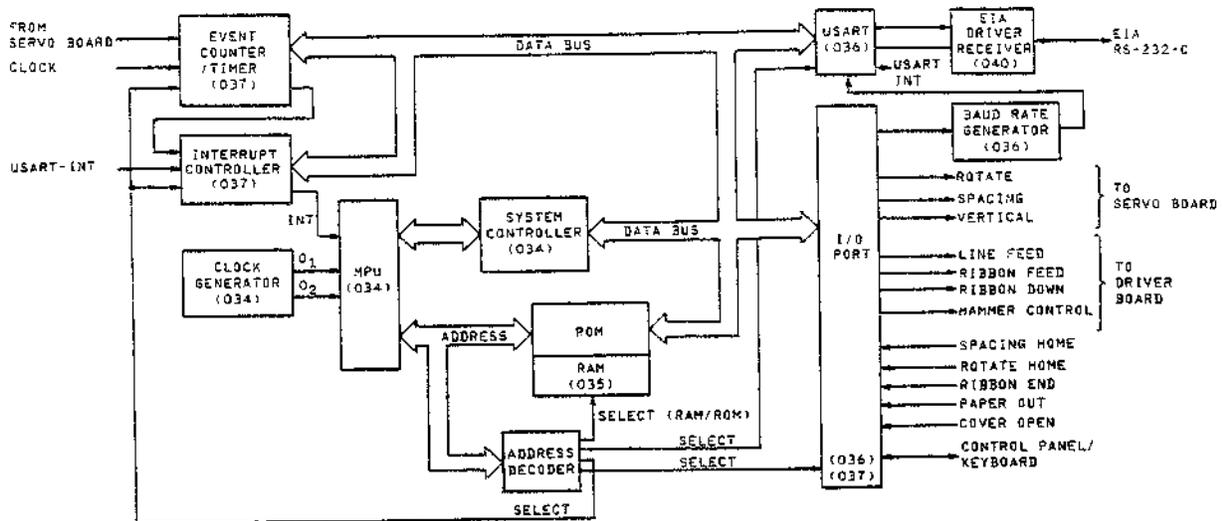
### 2.2.1 Circuit Description

This interface employs an 8251 USART (Z49) receiver/transmitter that is controlled by the microprocessor firmware program. Z29 outputs the switch selected baud rate to the baud rate generator Z22 and Z23. Received serial data is converted into parallel data. Presence of serial data (Rx RDY) is signaled to the MCS via an interrupt. When the interrupt is acknowledged, receiver data is stored (up to 256 bytes or characters) in RAM.

Table 2-3 Control Panel/Keyboard Port Signals (G9CUR)

COMMAND ADDRESS 6001 (BIT 2, 1, 0)	RESPONSE ADDRESS 6000	
	BIT	PORT
000	0	RESET
	1	TEST
	2	SET TOF.
	3	FF
	4	LOCAL-LF
	5	FULL DUPLEX
001	0	SP 10P
	1	LF 8P
	2	SPEED LOW
	3	SPEED HIGH
	4	PARITY ODD
	5	PARITY EVEN
	6	IMPRESSION - LOW
	7	IMPRESSION - HIGH
010	0-7	FF LENGTH
011	0	OPTION SPEED A
	1	OPTION SPEED B
	2	ASCII, 1; JIS, 0
	3	BUFFER STATE
	4	CURRENT LOOP
100	0	LOCAL
	1	AUTO-LF
	2	UC ONLY
	3	BREAK
101	0-6	KEYBOARD DATA
	7	KEYBOARD DATA ACK

Data characters from the processor in parallel format are converted to serial format for transmission to the host system. The data transmission process is serviced periodically under MCS program control. Z49 signals the processor when it has completely received a character and requires service. Z49 controls all of the handshaking signals required to operate with telephone modems. Z49 also provides data buffering, code conversion, and formatting processes for both received data and data transmitted. Port allocation information is shown in Table 2-4. Addresses 7000H, 7001H, and 8000H have been assigned for communications interfacing.



14-006

Figure 2-6 RS-232-C (G9CUR) Processor Board Block Diagram

Table 2-4 G9CUR Memory-Mapping Allocations

ADDRESS (Hexadecimal)	READ/INPUT	WRITE/OUTPUT
0000 → 1FFF	Program Memory Read	
2000 → 21FF	RAM Read	RAM Write
3000 3001		Rotate Commands, LF Drive (Spacing) Commands, Vertical Drive
3002 (LOW)		Ribbon-Down, Ribbon Hold, Hammer Drive, Drive Lock

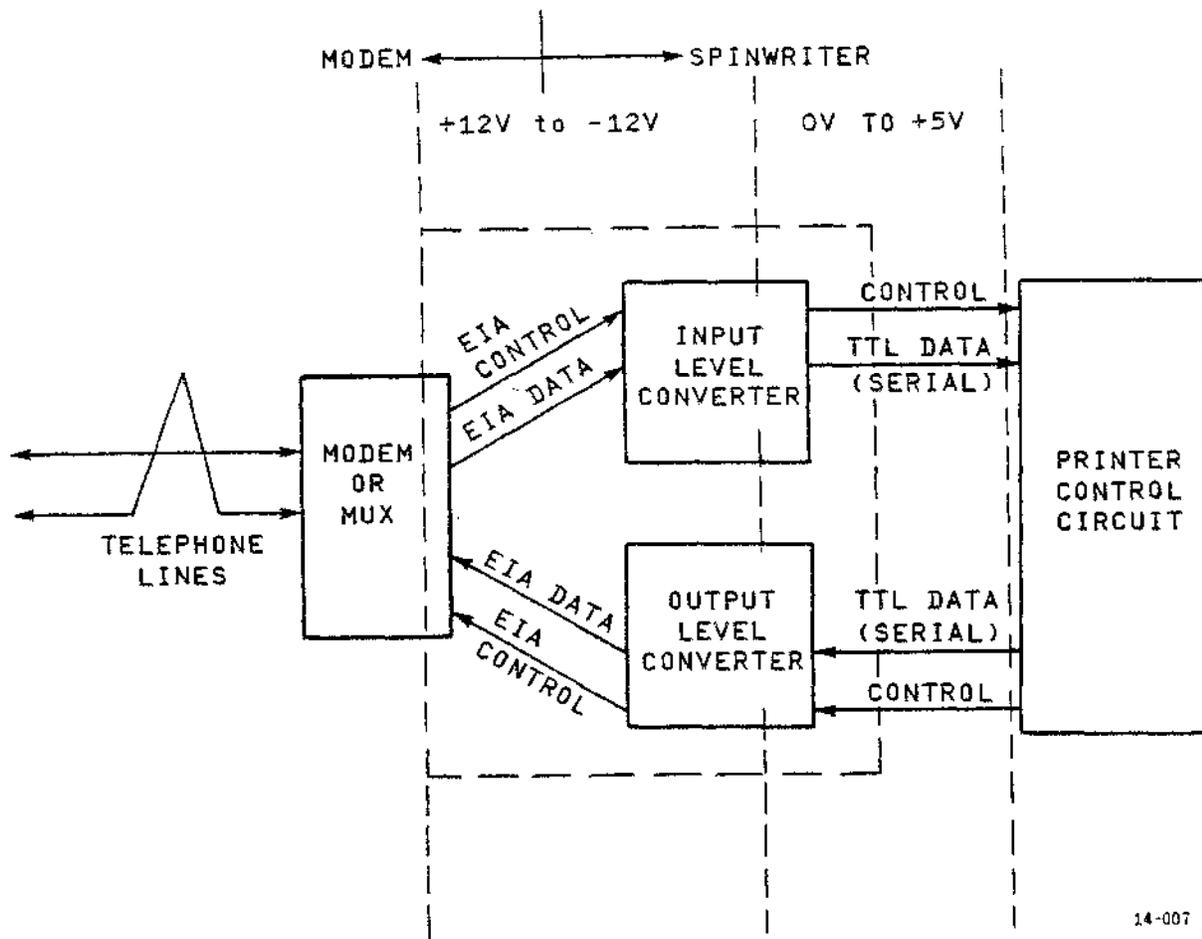
Table 2-4 G9CUR Memory-Mapping Allocations (contd)

ADDRESS (Hexadecimal)	READ/INPUT	WRITE/OUTPUT
3002 (HIGH) 3003	Paper End, Cover Open, SP-Home, RT-Home	3000 Port or Control Command
4000 4001 4002 4003	Rotate Event Counter Spacing Event Counter Timer	Rotate Event Counter Spacing Event Counter Timer 8253 Timer/Event Counter Control Command
5000 5001	Status Read Interrupt Mask	8259 Interrupt Controller or Command Interrupt Mask
6000 6001 6002 (LOW) 6002 (HIGH) 6003	Operator Control Panel, Keyboard-Response  Ribbon End, EIA Interface Control	Operator Control Panel, Keyboard-Commands Ribbon Feed, EIA Interface Control  6000 Port or Control Command
7000 7001	USART Rx Data USART Status Read	USART Tx Data USART Control
8000 8001 8002 (LOW) 8002 (HIGH) 8003	  Reset, Option Input	Baud Rate Factor Hammer Impression Control Option Output  8000 Port or Control Command

### 2.2.2 Signal Line Characteristics

The area within the broken lines of Figure 2-7, Interface Functional Block Diagram, is described in this section. Also described in this section are: signal names and their functions, voltages, data coding and format, and the input/output level converter.

The interface between the SPINWRITER and the modem satisfies EIA Standard RS-232-C and CCITT recommendation V.24. Specifications which are requested in above mentioned documents and are related directly to the SPINWRITER, are quoted in this section. Modem information is not given in this manual.



14-007

Figure 2-7 G9CUR Interface Functional Block Diagram

- Modem Compatibility - The SPINWRITER can be connected to Bell type 103A and 113A or their equivalent modems. An acoustic coupler can also be connected in lieu of a modem.
- Functional Description - The main purpose of the interface is to match SPINWRITER TTL logic signals to 12V (nominal) modem signal levels. The SPINWRITER can also be matched to signal levels of  $\pm 25V$ , the RS-232-C EIA standard limits.

The SPINWRITER sends signals of approximately  $\pm 8V$  to the modem. Data is transferred between the SPINWRITER and modem only after the ready status of the SPINWRITER is confirmed. Accordingly, no data loss is expected. Table 2-5 describes EIA signals and their functions.

Table 2-5 RS-232-C Interface Signals

PIN		SIGNAL NAME	FUNCTION
#	EIA		
1	AA	Protective Ground	This pin is not used in the SPINWRITER.
2	BA	Transmitted Data	The serial, ASCII coded digital data being transmitted by the SPINWRITER. This line is in the "mark" state (low) between characters, rises for logic 0, and drops for logic 1.
3	BB	Received Data	The serial, ASCII coded digital data being received by the SPINWRITER. This line must be held in the "mark" state between characters, and should go high for logic 0, low for logic 1.
4	CA	Request to Send	Goes high whenever power is on, Data Set Ready line is high, SPINWRITER is in Remote Mode and Data Terminal Ready is active.
5	CB	Clear to Send	Must be on (high) for SPINWRITER data transmission. If off, no data can be sent. (Remote mode.)
6	CC	Data Set Ready	Must be on (high) for SPINWRITER operation. If off, no data can be received. (Remote mode.)
7	AB	Signal Ground	Ground reference for all other interface signals.
8	CF	Received Line Signal Detector	Carrier Detect
9	--	Keyboard Inhibit	See Note
10	--	Print Inhibit	See Note
11	--	Reset	See Note
19	SCA	Reverse Channel	On (high or low depending upon position of switch 5 on operator control panel) when SPINWRITER data buffer is full or a SPINWRITER error has occurred.
20	CD	Data Terminal Ready	On (high) when SPINWRITER power is on and SPINWRITER is not in local mode.
23	CH	Data Signal Rate Selector	Not connected inside SPINWRITER. Included only for possible future use.

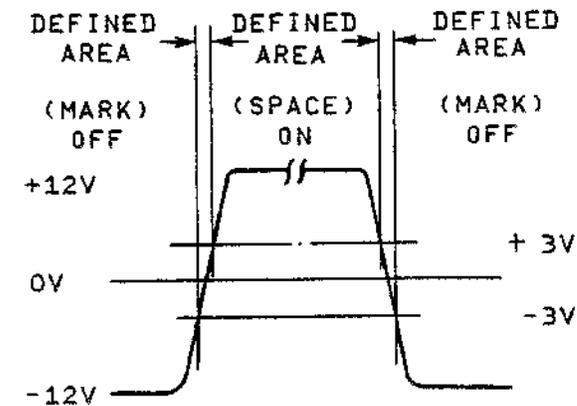
Note: These lines are connected and can be used.

### 2.2.2.1 Signal Level

The SPINWRITER can receive an input signal level of  $\pm 25V$  and the output signal from the SPINWRITER is set at approximately  $+8V$ . From now on, these signals are called  $+12V$  (nominal) and  $-12V$  (nominal). The status of the data signal is indicated by "Mark" and "Space". "Mark" is represented by the logic 1 and "Space" is represented by the logic 0. All other signals (control signals) are indicated by "on" and "off". Table 2-6 explains the relationship among these signals and the levels of voltage. Figure 2-8, Input Signal Threshold Levels, illustrates the area to assure "OFF" and "ON" (or Mark and Space) of input signal.

Table 2-6 RS-232-C Interface Signal Terminology

DATA CIRCUITS	CONTROL CIRCUITS	NOMINAL VOLTAGE
MARK ("1") SPACE ("0")	OFF ON	-12V +12V



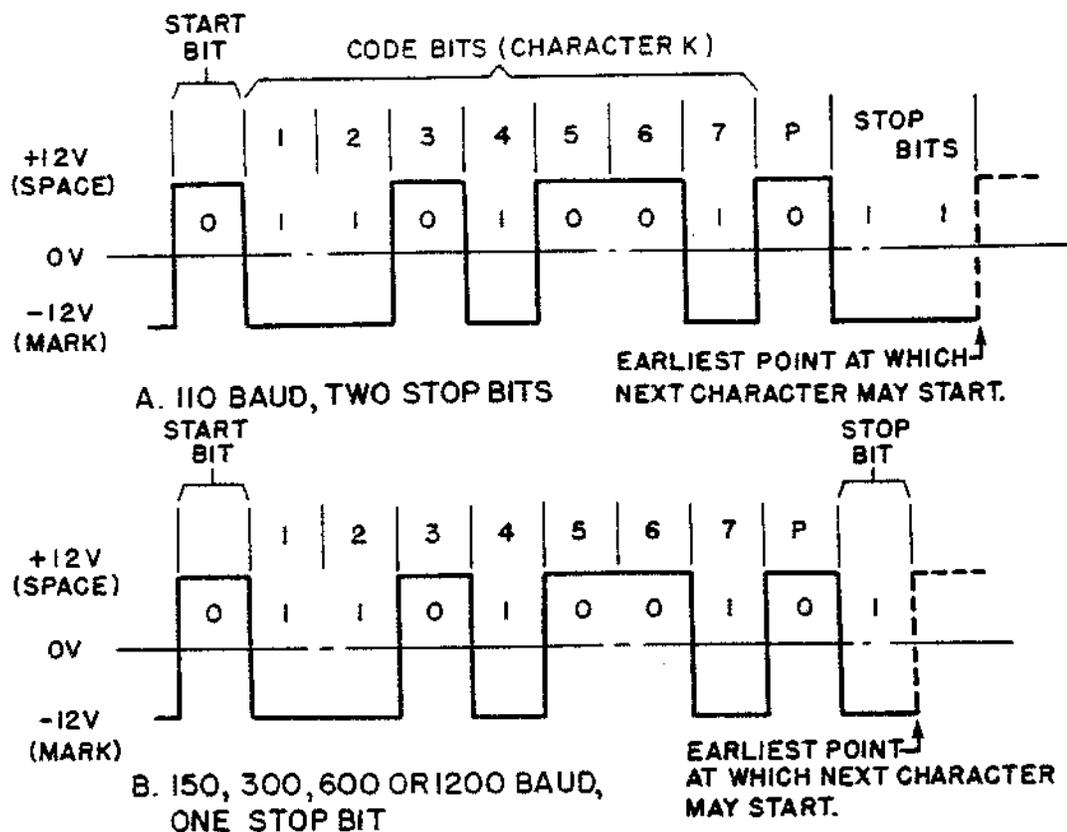
CONTROL SIGNALS AND RECEIVED DATA

14-008

Figure 2-8 Input Signal Threshold Levels

### 2.2.2.2 Data Format

Figure 2-9 illustrates ASCII upper case character (K) data of either the transmitted data line or the received data line. The voltage level is  $\pm 12V$  (nominal). The character period will vary as the baud rate changes. When no data is on line, the status is "Mark". The beginning of the character is the start bit which is the first movement from "Mark" to "Space". Each of seven bits comes on the heels of the lighter bit with the parity bit following them and then the last stop bit(s).



14-009

Figure 2-9 RS-232-C Interface Data Format

Figure 2-9 illustrates even parity, and the level of its parity bit is opposite to that of odd parity. If the parity switch on the operator control panel is set to "Mark", the parity bit in the received data (pin 3, Table 2-5) is not checked. The parity bit in the transmitted data (pin 2, Table 2-5) always becomes "Mark" ("1"=low) as well.

Figure 2-9 also illustrates the minimum periodic timings of 10 bits/character and 11 bits/character. Although the asynchronous data transmission sometimes varies the character period more than several seconds, the data produced by the host computer is, in general, sent out at the minimal interval. The character period of the data produced by the SPINWRITER is very much influenced by the speed of keyboard striking.

The coding system of the transmitted data and the received data is ASCII. Refer to Appendix A for character bit structures. (For reference information to the coding system, the standard number X3.4-1968 of the American National Standards Institute and the standard number ISO 646-1973 of the International Organization for Standardization are indispensable.)

### 2.2.2.3 Timing

The character time period is very much influenced by the baud rate. Table 2-7 gives the bit time and the character time of the minimum character period for each baud rate.

Table 2-7 Serial Interface Data Timing

BAUD RATE	TIME IN MILLISECONDS	
	BIT	CHARACTER
110	9.09	100.0
150	6.67	66.7
300	3.33	33.3
1200	0.83	8.3

### 2.3 DIABLO-COMPATIBLE INTERFACE (G9CUP)

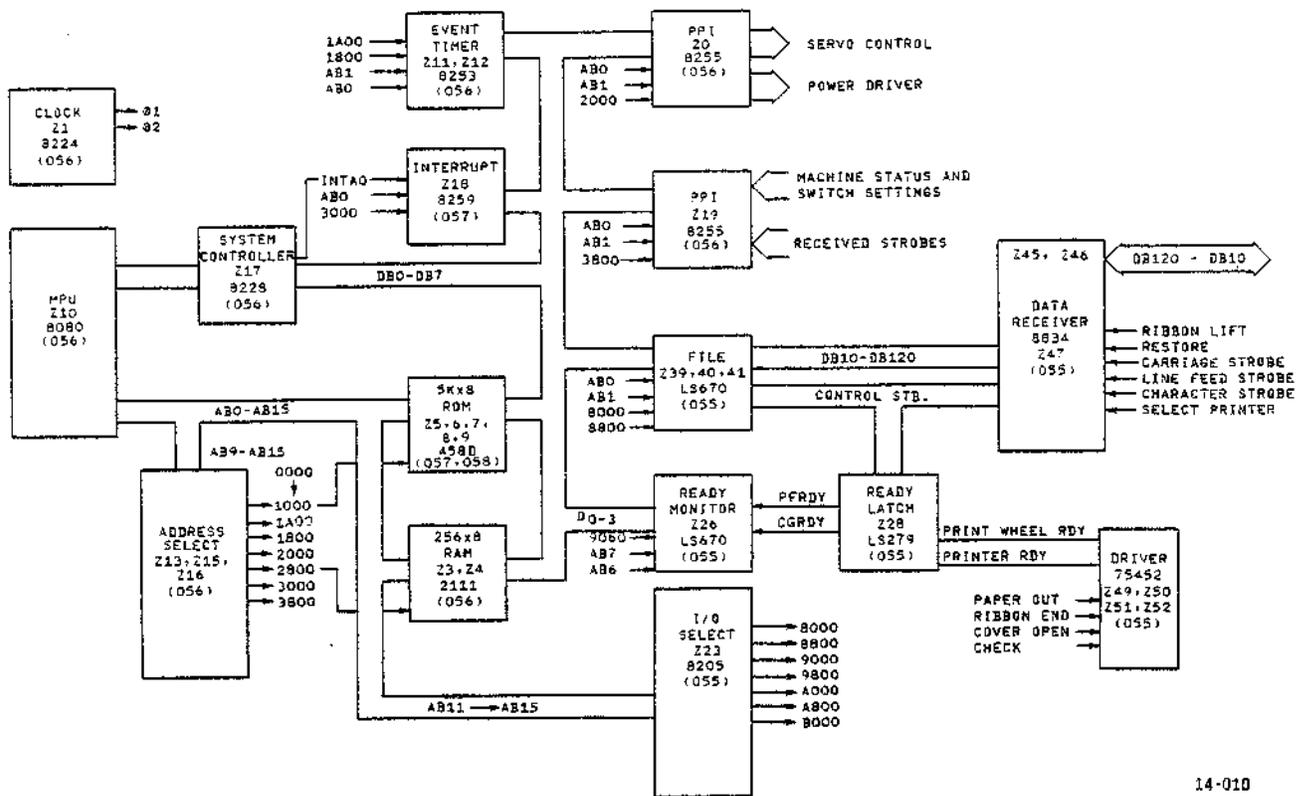
This parallel interface is fully implemented and contained on the G9CUP processor board. The SPINWRITER Model 5500-D system block diagram is shown in Figure 2-10 and the memory address and machine control I/O port allocations are listed in Table 2-8. Refer to SPINWRITER logic diagram 136-100235-055 for the following discussion.

#### 2.3.1 Circuit Description

Host system data signal lines (DB10-DB120) are inputted to the Z45, Z46 bus receivers (8837 type) which have built-in hysteresis circuits to provide signal line noise immunity. The twelve input data lines are then routed to the Z39, Z40, and Z41 (74LS670 type) register files. The individual address lines of these IC's permit direct acquisition of data stored in any twelve of these latches (4 latches per gate). File outputs connect directly to the MPS data bus and are normally in the high-impedance (third state) condition until enabled.

Bus receiver Z47 conditions the eight input control signals from the host system before they are inputted to programmable peripheral interface Z19. Table 2-9 lists the signals inputted via address 3801H. Upon MCS command, Z19 directs these signals to the MPS data bus for machine control.

Output control signals for the host system exit the processor board via four 75452 peripheral drivers (Z49, Z50, Z51, and Z52).



14-010

Figure 2-10 Model 5500-D Block Diagram (G9CUP)

Table 2-8 Model 5500-D Memory-Mapping Allocations (G9CUP)

ADDRESS (HEXIDECIMAL)	READ/INPUT	WRITE/OUTPUT
0000 13FF	ROM	
1800	Rotate Timer	
1801	Hammer, Ribbon Change Timer	
1802	Vertical Timer	
1803		Port Control
1A00	Space Timer	
1A02	Line Feed Timer	
1A03		Port Control
2000		Rotate Command, LF Drive
2001		Space Command, Ribbon Change
2002		Hammer Imp D, E, and F, VT Up/Down, Ribbon Feed
2003		Port Control
2800 28FF	RAM	RAM

Table 2-8 Model 5500-D Memory-Mapping Allocations (G9CUP) (contd)

ADDRESS (HEXIDECIMAL)	READ/INPUT	WRITE/OUTPUT
3000	Interrupts	Interrupt Masks
3001		Port Control
3800	DIP Switch, Imp. Switch Data	
3801	Diablo Interface Control Data	
3802	Diablo Interface Control Data	Hammer Imp A, B, and C
3803		Port Control
8001	Carriage Data From	
8801	Diablo Interface	
8002	Paper Feed Data From	
8802	Diablo Interface	
8003	Print Thimble Data From	
8803	Diablo Interface	
9000	Carriage Ready, PF Ready	
	Ribbon Lift	
9800	PF Ready Set	
A000	CG Ready Set	
A800	PW Ready Set	
B000	Restore	

Table 2-9 Model 5500-D Controller Interface Ports (Z19)  
(G9CUP)

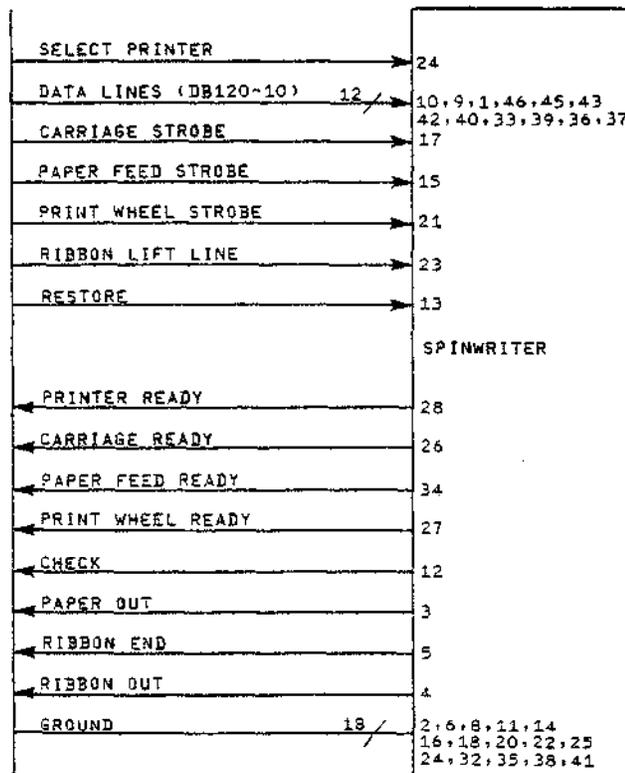
ADDRESS	READ/INPUT	WRITE/OUTPUT
3800	7	
	6 ASCII 1/JIS 0	
	5 CHAR 1/ABS 0	
	4 TEST0	
	3 SWCOV01	
	2 SWIMPHS	
	1 SWIMPLS	
	0 7.8 $\mu$ SENSE	
3801	7 PWRDY1	
	6 CGRDY1	
	5 PFRDY1	
	4 PWSTB0	
	3 CGSTB0	
	2 PFSTB0	
	1 SPHOME0	
	0 RTHOME1	

Table 2-9 Model 5500-D Controller Interface Ports (Z19)  
(G9CUP) (contd)

ADDRESS	READ/INPUT	WRITE/OUTPUT
3802	7 6 5 4 3 RBNLFT0 2 RESTORE0 1 RESTORE1 0 RBN END 1	HAMIMPC0 HAMIMPB0 HAMIMPA0 HMDRV1

### 2.3.2 Signal Line Characteristics

Printer operations are controlled through the interface (Figure 2-11). The interface consists of three strobe lines and twelve data lines for printing, spacing and line feed operations. The interface has four additional lines through which Ready/Busy status for each operation can be sensed outside the printer. In addition, there are Ribbon Lift, Restore, Paper Out, Ribbon Out, Cover Open, and Check signals.

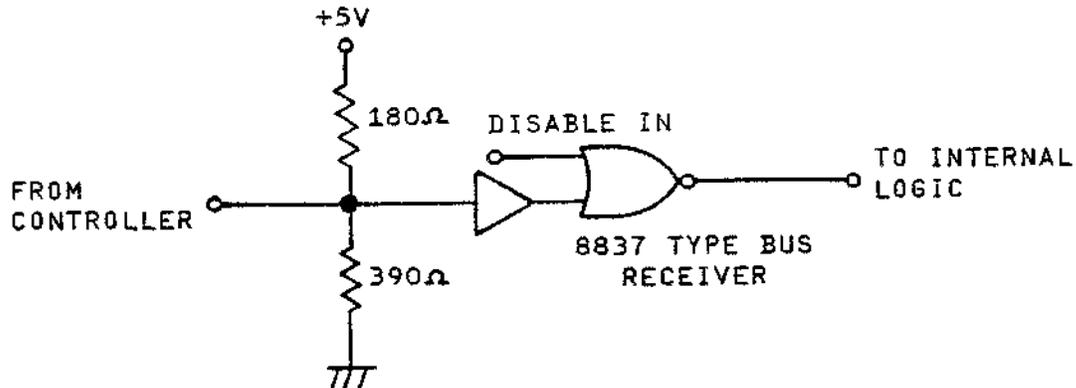


14-011

Figure 2-11 Diablo-Compatible Interface Lines (5500-D)

### 2.3.2.1 Input Circuits

The signals from the controller are routed through 8837 type bus receivers (Figure 2-12).



14-012

Figure 2-12 G9CUP Interface Input Circuit

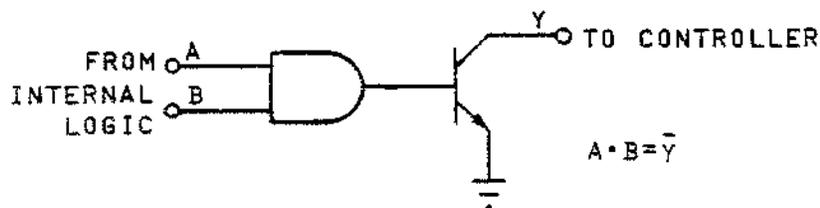
### 2.3.2.2 Output Circuits

The open collector circuit (Figure 2-13) drives the output lines to the controller; pull-up resistors are required at the controller side. The resistors shown in Figure 2-12 are recommended.

Output level conversion is required and is shown in Table 2-10 below.

Table 2-10 Interface Signal Level Conversion

LOGICAL	SIGNAL LEVEL
1 (True)	LO (0V)
0 (False)	HI (+5V)



14-013

75452 type TTL power gate

Figure 2-13 G9CUP Interface Output Circuit

### 2.3.2.3 Input Signal Line Descriptions

- a. Select Printer - With this signal on, the printer can be selected. That is, all the interface lines become valid. Then the printer controller can sense printer operation status through the four-ready lines. The controller instructs the execution of each operation by outputting data and strobe signals. The valid signals are:
  - Input Line - restore, three strobes, ribbon lift, and twelve data lines.
  - Output Line - paper out, ribbon end, cover open, check, and four ready lines.
- b. Data Lines - The interface has 12 data lines. The data is used in three ways by adopting the three kinds of strobes to be input to the printer. That is, the print thimble strobe, carriage strobe, and line feed strobe represent character and print hammer impression selections, carriage direction and distance selections, and line feed direction and distance selections, respectively.
- c. Strobe Lines - There are three strobe lines in this interface. The printer performs carriage, line feed and print thimble operations when the corresponding strobe line is "LO" state. Each strobe is used to sample data corresponding to the operation. Therefore, it is not valid to make more than one strobe line "LO" at the same time.
- d. Ribbon Lift - When this signal is made "LO", the ribbon is lifted toward the up-position to print by the primary ribbon color. In this situation, printing is done in black by using either a single color ribbon or a red/black color ribbon.

On the other hand, when this signal is made "HI", the ribbon is lowered toward the down-position in order to print in red with a red/black ink ribbon. In this case, if a single color ink ribbon (black) is used, the character printed can be observed after it is printed.
- e. Restore - With the signal made "LO", the printer executes the restore sequence. The restore sequences are:
  - Return carriage to the home position (column "1")
  - Return print thimble to the home position (absolute address "0")

- Move ribbon to the "down position"

NOTE

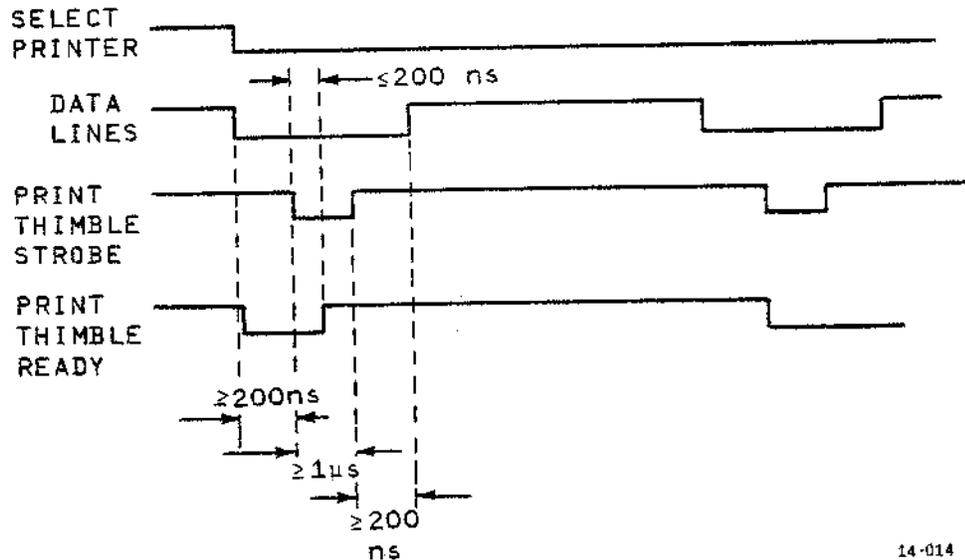
Since carriage velocity is minimum, do not use restore as carriage return.

#### 2.3.2.4 Output Signal Line Descriptions

- a. Ready Lines - Four lines transmit the status of several operating parts of the printer to the controller, when the printer is enabled by a "LO" Select Printer signal. These are printer, carriage, line feed and print thimble signals. The printer ready signal indicates that the printer is turned on and the restore sequence operation is finished. The other ready signals, when "LO", indicate that their associated circuits are in condition to receive and execute commands; that is, during operation in Busy (HI) condition, after execution in Ready (LO) condition.
- b. A check = "LO" signal indicates that a previously received print thimble or carriage movement command was not successfully completed due to a malfunction or a physical restriction. This condition stops printer activity, and disables the carriage, line feed, and print thimble ready lines. Only a restore sequence, whether initiated by controller command or reapplication of power, will clear a check condition.
- c. Paper Out - The paper-out circuit, when signal is "LO", reports the status of paper-out to the controller. This signal line without a paper-out detect will always be "HI".
- d. Cover Open - This active "LO" signal informs the controller of the status of the top cover open. Without the top cover installed, this signal will always be "HI".
- e. Ribbon End - This active "LO" signal informs the controller of the status of the multi-strike film ribbon end. The signal is "LO" when ribbon end is reached.

#### 2.3.2.5 Strobe Timing

Figure 2-14 shows the typical timing of the print thimble strobe. The timing of the carriage strobe and the line feed strobe is the same as that of the print thimble strobe.



14-014

Figure 2-14 G9CUP Print Thimble Strobe Timing

### 2.3.3 Input Command Format

#### 2.3.3.1 Print Wheel Command (With Print Thimble Strobe)

These data line commands when sampled by the print thimble strobe present character selection and hammer impression information to the printer. The CHARACTER/ABSOLUTE switch selection determines whether the character code information pertains to ASCII code or absolute (i.e., specific thimble finger, and plane) address code. Print hammer impression data must be supplied in the "ABS" mode. Table 2-11 shows the print command word format.

#### NOTES

In character mode, when data bits 1 - 7 are converted into the ASCII code and transmitted, the printer automatically selects the objective character. See Appendix A.

In the absolute mode, the character position arranged on the print thimble is directly specified. See Appendix B.

#### 2.3.3.2 Carriage Movement Command (With Carriage Strobe)

Data bit information for a carriage movement command word is shown in Table 2-12.

Table 2-11 G9CUP Print Wheel Command Format

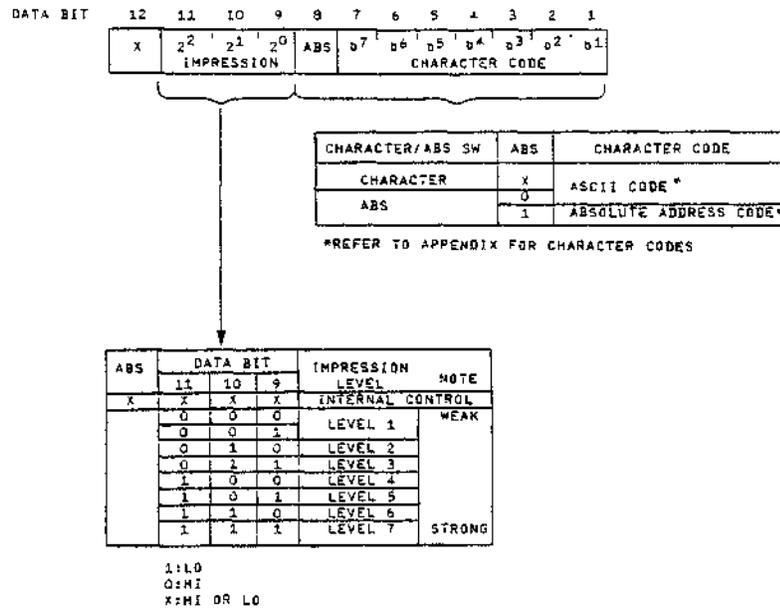
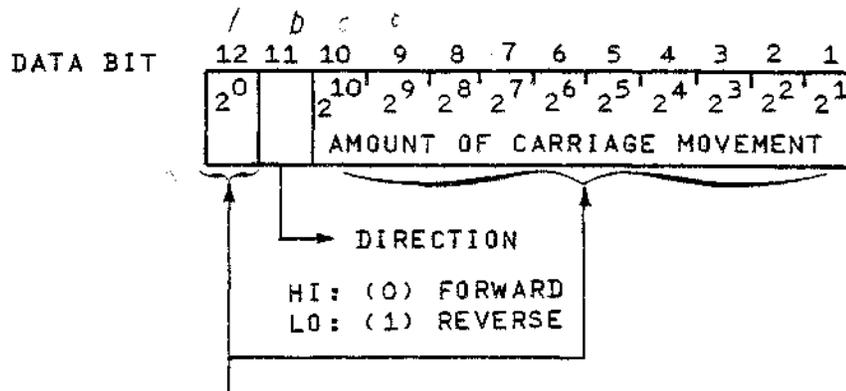


Table 2-12 G9CUP Carriage Movement Command Format

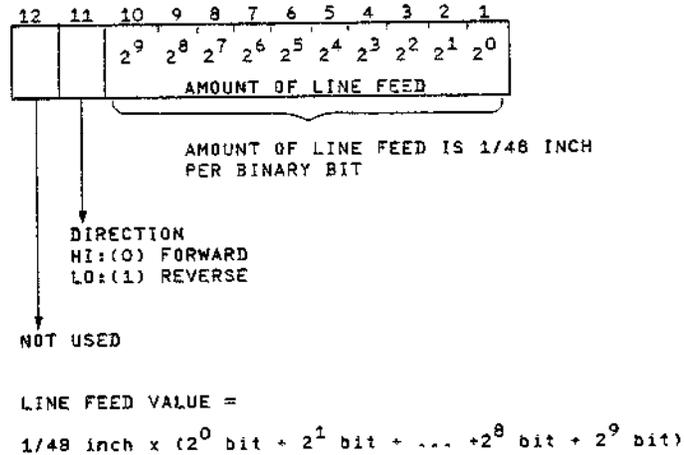


AMOUNT OF CARRIAGE MOVEMENT DISTANCE IS 1/120 INCH PER BINARY BIT

### 2.3.3.3 Paper Feed Command (With Line Feed Strobe)

Data bit information for a paper feed command word is shown in Table 2-13.

Table 2-13 G9CUP Paper Feed Command Format



### 2.3.4 Principle of Operation

The select printer signal is first transmitted to ensure printer ready status. At this time, each strobe is disregarded when the corresponding ready line is not in "LO" state. The printer processes input sequence strobes as shown in Figure 2-14.

#### 2.3.4.1 Print Thimble Positioning

Print thimble operations are roughly divided into the following functions.

**Character selection** - In order to select a desired character, the print thimble is provided with rotate operation and vertical (up-down) movement. The selection is made by the character code (refer to Section 2.3.3)

**Hammer operation** occurs only after the other printer operations are successfully completed: character selection, carriage movement, line feed, ribbon up-down, and ribbon advance.

Print hammer impression level is controlled by controller impression level specification in the absolute mode or by automatic specification generated inside the SPINWRITER (Table 2-11) in the character mode.

Print Thimble Positioning and Printing - First, a printer is identified by the select printer signal. Second, print thimble ready status is sampled in order to perform print thimble operation. Third, both character selection and hammer impression data are established on the data lines. Then the print thimble strobe of greater than 1 microsecond is transmitted. As mentioned before, hammer operation is prohibited until the operations of character selection, carriage movement, line feed, and ribbon up-down are successfully completed.

#### 2.3.4.2 Carriage Positioning

The sequence required to position the carriage is: first, select the printer; second, sample the carriage ready line to ensure that a carriage move command will be accepted; third, place the distance-and-direction of movement information on the data lines; and fourth, strobe the data. The carriage begins its movement after completion of the print thimble operation from the previous command.

#### 2.3.4.3 Paper Feed

The sequence required for paper feed is: first, select the printer; second, sample the paper feed ready line to ensure that the paper feed command will be accepted; third, place the distance-and-direction-of-movement information on the data lines; and fourth, strobe the data. The paper feed operation will be performed after the print thimble operation, if previously commanded, is completed.

#### 2.3.4.4 Ribbon Lift

If a two-color ribbon is being used and the lower ribbon color (black) is desired, the ribbon lift signal, with the printer select = "LO", must be made "LO" prior to the print command. If the upper color is desired to be printed, the ribbon lift = "HI" must be made. When using a single-color ribbon, the ribbon lift signal must always be "LO" to allow printing. If the ribbon lift signal is set "HI", the ribbon will be moved into the lower position to allow a view of the last printed character. The lift movement of the ribbon requires about 130 milliseconds, therefore the ribbon lift command is issued prior to the print thimble command. The ribbon lift movement and the ribbon lift command are related, as shown in Figure 2-15.

#### 2.3.4.5 Space-Before-Print Sequence

The interval between the carriage strobe and the print thimble strobe must be more than 400 nanoseconds in order to move the carriage or the print thimble. The hammer will be energized

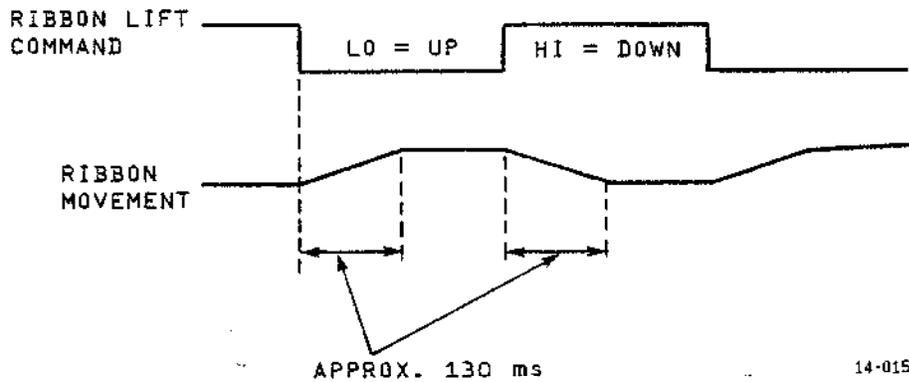


Figure 2-15 Ribbon Timing Sequence

after completion of the carriage movement. However, character selection and ribbon advance will be performed during the carriage movement by the print thimble strobe. The printing time required is shorter than that of the print-before-space sequence. Refer to Figure 2-16 for sequence timing.

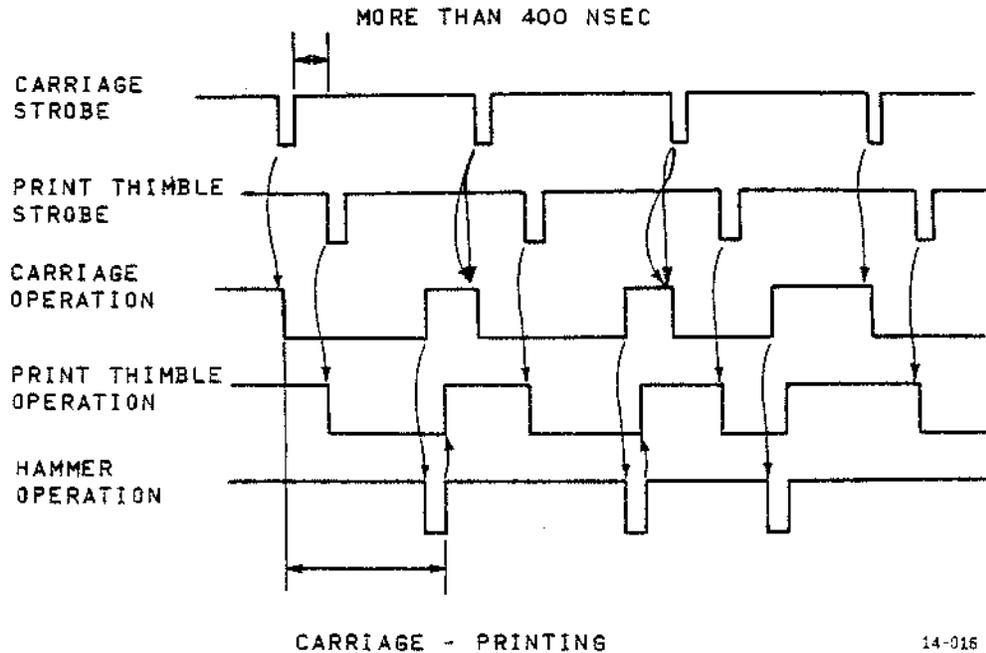


Figure 2-16 G9CUP Space-Before-Print Sequence

#### 2.3.4.6 Print-Before-Space Sequence

In order to operate the print thimble and carriage (or paper feed), an interval is needed between the trailing edge of the print thimble strobe and the leading edge of the carriage strobe (Figure 2-17). This interval must be more than 400 nsec.

The carriage begins its movement after completion of the print thimble operation (character selection, ribbon advance, and hammer). This operation requires a longer period of time than the space-before-print sequence does. However, when operations of print-space-print-space are repeated, the time required is just the same as the operations of the space-before-print sequence and the print-before-space sequence, except for the first sequence.

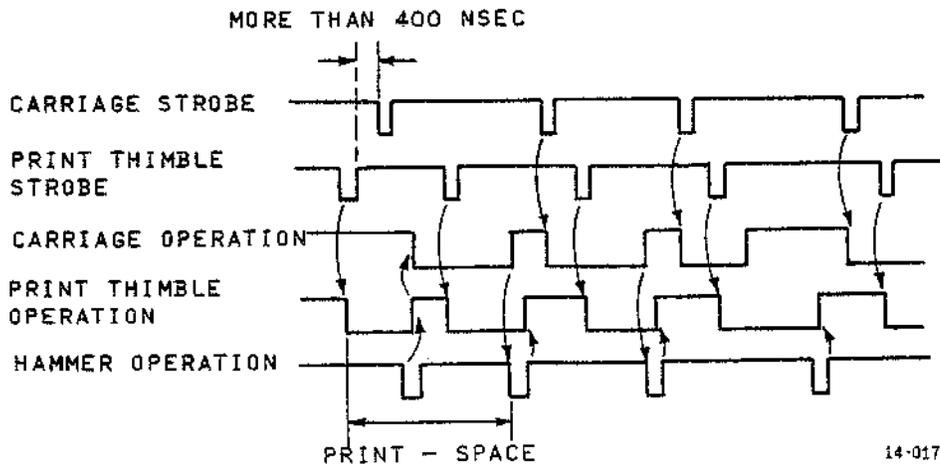


Figure 2-17 G9CUP Print-Before-Space Sequence

#### 2.4 8080 BUS LINE INTERFACE (G9CUQ)

This parallel interface is fully implemented and contained on the G9CUQ processor board. The SPINWRITER Model 5500-B system block diagram is shown in Figure 2-18, and the memory address and machine control I/O port allocations are listed in Table 2-14. Refer to SPINWRITER logic diagram 136-100235-050 through -054 for the following discussion.

##### 2.4.1 Circuit Description

The configuration of this board is similar to that of the G9CUP processor described in Section 2.3. Host system data lines (DB00 through DB70 and AB00 through AB30) are inputted to bus receivers (Z47, Z46) then routed to register files (Z39, Z40,

2-3

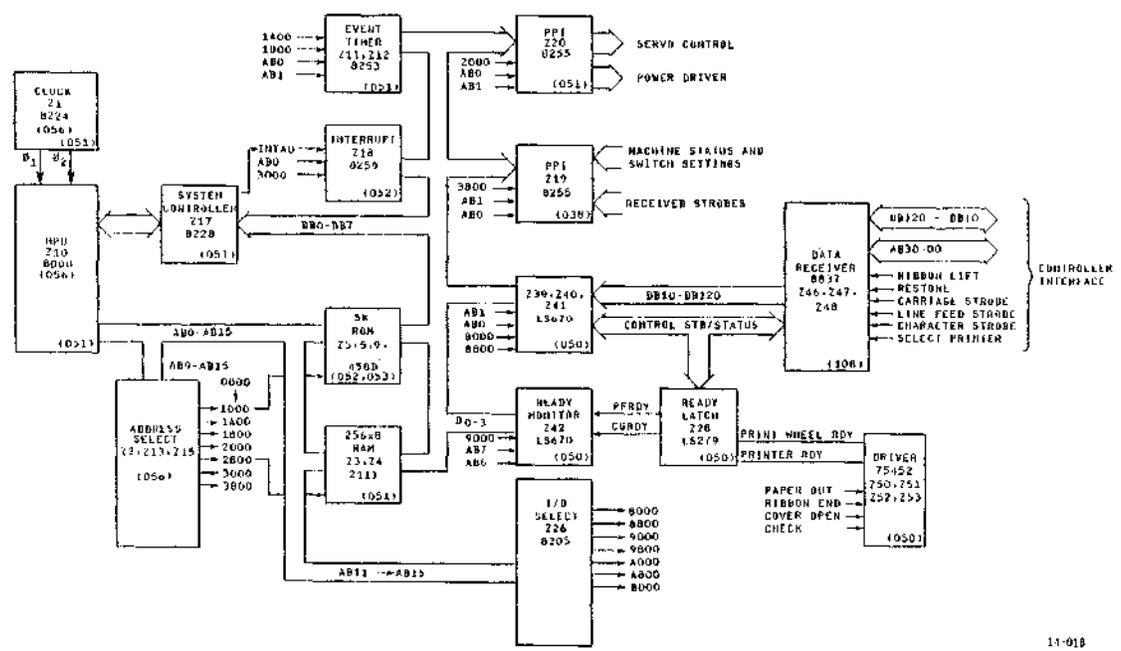


Figure 2-18 Model 5500-B Block Diagram (G9CUQ)

Table 2-14 8080 Bus Line Interface Memory-Mapping Allocations  
(G9CUQ)

ADDRESS	READ/INPUT	WRITE/OUTPUT
0000 → 13FF	ROM	
1800	Rotate Timer	
1801	Hammer, Ribbon Change Timer	
1802	Vertical Timer	
1803		Port Control
1A00	Space Timer	
1A01	Line Feed Timer	
1A02		
1A03		Port Control
2000		Rotate Command, LF Drive
2001		Space Command, Ribbon Change
2002		Hammer Imp D, E, and F, VT Up/Down, Ribbon Feed
2003		Port Control
2800 → 28FF	RAM	RAM
3000	Interrupts	Interrupt Masks
3001		Port Control
3800	DIP Switch, Imp Switch Data	
3801	8080 Bus Line Control Data	
3802	8080 Bus Line Control Data	Hammer Imp A, B, and C
3803		Port Control
8001	Carriage Data From	
8801	8080 Bus Line Interface	
8002	Paper Feed Data From	
8802	8080 Bus Line Interface	
8003	Print Thimble Data From	
8803	8080 Bus Line Interface	
9000	Carriage Ready, PF Ready	
	Ribbon Lift	
9800	PF Ready Set	
A000	CG Ready Set	
A800	PW Ready Set	
B000	Restore	

and Z41) for connection to the MPS data bus. Seven of the host system data lines (DB00-60) are bidirectional and are driven by 75452 type peripheral drivers (Z50, Z51, Z52, and Z53) when used in the output control signal line mode. Input control signals from the host system are routed to an 8837 type hex bus receiver (Z48). The RESTORE0 control signal line is also bi-directional and is driven by Z53 when in its output mode.

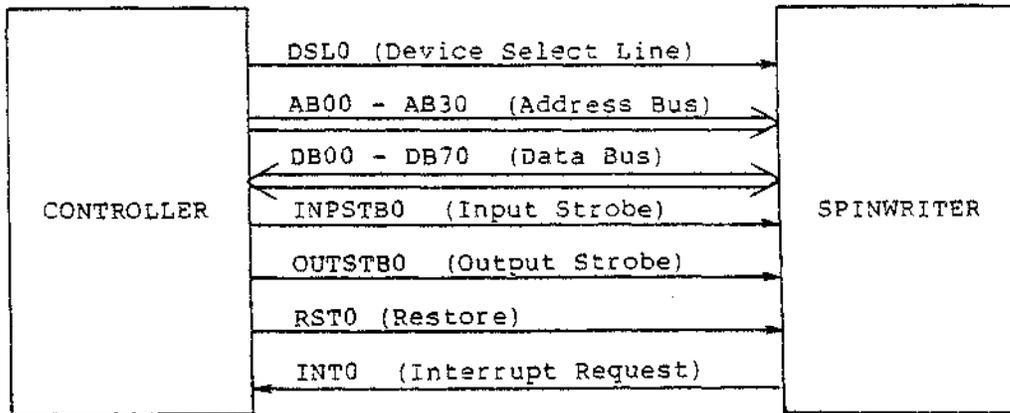
Bus receiver (Z48) conditions the input control signals before they are routed to programmable peripheral interface Z19. Table 2-15 lists the signals inputted to Z19 via address 3801H. Upon MCS command, Z19 directs these signals onto the MPS data bus for machine control.

Table 2-15 8080 Bus Line Interface Ports (Z34) (G9BMX)

ADDRESS	READ/INPUT	WRITE/OUTPUT
3800	7 SPARE 6 ASCII 1/JIS 0 5 ABS 0/CHAR 1 4 TEST0 3 SWCOV0 2 SWIMPHS 1 SWIMPLS 0 7.8 $\mu$ SENSE	
3801	7 PWRDY1 6 CGRDY1 5 PFRDY1 4 PWSTB0 3 CGSTB0 2 PFSTB0 1 SPHOME0 0 RTHOME1	
3802		7 HAMIMP C0 6 HAMIMP B0 5 HAMIMP A0 4 HMDRIV1  3 RBNLFT0 2 RESTORE0 1 RESTORE0 0 RBN END 1

#### 2.4.2 Signal Line Characteristics

Printer control and command transfers are established through the interface (Figure 2-19). The following sections define the input/output signals, I/O circuits, and strobe timing.



14-019

Figure 2-19 8080 Bus Line Interface Lines

#### 2.4.2.1 Input/Output Circuits

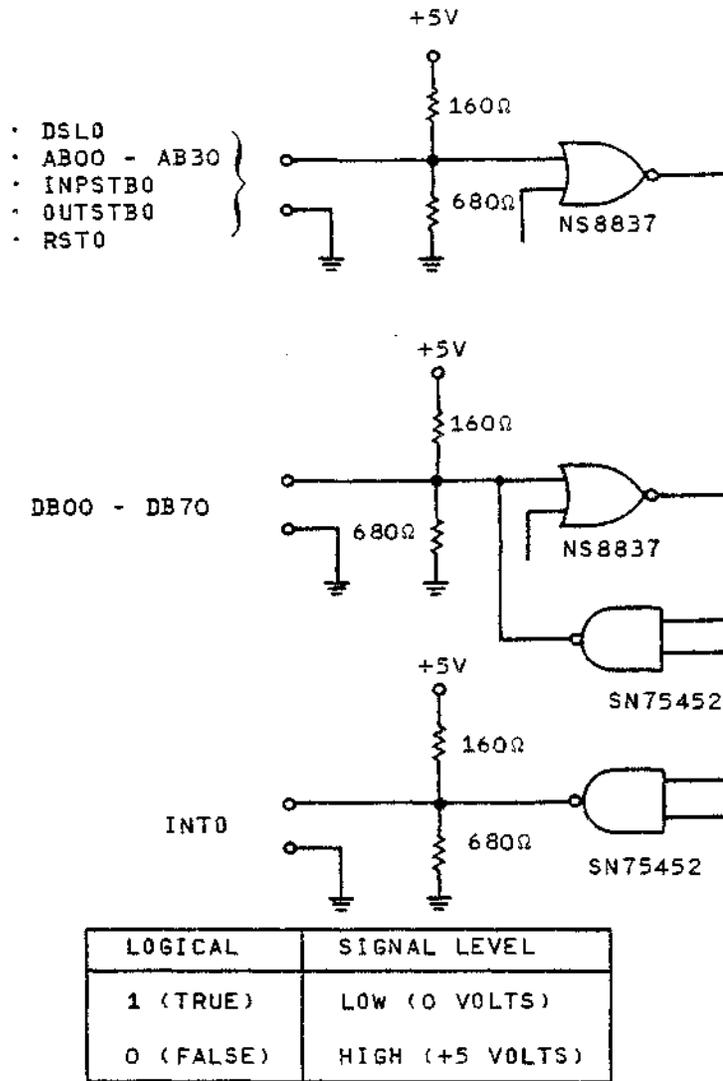
Table 2-16 lists logic level vs. voltage levels at the interface. Figure 2-20 illustrates the Gates 8837 and 75452 which are used for input and output circuits.

Table 2-16 Interface Signal Level Conversion

LOGICAL	SIGNAL LEVEL
1 (True)	Low (0 volts)
0 (False)	High (+5 volts)

#### 2.4.2.2 Input/Output Signal Line Descriptions

- DSL0 Device Select Line: This signal selects the device and has the highest priority.
- AB00 - AB30 Address Bus: These four address bus lines send the I/O register address to the printer.
- DB00 - DB70 Data Bus: These eight bidirectional bus lines command distance and direction for print thimble and carriage movement, and transfer control data for paper feed, ribbon lift, and hammer drive. They also transfer printer status information to the controller.
- INPSTB0 Input Strobe: This signal indicates that the printer status information exists in data bus.
- OUTSTB0 Output Strobe: This signal is used for data strobe to the printer command.



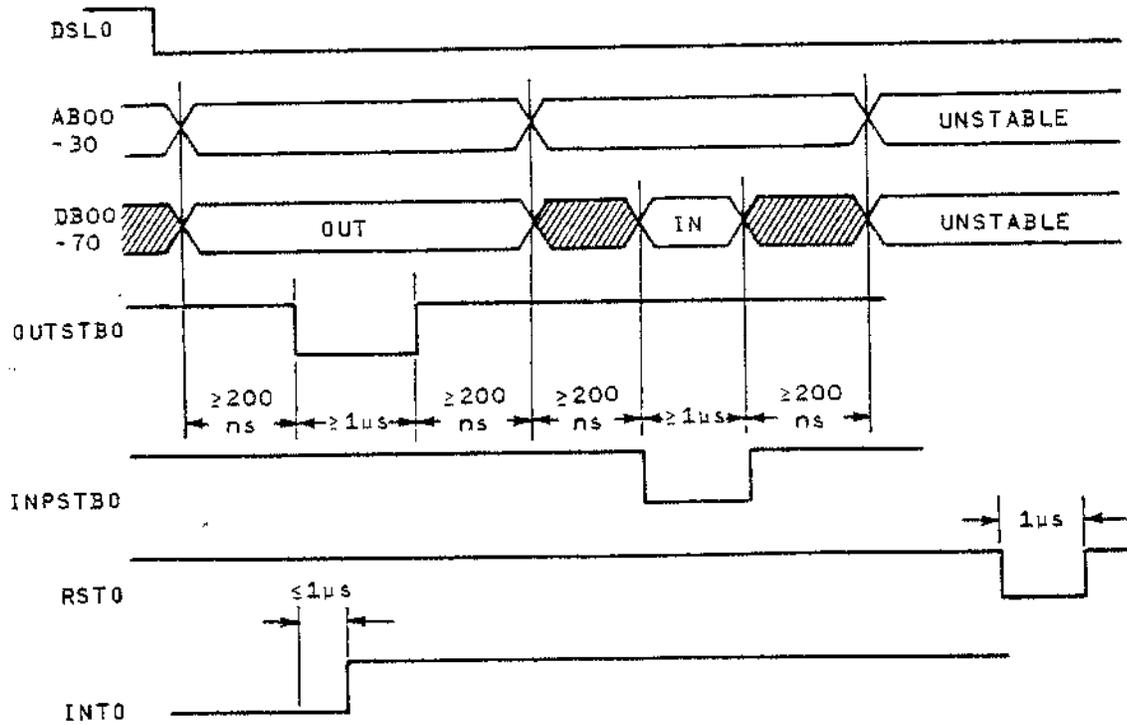
14-020

Figure 2-20 G9CUQ Interface I/O Circuits

- RST0 Restore: This signal initiates the Restore Sequence.
- INT0 Interrupt Request: This signal indicates that all the functions for the printer are ready.

#### 2.4.2.3 Strobe Timing

Figure 2-21 shows timing relationships of the interface signals.



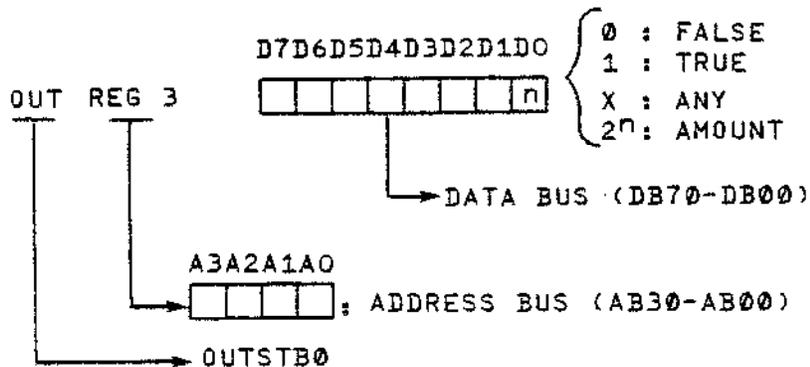
14-021

Figure 2-21 G9CUQ Interface Timing Diagram

### 2.4.3 Controller Command Formats

Printer input commands from the host controller consist of character, carriage, and paper feed commands. Commands are initiated by the OUTSTBO signal (Figure 2-21). Table 2-17 depicts an example of a single byte printer input command. In the case of a 2-byte command, the second byte initiates the operation. Thus, the command sequence must send the first byte followed by the second byte.

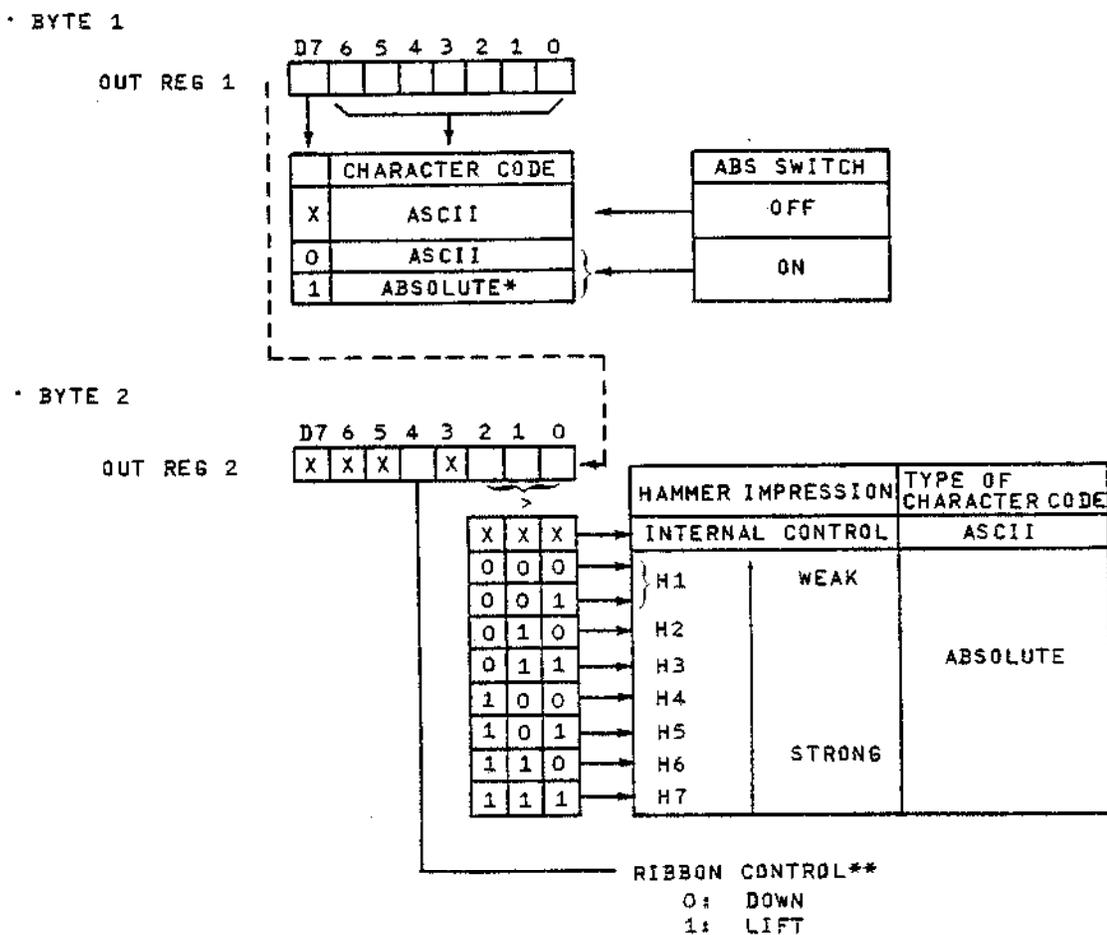
Table 2-17 G9CUQ Input Command Format



### 2.4.3.1 Character Command

Character selection, print hammer impression control, and ribbon control are achieved by the character command (Table 2-18). This 2-byte command is related to the G9CUQ PCB "ABSOLUTE" switch. With this "ABSOLUTE" switch set in the "OFF" position, the character code is fixed at ASCII and impression level control is automatically set, by the printer, at the appropriate impression level for each character. On the other hand, with this switch set in the "ON" position, the character code specifies either ASCII or ABSOLUTE. The hammer impression must be specified by the command for absolute character codes.

Table 2-18 G9CUQ Character Selection Command



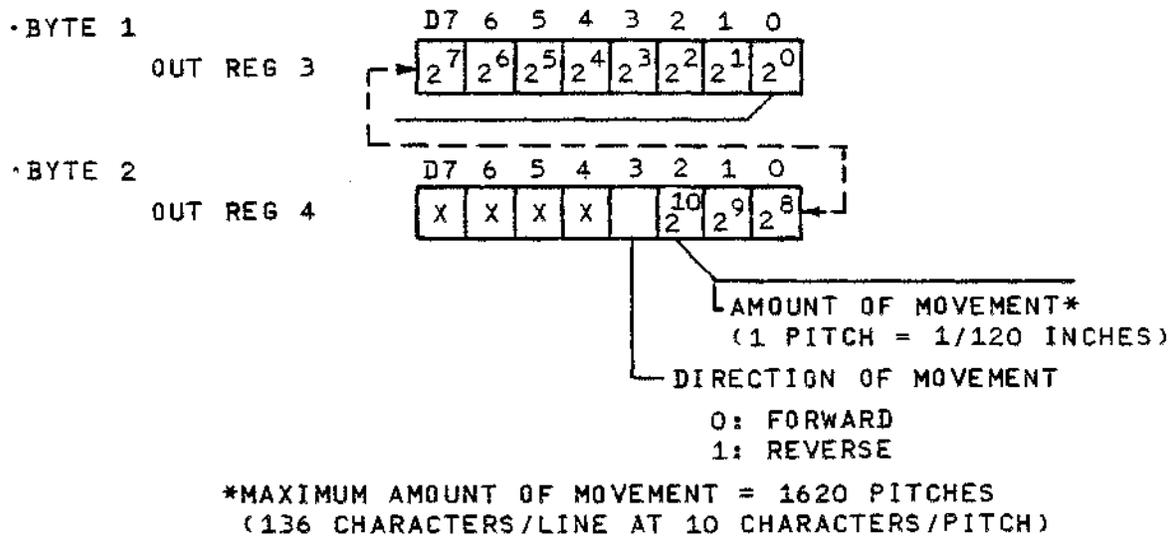
Note \*: Refer to Appendix for character codes.

\*\* : Ribbon control is performed as follows: With a red/black ribbon, black printing occurs in the lift position and red in the down position.

### 2.4.3.2 Carriage Command

This 2-byte command (Table 2-19) dictates the distance and direction of carriage movement. Note that the maximum amount of movement is 1620 pitches (136 characters/line at 10 characters/inch).

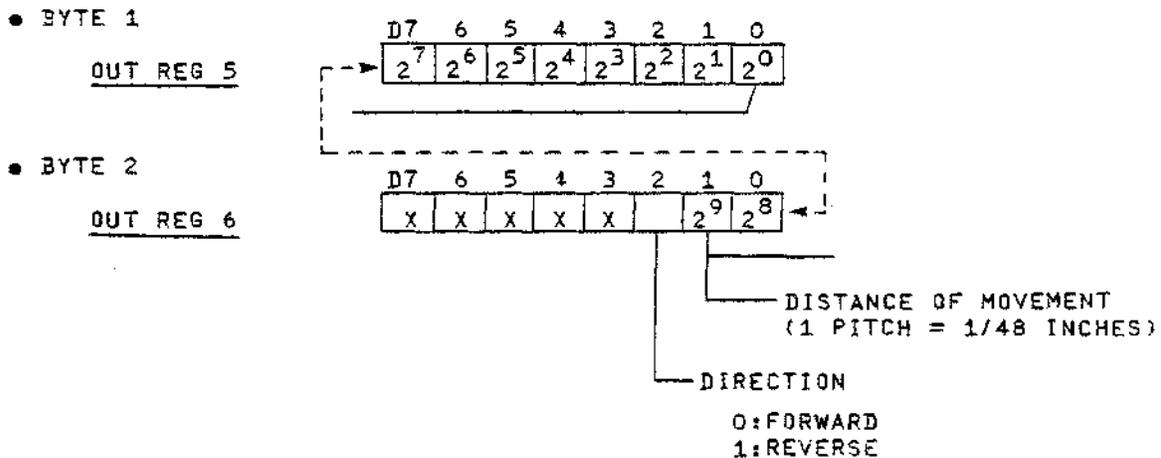
Table 2-19 G9CUQ Carriage Movement Command



### 2.4.3.3 Paper Feed Command

This 2-byte command (Table 2-20) dictates distance-and-direction of paper movement.

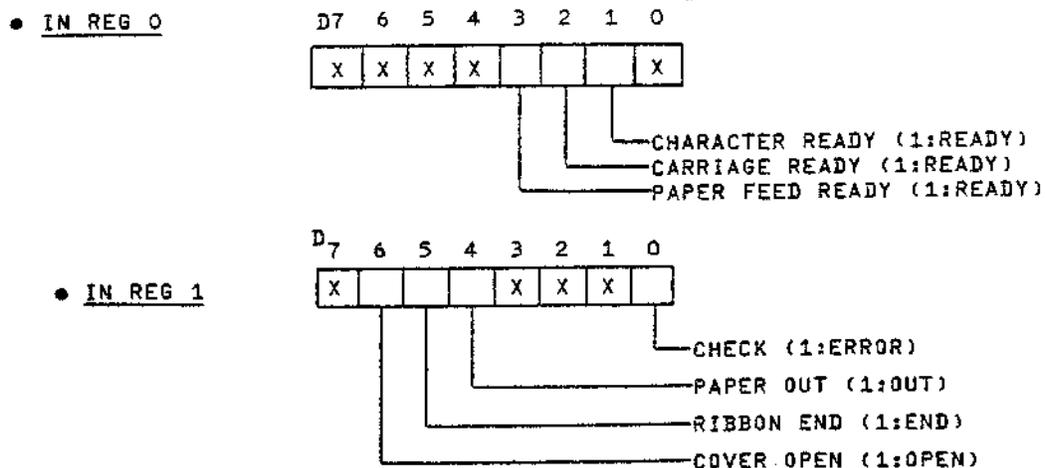
Table 2-20 G9CUQ Paper Feed Command



#### 2.4.3.4 Status Commands

Printer output commands to the host controller indicate ready status for the print, carriage, and paper feed commands. This controller input command (Table 2-21) is initiated by INSTB0, input strobe (Figure 2-21). "Check" indicates that the rotate servo or spacing servo is in the "TIME OUT" state or that the carriage is positioned in either the right emergency or left emergency margin areas.

Table 2-21 G9CUQ Status Commands



#### 2.4.4 Principle of Operation

This section presents the signals and command sequences required for proper machine control.

##### 2.4.4.1 Control Signals

- DSL0 Signal (Device Select)

This signal selects the SPINWRITER and has the highest priority.

- INT0 Signal (Interrupt Signal)

This signal indicates that all printer functions are ready for operation and any output command is acceptable. The signal is set when character ready, carriage ready, and paper feed ready are all in ready status (Logical "1"), and is reset if one of the output commands is received. However, INT0 will not be set under the condition of check, paper out, ribbon end or cover open.

- RST0 Signal

The RST0 command achieves a general reset of all printer functions.

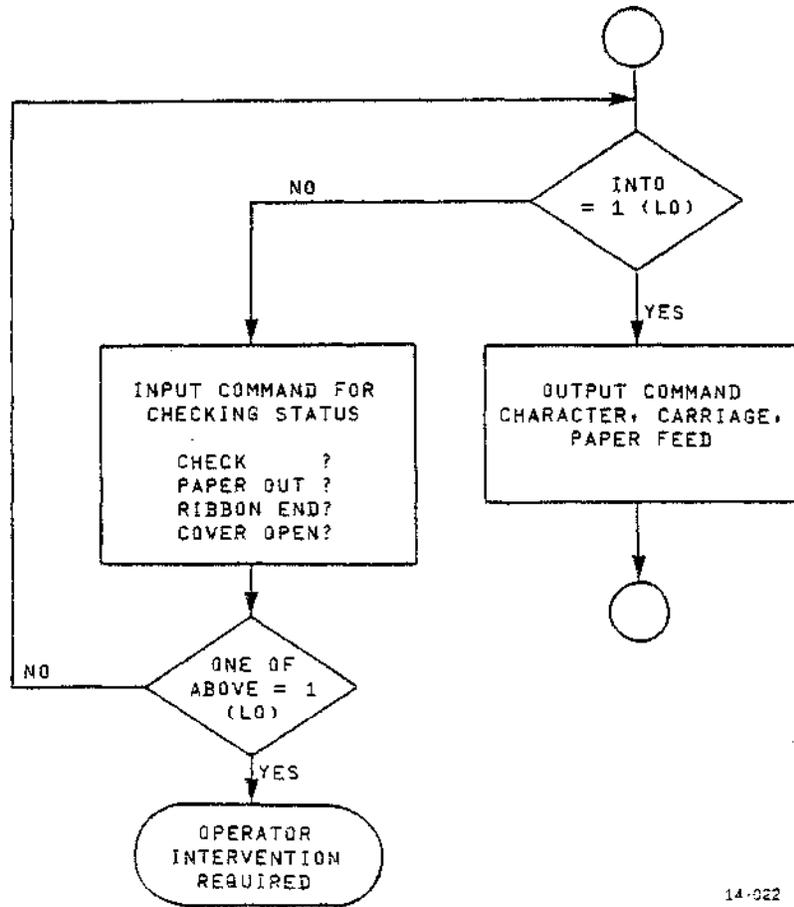
- Carriage: Home position (Column 1)
- Print Thimble: Home position (Character address 00)
- Ribbon: Down position (Red)

NOTE

This signal must not be used for carriage return.

2.4.4.2 Command Sequence

Figure 2-22 is a flow chart of the G9CUQ command sequence.



14-022

Figure 2-22 G9CUQ Command Sequence Flowchart

#### 2.4.4.3 Print, Carriage, Paper Feed Operations

During fundamental print functions, carriage and paper feed are performed independently.

- Print Thimble Positioning, Ribbon Change, and Printing.

The controller samples Character Ready and sends out a print command. Through calculation, the internal microprocessor determines the quickest processing method to select the proper print character and perform the remainder of the print operation. When the ribbon change function is included in the print command, the ribbon color function is selected before the printing operation is performed.

- Carriage Positioning

First, perform device select; second, sample the carriage ready information with input command (In Reg. 0) to ensure that a carriage move command will be accepted; and third, output the carriage command (Out Reg. 3 and Out Reg. 4) which includes direction-and-distance-of-movement information. The microprocessor then causes the carriage to be driven to the commanded position.

- Paper Feed

First, perform device select; second, sample the paper feed ready information to ensure that the paper feed command will be accepted; and third, output the paper feed command. The printer then functions properly according to the data inputted by output command (paper feed command).

#### 2.4.4.4 Interrupt Signal Operation

The simple burst-out method with INTO signal is as follows:

The INTO signal indicates that the printer is ready for operation. (Character ready, carriage ready, and paper feed ready are all ready state.) Thus the INTO signal is sampled before the burst-out commands are sent.

The printer will execute the operations according to the sequence of output commands received by the microprocessor.

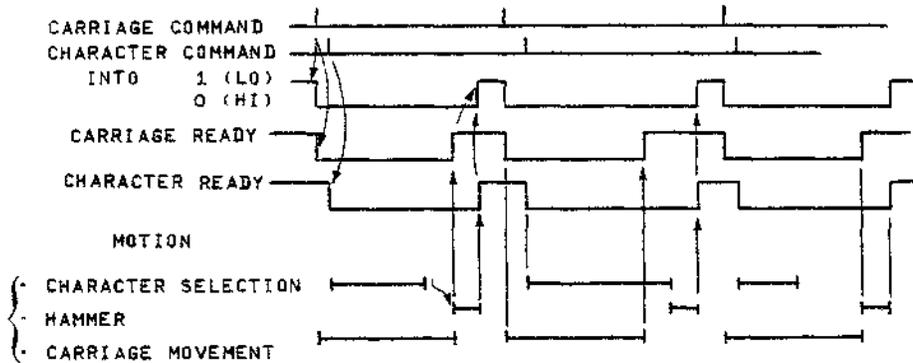
- Output Command Sequences

When the character command follows the carriage command or the paper feed command, the print hammer will be fired immediately after all operations (character selection, ribbon lift, carriage movement, and paper feed motion) are completed.

On the other hand, if a carriage command or paper feed command is received after a character command, the carriage movement or paper feed operations will be started after the print hammer impacts.

Because of the reasons mentioned above, the execution time or sequence of operation depends on the command sequence.

a. Carriage command then Character command (Figure 2-23)



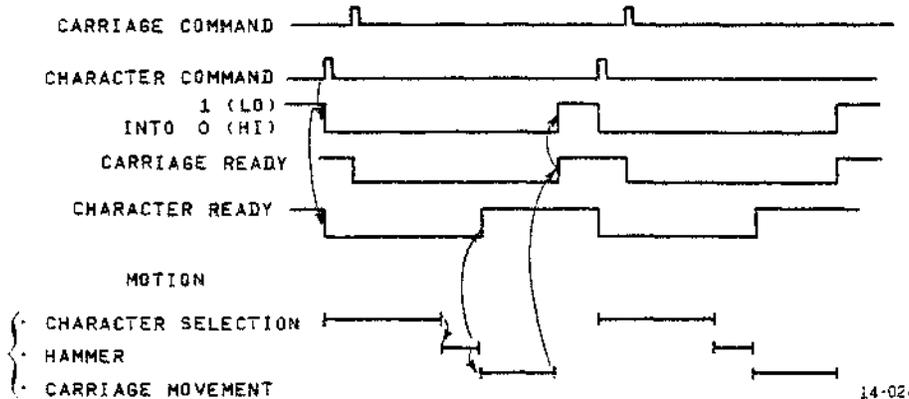
NOTE

THE CARRIAGE COMMAND OF COLUMN 1 MUST BE OMITTED OR ITS MOVEMENT DISTANCE MUST BE ZERO.

14-023

Figure 2-23 G9CUQ Carriage-Character Command

b. Character command then Carriage command (Figure 2-24)



14-024

NOTE: Since the character selection operation and carriage movement are carried out sequentially, the printer operation speed is slower than the speed in paragraph (a), unless character and carriage motion commands are received in continuous sequence.

Figure 2-24 G9CUQ Character-Carriage Command

## 2.5 QUME-COMPATIBLE INTERFACE (G9CUT)

This parallel interface is fully implemented and contained on the G9CUT processor board. The SPINWRITER Model 5500-Q system block diagram is shown in Figure 2-25.

### 2.5.1 Circuit Description

This interface circuitry configuration is different than that of the other parallel interfaces described in Sections 2.3 and 2.4. Host system data, strobe, and control lines are routed via 8837 type bus receivers directly to programmable peripheral interface (8255 type) ports. The data lines for the Qume-compatible interface are unidirectional. All printer function ready and status lines are outputted from 75452 type line drivers to the host controller on discrete signal lines.

### 2.5.2 Signal Line Characteristics

Printer control and command transfers are established through the controller interface (Figure 2-26). The following sections define input/output signals, I/O circuits, and strobe timing.

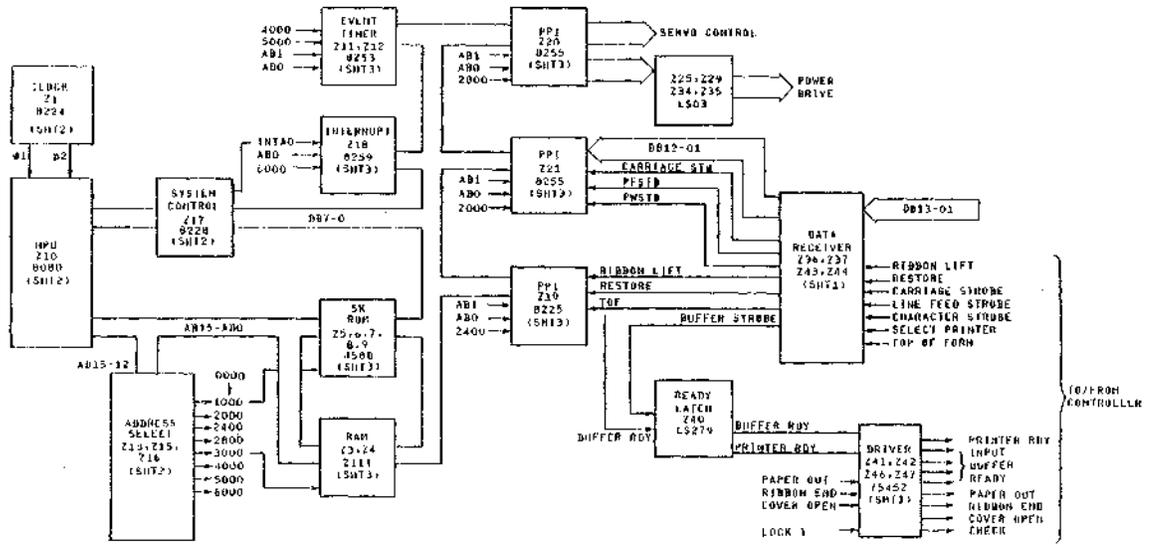
#### 2.5.2.1 Input/Output Circuits

The Qume-compatible (G9CUT) I/O circuits are identical to those of the Diablo-compatible (G9CUQ) I/O circuits discussed in Sections 2.3.2.1 and 2.3.2.2

#### 2.5.2.2 Input Signal Line Descriptions

- Printer Select - This signal, when logic "low", enables the four printer ready output lines. The controller instructs execution of each operation by outputting data and strobe signals upon receipt of printer ready signals.
- Data Lines - The 12 lines of this bus represent character and print hammer impression selections, carriage direction-and-distance selections, and paper feed direction-and-distance selections when strobed by the print carriage, or paper feed strobes respectively.
- Strobe Lines - Each of the three strobes (character, carriage, or paper feed) when logic "low" is used by the printer to sample the corresponding data line information.

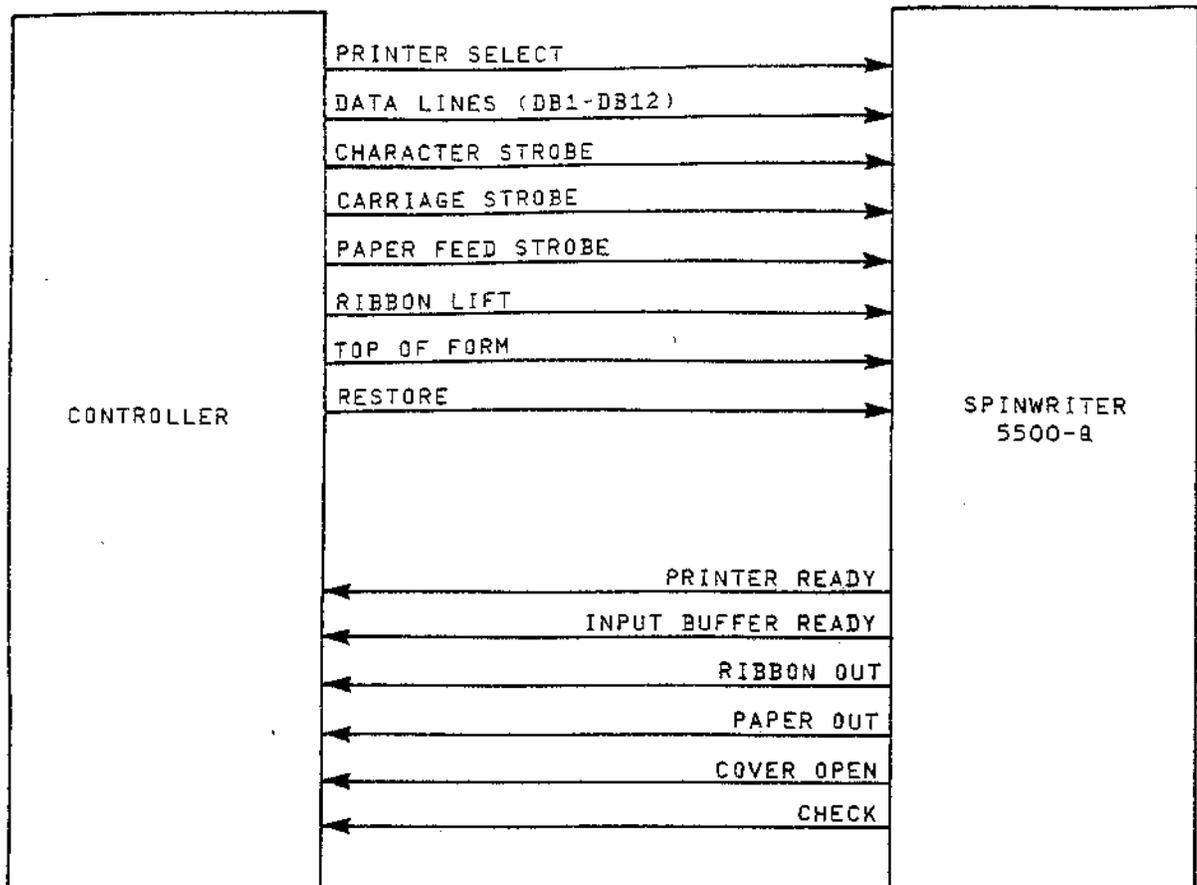
G9CUT



(136-440B79)

14-025

Figure 2-25 Model 5500-Q Block Diagram (G9CUT)



14-026

Figure 2-26 G9CUT Interface Lines

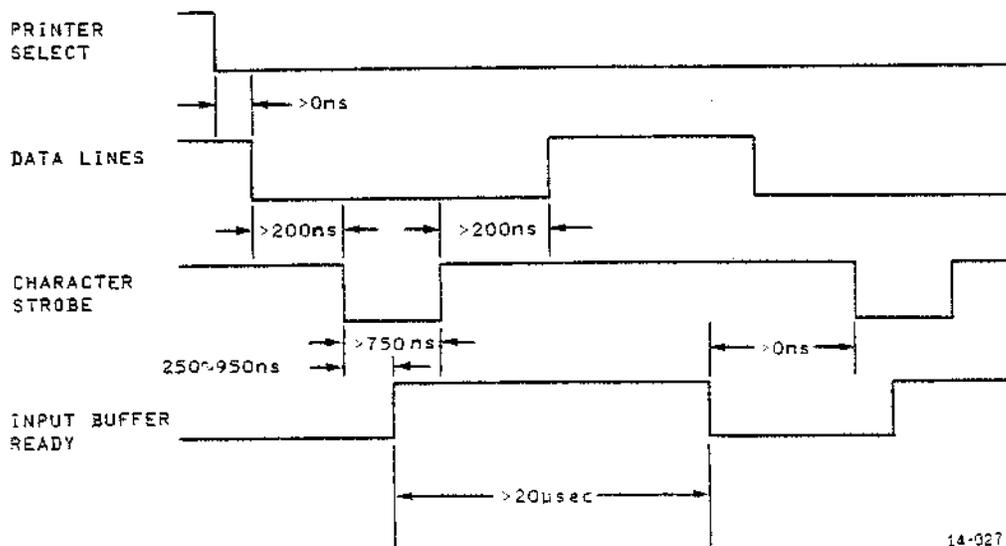
- Ribbon Lift - Logic "low" commands ribbon lift to the primary ribbon color position. Logic "high" commands the ribbon down position, in order to print red with a red/black ink ribbon. Ribbon down also allows viewing of characters as they are printed.
- Restore - When logic "low", the SPINWRITER executes the restore sequence which returns the print thimble to the home position (absolute address "0") and returns the carriage to home position (column "1").
- Top of Form (TOF) - This signal, if connected, enables the user to program 1 of 16 form increments by the generation of a special ASCII form feed code coincidental with a character strobe. After the form length has been programmed, the TOF signal initiates form positioning.

### 2.5.2.3 Output Signal Line Descriptions

- READY Lines - These four lines, when enabled by the logic "low" PRINTER SELECT input signal, transmit printer subassembly operation status to the host controller.
- CHECK - This line when logic "low" indicates that a previously received character or carriage movement command was not successfully completed. Under this condition, printer activity ceases and the INPUT BUFFER READY lines are disabled. Only a RESTORE command, whether initiated by controller command or reapplication of power, will clear a check condition.
- PAPER OUT - Logic "low" indicates to the controller a SPINWRITER paper out status. Models supplied without a paper-out switch will present a constant logic high on this line.
- COVER OPEN - Logic "low" level indicates that the top cover is open and/or the acrylic cover is open.
- Ribbon Out - Logic "low" indicates that the multi-strike film ribbon cartridge is empty.

### 2.5.2.4 Strobe Signal Timing

Figure 2-27 shows minimum time required for settling time of data lines before the character strobe is initiated. Timing sequences shown are also applicable to carriage and paper feed commands.



14-027

Figure 2-27 G9CUT Interface Strobe Timing

### 2.5.3 Input Command Format

The following sections present data line function assignment information for the three (character, carriage, and paper feed) input commands.

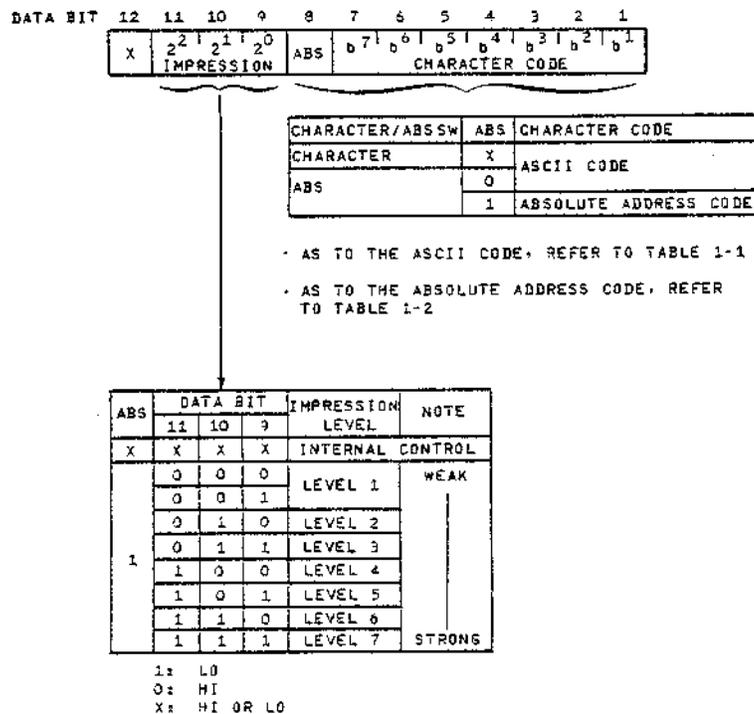
#### 2.5.3.1 Print Command (With Character Strobe)

These data line commands when sampled by the CHARACTER strobe present character selection and hammer impression information to the printer. The CHARACTER/ABSOLUTE switch selection determines whether the character code information pertains to ASCII code or absolute (i.e., specific thimble finger, and plane) address code. Print hammer impression data must be supplied in the "ABS" mode. Table 2-22 shows the print command word format.

#### NOTES

1. Character Mode - data bits 2-8 represent the ASCII code. Objective character is automatically selected by the printer.
2. Absolute Mode - The print thimble character position arranged is directly specified.

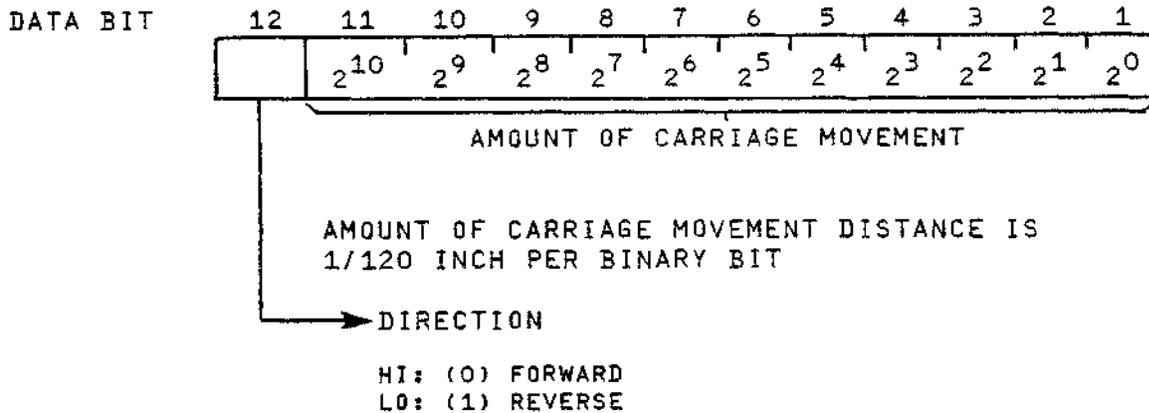
Table 2-22 G9CUT Print Character Word Format



### 2.5.3.2 Carriage Movement Command (With Carriage Strobe)

Data bit information for the carriage movement command word is shown in Table 2-23.

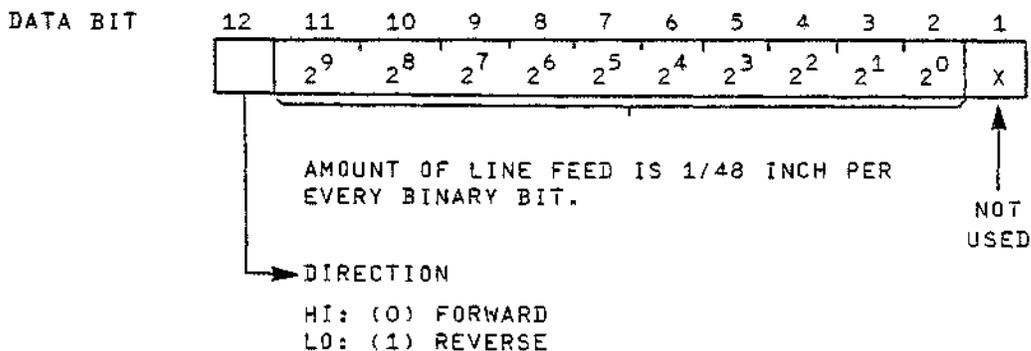
Table 2-23 G9CUT Carriage Movement Command Format



### 2.5.3.3 Paper Feed Movement Command (With Paper Feed Strobe)

Data Bit information for the paper feed movement command word is shown in Table 2-24.

Table 2-24 G9CUT Paper Feed Command Format



LINE FEED VALUE =  
 $1/48 \text{ INCH} \times (2^0 \text{ BIT} + 2^1 \text{ BIT} + \dots + 2^9 \text{ BIT} + 2^{10} \text{ BIT})$

### 2.5.3.4 Top of Form Command

This signal advances the paper to its starting point at the Top of Form. There are sixteen programmable lengths of form feed (FF) available. The length of form to be used should be programmed prior to applying the TOP OF FORM strobe by initiating

a character strobe coincidental with the ASCII code with data bits 9, 10, 11 and 12 determining the length of feed. See Table 2-25. If the FF code is not used, the Top of Form increment will be automatically set at eleven inches.

Table 2-25 TOF Form Length

Data Bit 12	Data Bit 11	Data Bit 10	Data Bit 9	Inches
0	0	0	0	11 [66 line]
0	0	0	1	3
0	0	1	0	3.5
0	0	1	1	4
0	1	0	0	5
0	1	0	1	5.5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	8.5
1	0	1	0	9
1	0	1	1	10
1	1	0	0	11-2/3 [70 line]
1	1	0	1	12
1	1	1	0	14
1	1	1	1	17

#### 2.5.4 Principle of Operation

The select printer signal is first transmitted to ensure the printer ready status. At this time, each strobe is disregarded when the corresponding ready line is not in "LO" state. The printer processes a strobe in the input sequence as shown in Figure 2-27.

##### 2.5.4.1 Print Thimble Positioning

Print thimble operations are roughly divided into the following functions.

- Character selection - In order to select a desired character, the print thimble is provided with rotate operation and vertical (up-down) movement. The selection is made by the character code (refer to Section 2.5.3.1)
- Hammer - Hammer operation occurs after the other operations are successfully completed: character selection, carriage movement, line feed, ribbon up-down, and ribbon advance. That is, hammer operations occur only after these operations are completed.

- Print hammer impression level is controlled by the impression level specification in the Absolute mode or by automatic specification generated inside the SPINWRITER (Table 2-22) in the character mode.
- Print Thimble Positioning and Printing - First, a printer is identified by the select printer signal. Second, print thimble ready status is sampled in order to perform print thimble operation. Third, both the data of character selection and hammer impression are established on the data lines. Then the print thimble strobe of greater than 750 nanoseconds is transmitted. As mentioned before, hammer operation is prohibited until the operations of character selection, carriage movement, line feed, and ribbon up-down are successfully completed.

#### 2.5.4.2 Carriage Positioning

The sequence required to position the carriage is, first, select the printer; second, sample the carriage ready line to ensure that a carriage move command will be accepted; third, place the distance-and-direction of movement information on the data lines; and fourth, strobe the data. The carriage begins its movement after completion of the print thimble operation from the previous command.

#### 2.5.4.3 Paper Feed

The sequence required for paper feed is, first, select the printer; second, sample the paper feed ready line to ensure that the paper feed command will be accepted; third, place the distance-and-direction-of-movement information on the data lines; and fourth, strobe the data. The paper feed operation will be performed after the print thimble operation, if previously commanded, is completed.

#### 2.5.4.4 Ribbon Lift

If a two-color ribbon is being used and the lower ribbon color (black) is desired, the ribbon lift signal, with the printer select = "LO", must be made "LO" prior to the print command. If the upper color is desired to be printed, the ribbon lift = "HI" must be made. When using a single-color ribbon, the ribbon lift signal must always be "LO" to allow printing. If the ribbon lift signal is set "HI", the ribbon will be moved into the lower position to facilitate visualizing a printed character. The lift movement of the ribbon requires about 130 milliseconds, therefore the ribbon lift command is issued prior to the print thimble command. The ribbon lift movement and the ribbon lift command are related, as shown in Figure 2-28.

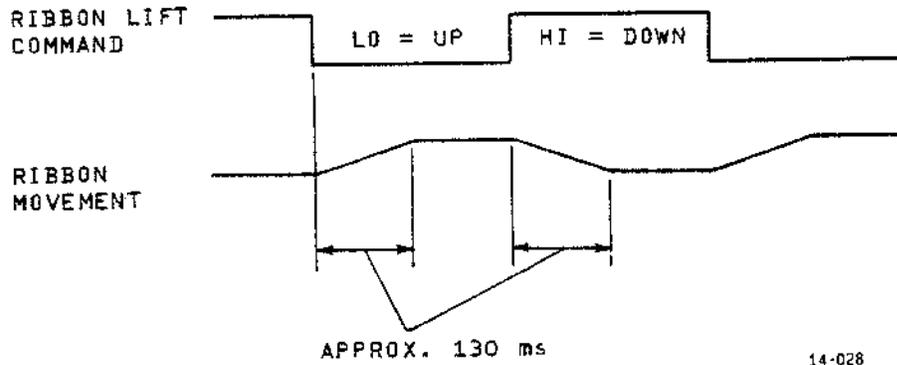


Figure 2-28 Ribbon Timing Sequence

#### 2.5.4.5 Space-Before-Print Sequence

The interval between the carriage strobe and the print thimble strobe must be more than 400 nanoseconds in order to move the carriage or the print thimble. The hammer will be energized after completion of the carriage movement. However, character selection and ribbon advance will be performed during the carriage movement by the print thimble strobe. The printing time required is shorter than that of the print-before-space sequence. Refer to Figure 2-16.

#### 2.5.4.6 Print-Before-Space Sequence

In order to operate the print thimble and carriage (or line feed), an interval is needed between the trailing edge of the print thimble strobe and the leading edge of the carriage strobe. The interval must be more than 400 nsec.

The carriage begins its movement after completion of the print thimble operation (character selection, ribbon advance, and hammer). This operation requires a longer period of time than the space-before-print sequence does. However, when the operations of print-space-print-space are repeated, the time required is just the same as the operations of space-before-print sequence and print-before-space sequence, except for the first sequence. Refer to Figure 2-17.

### 2.6 OUTPUT DEVICE ADAPTER (ODA) INTERFACE (G9BNB)

This parallel interface is fully implemented and contained on the G9BNB processor board. The ODA type processor board is used in SPINWRITER printers that are connected to NEC controllers. Model 5510-C also utilizes this processor board in concert with the G9BNA, Centronics-type signal conversion, circuit board.

The ODA Interface block diagram is shown in Figure 2-29. Refer to SPINWRITER logic diagrams 136-100235-021 through -025 for the following discussion.

### 2.6.1 Circuit Description

Host system data and signal lines (or G9BNA output lines for Model 5510-C) are inputted to the Z46, Z50, and Z51 (1489L type) line receivers (Figure 2-29). The eight data lines, RD1-8, are then routed to Z42 programmable peripheral interface (PPI) for input to the G9BNB microprocessor system (MPS). Three control lines (IRT, RDP, and RMS) are also routed from line receivers to Z42. Z42 PPI port A sends status signals to Z47, Z49 for output to the host controller. Z3 PPI ports A and B provide data and control signals between MPS and control panel. Also inputted at this PPI (port C) are impression, cover, and paper switch status information.

Z27 and Z43, both PPIs, provide connection of control and status information to machine control subassemblies, i.e., servo and driver circuits.

### 2.6.2 Signal Line Characteristics

Printer operations are controlled through the interface (Figure 2-30). The interface consists of a reset line, eight data lines, a select line, and a data present line all of which represent commands and information to the printer. The printer in turn responds by outputting machine ready, device connected, data acceptable, media low, and alarm signals to the controller.

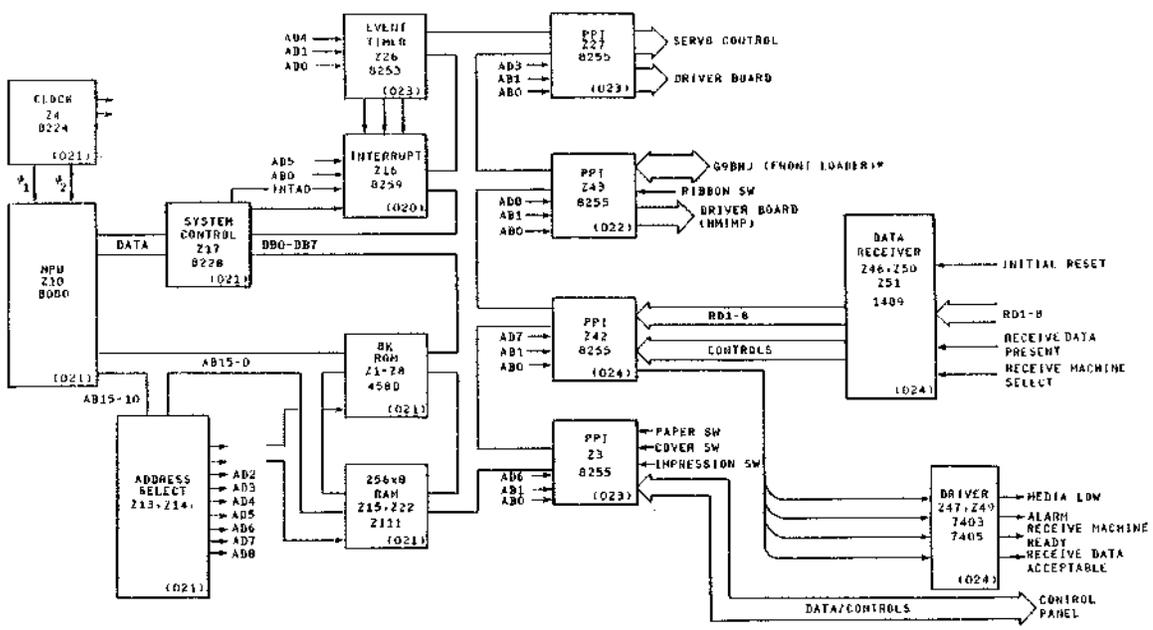
#### 2.6.2.1 Input/Output Interface Circuits

G9BNB interface circuitry utilizes 1489 type line receivers for input circuits and 7403, 7405 type open collector gates for output circuits (Figure 2-31). Table 2-26 shows logic level vs. voltage levels at the interface.

#### 2.6.2.2 I/O Signal Line Descriptions

Table 2-27 describes G9BNB interface signal line functions, refer to Figure 2-30 for signal line source/destination information.

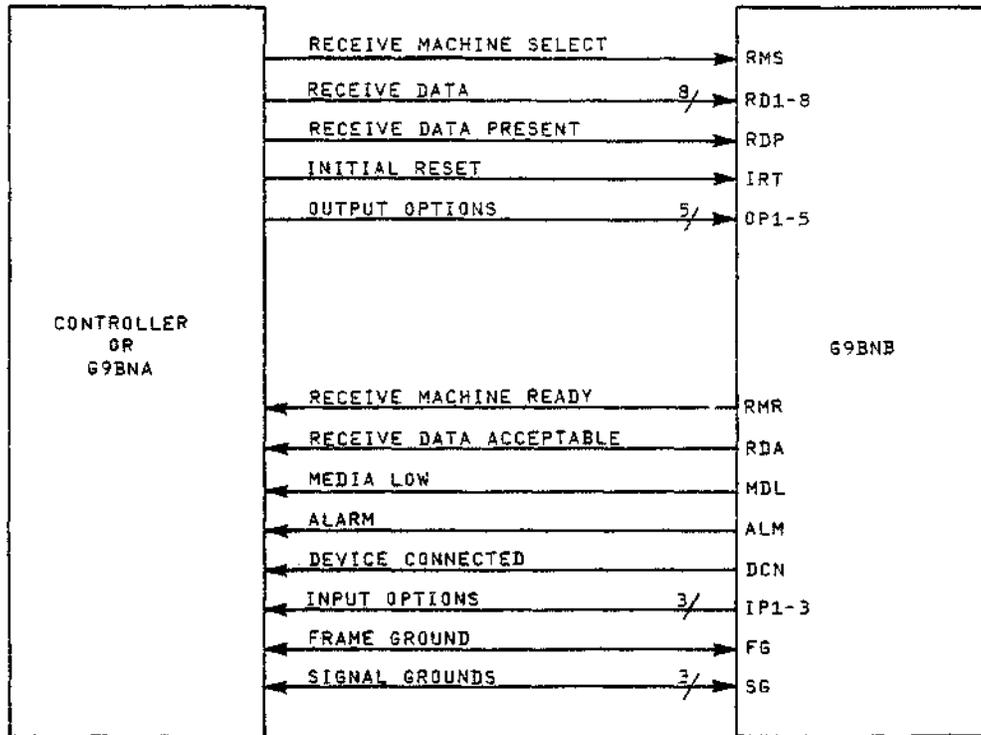
CU-13



\*G9BNJ NOT USED WITH MODEL 5510-C

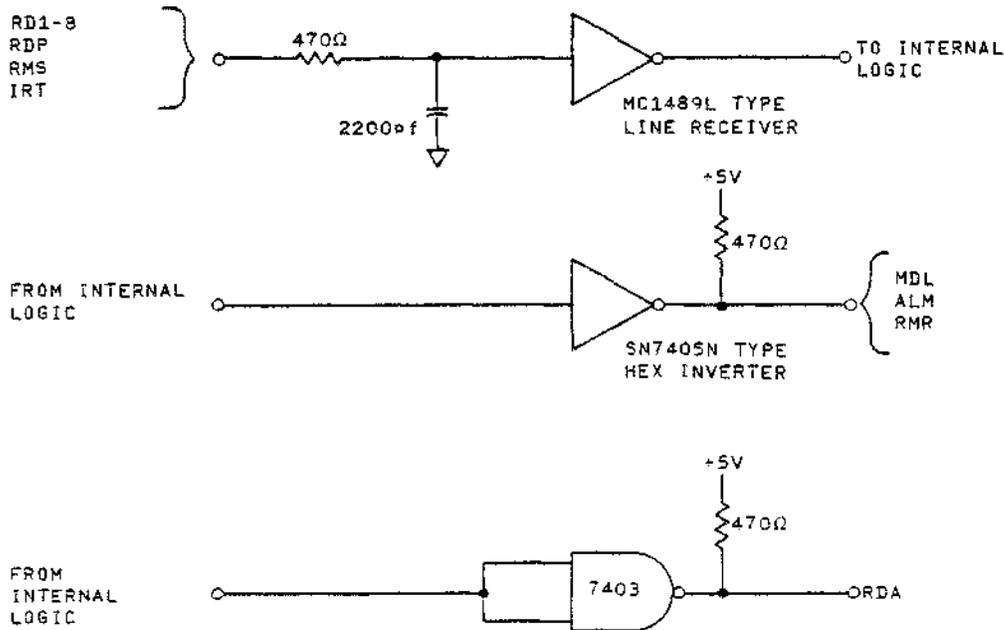
(136-100235-21 → 25)

Figure 2-29 ODA Interface Block Diagram (G9BNB)



14-020

Figure 2-30 G9BNB Interface Lines



14-031

Figure 2-31 G9BNB I/O Circuits

Table 2-26 G9BNB Interface Signal Level Conversion

LOGIC	VOLTAGE AT THE INTERFACE
1 ON	2.4V
0 OFF	0.4V

Table 2-27 I/O Signal Line Functions

SIGNALS	ABBREVIATION	FUNCTION
Frame Ground	FG	
Receive Machine Select	RMS	Logic high, selects PR
Receive Machine Ready	RMR	Logic high, PR is ready
Receive Data #1	RD1	Character, control information (2 <sup>0</sup> Bit)
Receive Data #2	RD2	Character, control information (2 <sup>1</sup> Bit)
Receive Data #3	RD3	Character, control information (2 <sup>2</sup> Bit)
Receive Data #4	RD4	Character, control information (2 <sup>3</sup> Bit)
Receive Data #5	RD5	Character, control information (2 <sup>4</sup> Bit)
Receive Data #6	RD6	Character, control information (2 <sup>5</sup> Bit)
Receive Data #7	RD7	Character, control information (2 <sup>6</sup> Bit)
Receive Data #8	RD8	Character, control information (2 <sup>7</sup> Bit)
Receive Data Acceptable	RDA	Logic high indicates PR is ready to accept data on RD1→RD8 lines
Receive Data Present	RDP	Logic high indicates that there is valid information on the RD1→RD8 data lines

Table 2-27 G9BNB I/O Signal Line Functions (contd)

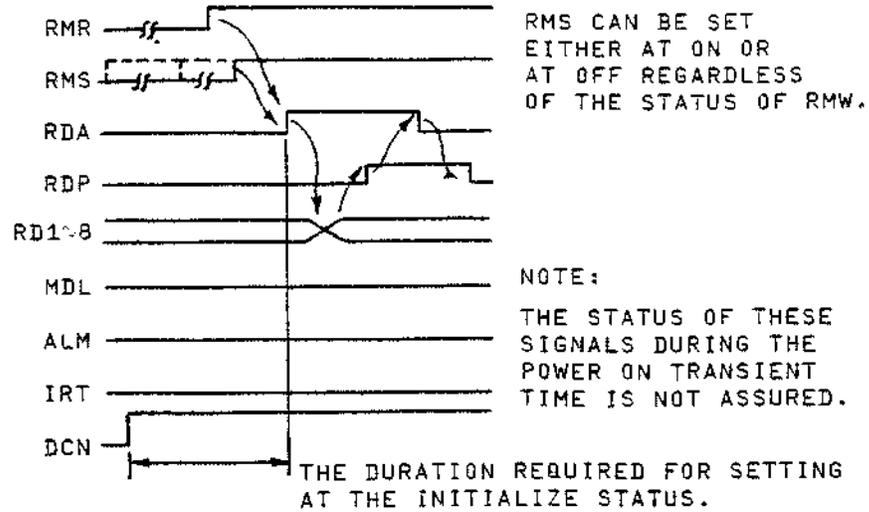
SIGNALS	ABBREVIATION	FUNCTION
Media Low	MDL	Logic high indicates the paper out condition
Alarm	ALM	Logic high indicates that a data error or a PR machine alarm is detected
Device Connected	DCN	Logic high indicates that the connecting cables between PRs are connected, and power is applied to PR
Initial Reset	IRT	Logic high resets PR initial state if duration $\geq 10 \mu\text{sec}$
Output Option #1	OP1	Reserved
Output Option #2	OP2	Reserved
Output Option #3	OP3	Reserved
Output Option #4	OP4	Reserved
Output Option #5	OP5	Reserved
Input Option #1	IP2	Reserved
Input Option #2	IP2	Reserved
Input Option #3	IP3	Reserved
Signal Ground	SG	

### 2.6.3 Principle of Operation

The following description presents the sequence of controller/printer command and control signals for print operations. Refer to Figures 2-32 through 2-35 for interface signal timing relationships.

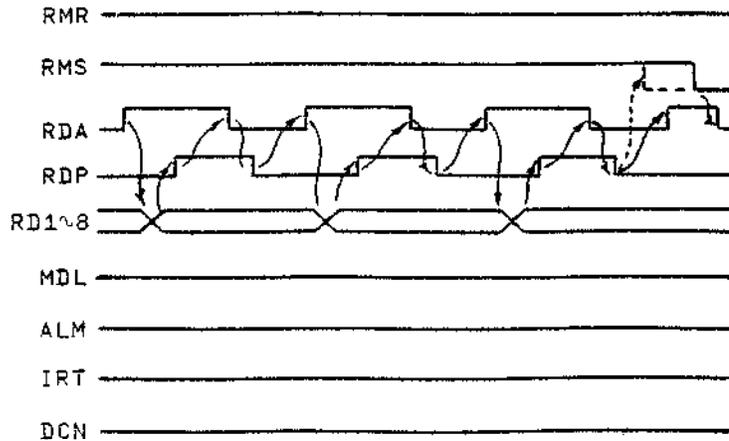
The RMR signal is checked before controller issues a data command. If RMR is on and RDA is also on, the controller sends one character of printing datum via the RD1-8 lines. Then the controller sends the RDP signal. Printer senses presence of RDP and accepts the RD1-8 printing data while simultaneously turning off RDA. Controller senses RDA off, turns off RDP and the character datum transfer is terminated. When printer is ready to accept another character, RDA is turned on again. This sequence of events transfers all of the printing data,

prepared by the controller, to the printer, character by character. The controller is informed of printer mechanism error conditions via the ALARM and MEDIA LOW lines.



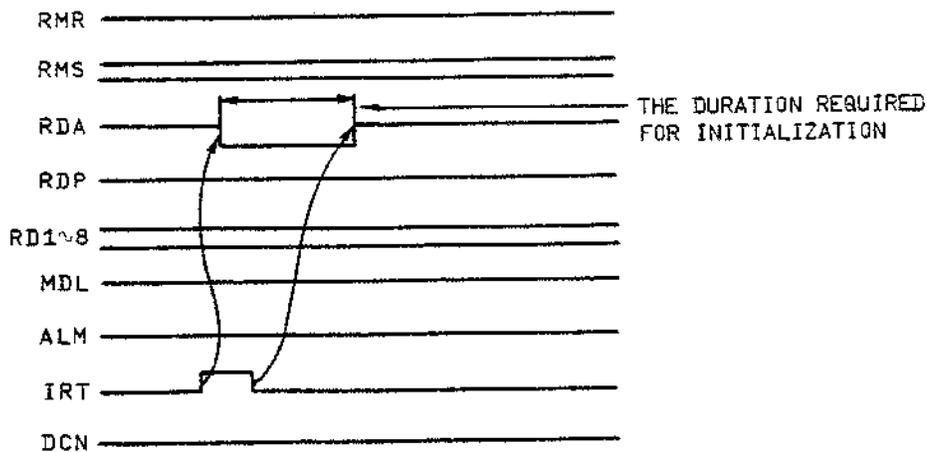
14-032

Figure 2-32 G9BNB Power On Timing



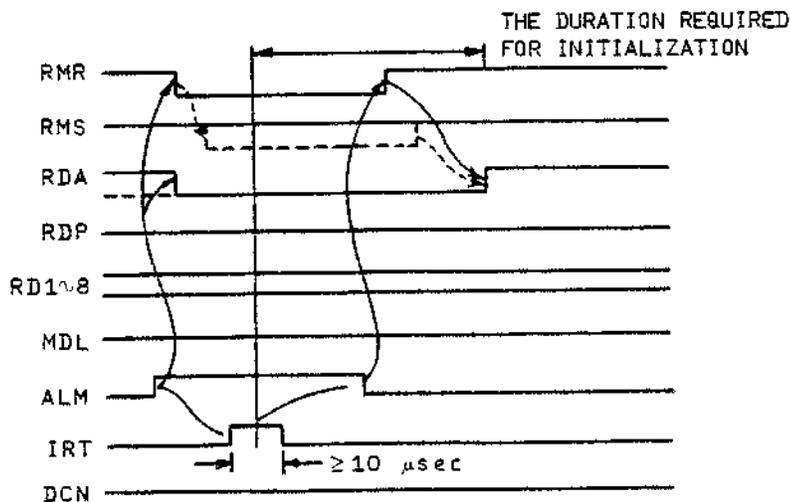
14-033

Figure 2-33 G9BNB Data Transfer Timing



14-034

Figure 2-34 G9BNB IRT Timing

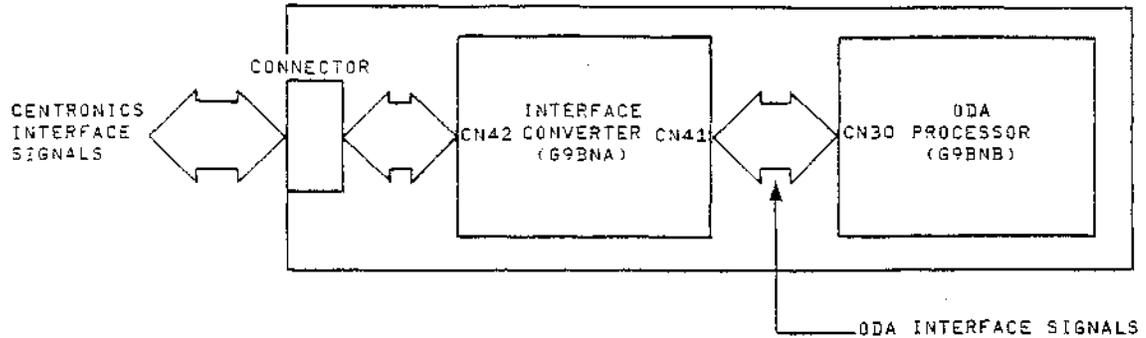


14-035

Figure 2-35 G9BNB Alarm Timing

## 2.7 CENTRONICS-TYPE SIGNAL CONVERTER (G9BNA)

The G9BNA circuit board provides conversion of Centronics-type interface signals for SPINWRITER 5510-C Models. This circuit board produces ODA type interface signals for connection to the G9BNB processor board (Figure 2-36). Refer to SPINWRITER logic diagram 136-100235-060 and -061 for the following discussion.



14-036

Figure 2-36 G9BNA Interconnection Diagram

### 2.7.1 Circuit Description

Incoming character and command data words on the Data 1-8 lines (Figure 2-37) from the controller are latched in the Z37/Z33 4-bit registers. Register signals, REGSET1 and READ1, provide control to latch incoming signals or output the latch contents onto the converter data bus, respectively. The incoming data bus character words are stored in the Z34/Z38 RAM until they are required later for printer operations. Incoming command data words address stored code commands in ROM as mentioned below.

Maximum buffer length, the number of characters that can be stored in RAM, is determined by S1 switch selections (136 or 132 and 12 CPI or 10 CPI). RAM addressing is provided by counter Z28/Z29, which also connects to the comparator Z27/Z26 input lines. The comparator is preset by the decoder, Z31, output signals. The comparator output signal, BUFFER FULL, becomes true when inputs match.

Data input signals, via the input latch, also connect to the ROM, Z35, address lines. Specific code words on the converter data bus, when addressing ROM, provide output command codes (PR START LF, DEL, WRITE INH, and PRINT START) which inhibit RAM write, and initiate printer control functions.

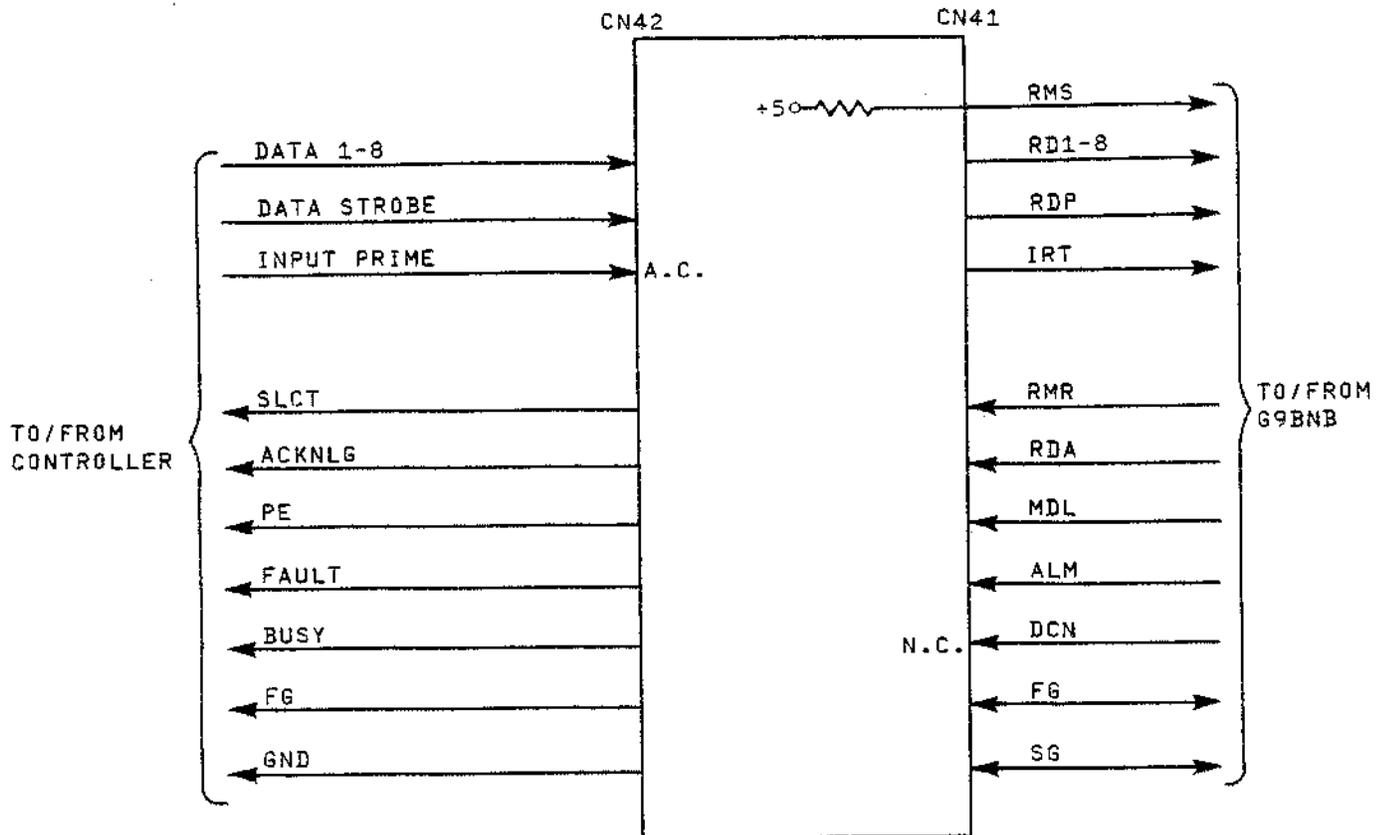
An end of text code sent by the controller is detected by ROM, Z35, which outputs the DELETE CODE signal to disable further RAM write operations.

During print operations the contents of RAM are read, character by character, onto the data bus and routed through the data selector, Z29/Z36 to the RD1-8 output lines.



## 2.7.2 Signal Line Characteristics

Printer operations are controlled through the interface (Figure 2-38). The interface input signals, from the controller, consist of eight data lines, a data strobe, and an input prime signal. Interface output signals, to the controller, include the select, acknowledge, paper end, fault and busy lines.

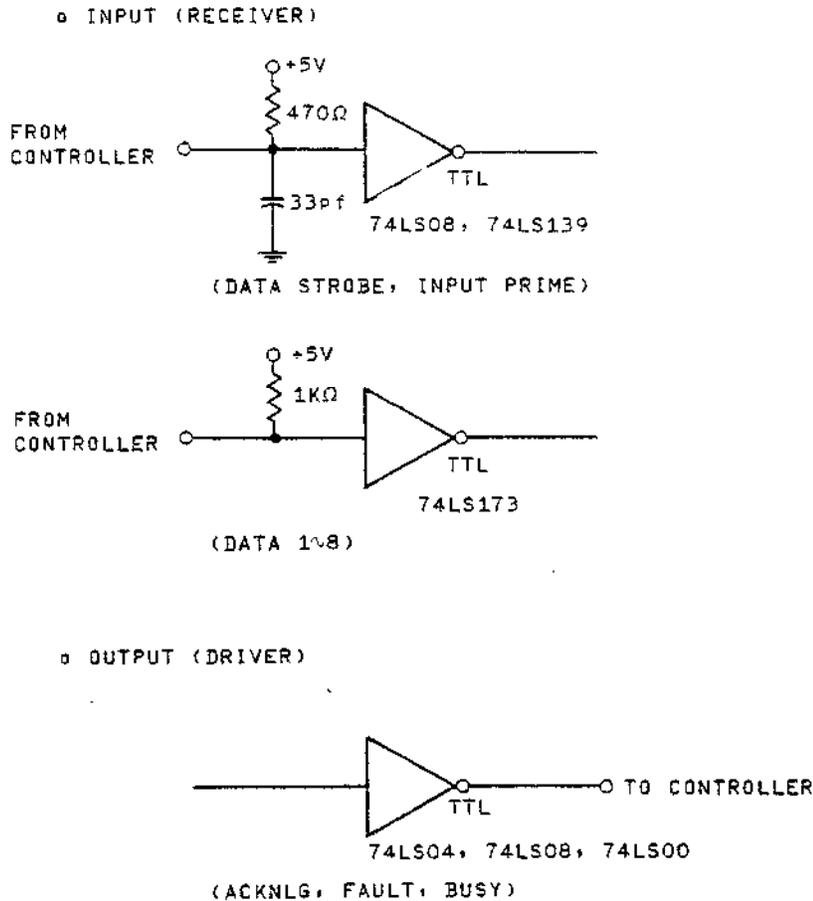


14-038

Figure 2-38 G9BNA Interface Signals

### 2.7.2.1 Input/Output Interface Circuits

G9BNA interface circuitry utilizes low power Schottky (LS type) TTL (SSI and MSI) input and output gates (Figure 2-39). Two G9BNA output signals (SLCT and PE) are wired straight through from the ODA Processor board output signals (RMR and MDL, respectively).



14-039

Figure 2-39 G9BNA I/O Circuits

### 2.7.2.2 I/O Signal Line Descriptions

Table 2-28 lists controller interface signals, their functions, and source (either printer or controller). The ODA signals generated or received by the G9BNA conversion board are described in Section 2.6.2.2.

### 2.7.2.3 Strobe Signal Timing

Figure 2-40 shows the strobe signal timing relationship to data lines during buffer write operations.

### 2.7.3 Principle of Operation

Data from the buffer is sent character by character to the G9BNA processor board as described in Section 2.6.3. The G9BNA conversion board responds as a controller would to the ODA commands from the G9BNA processor board. This section describes the sequences followed by the converter circuitry during buffer write operations.

Table 2-28 G9BNA I/O Signal Line Functions

SIGNAL NAME	DIRECTION CONT ← PR	DESCRIPTION
DATA STROBE	→	Strobe for DATA 1→8
DATA 1	→	Received Data
DATA 8	→	
INPUT PRIME	→	Initiates Restore operation and clears Input Buffer
ACKNLG	←	Acknowledgement for Data input (Data Request)
BUSY	←	Shows operating condition of printer (Low level of this signal shows ready condition.)
PE	←	(Paper End) High level shows paper end condition.
SLCT	←	(Select) High level shows available condition, low level shows CHECK condition or local mode.
FAULT	←	Shows following condition 1 CHECK condition 2 Paper End

• DATA INPUT (BUFFER WRITE)

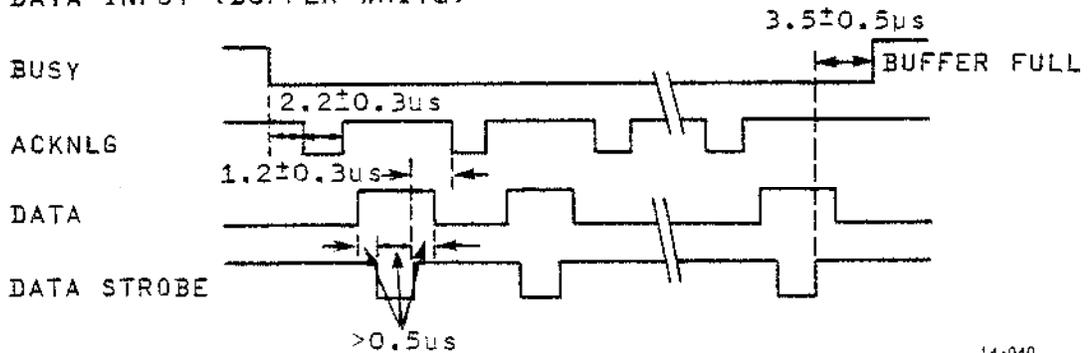


Figure 2-40 G9BNA Strobe Timing

First, converter sends the logic low BUSY signal to the controller signifying printer ready status; second, approximately 10  $\mu$ sec later the logic low BUSY signal is followed by the 2.2  $\mu$ s low going ACKNOWLEDGE pulse which requests that the controller send a character word on the data lines; third, character data is presented on the data lines; and fourth, the low going data strobe pulse is applied from the controller.

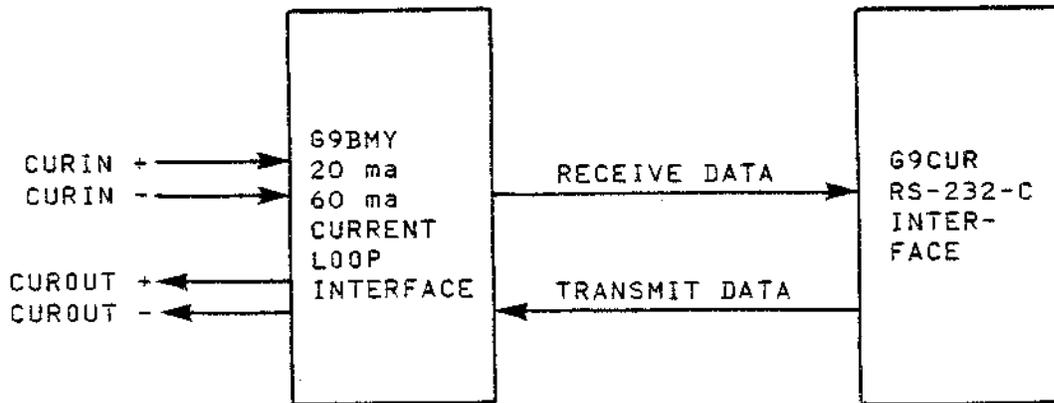
As shown in Figure 2-40, data has at least 0.5  $\mu$ sec settling time before the data strobe is applied. The data strobe initiates the latching of the data line contents in the input registers and the writing of character words into the buffer.

The ACKNLG pulse is applied again and the cycle is repeated until the buffer is full. 3.5  $\mu$ sec after buffer is filled the converter returns the BUSY signal line to the logic high level signifying to the controller that write operations are completed.

### 2.8 CURRENT LOOP INTERFACE (G9BMY)

This interface is packaged on the G9BMY circuit board, and is used in conjunction with the RS-232-C type interface circuit board (G9CUR) to provide input/output signal conditioning for current loop transmission systems. Figure 2-41 shows interconnections between the two circuit boards.

Refer to SPINWRITER schematic drawing 136-100235-046 for the following discussion.



14-041

Figure 2-41 Current Loop Interface Interconnection Diagram

### 2.8.1 Circuit Description (G9BMY)

The incoming current signal, which is shunted by current limiter Q2 for proper drive, is applied to the PC504 optical isolator. The signal from the isolator is then level shifted by Z3 and Z4 to match RS-232-C signal level characteristics on the receive data (RD) line.

Transmitted data from the G9CUR circuit board is signal-conditioned for T1 primary drive. The transformer secondary signal is rectified and filtered to provide base drive for switch Q1 which, in turn, controls the current loop interface output signals.

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## CHAPTER 3

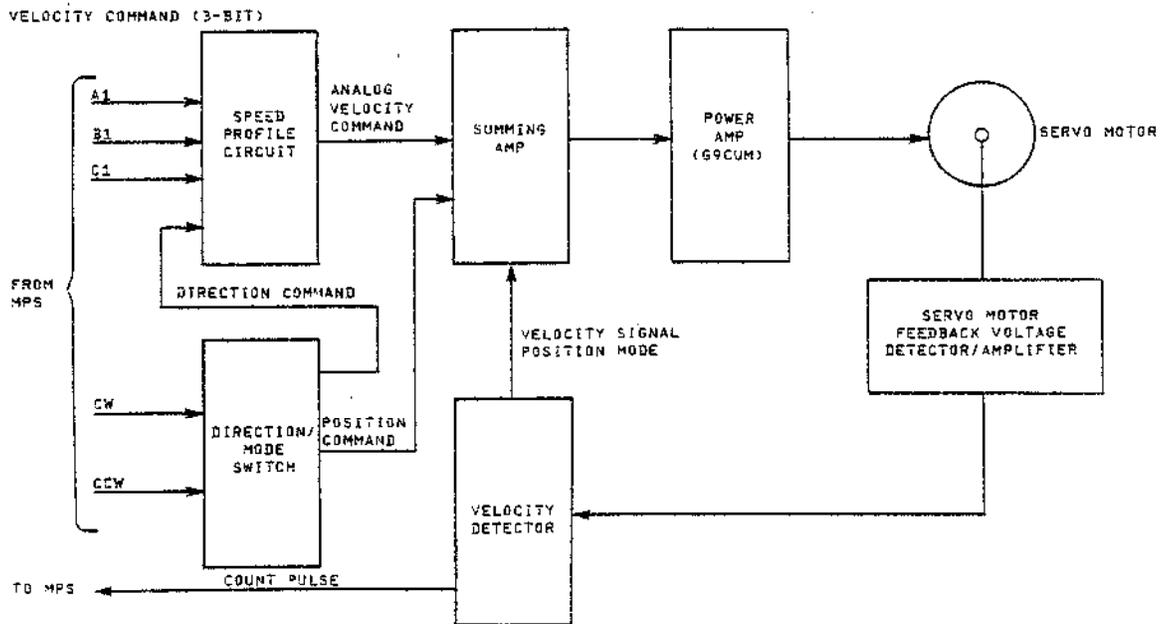
### SERVO BOARD (G9CUN)

The servomotor control circuits decode the processor board digital output signals into analog voltage commands to drive the rotate and spacing servo motors as shown in Figure 3-1. These circuits are controlled in two modes: in the velocity mode by velocity signals from the processor, and in the position mode by position signals from the position transducer.

The rotate and space servomotors are functionally identical. The rotate servomotor rotates the print thimble to a new character position, and the spacing servomotor moves the print carriage to a new horizontal print position. The following circuit theory deals with the rotate functions. This theory can be applied to spacing servo system circuits.

- Velocity Mode

The rotate servo control circuit receives velocity (RTVELA1, B1, C1) and direction of rotation (RTXXCW0, RTXCCW0) commands from the microprocessor system (MPS)



14-042

Figure 3-1 Servomotor Control Block Diagram

as shown in Figure 3-2. A feedback signal, RTØAPOS and RTØBPOS developed by the velocity detector, informs servo control of the motor's rotational speed and direction. The spacing servo control circuit receives similar input signals and operates in much the same manner as the rotate servo control circuit. Spacing servo control circuit differences are contrasted in Section 3.2.

The MPS and feedback commands are applied to a summing amplifier. The resultant output (RTSUMMS) of the summing amplifier is used to accelerate and decelerate the servomotor.

In addition, one count pulse (RTCONT1) is developed every increment of rotation (one character position or one space position) and is forwarded to the MPS.

- Position Mode

When the servomotor reaches a point 1/8th position from the specified stop position, the direction command from the MPS is turned off. As a result, the position mode is entered. The position signal (RTØAPOS) is applied to the summing amplifier in place of the velocity command voltage.

In the position mode, the position signal, RTØAPOS, is amplified by the summing amplifier and used as the error voltage signal. The motor will continue to rotate until RTØAPOS becomes zero.

### 3.1 ROTATE FUNCTION

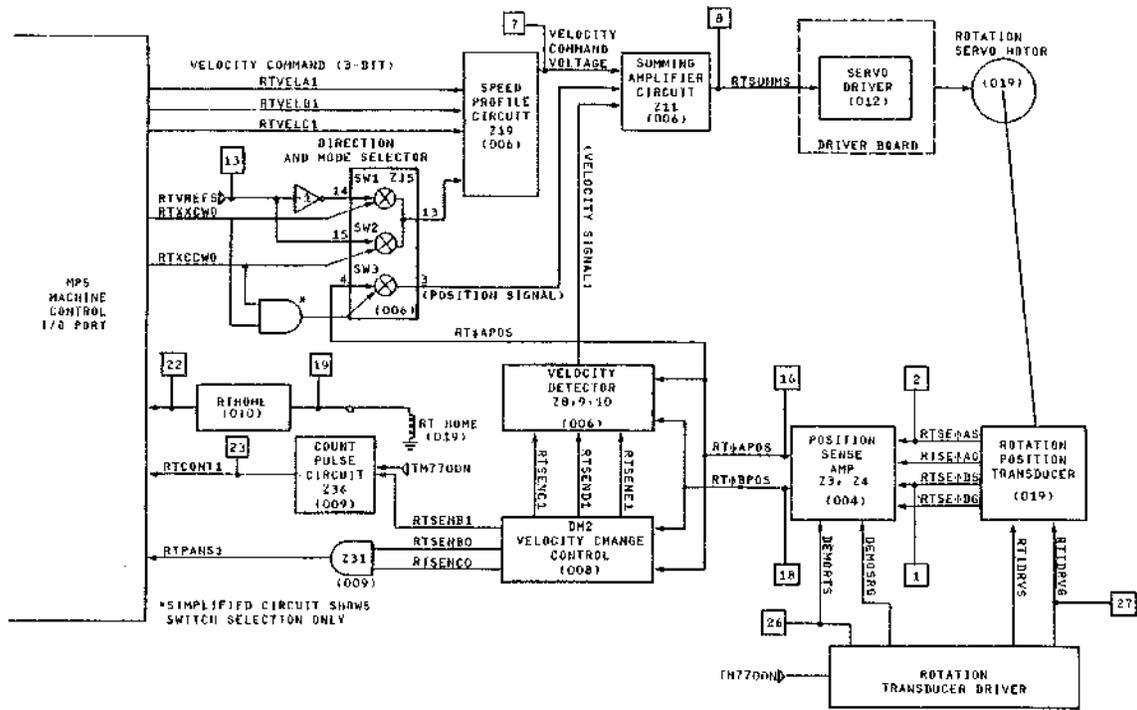
#### 3.1.1 Position Transducer Drive

The position transducer drive circuit (Figure 3-3) provides a sinusoidal waveform that is used by the rotate and spacing transducers. Figure 3-4 shows output waveforms generated by the drive circuit.

##### 3.1.1.1 Circuit Description (G9CUN)

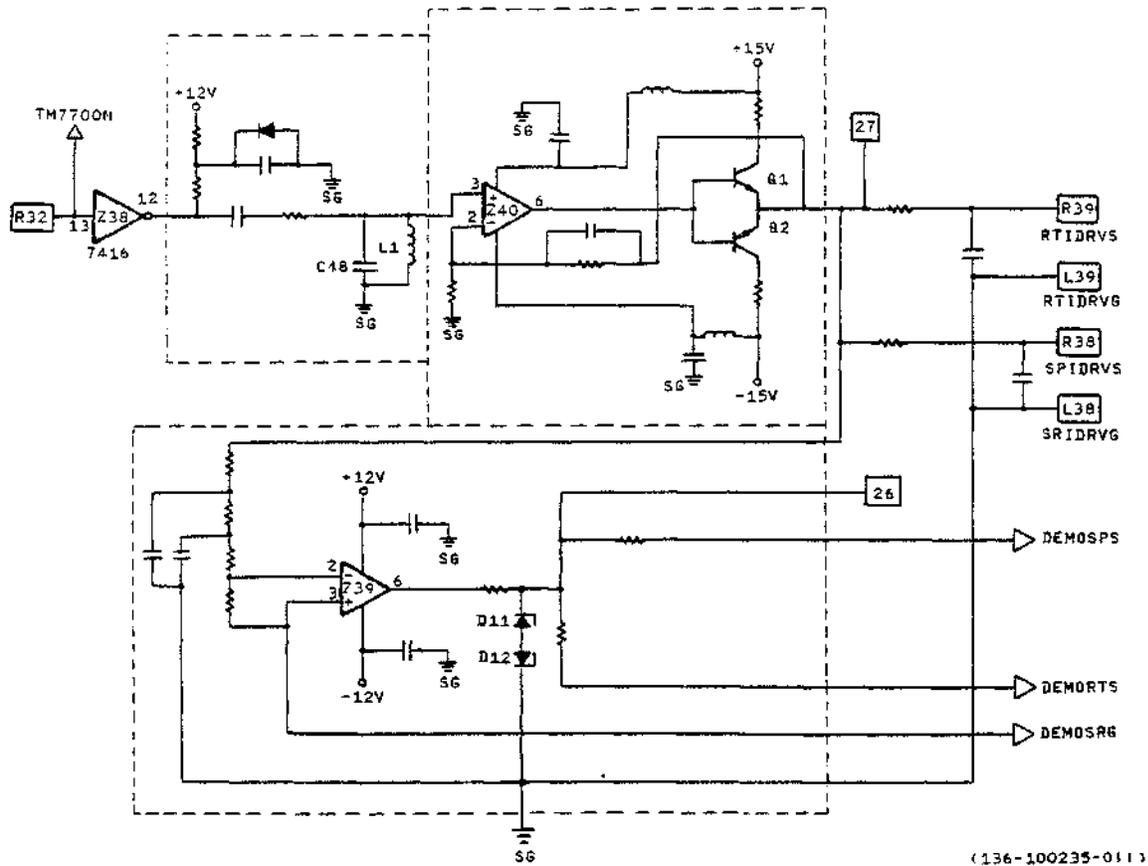
The input signal, TM7700N (7.7 microsecond clock), is converted into a sine wave of 130 kHz by an LC resonant circuit composed of C48 and L1. The sine wave is further amplified by Z40, Q1, and Q2 to provide an output amplitude of 21 volts peak-to-peak at TP27.

Additionally, to make the position sense amplifier and demodulator carrier (DEMORTS) signals in phase, the signal at TP27 is shifted 45 degrees and converted to a square wave of +12 volts. This signal at the output of Z39 is called DEMORTS.



3-3

Figure 3-2 Rotate Servo Control Block Diagram



14-044

Figure 3-3 Position Transducer Drive Circuit

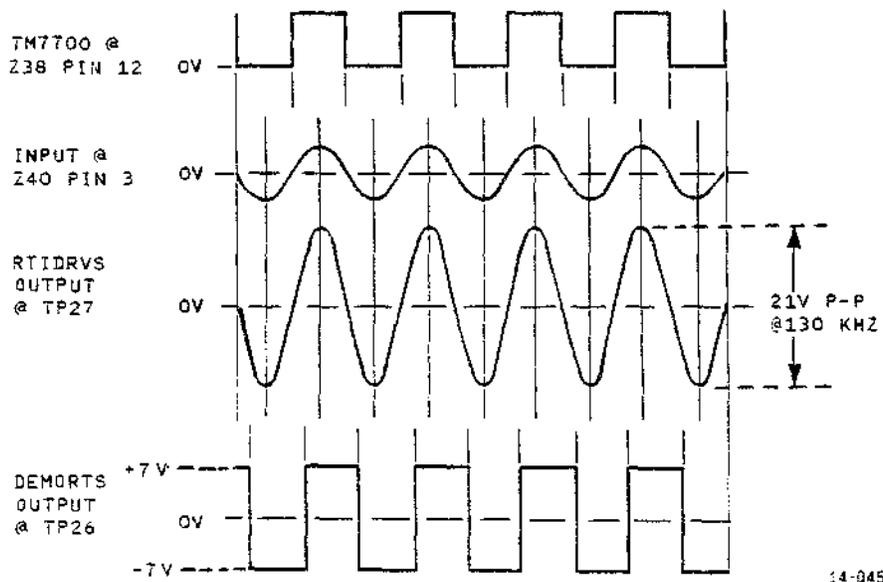
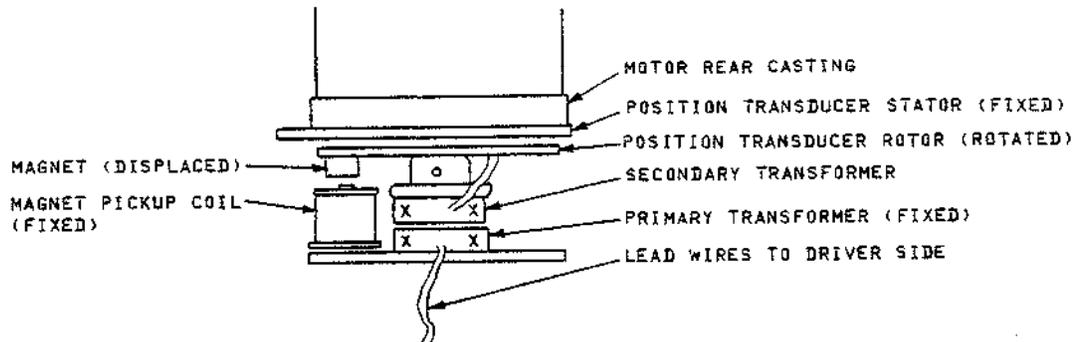


Figure 3-4 Position Transducer Drive Circuit Waveforms

### 3.1.2 Position Transducer

The position transducer generates position information signals for use by the servo control system. These signals indicate direction and velocity of rotation. A partial view of the rotate sensor is shown in Figure 3-5.



14-046

Figure 3-5 Partial View of Rotate Sensor

#### 3.1.2.1 Circuit Description

The position transducer consists of a rotor and stator. The rotor is physically attached to the servomotor shaft and is driven by a 130 kHz sine wave. The stator is mounted to the servomotor rear casting and contains two inductors 90 degrees out of phase. As the rotor rotates, a voltage is induced in the stator. The two resultant sine waves are called RTSEØA and RTSEØB.

### 3.1.3 Rotate Sense Amplifier

The rotate sense amplifier circuit amplifies and demodulates the position transducer outputs to obtain position signals. Figure 3-6 is the schematic diagram of the sense amplifier used for phase A. An identical circuit, Z4, is used for phase B. Amplifiers Z1 and Z2 provide spacing position signals.

#### 3.1.3.1 Circuit Description (G9CUN)

The rotate sense amplifier input signals (RTSEØA, RTSEØB) from the position transducers are amplitude-modulated, 130 kHz sine waves. There is a 90-degree phase difference between the ØA and ØB signals. The ØA signal is demodulated by Z3, and the ØB signal is demodulated by Z4.

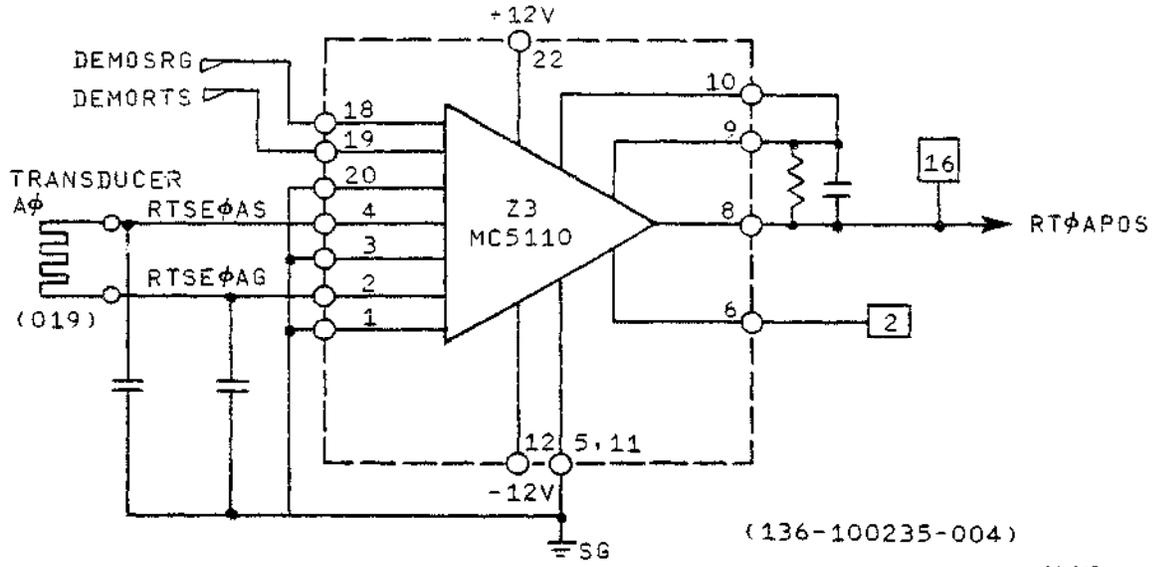


Figure 3-6 Rotate Sense Amplifier Circuit (ØA)

The position transducer outputs are combined with the DEMORTS signal to produce a sine wave signal, RTØAPOS or RTØBPOS, at TP16 and TP18, respectively. Figure 3-7 represents the waveforms for the rotate sense amplifier.

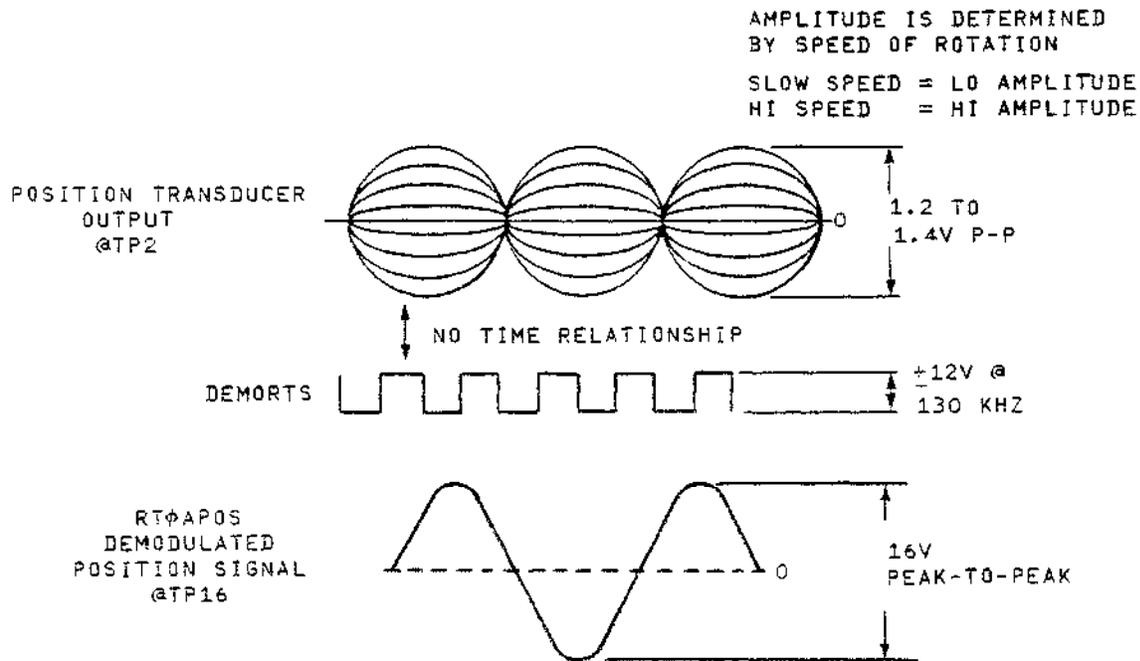


Figure 3-7 Rotate Sense Amplifier Waveforms

### 3.1.4 Velocity Change Control

The velocity change control circuit generates six signals (RTSENB0, RTSENB1, RTSENC0, RTSENC1, RTSEND1, and RTSENE1) from the two position signals (RTØAPOS, RTØBPOS). Figure 3-8 shows a schematic diagram of the velocity change control circuit, and Figure 3-9 illustrates typical waveforms.

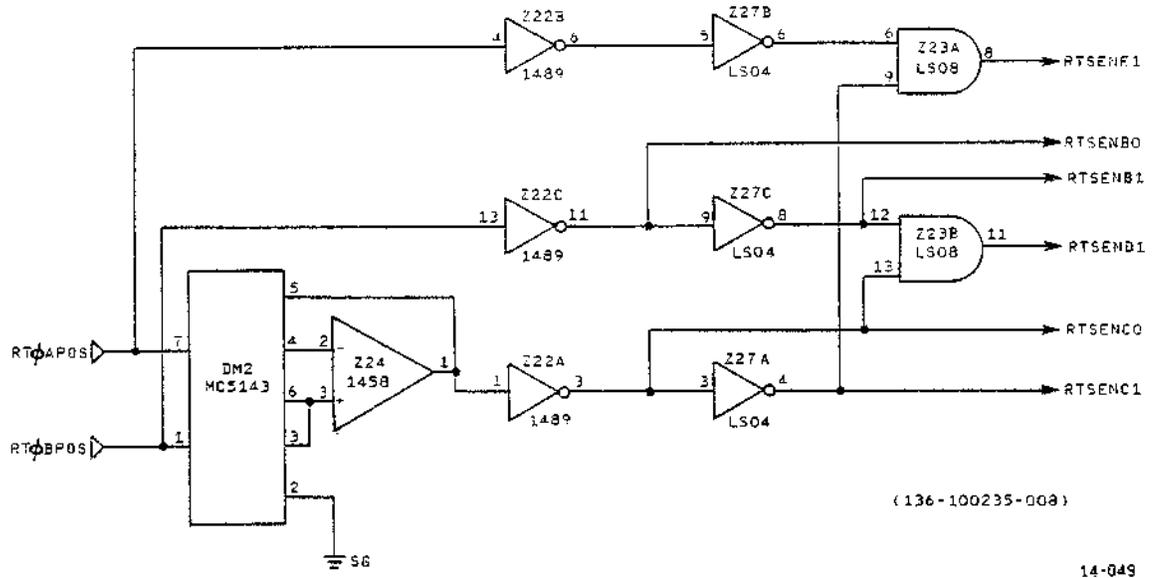


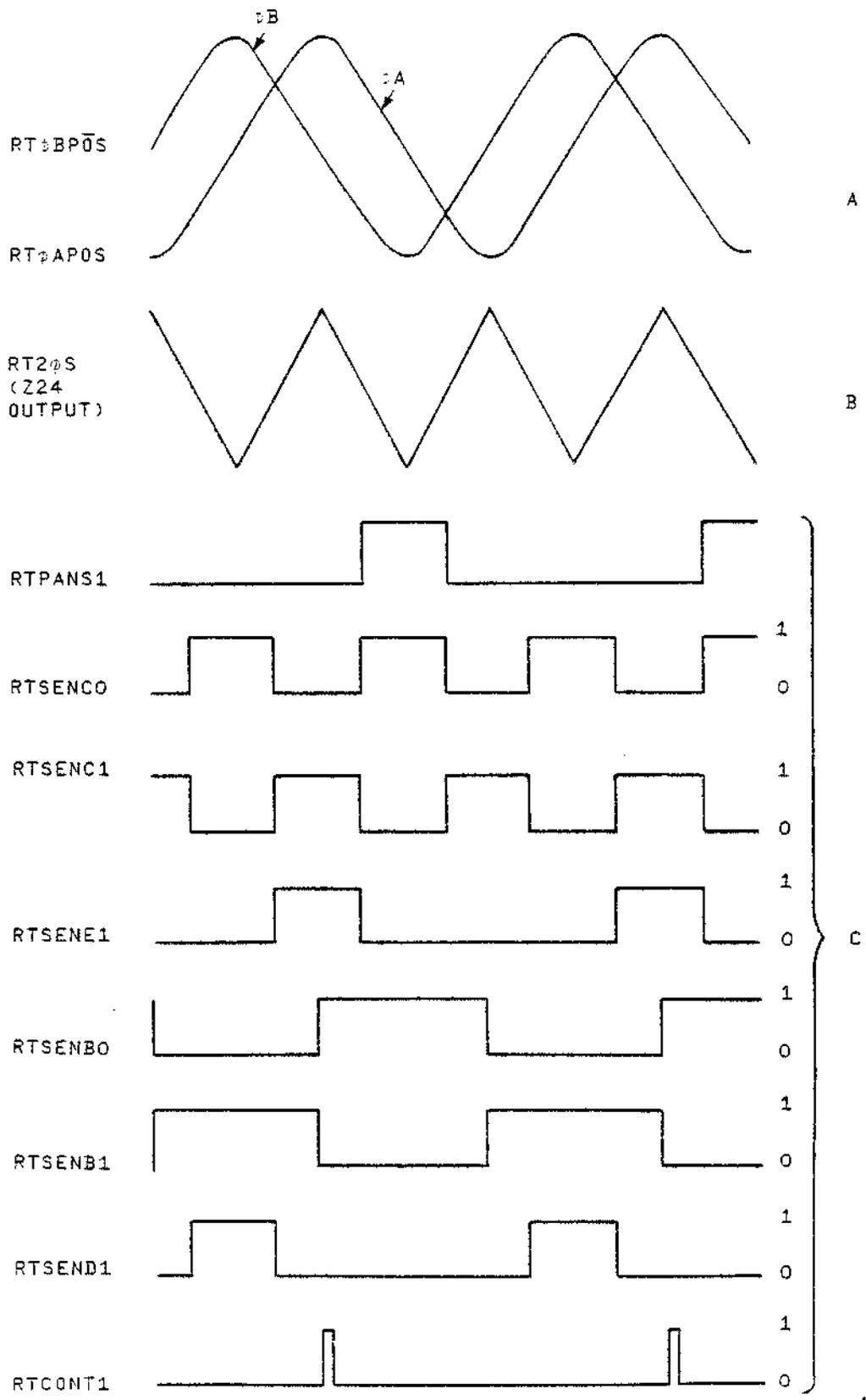
Figure 3-8 Velocity Change Control Circuit

#### 3.1.4.1 Circuit Description (G9CUN)

DM2 is a dual rectifier whose output is applied to operational amplifier Z24. When signals RTØAPOS and RTØBPOS are applied to DM2, during clockwise print thimble rotation the resultant output of Z24 is a triangular waveform (Figure 3-9, RT2ØS). The output of Z24 is applied to Z22A, and signal RTSENC0 is obtained. RTSENC0 is inverted by Z27A to produce RTSENC1.

Signal RTØAPOS is shaped to a square wave by Z22B and inverted by Z27B. The output of Z27B is ANDed with RTSENC1 at Z23A to produce RTSENE1. Referring to Figure 3-9, observe that RTSENE1 occurs 45 degrees after RTØAPOS crosses 0 volts in a positive direction.

RTØBPOS is shaped to a square wave by Z22C. Z22C's output is RTSENB0. Z27C inverts RTSENB0 to produce RTSENB1. RTSENB1 is ANDed with RTSENC0 at Z23B to produce RTSEND1.



14-050

Figure 3-9 Typical Waveforms, Velocity Change Control

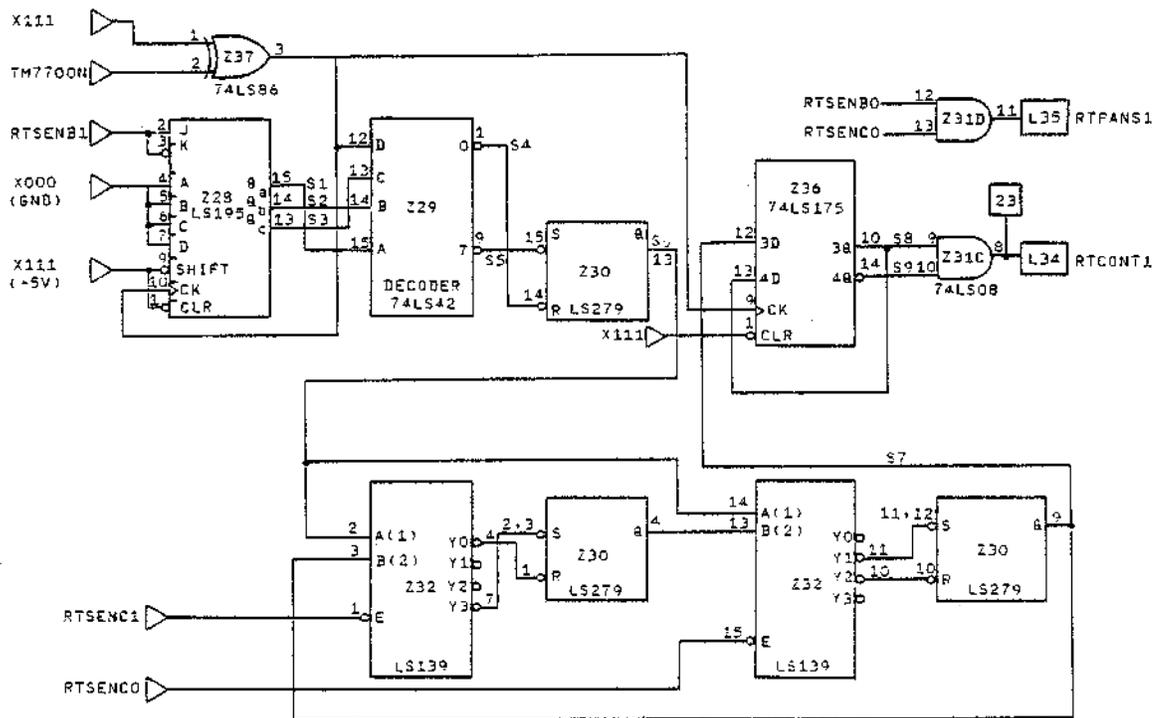
### 3.1.5 Count Pulse Circuit

The count pulse circuit produces a signal, RTCONT1, from input signal RTSENBl. Each RTCONT1 pulse indicates a print thimble rotation of one character position. Figure 3-10 is the schematic diagram of the count pulse circuit.

#### 3.1.5.1 Circuit Description (G9CUN)

The signal, RTSENBl, from the velocity change control circuit is applied to shift register Z28 (Figure 3-10). With a clock pulse of 7.7 microseconds (TM7700N) applied to pin 10 of Z28, the resultant outputs of Z28 will be three square waves: S1, S2, and S3. Signals S1, S2, S3 and TM7700N are applied to the input of decoder Z29. The S4 and S5 outputs of Z29 are applied to the input of latch circuit Z30.

The S6 output from Z30 is applied to the latch circuitry which when enabled by RTSENCO and RTSENCl produces S7. The S8 output of Z36 is reapplied to Z36 at pin 13. The resultant output at pin 14 of Z36 is S9. Note that S9 is the inverted S8 signal shifted 7.7 microseconds. S8 and S9 are ANDED by Z31C to produce RTCONT1.



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14-051

Figure 3-10 Rotate Count Pulse Circuit

### 3.1.6 RTPANS1 Circuit

The RTPANS1 circuit produces a pulse which occurs 1/8th of a character position before the specified stop position. Refer to Figure 3-10.

#### 3.1.6.1 Circuit Description (G9CUN)

Signal RTPANS1 is produced by ANDing RTSENBO and RTSENCO at Z31D on the servo control board. RTPANS1 is used to direct the MPS to disable the direction command signals. With the direction command turned off, the servo system enters the position mode.

### 3.1.7 Velocity Detector

The velocity detector consists of an analog differentiation circuit, an analog switch, and an amplifier. The detector converts the position signal into the velocity signal that is proportional to the servomotor rotational speed. Figure 3-11 shows the schematic of the detector and Figure 3-12 shows typical circuit waveforms.

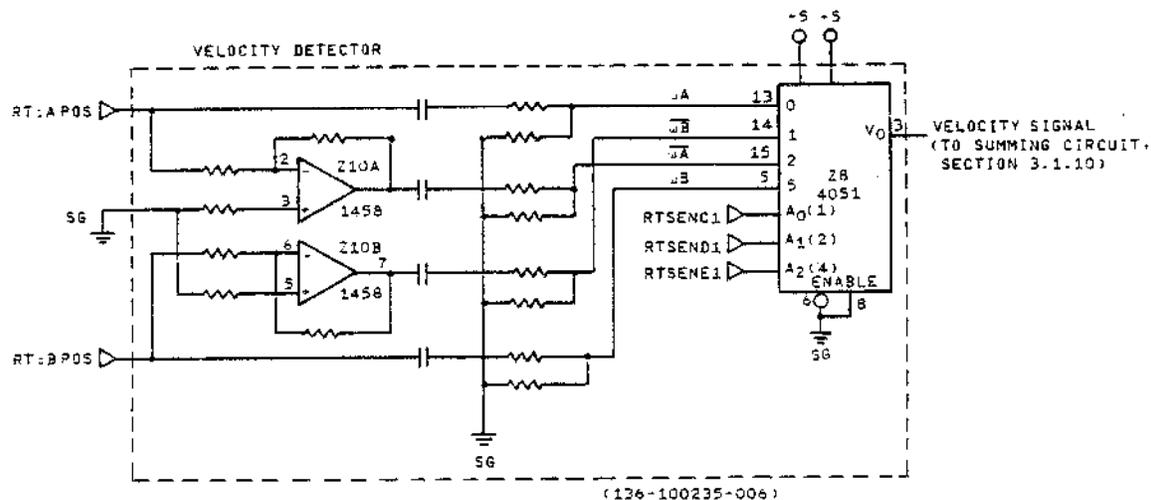
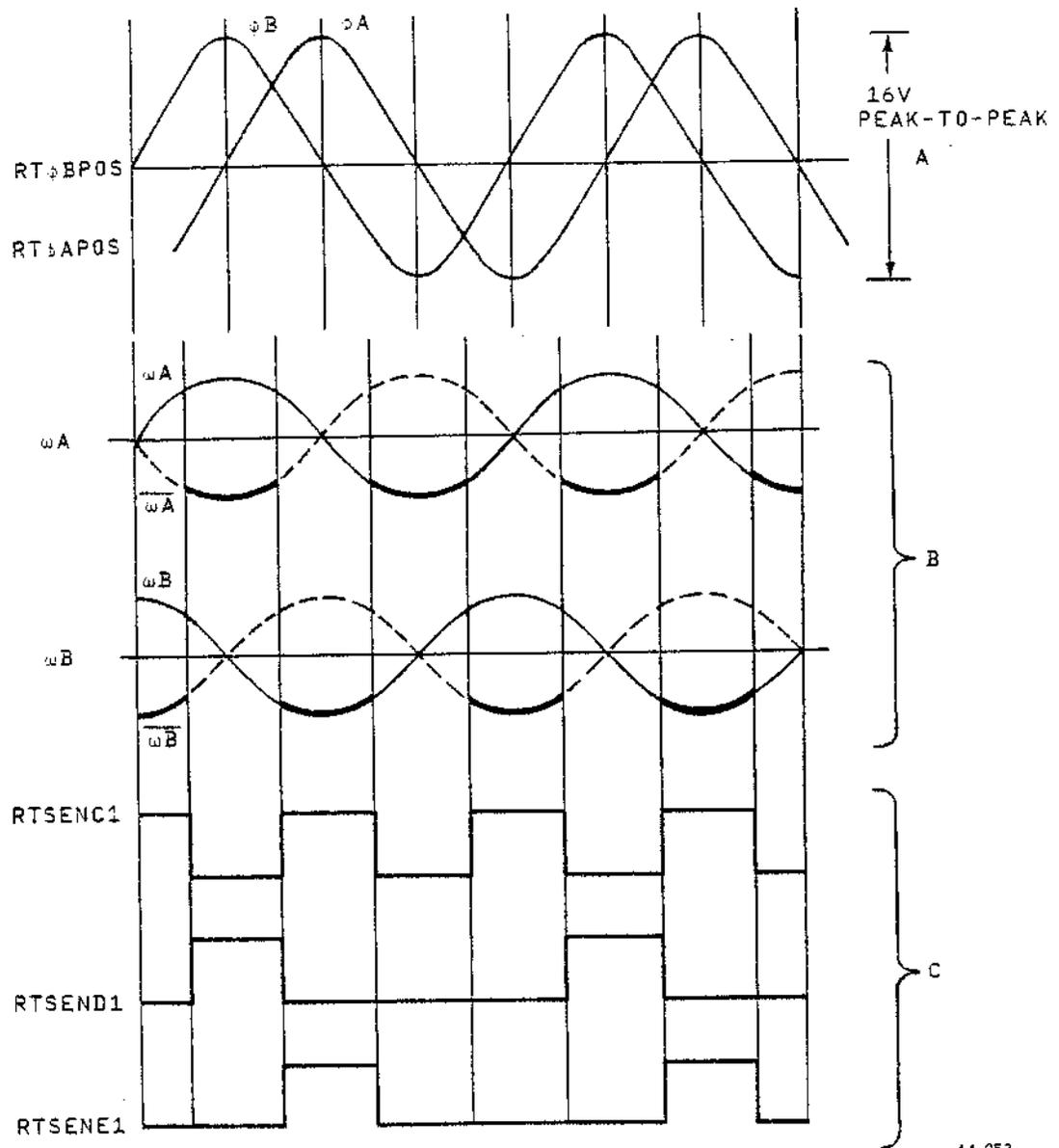


Figure 3-11 Velocity Detector Circuit

14-052

#### 3.1.7.1 Circuit Description (G9CUN)

The analog position signals, RTAPOS and RTBPOS, are applied directly to velocity detector Z8 (at pins 13 and 5 respectively) as omega A and omega B. RTAPOS and RTBPOS are also applied to inverters Z10A and Z10B to produce omega A not and omega B not, which are then applied to Z8 on pins 15 and 14



14-053

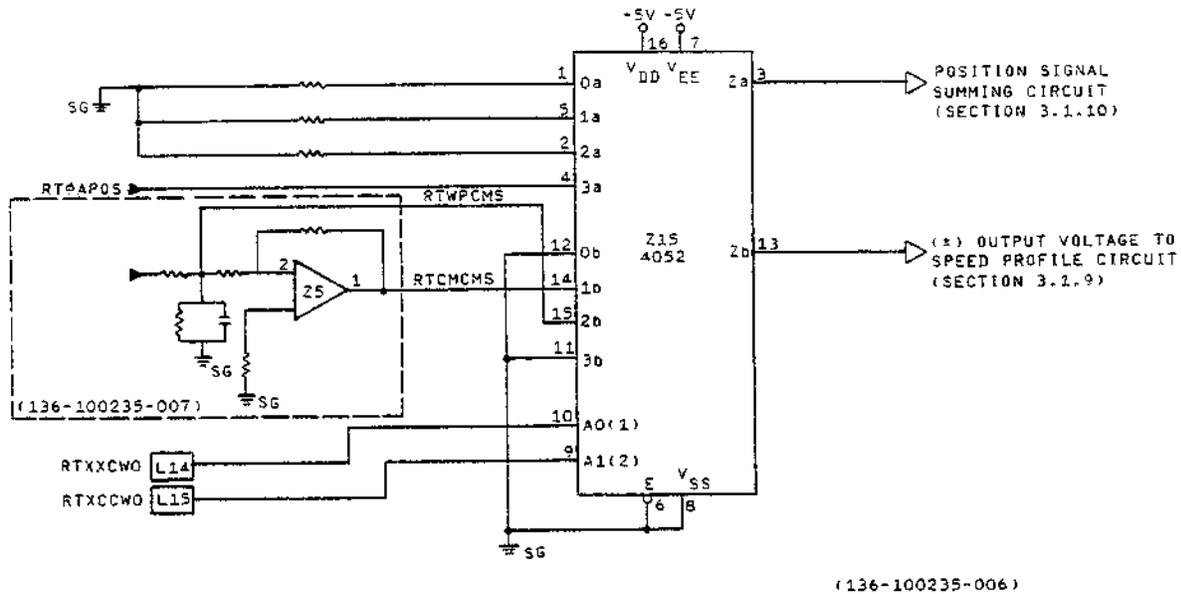
Figure 3-12 Velocity Detector Waveforms

respectively. In addition, three signals from velocity change control, (RTSENC1, RTSEND1, and RTSENE1) provide addressing to route one of the four input position signals from Z8 as the velocity signal.

The output velocity signal of Z8 is an analog waveform whose amplitude and polarity indicate the present velocity and direction of rotation.

### 3.1.8 Direction and Mode Selector

The direction and mode selector determines the direction of SPINWRITER print thimble rotation and velocity/position mode selection. Figure 3-13 is the schematic diagram of the direction and mode selector circuit, and Table 3-1 describes the selector's input and output signals.



14-054

Figure 3-13 Rotate Direction and Mode Selector Circuit

#### 3.1.8.1 Circuit Description (G9CUN)

The direction and mode selector, Z15, is an analog switch. Its major inputs are RTWPCMS, RTCMCMS, RTØAPOS, RTXXCW0, and RTXCCW0. RTWPCMS is a reference voltage of +0.52 to +0.55 volts applied to Z15, pin 15. The voltage reference is also applied to Z25, inverted, and applied to Z15, pin 14.

When the servo system is in the velocity mode, the polarity of the output voltage at Z15, pin 13, is determined by either RTXXCW0 or RTXCCW0. When both RTXXCW0 and RTXCCW0 are high (+5V), the system enters the position mode (Table 3-1). At this time Z15, pin 13 goes to zero volts and Z15, pin 3 outputs the position signal to the summing amplifier circuit.

Table 3-1 Relationship Between Selector Input and Analog Switch Output

SELECTOR INPUT OF ANALOG SWITCH Z15		FUNCTION OF ANALOG SWITCH Z15 OUTPUT
RTXXCW0	RTXCCW0	
Low Level	High Level	Turns on terminals 2 and 15 of analog switch to send the output voltage to the speed profile circuit.
High Level	Low Level	Turns on terminals 5 and 14 of the analog switch to send the polarity inverted output voltage to the speed profile circuit.
High Level	High Level	Turns on terminals 4 and 11 of the analog switch to output the position signal to the summing amplifier circuit.

### 3.1.9 Speed Profile Circuit

The speed profile circuit, Z19, generates an analog voltage representative of the speed and direction that the print thimble must rotate to access a new character in minimum time. The decision process is handled by the MPU which outputs the 3-bit velocity command that Z19 decodes to select one of the eight analog inputs proportional to the direction command voltage sourced at Z15. The polarity of the direction command voltage indicates the direction of rotation (positive equals clockwise, negative equals counterclockwise). Figure 3-14 is the schematic diagram of the speed profile circuit, and Figure 3-15 is a timing chart showing the velocity command voltage output vs. rotate velocity input commands.

#### 3.1.9.1 Circuit Description (G9CUN)

The speed profile circuit, Z19, is an analog switch with eight analog and three digital select line inputs. The analog inputs are tapped at voltage divider RM26 which is sourced at Z15, direction command voltage. Eight steps labeled V0 through V7, as shown in Figure 3-14, provide voltage levels proportional to velocity of rotation. As shown in Figure 3-15, when RTVELA1, B1 and C1 are low at 0V, the output of Z19 is V7 or maximum voltage. When input select lines are all high (5V), the output of Z19 is V0 or minimum voltage. The selection of V7 indicates maximum velocity of rotation for maximum distance to rotate.

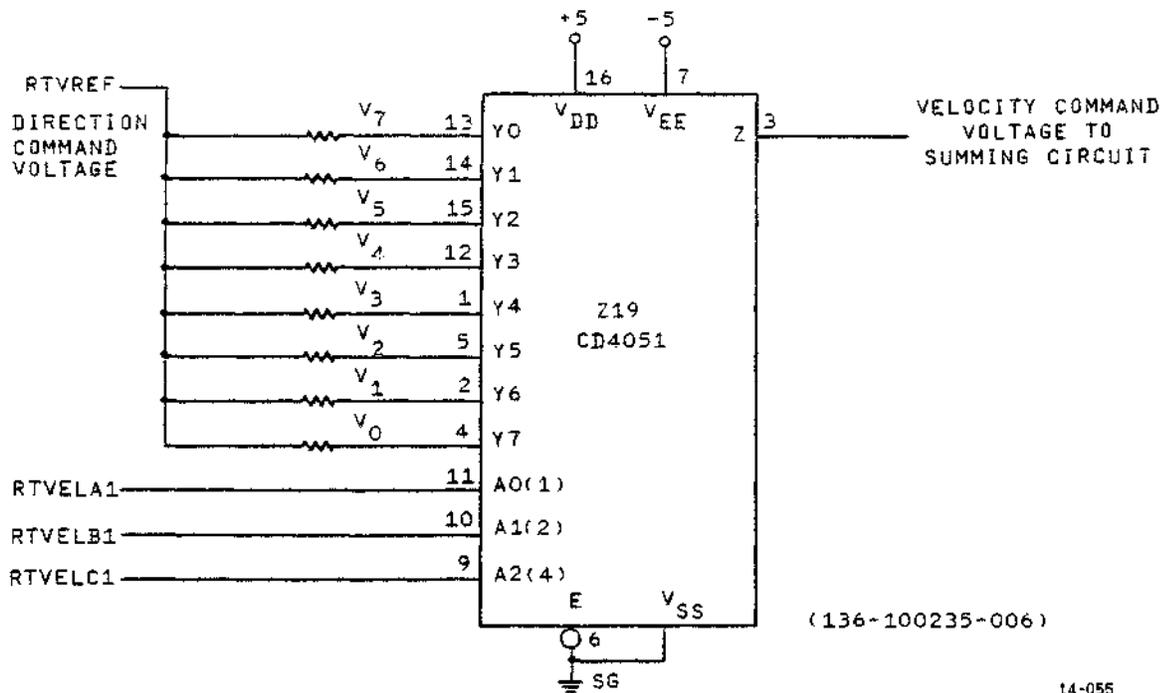


Figure 3-14 Speed Profile Circuit

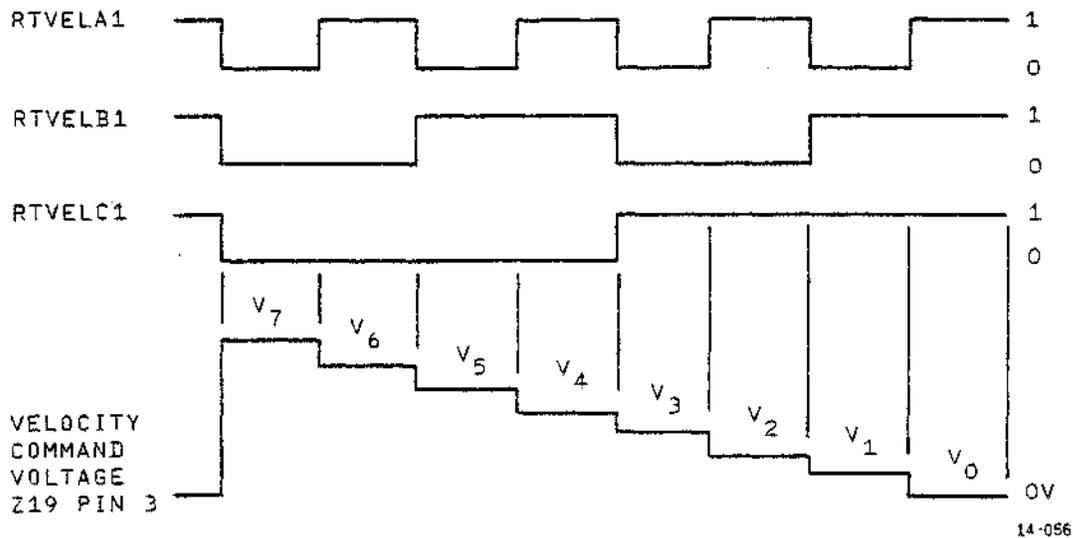
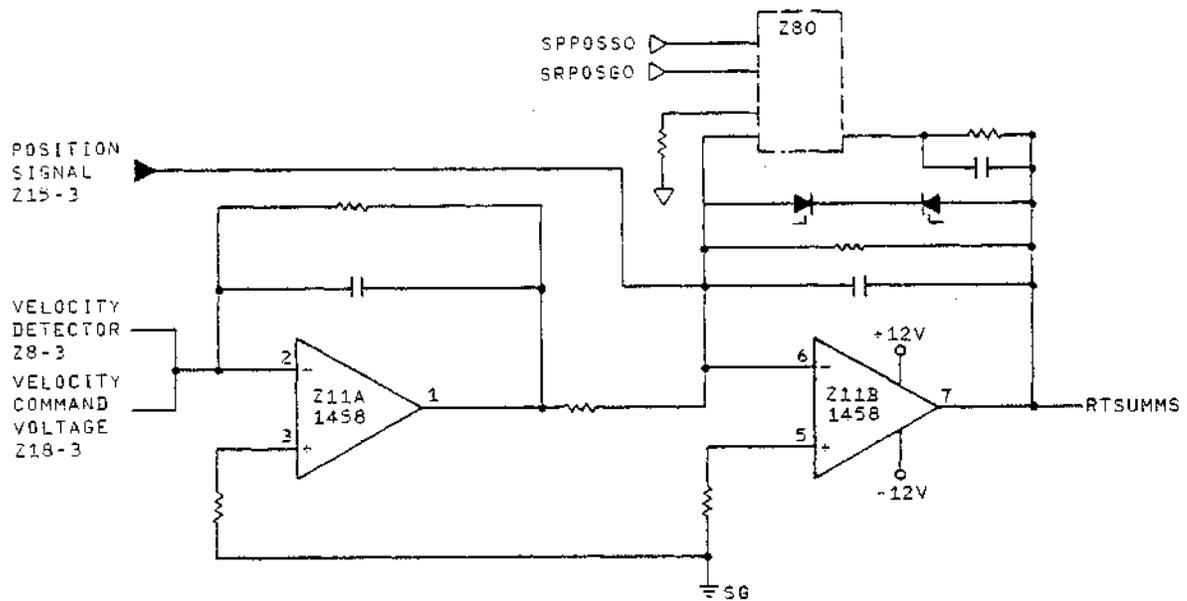


Figure 3-15 Timing Chart of Velocity Command Voltage (Clockwise Rotation)

### 3.1.10 Summing Amplifier Circuit

The summing amplifier circuit (Figure 3-16) provides the voltage amplitude and polarity necessary to drive the servomotor power amplifier.



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14-057

Figure 3-16 Summing Amplifier Circuit

### 3.1.10.1 Circuit Description (G9CUN)

When a direction command indicates velocity mode, the summing circuit, Z11A, combines the velocity detector output and the velocity command voltage to produce a voltage which is amplified by Z11B. When the direction commands indicate position mode, the position signal from Z15, pin 3, is amplified by Z11B. The output of Z11B, RTSUMMS, is used to drive the servo power amplifier. Z80 is used to reduce servo motor feed voltage in order to reduce the amount of noise generated by the servo feedback system.

### 3.1.11 Rotate Home Detector

The rotate home detector indicates the home position of the rotate servo system. Home position is character position zero on the print thimble. The servo system is stopped eight character positions in a clockwise direction from the home position detector. Figure 3-17 is the schematic diagram of the detector circuit, and Figure 3-18 shows the waveforms for the circuit.

#### 3.1.11.1 Circuit Description (G9CUN)

The rotate home signal, RTHOME1, is detected only when the velocity command, RTVELC1, is zero. In Figure 3-17, RTHMEB0, is generated by RTVELC1. When the magnet attached to the position transducer rotor, shown in Figure 3-5, passes near the magnet pickup coil, a voltage is generated. This voltage is applied to operational amplifier Z25 and signal RTHMPOS is produced.

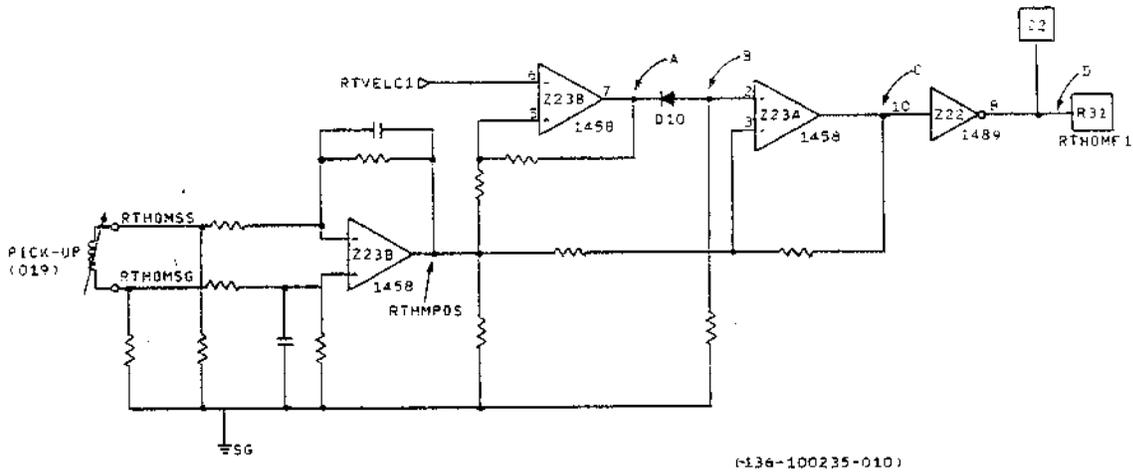


Figure 3-17 Rotate Home Detect Circuit

14-058

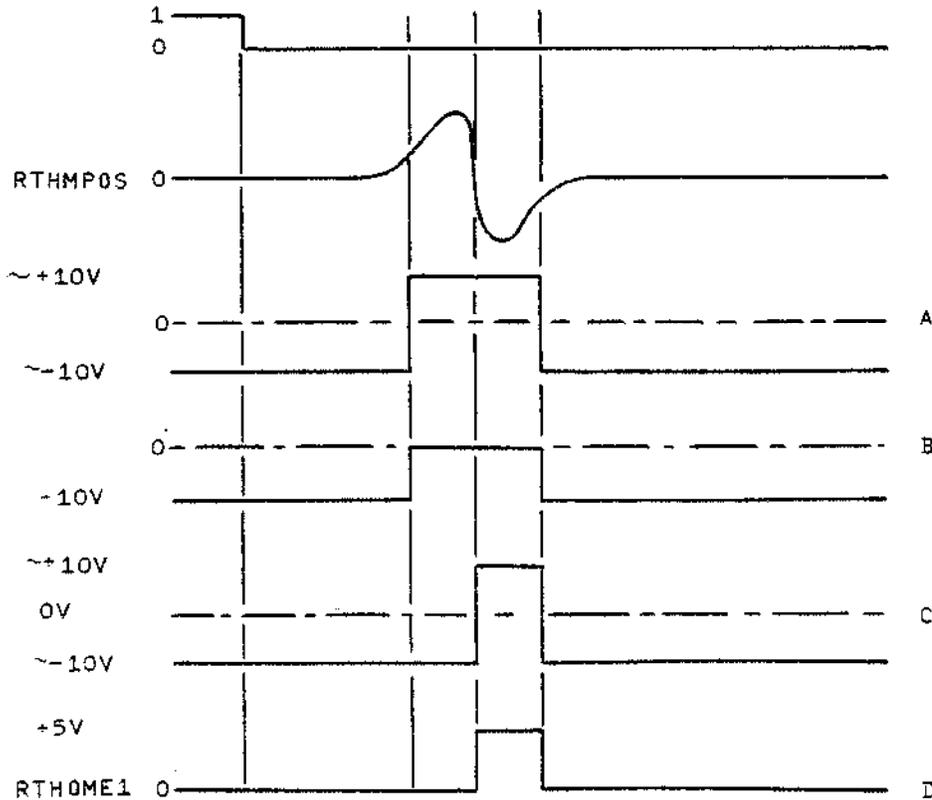


Figure 3-18 Typical Theoretical Home Detect Circuit Waveforms

14-059

When RTHMPOS is applied to comparator Z23B with a low RTHMEB0, a square wave is produced as shown in Figure 3-18A. Diode D1 limits the signal from Z23B to a -10V to 0V square wave (Figure 3-18B). Comparator Z23A combines the limited square wave with the original RTHMPOS signal, and produces a square wave whose

positive going zero crossing occurs near the zero crossing of the RTHMPOS wave (Figure 3-18C). The waveform at (C) is applied to line driver Z22 to generate the RTHOME1 signal (Figure 3-18D) which is routed back to the MPS as rotate status information.

### 3.2 SPACING SERVO CONTROL CIRCUIT

The spacing servo control and rotate servo control circuits are nearly identical in operational principle. However, they differ slightly in the positioning mode. To provide for the required number of spaces, the number of motor stop positions in the spacing servo control circuit is double that of the rotate servo control circuit (refer to Figure 3-19). To obtain double the number of motor stop positions, the following circuits on the spacing servo control system differ from those in the rotate servo control system: direction and mode selector, and count pulse circuit.

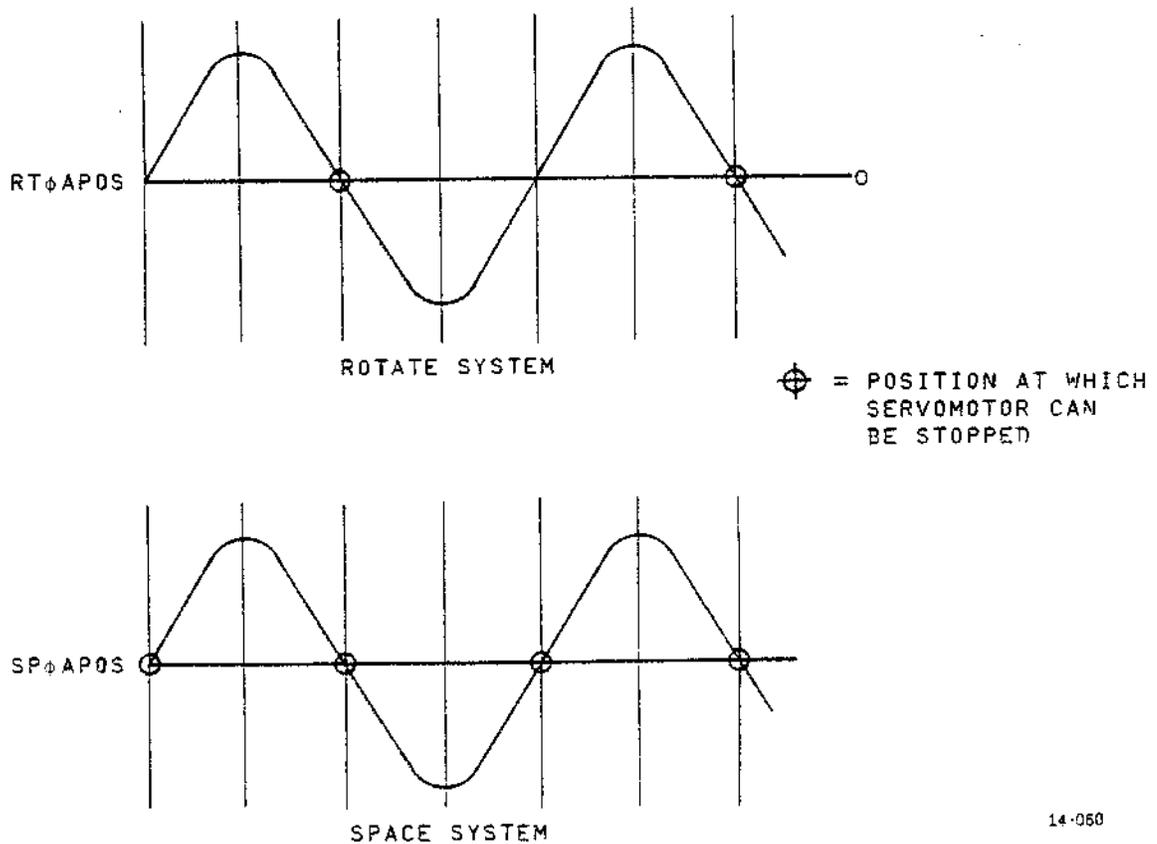


Figure 3-19 Difference in Stop Positions Between Rotate Servo and Spacing Servo Control Circuit

As shown in Figure 3-19, the rotate system can be stopped only when the RTØAPOS signal crosses zero reference in a negative-going direction. The spacing system, however, can be stopped when the SPØAPOS signal crosses zero reference in either a positive or negative direction. This capability is produced by the direction and mode selector, Z12, as shown in Figure 3-22. In the position mode, Z12 selects either the SPØAPOS or an inverted SPØAPOS signal to use as the positioning stop signal.

The count pulse circuit for the rotate system can generate a pulse only at the positive peak value of the RTØAPOS signal. In the spacing system, a pulse is generated for each positive and negative peak of the SPØAPOS signal.

Figure 3-20 presents the block diagram of the spacing servo control system, and Figure 3-21 shows the typical waveforms using forward motion as an example.

### 3.2.1 Direction and Mode Selector (Spacing Servo)

In the velocity mode, the operation of the direction and mode selector circuit is similar to that of the rotate servo control circuit. In the position mode, it differs from the rotate servo control in that the spacing control can select twice as many stop positions. Figure 3-22 is the schematic diagram for this circuit, and Table 3-2 defines the selection of the output signals.

#### 3.2.1.1 Circuit Description (G9CUN)

In the velocity mode, Z12 Pin 13 outputs a reference voltage whose polarity is selected by the forward (SPXFWD0) or reverse (SPXRVS0) command.

In the position mode, Z12 outputs a position signal whose polarity is controlled by SPSEN0 if both direction signals are high; a low SPSEN0 signal will select SPØAPOS for Z12's output. If SPSEN0 is high, the circuit selects the inverted SPØAPOS signal for Z12's output.

#### 3.2.2 Count Pulse Circuit

In the rotate servo control circuit, the count pulse circuit produces a count pulse only at the point corresponding to the positive peak value of position signal RTØAPOS. In the spacing servo control circuit, the count pulses are produced at the positive and negative peak values of position signal SPØAPOS. Figure 3-23 is the schematic diagram for the count pulse circuit, and Figure 3-24 shows typical waveforms.

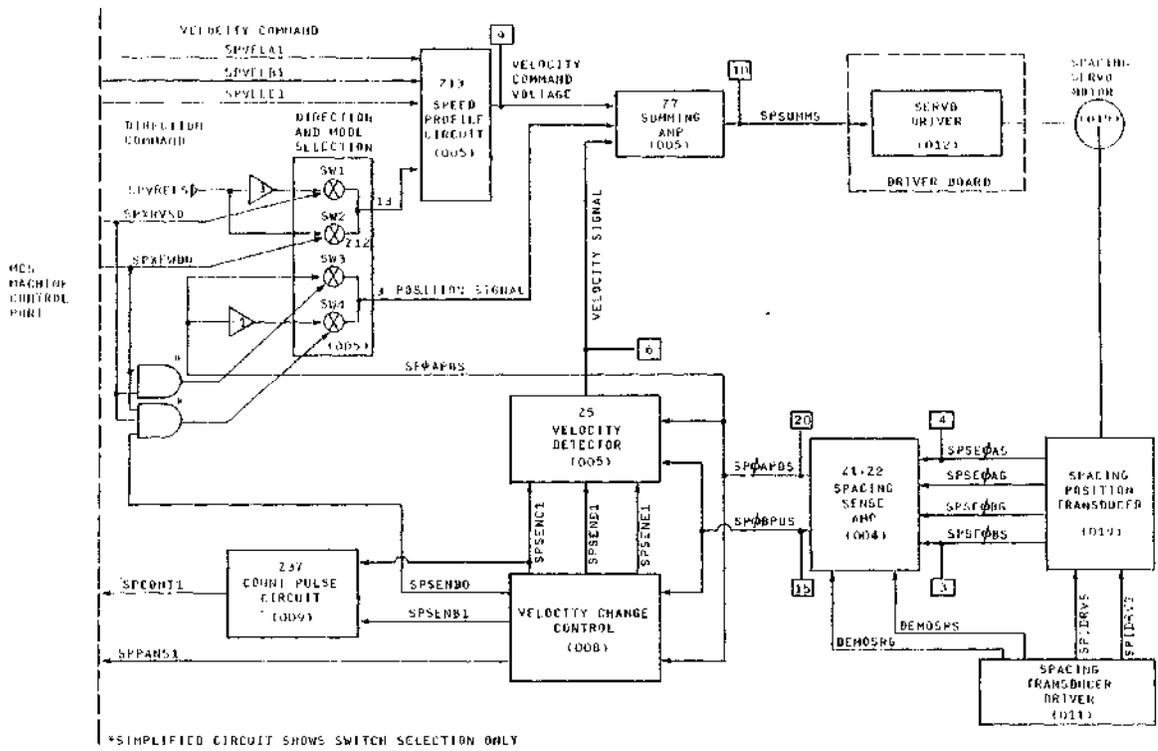
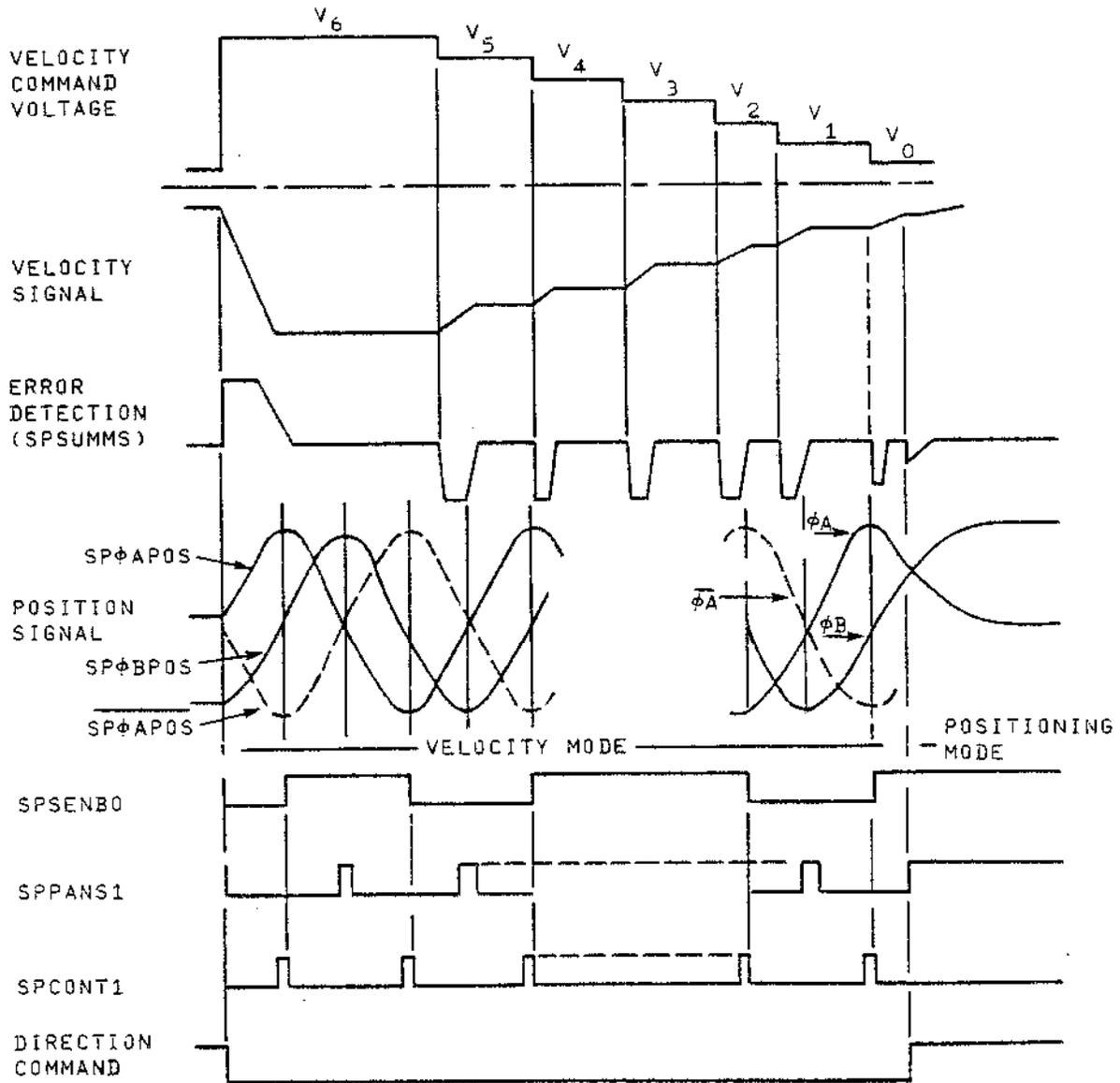
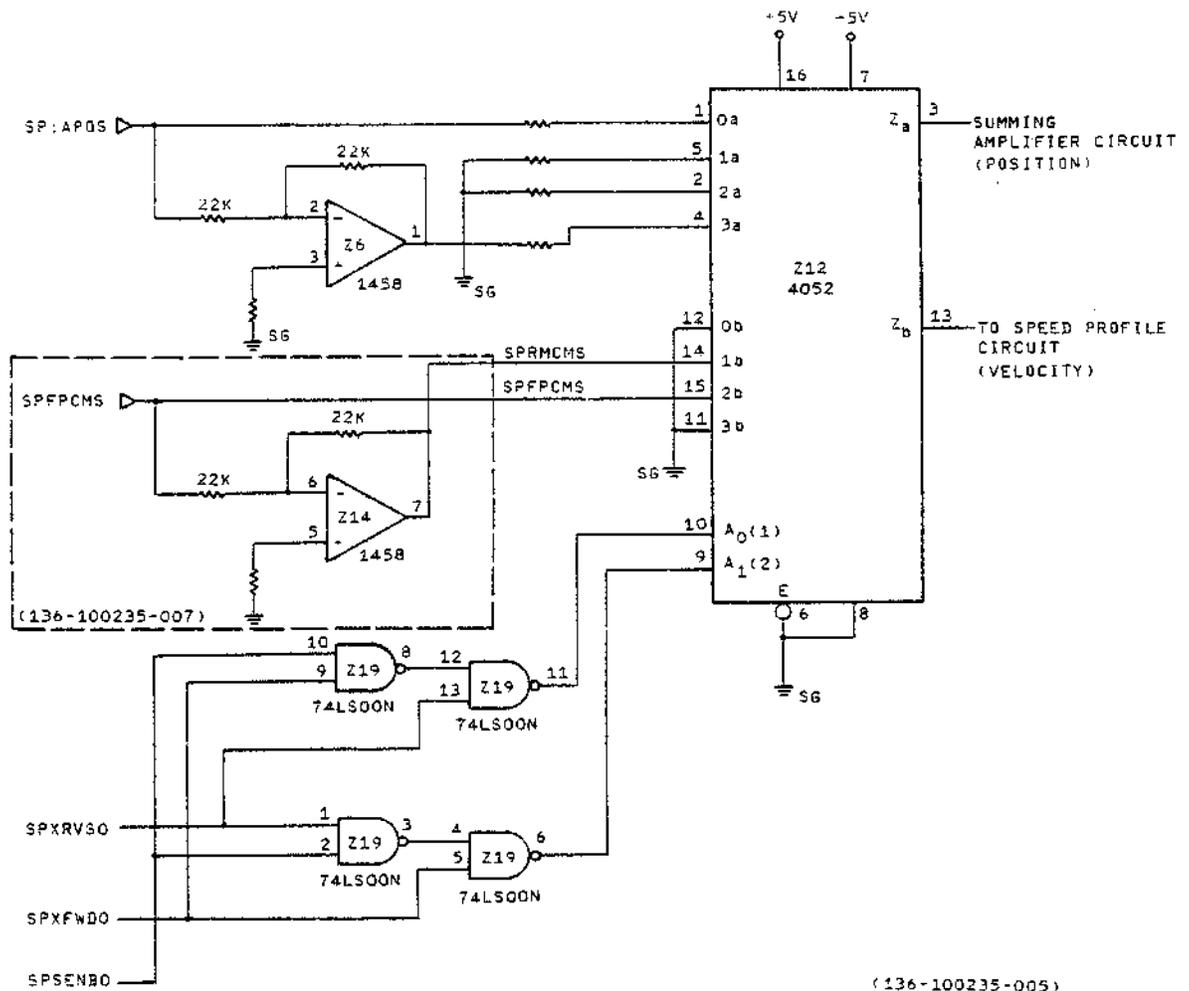


Figure 3-20 Spacing Servo Control Block Diagram



14-062

Figure 3-21 Spacing Servo System Timing Diagram (Forward Motion)



14-063

Figure 3-22 Spacing Direction and Mode Selector Circuit

### 3.2.2.1 Circuit Description (G9CUN)

Signals S1 through S8 of the spacing count pulse circuit coincide perfectly with signals S1 through S8 of the rotate count pulse circuit. However, to obtain the SPCONT1 pulse, S7 and S8 are applied to an exclusive OR circuit, Z37C. This allows a pulse to be generated on the positive and negative peaks of SPØAPOS.

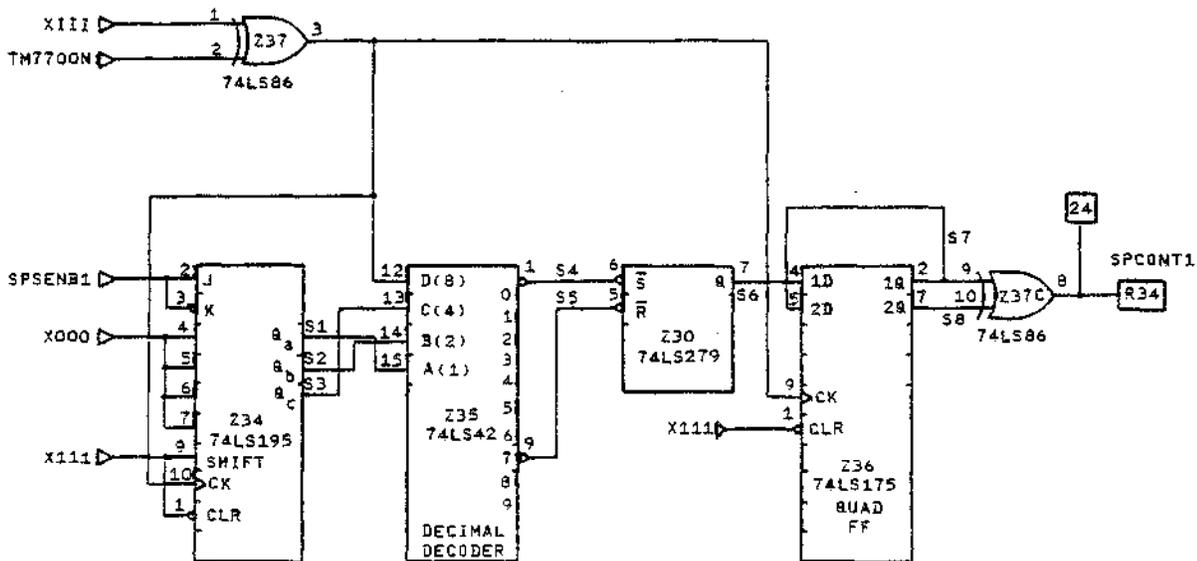
### 3.3 PRINT THIMBLE VERTICAL LIFT CONTROL

This circuitry is described in Section 4.2 - Vertical Driver.

Table 3-2 Function of Analog Switch Z12

SELECTOR INPUT OF ANALOG SWITCH Z12			ANALOG SWITCH Z12 OUTPUT
SPXFWD0	SPXRVS0	SPSEN00	
LO	HI	X	Terminals 2 and 15 are enabled to output SPFPCMS to the speed profile circuit.
HI	LO	X	Terminals 5 and 14 are enabled to output SPRMCMS to the speed profile circuit.
HI	HI	LO	Terminals 1 and 12 are <u>enabled</u> to output position signal SP0APOS to summing amplifier.
HI	HI	HI	Terminals 4 and 11 are enabled to output the inverted position signal SP0APOS to the summing amplifier.

X = Don't care condition



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14-064

Figure 3-23 Spacing Count Pulse Circuit

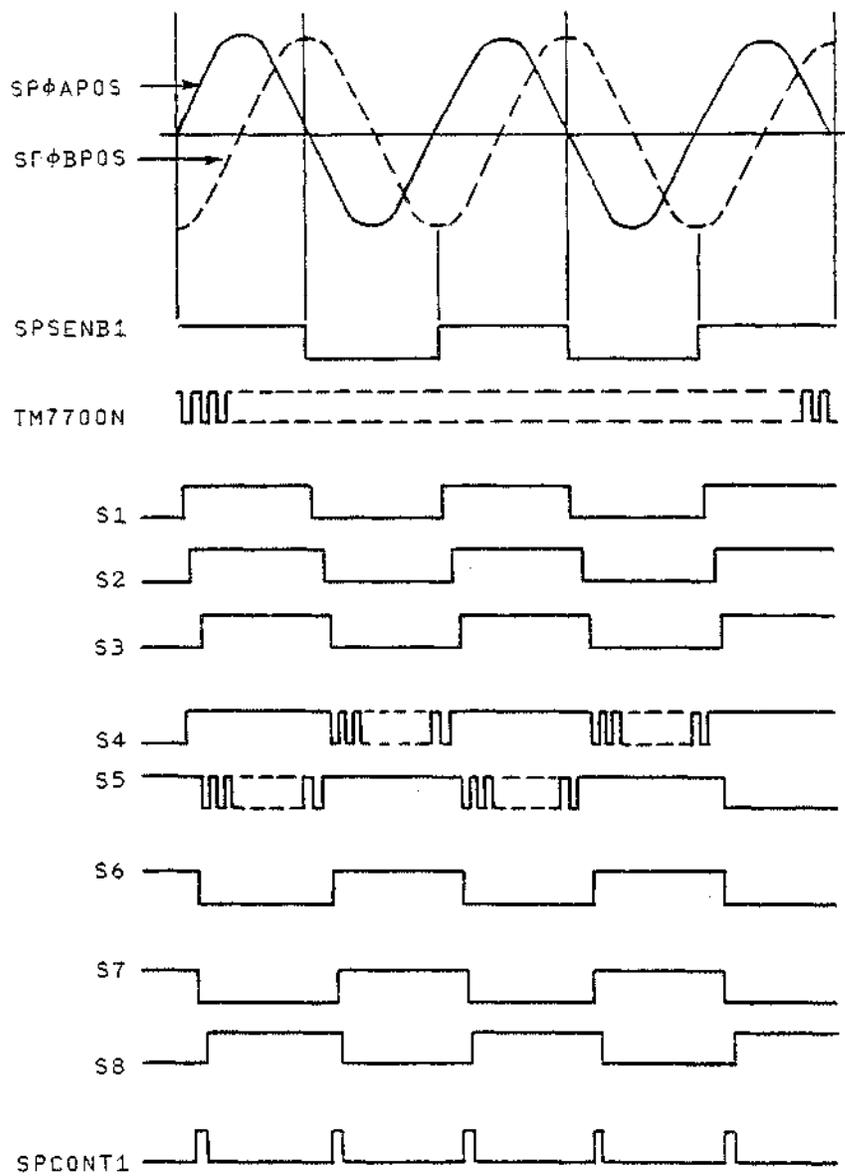
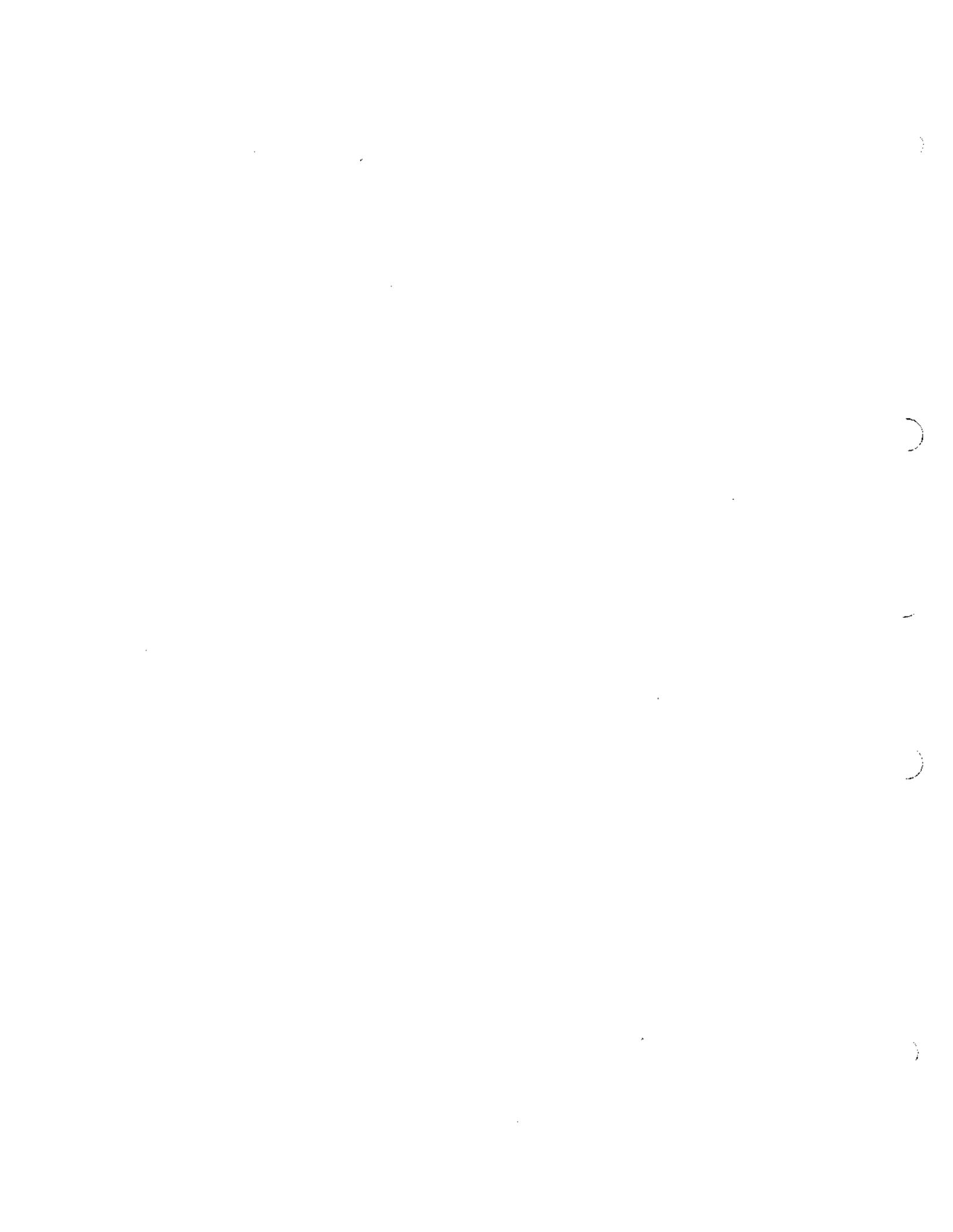


Figure 3-24 Count Pulse Circuit Timing Chart

14-065



## CHAPTER 4

### DRIVER BOARD (G9CUM)

The driver circuits provide voltage and current for the various SPINWRITER motors and solenoids. The driver board includes circuitry for the following functions:

- Rotate and Space Servomotors
- Print Thimble Vertical Lift Coil
- Print Hammer Drive
- Ribbon Color Change Magnet
- Ribbon Drive Motor
- Paper Feed Drive Motor
- Driver Interlock

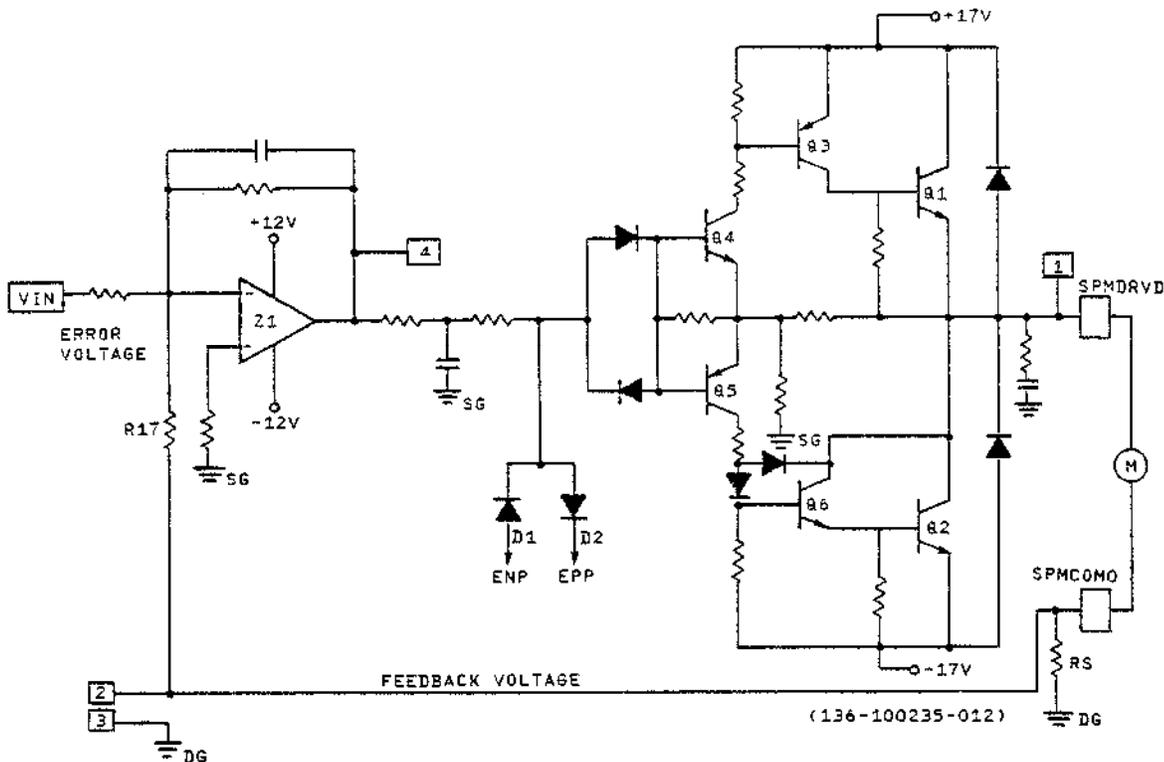
#### 4.1 SERVO DRIVER

There are two kinds of servo drivers, space and rotate, and circuit operation is common to both. The spacing servo driver circuits are described in detail in this section. This explanation also applies to rotate driver circuits. Figure 4-1 is the schematic diagram of the space servo driver circuit.

##### 4.1.1 Circuit Description

The servo driver receives the direction and velocity command voltage in the form of an error voltage (SPSUMMS) from the servo board summing amplifier. With reference to Figure 4-1, the output signal of the summing amplifier is the input signal  $V_{in}$  of the driver circuit. When  $V_{in}$  is positive, test point 4 (TP4) of the driver circuit is negative and Q5, Q6, and Q2 are turned on. At this time, TP1 is negative with respect to DG (TP3), and the resultant current flow causes the motor to rotate clockwise. When  $V_{in}$  is negative, Q1 is turned on. TP1 is now positive with respect to DG, and the resultant current causes the motor to rotate counterclockwise.

When current flows through the motor, a voltage is developed across resistor RS. The voltage,  $V_{rs}$ , will be positive or negative with respect to DG, depending upon the direction of current flow through the resistor. The feedback voltage is routed to the driver input via resistor R17. As the motor current approaches 3.2 amperes the increasing voltage across RS will start to limit the input voltage of Z1. The driver transistor, Q1 or Q2, will start to shut off, thus insuring that the motor does not draw more than 3.2 amperes.



14-066

Figure 4-1 Space Servo Driver Circuit

## 4.2 VERTICAL DRIVER

The vertical driver circuits provide the necessary control current for the print thimble vertical lift magnet. The stepper-type vertical lift magnet positions or lifts the print thimble between two vertical planes. Processor command signals are applied directly to the G9CUM driver board (Figure 4-2). Circuitry on the G9CUM servo board produces the vertical sense signal which is fed back to the processor.

### 4.2.1 Circuit Description (G9CUM, G9CUN)

In Figure 4-2, the print thimble lift control signals from the processor are converted to drive signals by two transistor pairs (Q9,Q7 and Q10,Q8), and are routed directly to the vertical magnet. These drive signals are also connected to differential amplifier Z26A which connects in turn to comparator Z26B to output the VTSENS1 signal back to the processor. The enable signal, VTENAB1, from the processor provides gating to the comparator. Figure 4-3 shows the timing relationships between the control and response signals for both the LIFT and DOWN commands.



### 4.3 HAMMER DRIVER

The hammer driver circuit provides the proper amount of drive current to operate the print hammer solenoid for optimum print quality. The amount of drive current is determined by six different impression levels and one of two drive pulses controlled by the microprocessor control system.

#### 4.3.1 Circuit Description (G9CUM)

When the absolute character position is specified by the external controller, the received data specifies an absolute character address and a 3-bit hammer impression selection code. Table 4-1 shows the relationship between the 3-bit hammer impression selection code and the resultant hammer drive pulse and hammer current.

Table 4-1 Selection of Hammer Driver Pulse Width for Specified Hammer Impression Level

HAMMER IMPRESSION LEVEL	7	6	5	4	3	2	1
HAMDRV PULSE (MS)	2.0			1.6			
HAMMER CURRENT (A)	3.3	2.8	2.55	3.0	2.8	2.55	2.4

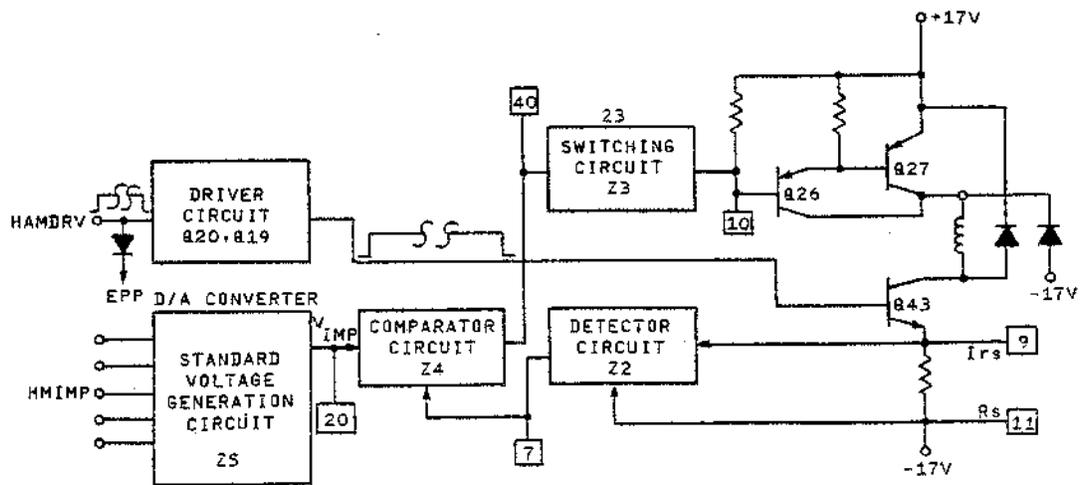
When the ASCII mode is specified, the received ASCII character data is converted to an internal code which specifies the physical location of the character on the print thimble (for example, which row, top or bottom, and which one of 64 fingers). The internal code is then used to determine which of four possible type groups the character belongs to. From Table 4-2, a hammer impression level is selected based on the type group and the position of the operator impression level switch. When the proper impression level is determined, Table 4-1 is used to select the hammer drive pulse width.

Figure 4-4 is the block diagram of the hammer drive circuit. When the driver signal (HAMDRV) is high, Q20 and Q43 are turned on. The hammer impression level data applied at voltage reference circuit Z5 establishes a unique voltage level for each of the seven impression levels. Circuit Z2 detects how much current, IRS, is flowing through the hammer drive solenoid and converts IRS to a reference voltage level available at TP7.

When HAMDRV first goes high, IRS will be zero and the Z4 amplifier circuit output at TP40 will be a negative voltage. This negative voltage applied at Z3 will cause Q27 to turn on. Current will start to flow through the hammer solenoid.

Table 4-2 Selection of Hammer Impression Level When ASCII Code Specified

IMPRESSION SWITCH	TYPE GROUP	a	b	c	d
	HIGH		7	6	5
MEDIUM		6	5	4	2
LOW		5	4	3	1



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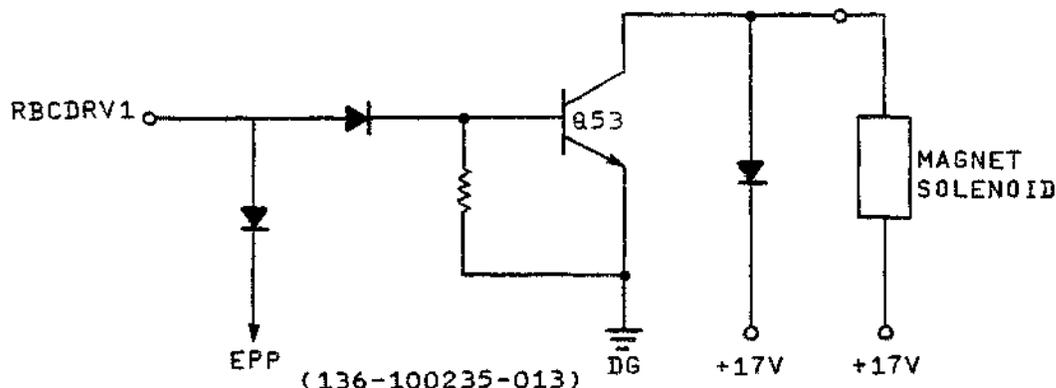
14-069

Figure 4-4 Hammer Drive Block Diagram

Hammer drive current,  $I_{RS}$ , will increase, as will the Z2 voltage output at TP7. Z4's output voltage (TP40) will increase from a negative value to 0 volts. When this output voltage starts to go positive (detected current flow equals specified hammer impression), Q27 starts to shut off. The amplifier's output voltage controls the conduction of Q27 to keep the current flow at the specified value. Hammer drive current continues to flow until the HAMDRV pulse goes low at which time Q43 is shut off.

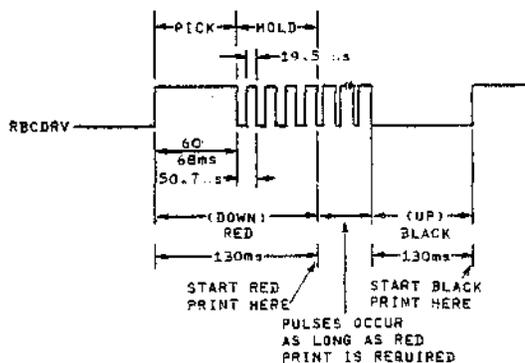
#### 4.4 RIBBON COLOR CHANGE MAGNET DRIVER

The ribbon change magnet driver controls the ribbon color change magnet upon MPS command. Figure 4-5 is a schematic representation of the driver circuitry, and Figure 4-6 shows the driver circuit input signal waveforms from the processor board.



14-070

Figure 4-5 Ribbon Color Change Magnet Driver



14-071

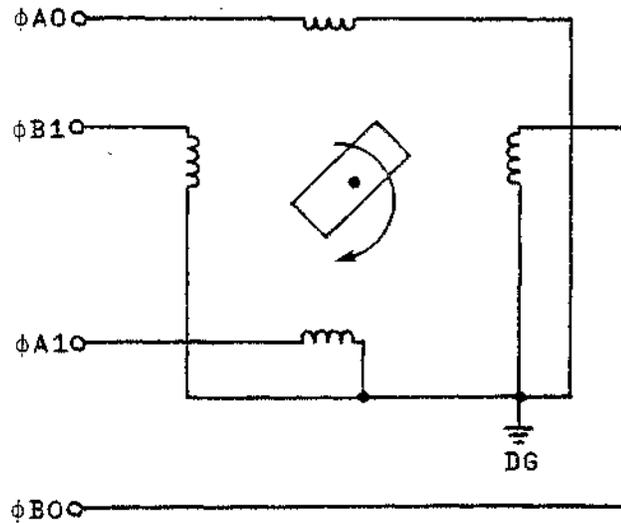
Figure 4-6 Ribbon Color Change Timing

##### 4.4.1 Circuit Description (G9CUM)

Q53 provides a return path for the magnet solenoid when the RBCDRV1 input signal is logic high, causing the magnet to be energized. When the magnet is energized for 60 to 68 milliseconds, the ribbon cartridge will be lowered into the red position. The cartridge is then held down by a series of pulses, as shown in Figure 4-6. Spring tension returns the cartridge to the upper or black position when RBCDRV1 remains at logic low input level. The change from red to black requires approximately 130 milliseconds.

## 4.5 RIBBON DRIVE

The ribbon drive circuit provides the necessary current to control the stepper-type ribbon drive motor, which has two stator windings 90 degrees apart. These windings are center-tapped to provide four smaller windings, as shown in Figure 4-7.

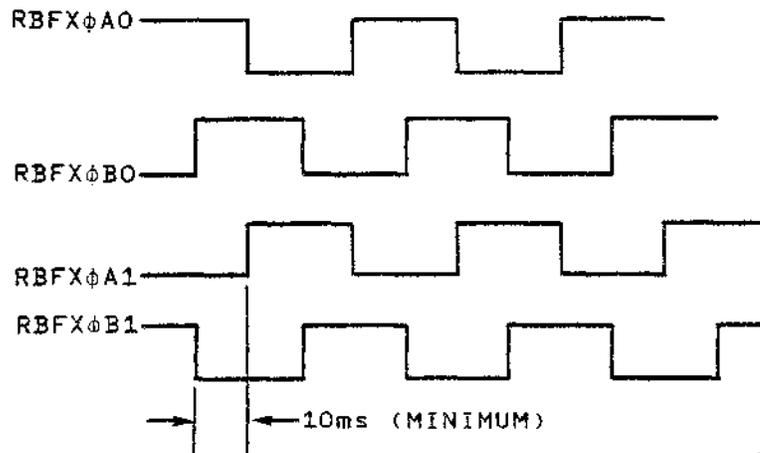


14-072

Figure 4-7 Ribbon Drive Motor Windings

### 4.5.1 Circuit Description (G9CUM)

The motor windings are energized by four signals whose time relationships are shown in Figure 4-8. Only two windings will be energized at one time and the energized windings will always be 90 degrees apart. The resultant magnetic field produced by the current flow through the stator windings will cause the rotor to rotate 90 degrees clockwise.



14-073

Figure 4-8 Ribbon Feed Drive Timing

Figure 4-9 is a schematic diagram of the ribbon drive motor circuits. As an example, when RBFX $\phi$ A0 is low, Q52 will be biased on. Q48 will be turned on and current will flow from the -17-volt supply through the  $\phi$ A0 winding to driver ground.

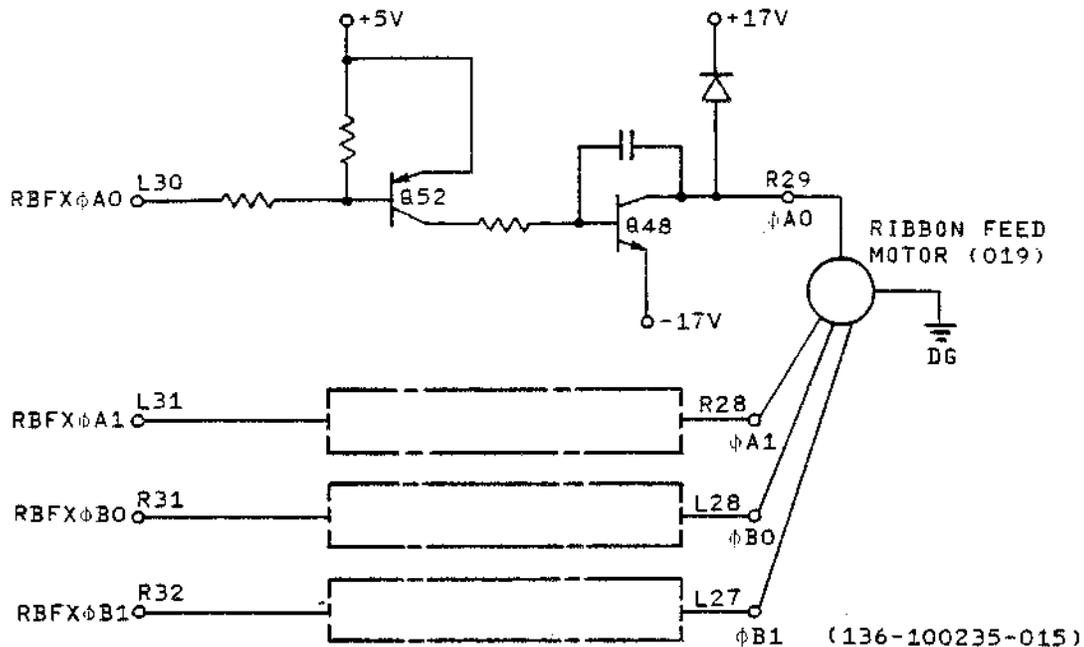


Figure 4-9 Ribbon Motor Driver Circuit

14-074

#### 4.6 PAPER FEED DRIVER

The paper feed driver circuit provides the necessary current to operate the paper feed drive motor. This motor employs two center-tapped field windings and an armature. The field windings are arranged (Figure 4-10) in twelve groups of four small windings. This arrangement of field windings produces 48 positions at which the armature can align itself. One revolution of the motor armature is equal to 48 pitches, or one inch of paper travel at the platen. Figure 4-11 is a schematic diagram of the paper feed motor drive.

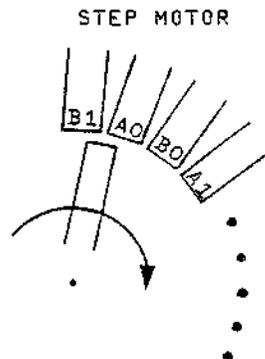
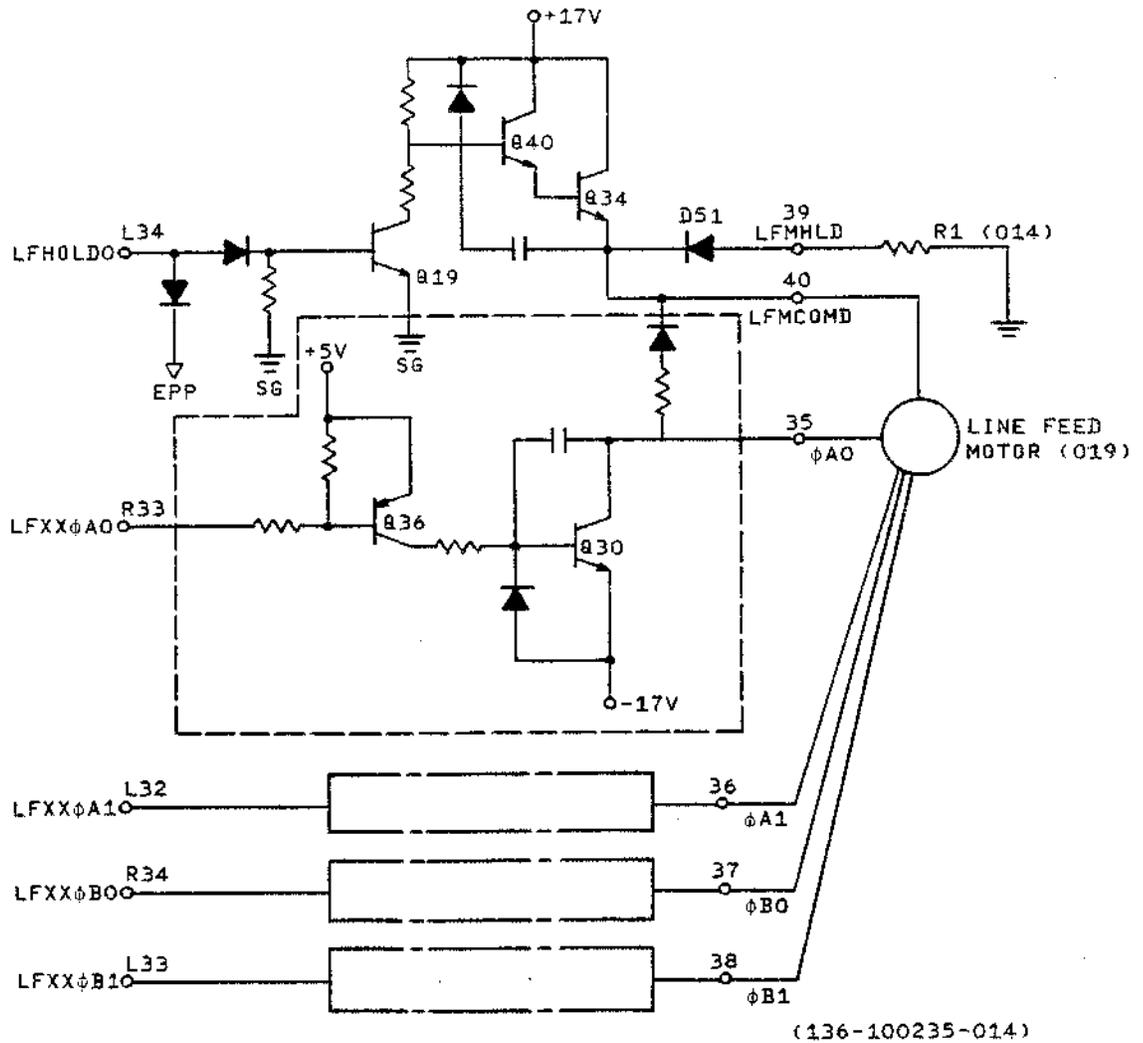


Figure 4-10 Paper Feed Motor Field Winding Arrangement

14-075



(136-100235-014)

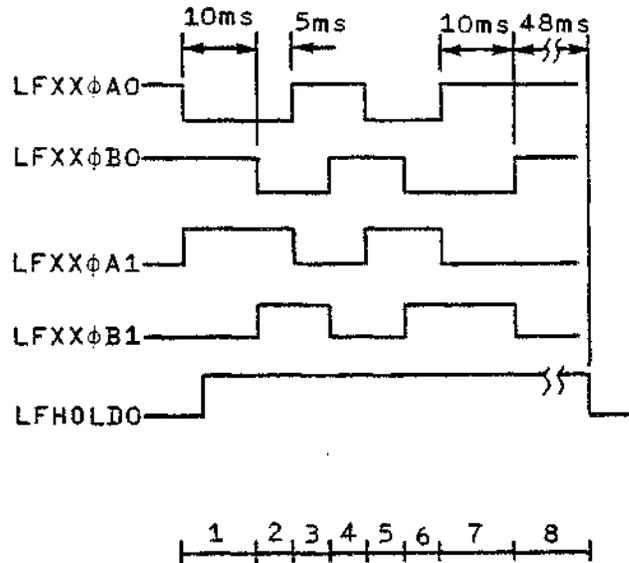
Figure 4-11 Paper Feed Motor Drive Circuit

14-076

#### 4.6.1 Circuit Description (G9CUM)

The circuit operation will be explained using six lines per inch forward line feed (8 pitches) as an example. Before a paper feed cycle is started, two field windings will be energized and hold current will flow through the windings to driver ground via D51 and R1. Refer to Figure 4-12 for the following signal relationships.

When the LFHOLD0 signal is turned on (0V to +5V), field winding current will start to flow from -17V to +17V, via Q34. Ten milliseconds after LFHOLD0 is turned on, the armature will rotate at five milliseconds per pitch. At the seventh pitch, acceleration is retarded by extending the drive signal change to ten milliseconds. At the eighth pitch, the drive signal



14-077

Figure 4-12 Paper Feed Motor Drive Timing

change is suppressed for 48 milliseconds at which time the LFHOLD0 signal returns to a low level. Q34 will be shut off and hold current will flow from -17V to ground via the selected driver transistors, the field windings, D51, and R1.

#### 4.7 DRIVER INTERLOCK

The drive lock circuit is used to turn off various power driver circuits to prevent printer operation if a fault condition should occur. The drive lock circuit will be active:

- Until the dc power has been established after initial ac power on.
- 21 milliseconds after ac power is shut off, reset signal goes low.
- If the dc voltages (+12V, -12V, +5V) exceed 20% of their rated value.
- If the microprocessor control system has detected a fault condition and has enabled DRVLOCK to a high level.

Figure 4-13 is a simplified schematic diagram of the drive lock circuit, and Figure 4-14 is it's detailed schematic.

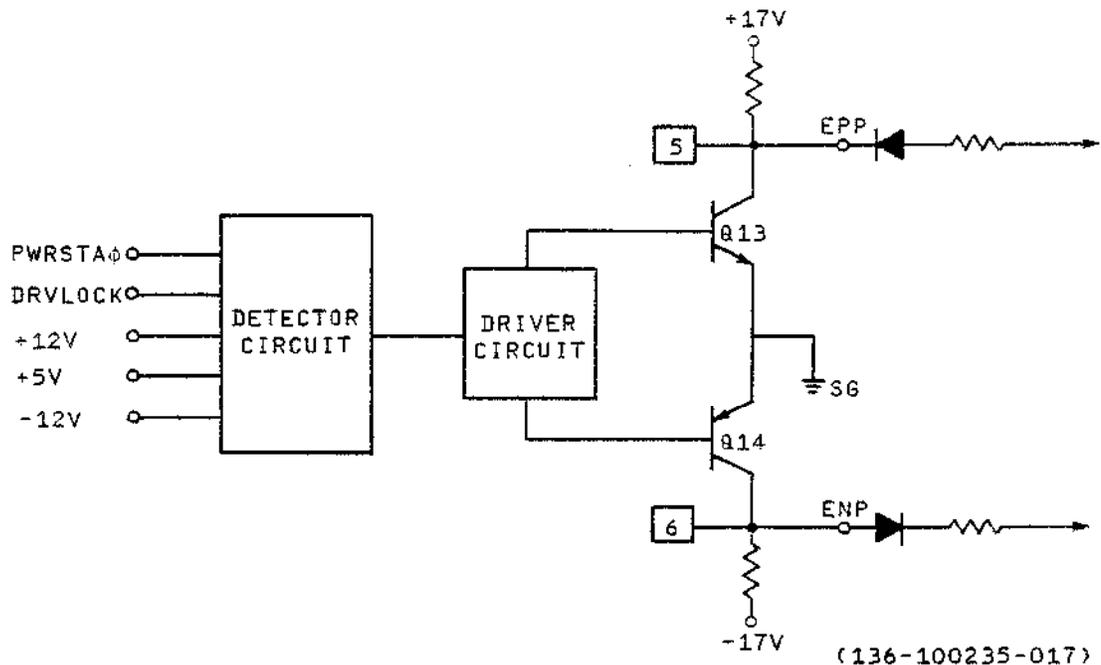


Figure 4-13 Drive Lock Block Diagram

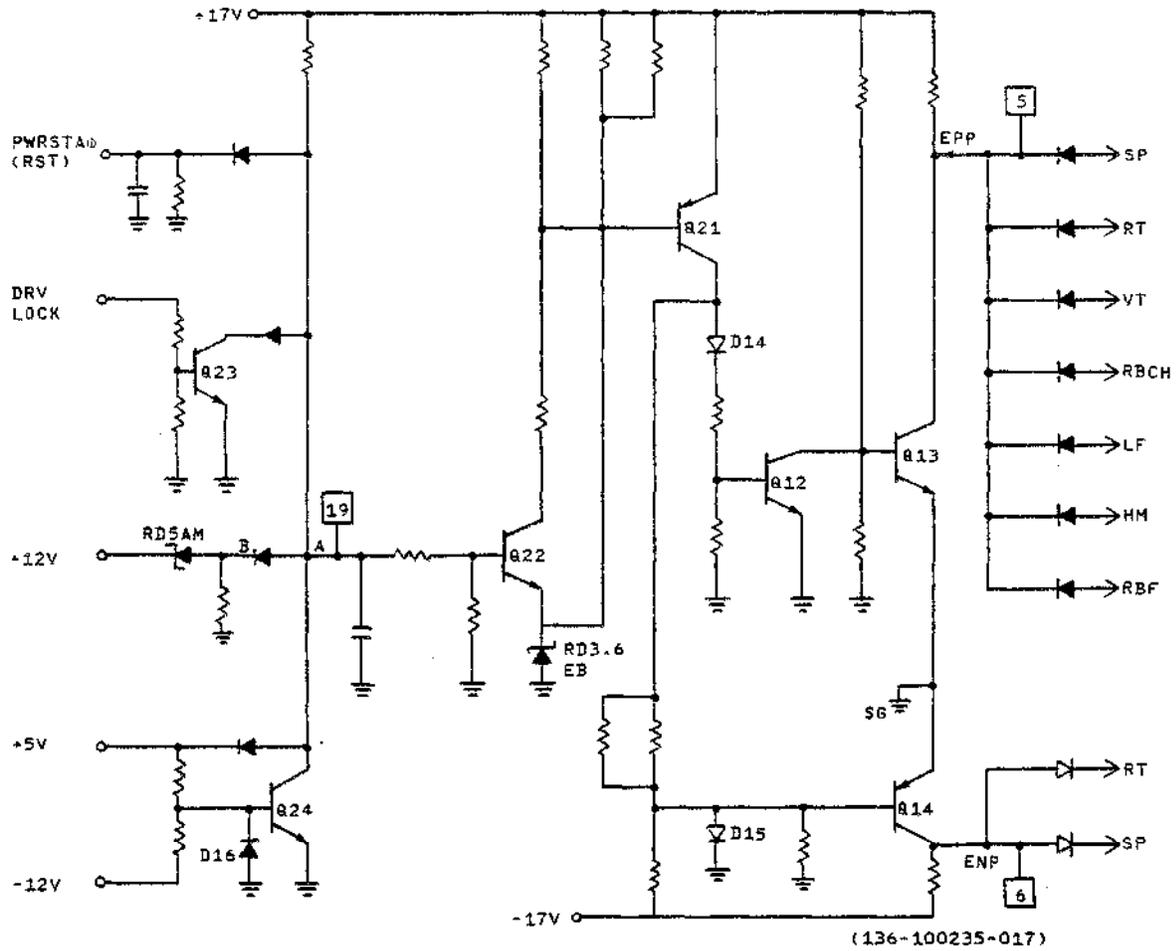
14-078

#### 4.7.1 Circuit Description (G9CUM)

Refer to Figure 4-13. During normal operation, the detector circuit output will be at a high voltage level at TP19. Q13 and Q14 are shut off and the driver circuits will operate properly. If one of the inputs to the detector circuit is abnormal, the detector output will be a low level which will turn on Q13 and Q14. The driver circuit inputs are now held at ground and printer operation is stopped.

In Figure 4-14, test point 19 (TP19) is the detector circuit output. If TP19 is zero volts, Q13 and Q14 will conduct and printer operation stops. TP5 will be driven low if:

- PWRSTA0 (RST) is low.
- DRVLOCK is high, Q23 will be turned on.
- +12V drops below a voltage level determined by zener diode RD2.
- +5V drops to a low level.
- -12V drops toward ground, Q24 will start to conduct.



(136-100235-017)

14-079

Figure 4-14 Detailed Driver Lock-Out Circuit

## CHAPTER 5

### CONTROL PANEL LOGIC BOARD

The control panel logic board contains logic circuits for operator control panel operation and keyboard interfacing (Model 5520 only) to the processor board. The operator control panel logic board is located on the front of the SPINWRITER and all panel switches, except the POWER switch, are mounted on the logic board. Figure 5-1 shows pictorial views of each operator control panel.

#### 5.1 MODEL 5510R/L, 5520R/L SERIAL INTERFACE CONTROL PANEL (G9BNF)

Figure 5-2 shows electrical interconnections between the G9BNF control panel logic board, processor board, and the keyboard. Figure 5-3 shows the bidirectional data bus between the control panel and the processor board. Information on this bus includes (1) commands from the processor, (2) input status information to the control panel indicators, (3) control panel switch selection status, and (4) commands and data from the keyboard. Refer to SPINWRITER schematic 136-100235-044 for the following discussion.

##### 5.1.1 Circuit Description (G9BNF)

The processor board firmware program monitors data from the operator controls by scanning the various switch positions. Data is read from the operator controls into the processor by first setting three bits of information in address 6001H. These bits indicate the type of data the MPU wants to read.

Commands placed on the data bus (Figure 5-4) by the processor are strobed into Z9 by Out-STB. The latched outputs of Z9 (bits 0, 1, 2) are decoded at Z7 by Out-Mode into one of six gate commands. Three other Z9 outputs (bits 3, 4, and 5) are used as direct command functions. Bit 3 is the Keyboard Reset command. Bit 4, via Z10A, illuminates the ALARM lamp. Bit 5, via Z10B, turns on the alarm buzzer.

The Gate 0 control command (Figure 5-5) from Z12 is used to input the selection of the specified operator control panel switches.

5-2

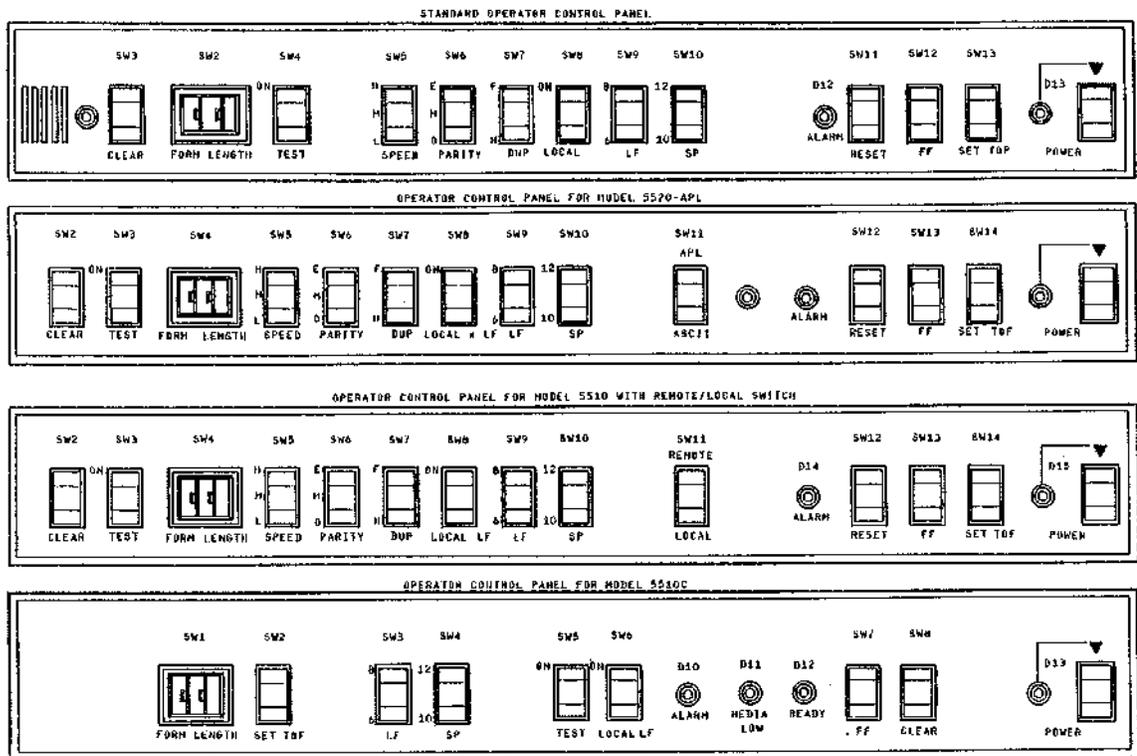


Figure 5-1 Model 5510/5520 Operator Control Panels

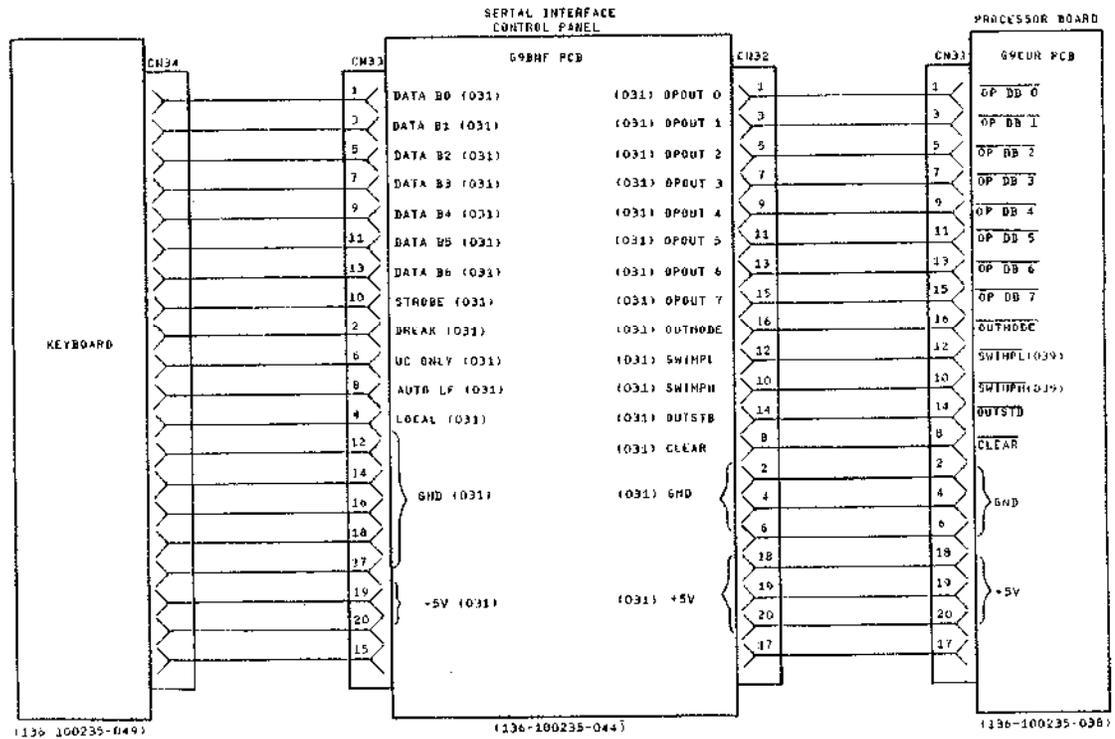


Figure 5-2 Control Panel Interconnection Diagram (G9BNF)

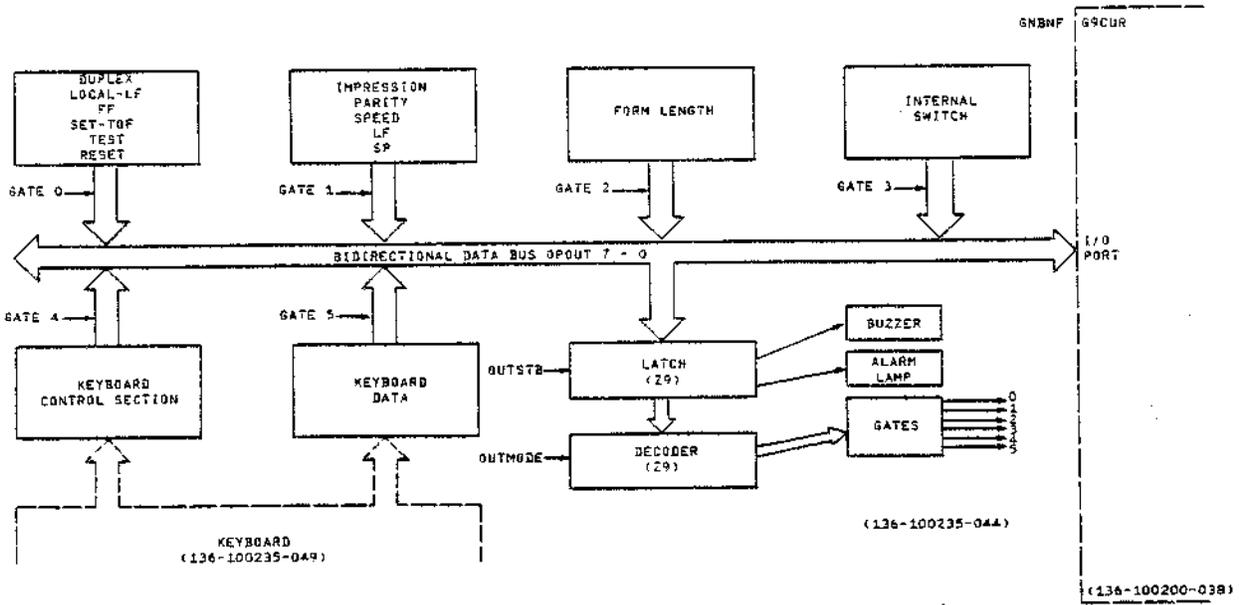
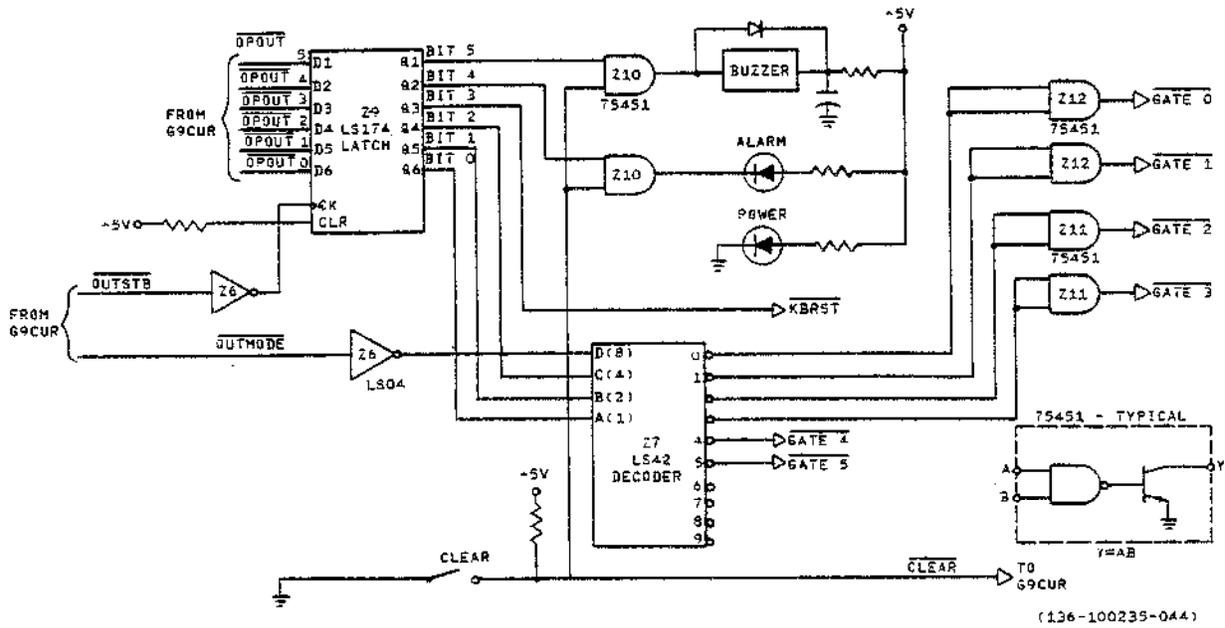


Figure 5-3 Control Panel Logic Block Diagram (G9BNF)

14-082



14-083

Figure 5-4 Gate Command Generation (G9BNF)

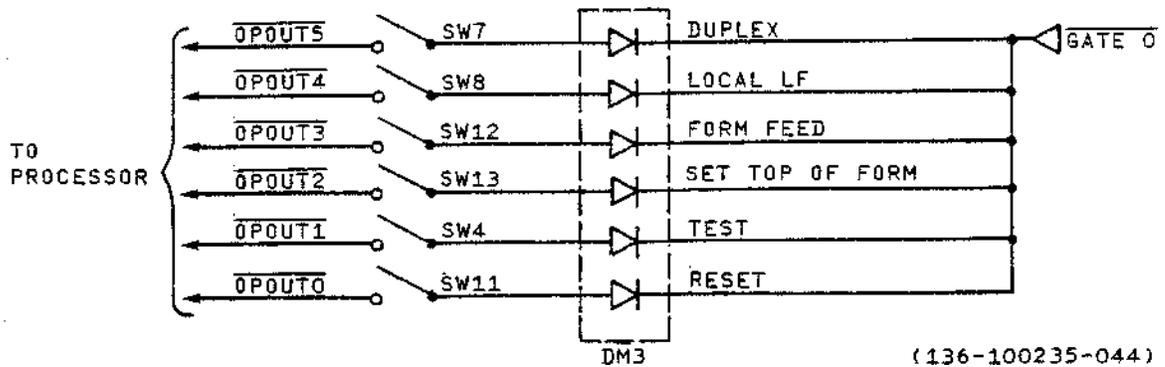


Figure 5-5 Gate 0 Control (G9BNF)

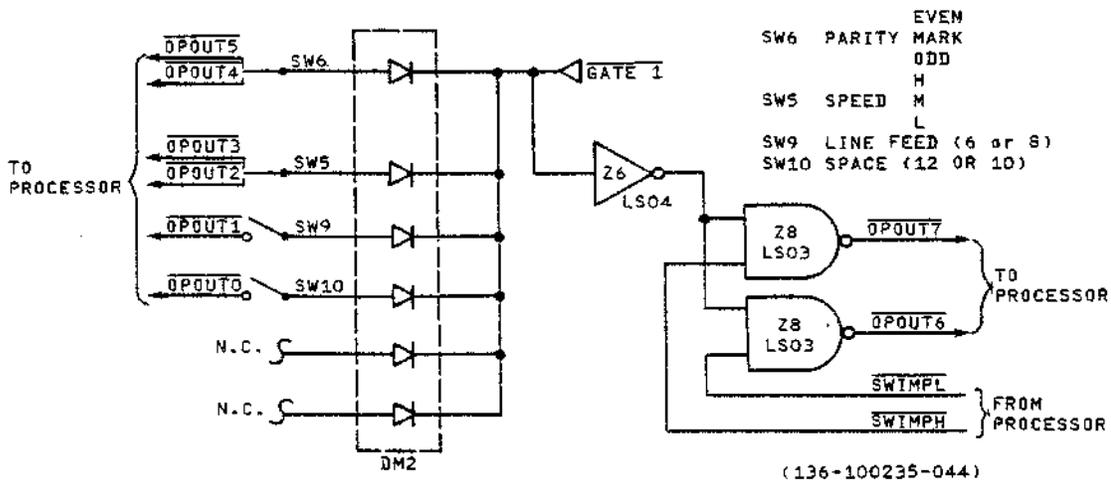
14-084

The Gate 1 control command (Figure 5-6) from Z12 is used to input the selection of the specified operator control panel switches.

The Gate 2 control command (Figure 5-7) from Z11 is used to input the selection of the forms length thumbwheel switches.

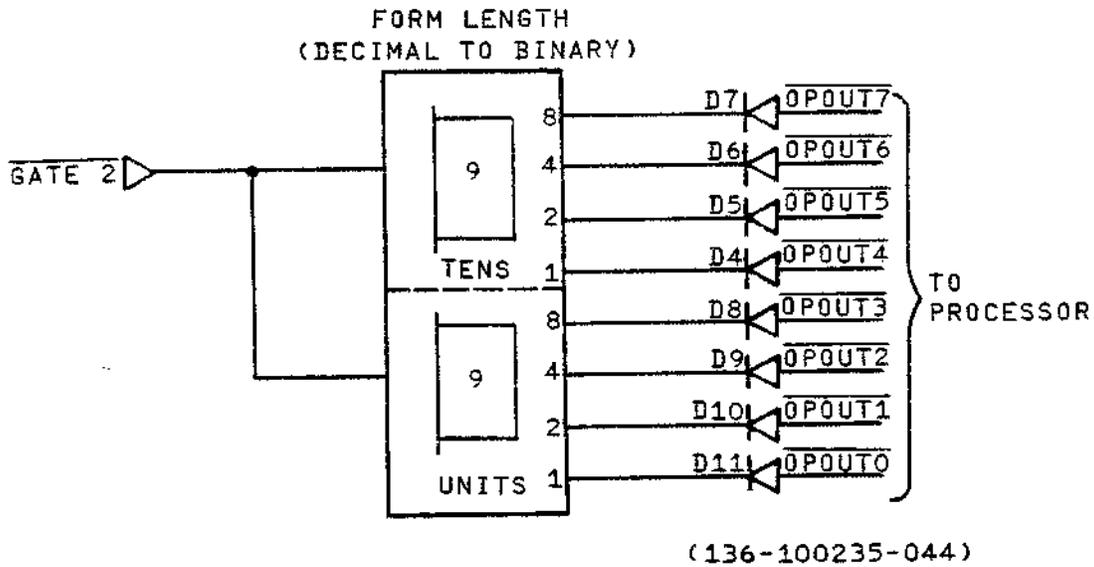
The Gate 3 control command (Figure 5-8 and Table 5-1) from Z11 is used to input the switch settings of DIP switch SW1 (Internal Function Control Switch). Table 5-1 describes the functions of the individual switches in DIP switch SW1.

The Gate 4 control command (Figure 5-9) from Z7 is used to input keyboard control switch signals: BREAK, LOCAL, UC ONLY, and AUTO LF.



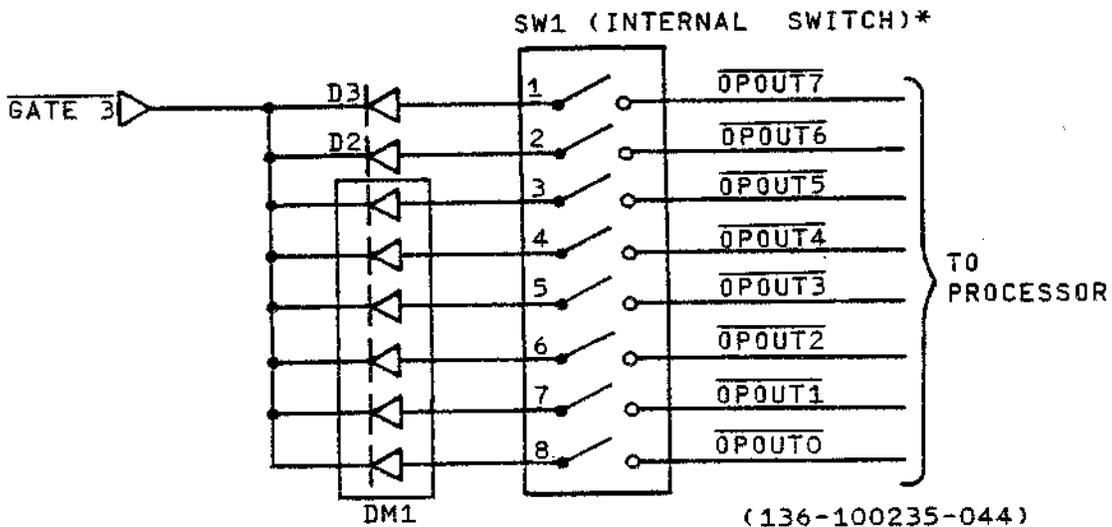
14-085

Figure 5-6 Gate 1 Control (G9BNF, G9DGC, G9DGD)



14-086

Figure 5-7 Gate 2 Control (G9BNF, G9DGC, G9DGD)



\*SEE TABLE 5-1  
FOR FUNCTIONS

14-087

Figure 5-8 Gate 3 Control (G9BNF, G9DGC, G9DGD)

The Gate 5 control command (Figure 5-10) from Z7 is used to input the alphanumeric data from the keyboard. Keyboard data is strobed into Z1 and Z3 by the keyboard STROBE. The latched outputs of Z1 and Z3 are ANDed with Gate 5 onto the data bus. Z1 and Z3 are reset by the Control Command  $\overline{KBRST}$  from Z7.  $\overline{KBRST}$  is generated for every character the MPU receives to insure that the next character has the proper bit configuration.

Table 5-1 Internal Function Control Switch (SW1)

SWITCH POSITION	SETTING/FUNCTION
1	0 = Automatic Carriage Return Off 1 = Automatic Carriage Return at Column 132
2	0 = Clear Individual Tabs 1 = Clear All Tabs
3	0 = Break Enable 1 = Console Interrupt Enabled
4	0 = ETX/ACK Protocol 1 = X-On/X-Off Protocol
5	0 = Reverse Channel Active High 1 = Reverse Channel Active Low (SCA-EIA RS-232-C Pin 19)
6	0 = ASCII 1 = JIS
Baud Rate	
	110,150,300    110,200,300    110,300,600    110,300,1200
7	0                    0                    1                    1
8	0                    1                    0                    1

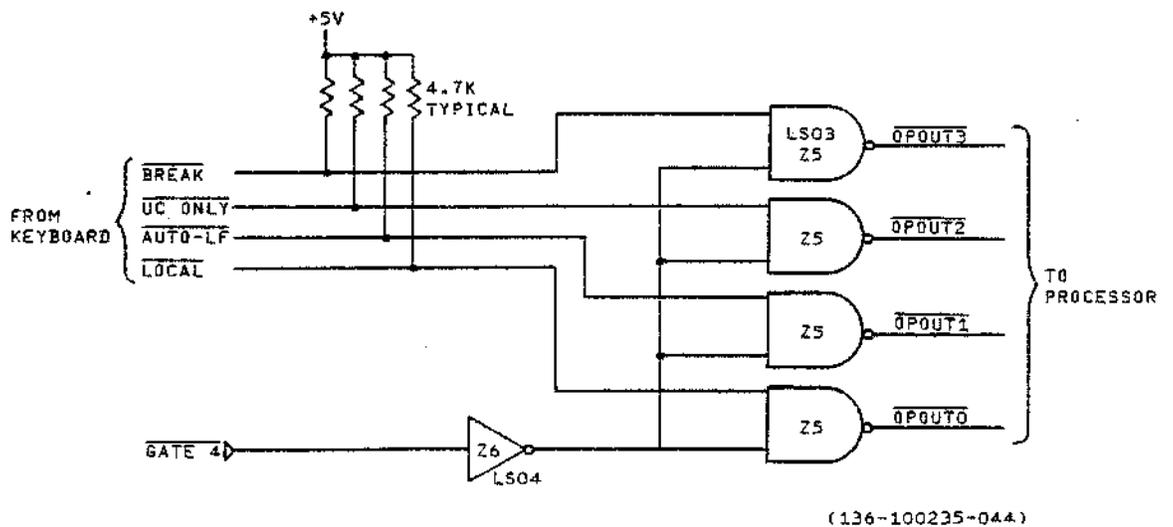


Figure 5-9 Gate 4 Control (G9BNF, G9DGC)

14-088

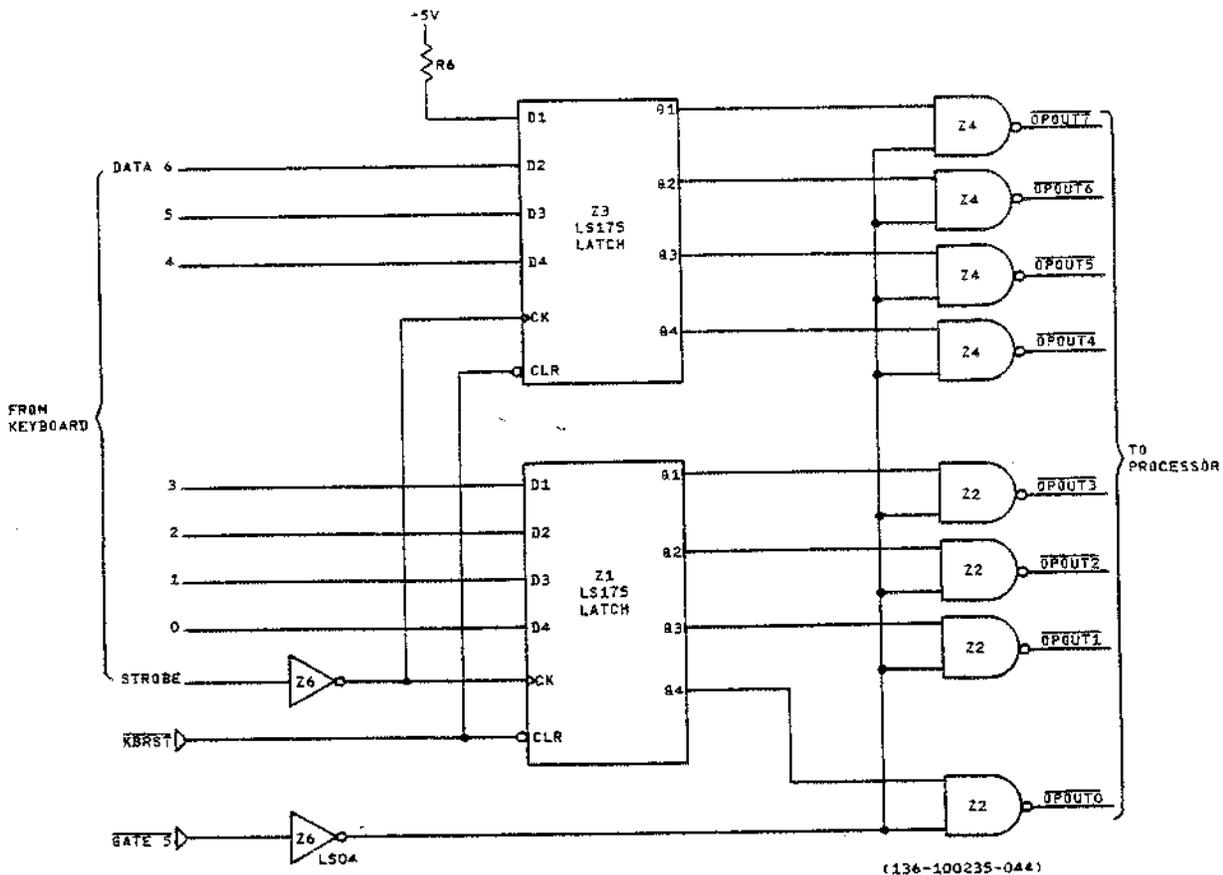


Figure 5-10 Gate 5 Control (G9BNF, G9DGC)

## 5.2 MODEL 5520R-APL SERIAL APL INTERFACE CONTROL PANEL (G9DGC)

Figure 5-11 shows electrical interconnections between the G9DGC control panel logic board, the G9DWJ processor board, and the keyboard. Figure 5-12 shows the bidirectional data bus between the control panel and the processor board. This control panel configuration is similar to that of the G9BNF described in Section 5.1. Note the following additions: the APL/ASCII switch in the Gate 0 control block, the APL indicator, and the new latch (Z10) required to accommodate the APL indicator. Refer to SPINWRITER schematic 136-440934 for the following discussion.

### 5.2.1 Circuit Description (G9DGC)

The processor board firmware program monitors data from the operator controls by scanning the various switch positions. Data is read from the operator controls into the processor by first setting three bits of information in address 6001H. These bits indicate the type of data the MPU wants to read.

5-10

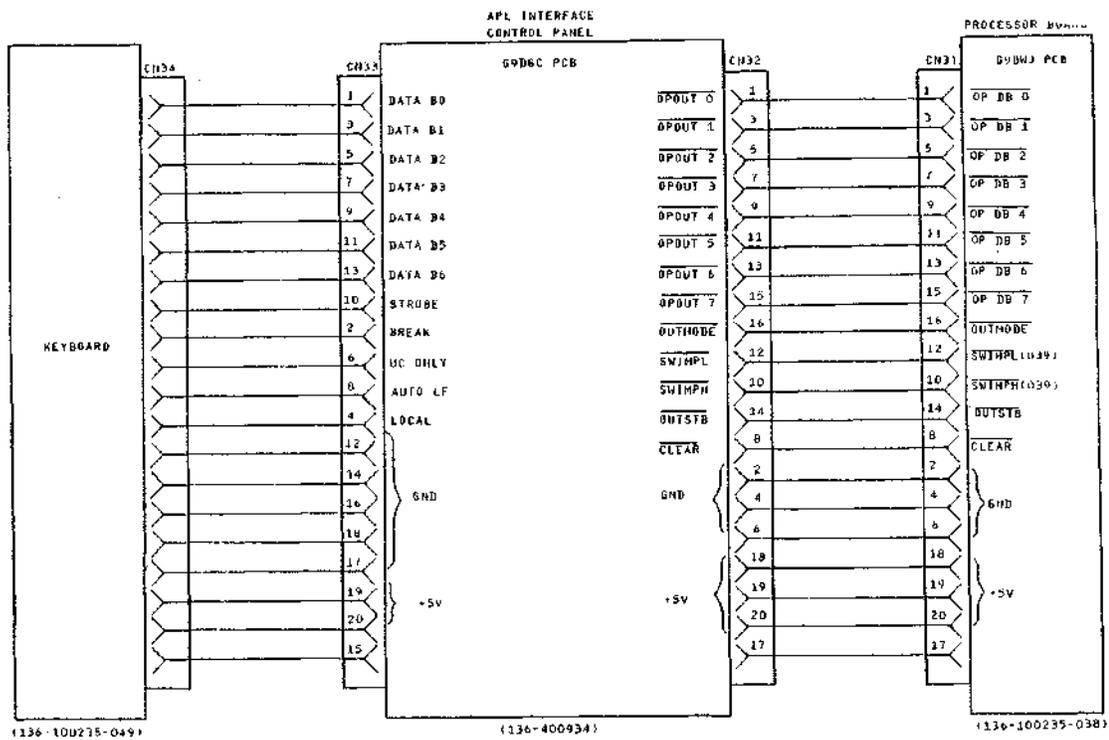


Figure 5-11 Control Panel Interconnection Diagram (G9DGC)

5-110

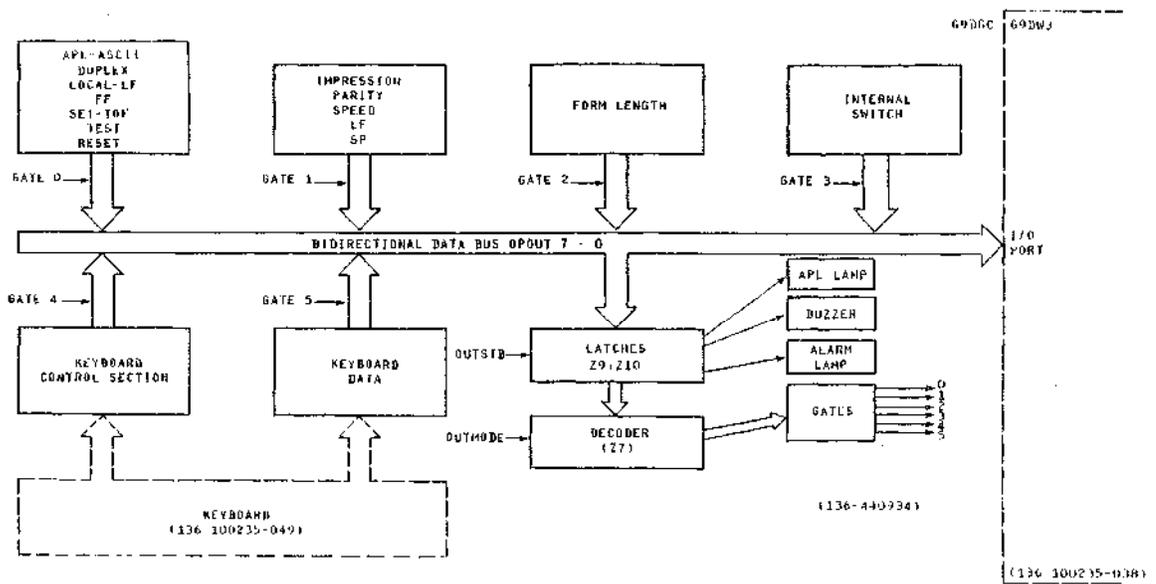
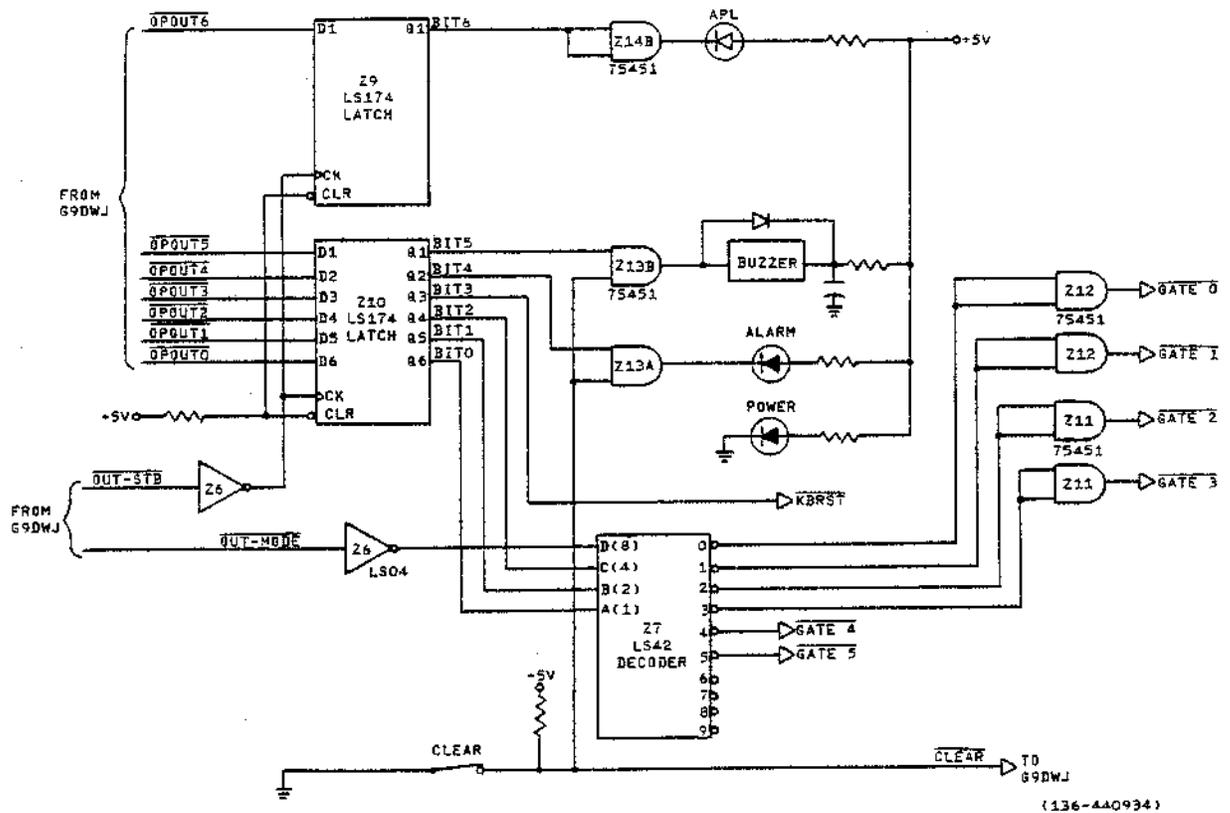


Figure 5-12 Control Panel Logic Block Diagram (G9DGC)

Commands placed on the data bus (Figure 5-13) by the processor are strobed into Z9 and Z10 by Out-STB. The latched outputs of Z10 (bits 0, 1, 2) are decoded at Z7 by Out-Mode into one of six gate commands. Three other Z10 outputs (bits 3, 4, and 5) are used as direct command functions. Bit 3 is the Keyboard Reset command. Bit 4, via Z13A, illuminates the ALARM lamp. Bit 5, via Z13B, turns on the alarm buzzer. Bit 6 from latch Z9 via Z14B, illuminates the APL lamp.

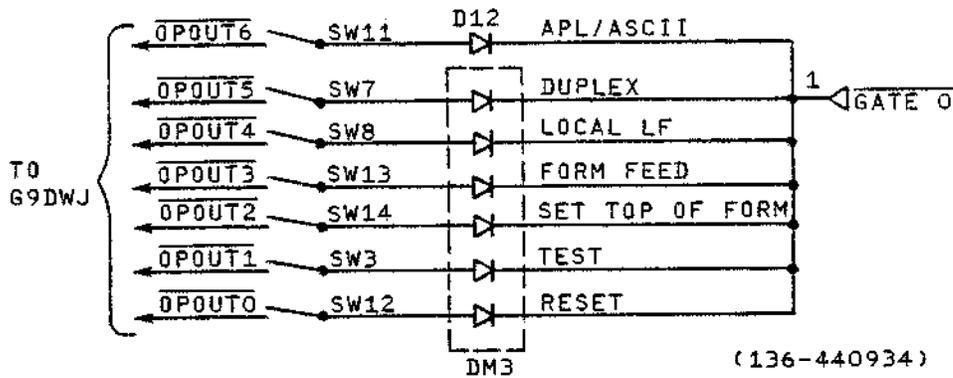


14-092

Figure 5-13 Gate Command Generation (G9DGC)

The Gate 0 control command (Figure 5-14) from Z12 is used to input the selection of the specified operator control panel switches.

The remaining gate control commands (Gate 1-5) are identical to those of the G9BNF control panel commands (see Section 5.1). DIP switch SW1 functions are also identical to those of SW1 on the G9BNF board (Table 5-1).



14-093

Figure 5-14 Gate 0 Control (G9DGC)

### 5.3 MODEL 5510 R/L SERIAL REMOTE/LOCAL INTERFACE CONTROL PANEL (G9DGD)

Figure 5-15 shows electrical interconnections between the G9DGC control panel logic board and the G9DWH processor board. Provision for keyboard connection exists but is not required for Model 5510 printers. Figure 5-16 shows the bidirectional data bus between the control panel and the processor board. This control panel configuration is similar to that of the G9BNF control panel discussed in Section 5.1. Note the following addition: The REMOTE/LOCAL switch in the Gate 0 control block.

#### 5.3.1 Circuit Description (G9DGD)

The processor board firmware program monitors data from the operator controls by scanning the various switch positions. Data is read from the operator controls into the processor by first setting three bits of information in address 6001H. These bits indicate the type of data the MPU wants to read.

Commands placed on the data bus (Figure 5-17) by the processor are strobed into Z10 by OUT-STB. The latched outputs of Z10 (bits 0, 1, 2) are decoded at Z7 by Out-Mode into one of six gate commands. Three other Z10 outputs (bits 3, 4, and 5) are used as direct command functions. Bit 3 is the Keyboard Reset command. Bit 4, via Z13A, illuminates the ALARM lamp. Bit 5, via Z13B, turns on the alarm buzzer.

The Gate 4 control command (Figure 5-18) enables Z5 which places the status of the Remote/Local switch onto the OPOUT 0 output line.

The remaining gate control commands (Gate 0-3) control the same functions as described in Section 5.1.

615

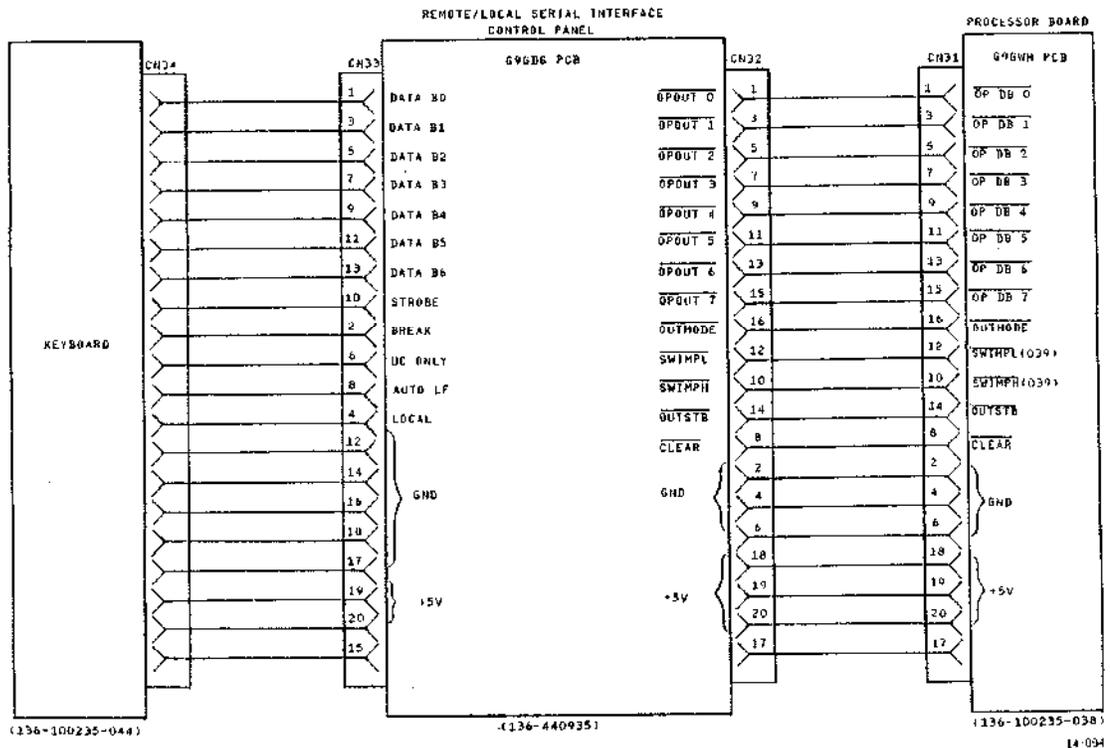
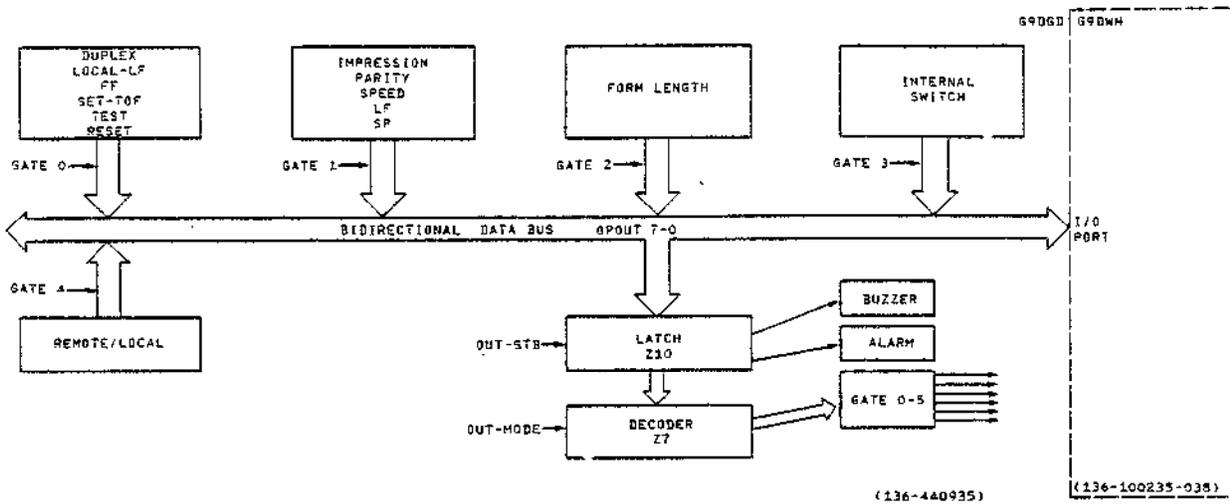
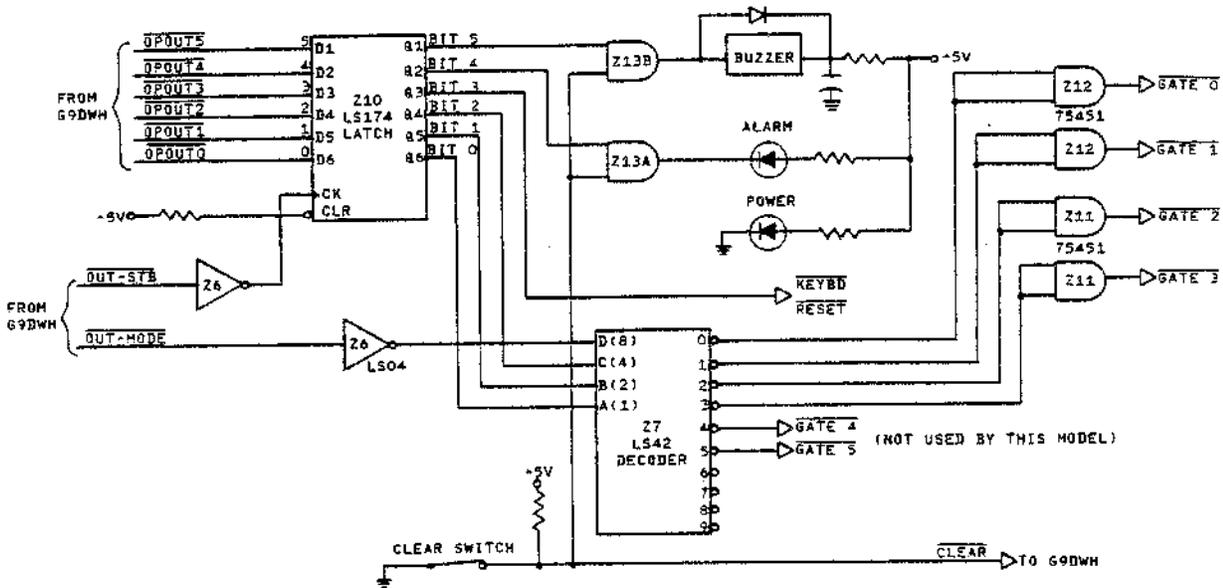


Figure 5-15 Control Panel Interconnection Diagram  
(G9DGD)



14-095

Figure 5-16 Model 5510 REMOTE/LOCAL Control Panel Logic Block Diagram (G9DGD)



14-096

Figure 5-17 Gate Command Generation (G9DGD)

The Gate 5 control command is not utilized by this control board model due to the absence of the keyboard.

Switch SW1 has the same functions as switch SW1 on the G9BNF control board. These functions are described in Table 5-1.

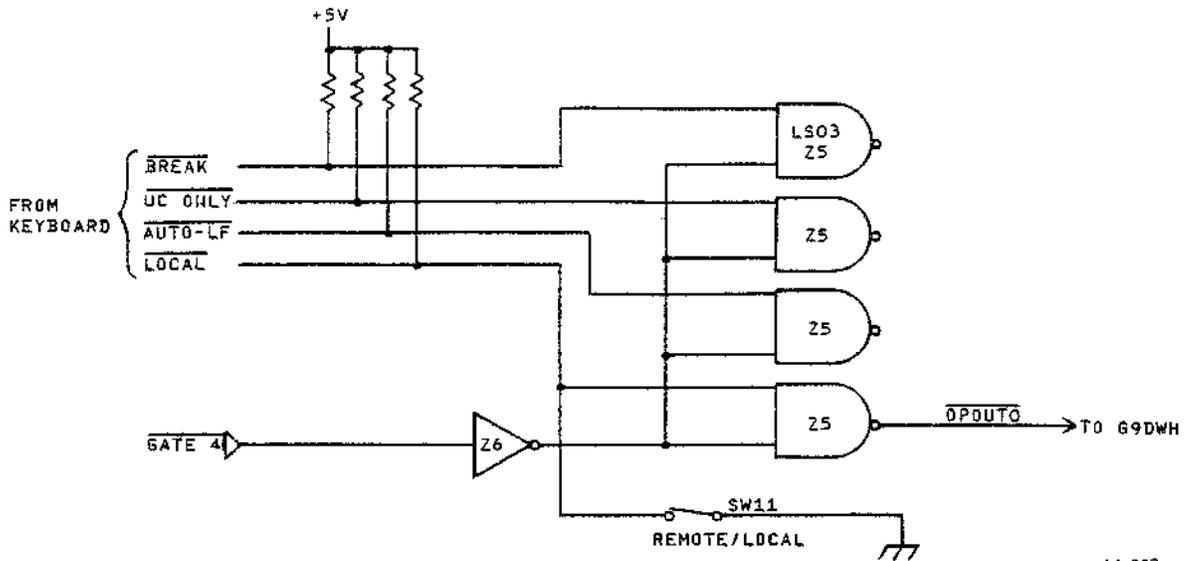


Figure 5-18 Gate 4 Control (G9DGD)

#### 5.4 MODEL 5510C CENTRONICS-TYPE INTERFACE CONTROL PANEL (G9BNE)

Figure 5-19 shows electrical interconnections between the G9BNE control panel logic board and the G9BNB processor board. Figure 5-20 shows the G9BNE data transfer bus to the G9BNB processor board. Information on this bus includes front panel switch selection data. Refer to SPINWRITER schematic 136-100235-027 for the following discussion.

##### 5.4.1 Circuit Description (G9BNE)

The processor board firmware program monitors data from the operator controls by scanning the various switch positions. Data is read from the operator controls into the processor by first setting a switch gate line (SWGT 1 or SWGT 2) at logic low (Figure 5-21). Signal lamps indicate ALARM, READY, and/or MEDIA LOW printer status when applicable lines go to a logic low level (Figure 5-22).

5-16

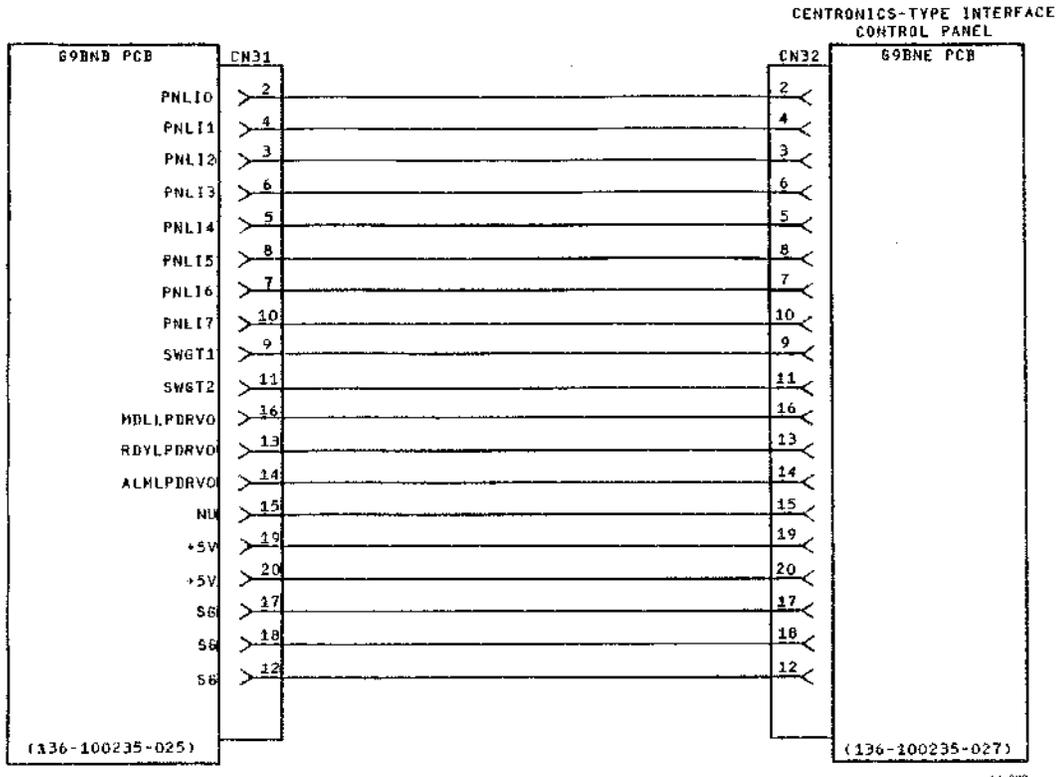
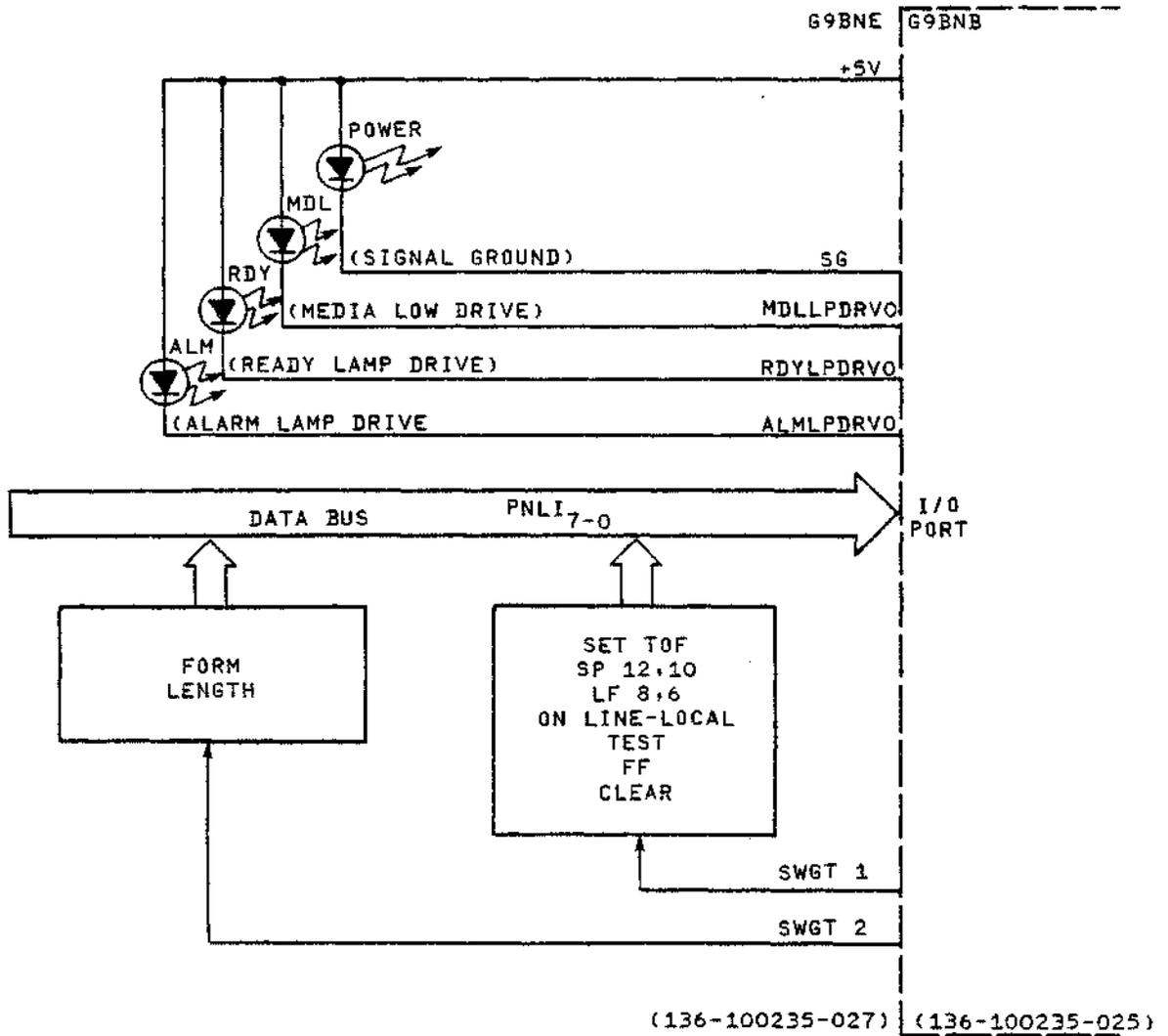


Figure 5-19 Control Panel Interconnection Diagram (G9BNE)



14-099

Figure 5-20 Control Panel Logic Block Diagram (G9BNE)

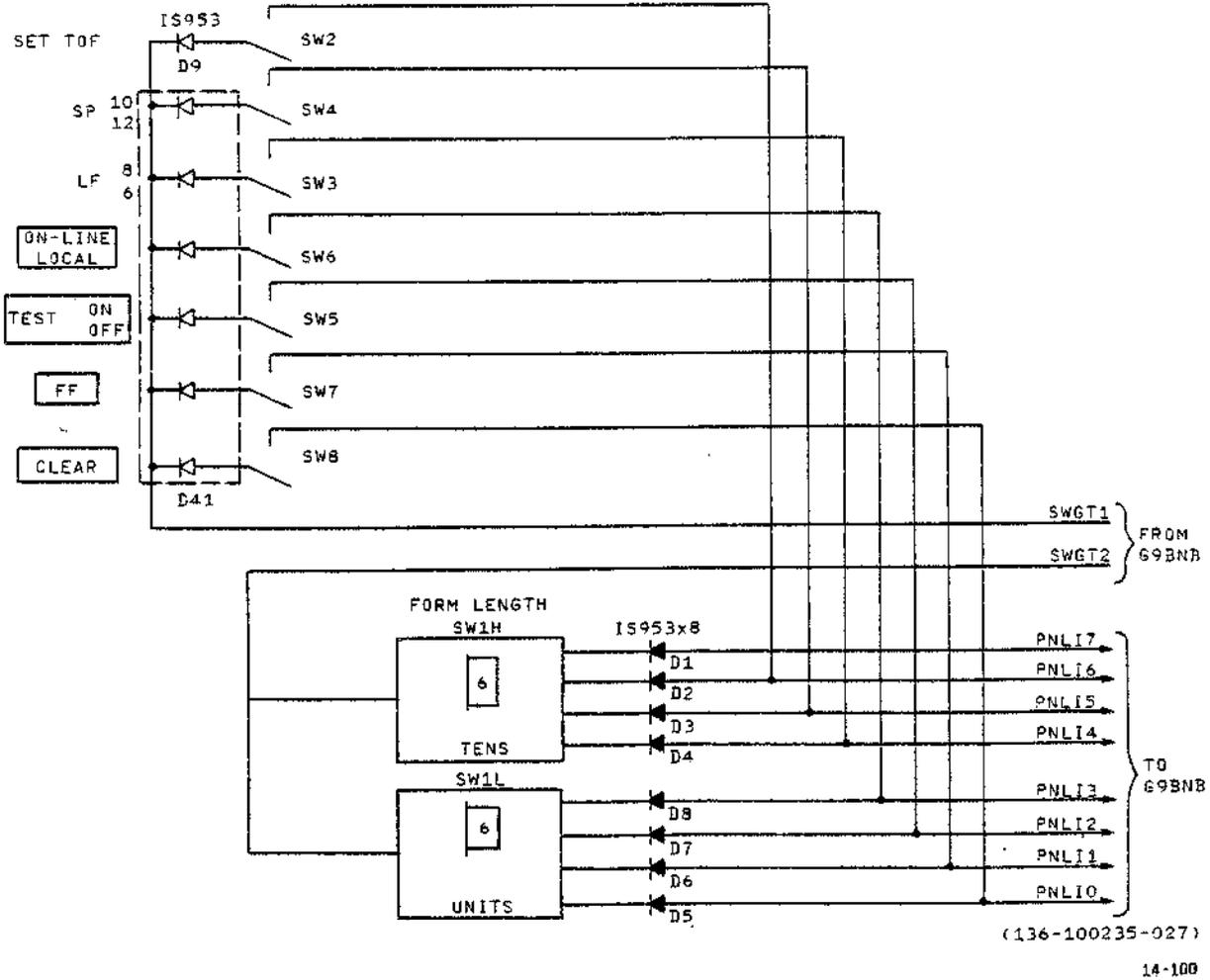


Figure 5-21 Gate 1 and Gate 2 Control (G9BNE)

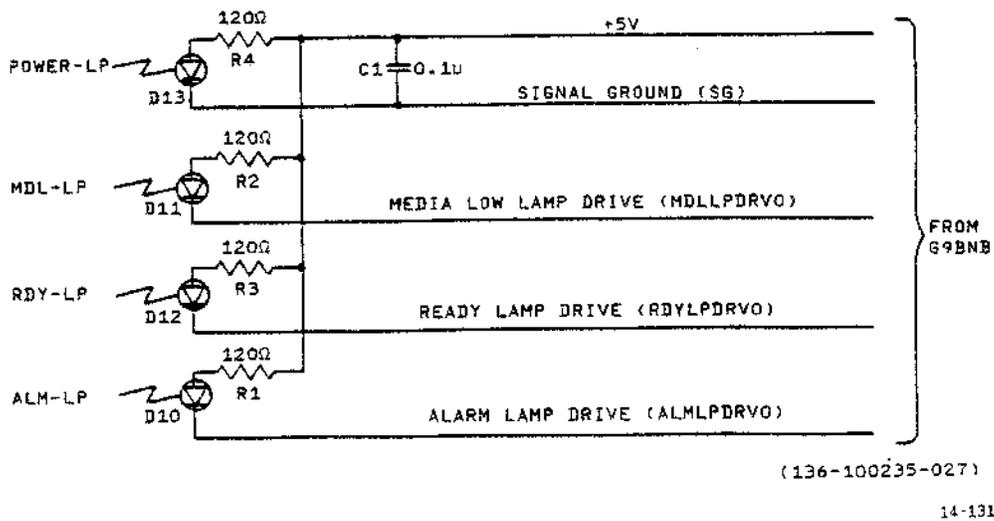


Figure 5-22 Printer Status Indications (G9BNE)



The first three groups employ level output type keys, while the last group uses pulsed output keys.

The control section keys are directly connected to the keyboard/operator control panel interface (Figure 6-2). Each of the repeat, function, and alphanumeric keys are arranged to form unique PROM addresses. The selected ASCII code is sent, via the seven data lines, to the operator control panel logic board where the code is latched on command by the keyboard strobe output signal.

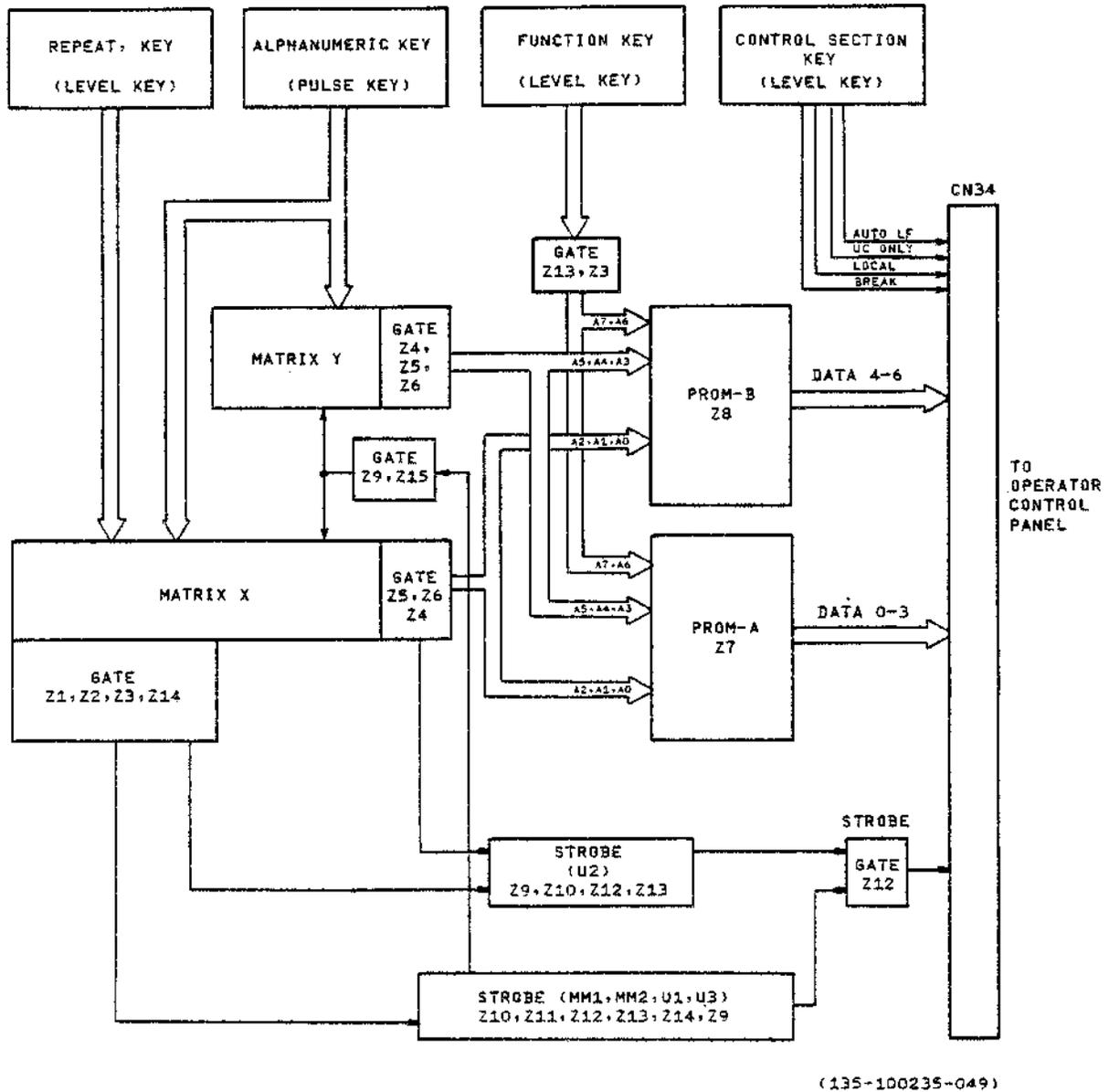


Figure 6-2 Keyboard Block Diagram

14-102

## 6.1 KEY ENCODING

Each Hall-effect key switch contains an integrated circuit (IC) chip that is sensitive to a magnetic field. When the key is depressed, the magnetic field around the IC is altered and the switch produces a low level output signal. Depression of a pulse output key produces a low level for 25 to 80 microseconds. The level output keys produce a low level output as long as the key is depressed.

The outputs (Figure 6-3) of the four control keys are sent directly to the operator control panel via connector CN34. These are locking-type keys in that they lock in the down or depressed position in order to maintain the logic low output. They may be unlocked by slightly depressing the key top. The key's output will now return to a logic high.

The function key outputs (Figure 6-4) are encoded to produce a two-bit PROM address. The LOCK key switch locks in the down position to produce a continuous uppercase shift. All four switches produce a low level output as long as they are depressed.

The repeating keys (Figure 6-5) are encoded to produce a three-bit PROM address. The keys are also encoded to enable the repeat character strobe circuit.

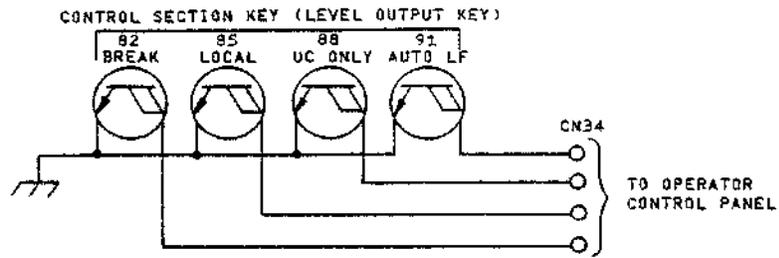
The remaining alphanumeric keys are encoded to produce a six-bit PROM address as shown in Figure 6-6. The alphanumeric key outputs are available for 25 to 80 microseconds.

The X,Y matrix used for encoding the PROM address is shown in Figure 6-7. Address bits A6 and A7 are active according to which function key is depressed. The repeat keys are encoded to activate data bits A0, A1, and A2. Bits A3, A4, and A5 are disabled by the input to pin 4 of Z3. The remaining alphanumeric keys are encoded by using ADDRESS bits A0 through A5.

The PROM's, Z7 and Z8 in Figure 6-7, contain the seven-bit ASCII code data which corresponds to the input address selected by A0-7. Refer to Appendix A for the ASCII code generated by a particular key switch input address. The ASCII code data is latched on the control panel by the character strobe from the keyboard. Appendix C shows APL characters versus code data codes from the PROM.

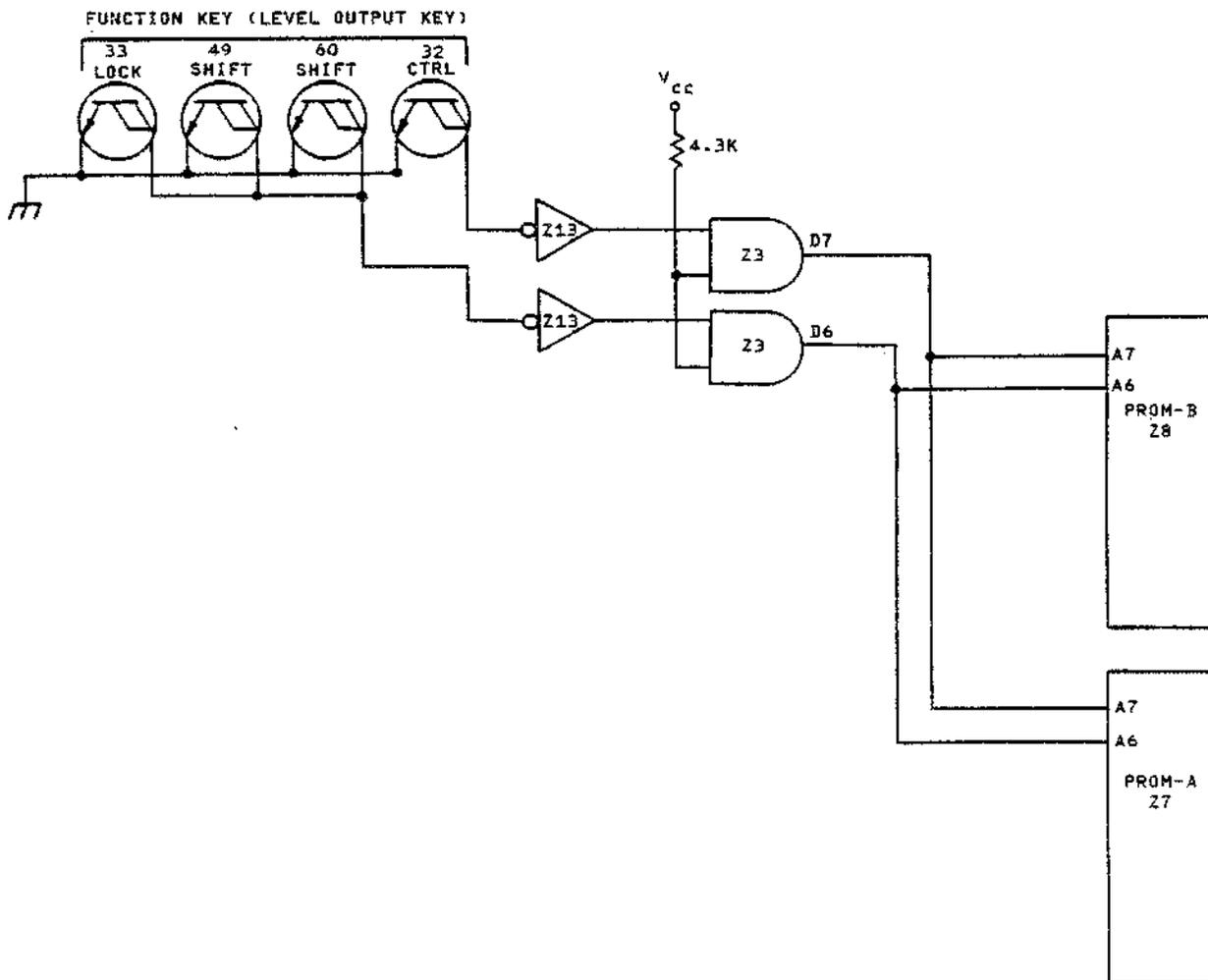
## 6.2 CHARACTER STROBE GENERATION

The character strobe generator has two modes of operation, one for alphanumeric keys and one for repeat keys. The operator control panel uses the character strobe to latch the ASCII data from the keyboard into the control panel circuit. The strobe signal will be a low-going pulse when keyboard data is ready. Figure 6-8 is a schematic diagram of the keyboard strobe generation circuit.



14-103

Figure 6-3 Control Keys



14-104

Figure 6-4 Function Key

6-5

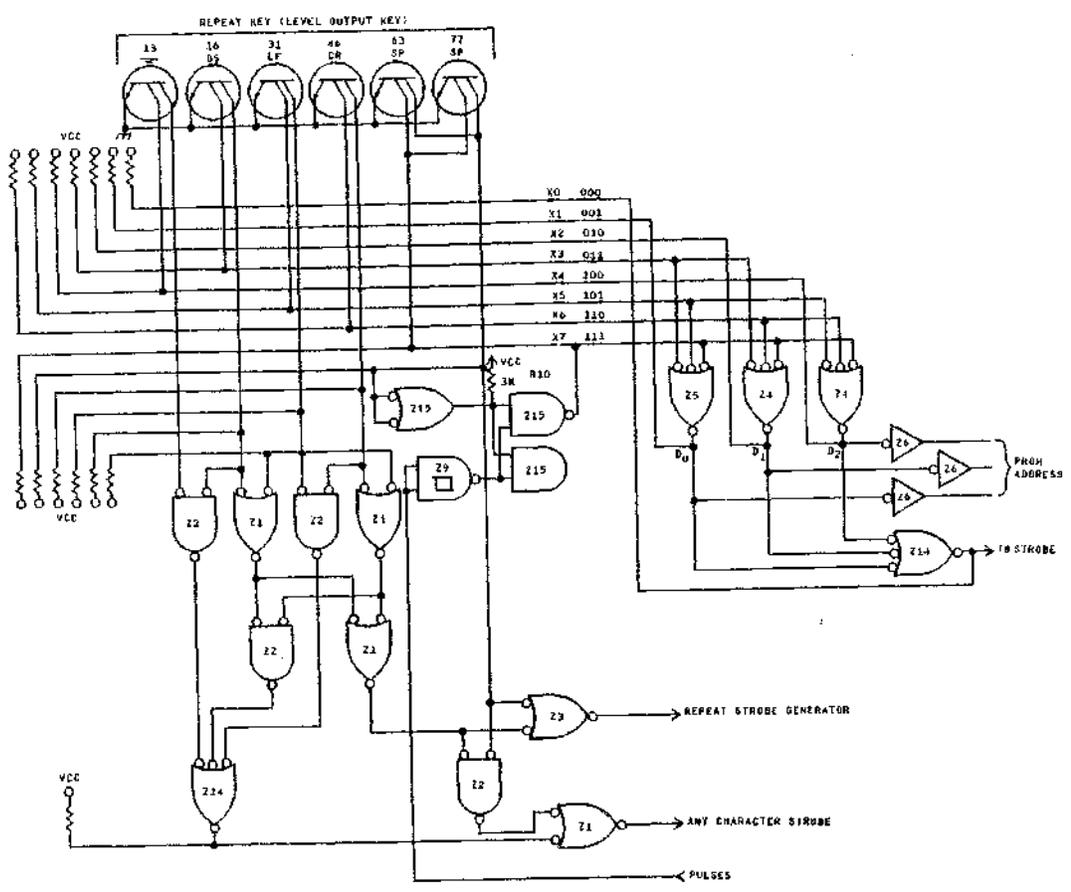
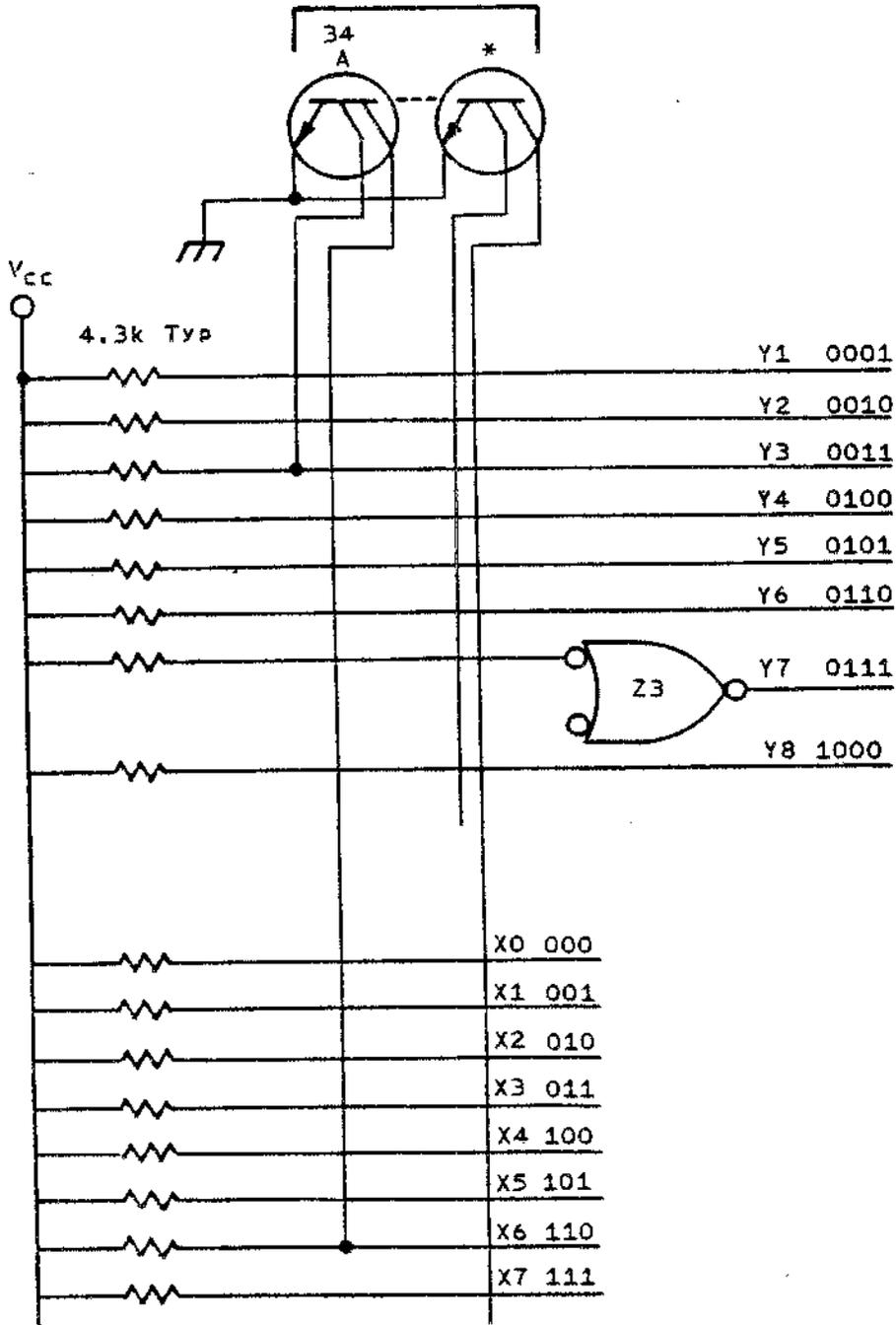


Figure 6-5 Repeat Keys

ALPHANUMERIC KEY  
(PULSE OUTPUT KEY)



\*CONNECTIONS TO X, Y MATRIX SHOWN FOR KEY A ONLY.

14-106

Figure 6-6 Alphanumeric Keys

6-7

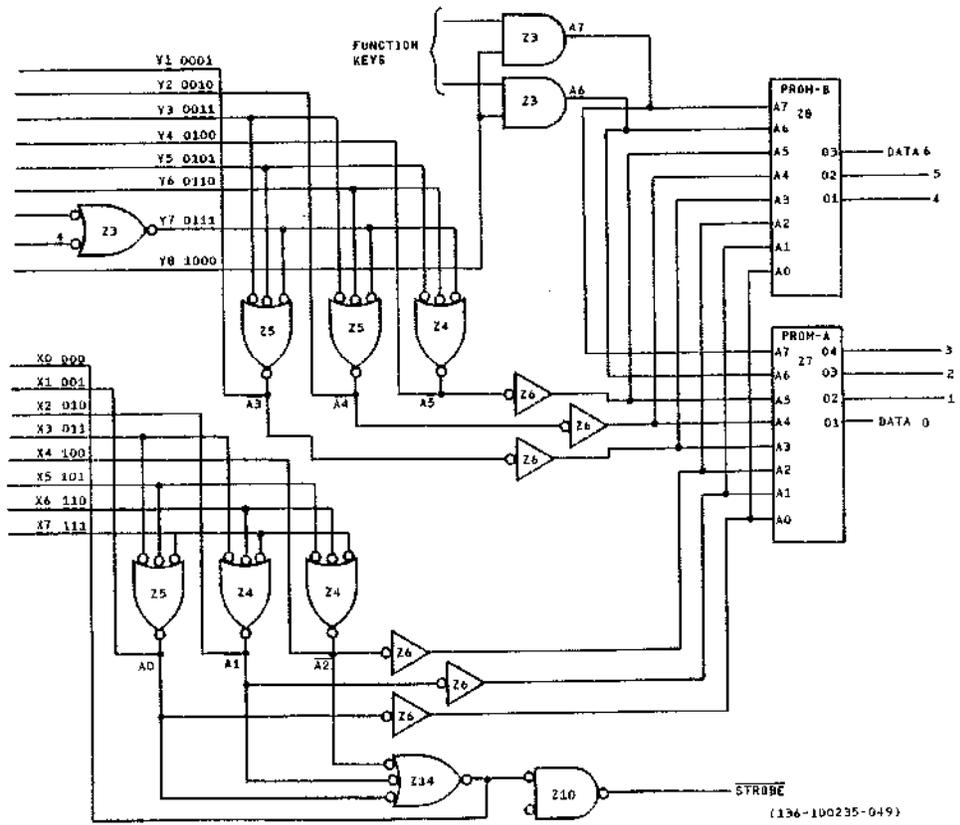
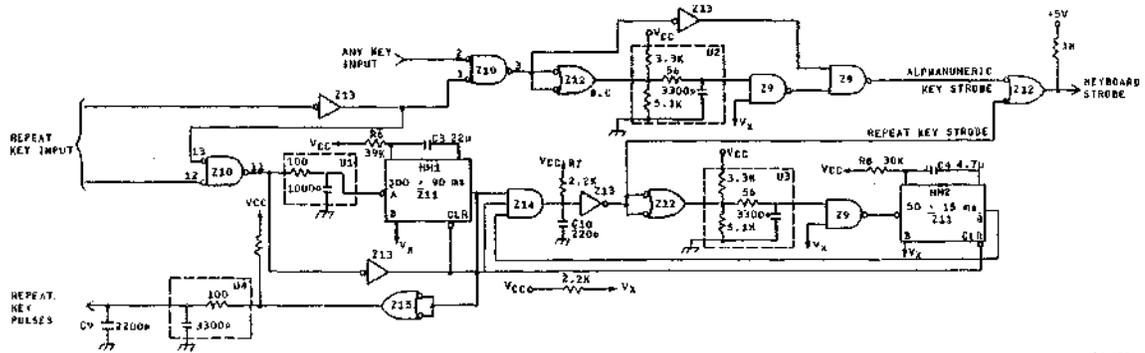


Figure 6-7 X,Y Matrix Decode

14-101

31  
DO



14-100

Figure 6-8 Keyboard Strobe Generator

### 6.2.1 Alphanumeric Key Strobe

When an alphanumeric key is pressed, the key output will be low for 25 to 80 microseconds. The negative-going output of the key enables pin 2 of Z10 in Figure 6-8. This activates strobe circuit U2, and the output of Z12 will be low for 1 to 20 microseconds.

### 6.2.2 Repeat Key Strobe

When a repeat key is pressed, its output is low as long as the key is depressed. The low-going output of the key enables pin 2 of Z10, and a character strobe is generated in the same manner as with the alphanumeric keys. The repeat keys also enable pin 12 of Z10. If the repeat key is held pressed, a second strobe will be generated by U1, and delayed 300 ms  $\pm$ 90 from the first initial character strobe. Character strobes will then be generated every 50 ms  $\pm$ 15 by U3 as long as the key is pressed.

## 6.3 KEYBOARD TIMING

Key output pulses, ASCII codes (PROM outputs) and strobe outputs which are representative of the pressed keys A, B, C.....N and M, are shown in Figures 6-9 through 6-12.

The keyboard is designed to produce a character strobe pulse on the negative-going output of the key switch, and Figure 6-10(a) shows the basic timing using a pulse key switch. Figure 6-10(b) illustrates the N-key rollover timing for the pulse output keys. Time TKI2 will vary with the operator's typing speed. If the time between the key A output and the key B output is less than 22 microseconds, the data for key A may not be valid.

Figure 6-11 shows the timing relationship for repeat keys, and Figure 6-12 shows the relationship between repeat and pulse keys. Note that the data out is indefinite if a pulse key is pressed while a repeat or level key is pressed.

## 6.4 EXPLANATION OF TIMING CHART CODES

- TK: Time period for a key to be kept pressed to insure reliable operation
- TKI1: Time interval between repeated depressions of the same key.
- TKI2: Time interval between the depression of different keys.

TPW1: Output pulse width of pulse output key.

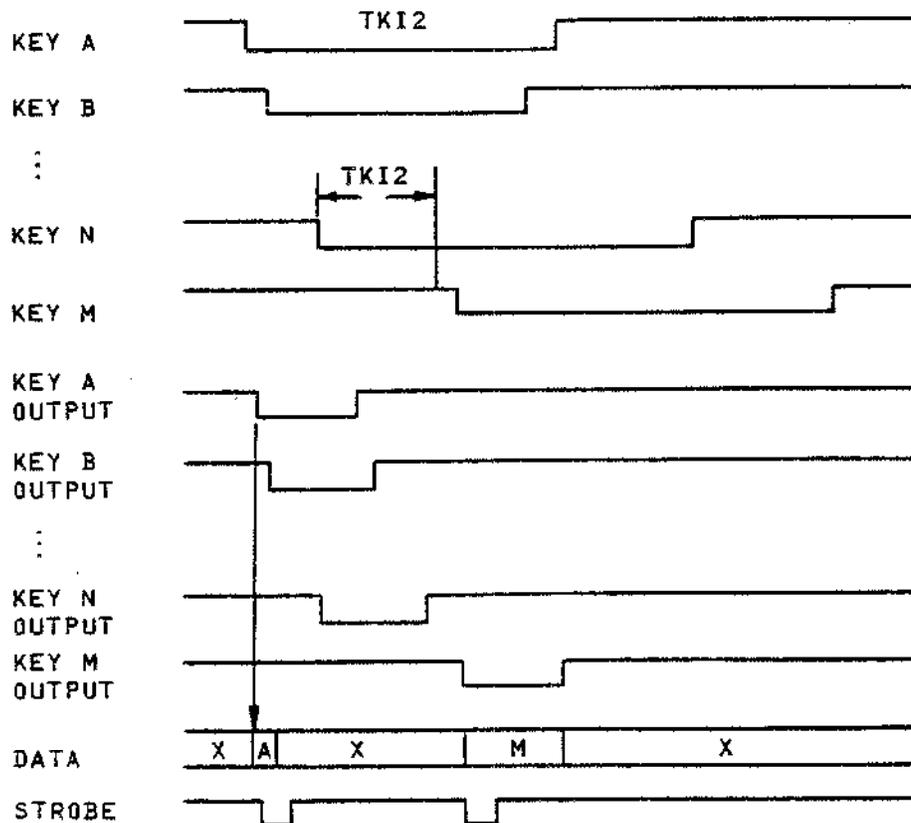
TPW2: Pulse width of character strobe.

Pulse Times

TK: 85 microseconds (min.)  
TKI1: 200 microseconds (min.)  
TPW1: 25 to 80 microseconds  
TPW2: 1 to 20 microseconds

(a) Depression of N-key when TKI2 is shorter than the specified time. When TKI2 is shorter than the specified length, the depressions of key B through key N succeeding the depression of key A are not effective.

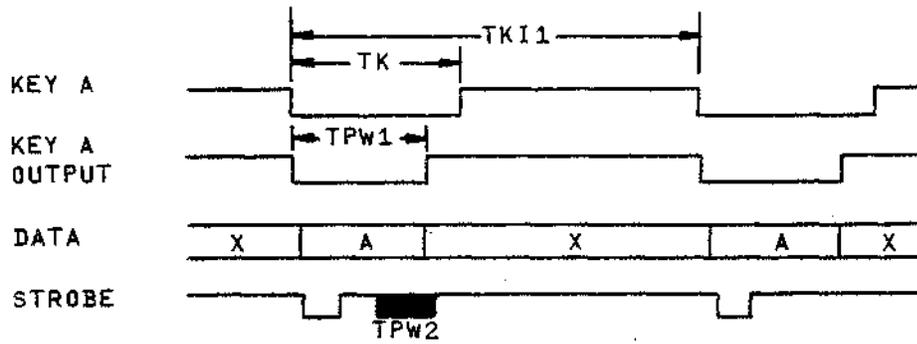
When the time between key output A and key output B is below 22 microseconds, the data of A cannot be guaranteed.



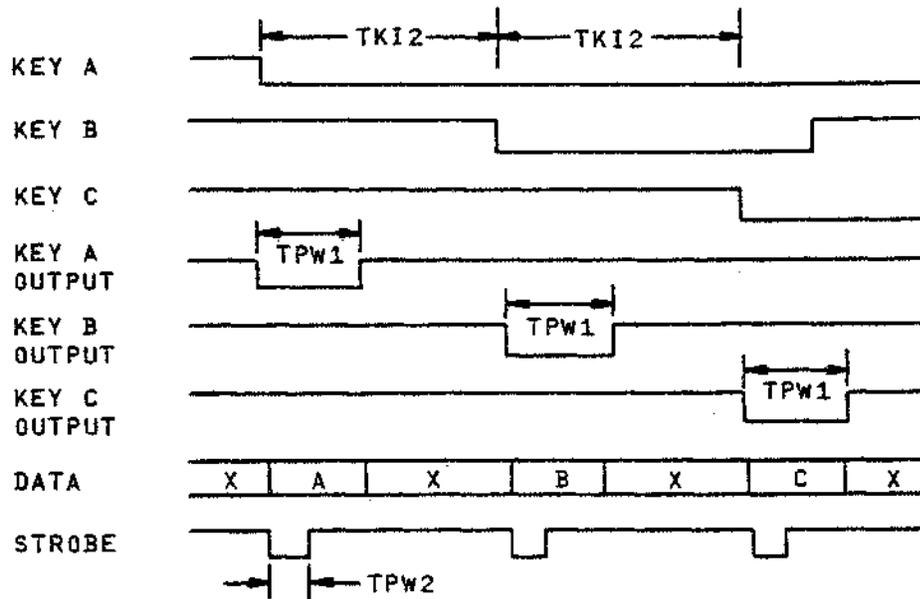
14-109

Figure 6-9 N-key Rollover Timing (1)

(a) Depression of one key



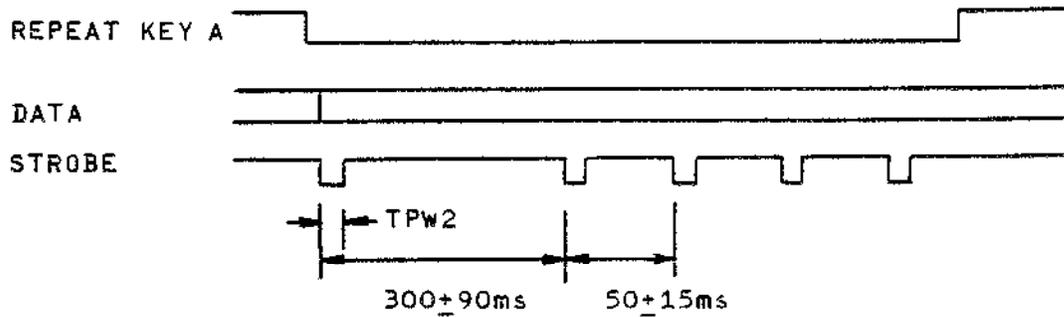
(b) Depression of N-key



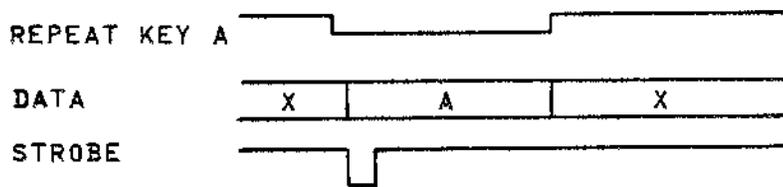
14-110

Figure 6-10 N-key Rollover Timing (2)

(a) Long duration of repeat key depression

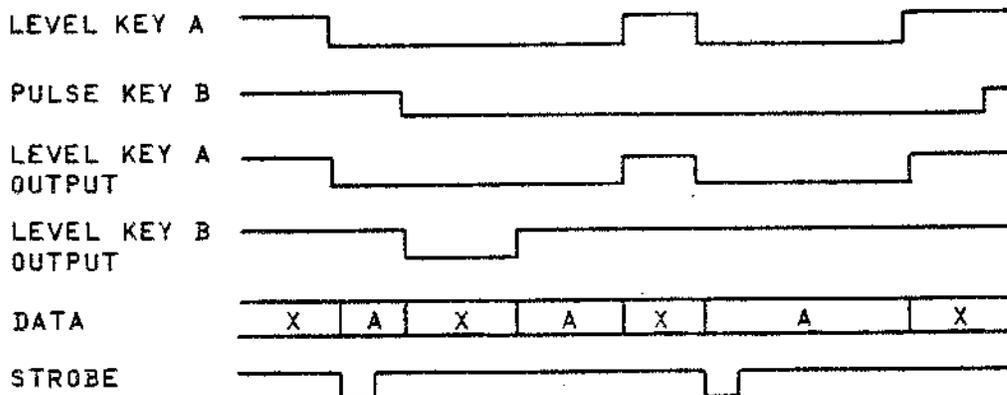


(b) Reset of pressed repeat key



14-111

Figure 6-11 Repeat Key Timing



14-112

Figure 6-12 Repeat Key/Other Key Timing

## CHAPTER 7

### POWER SUPPLY

The SPINWRITER power supply provides the required dc voltages for the printer electronics. The power supply consists of an inverter/control unit with permanently mounted circuit boards, and a separate plug-in regulator PCB. Refer to SPINWRITER electrical schematics 136-100235-001-A and 002 for the following discussion.

#### 7.1 INPUT/OUTPUT VOLTAGE SPECIFICATIONS

The power supply operates from 115 or 230 Vac and supplies the dc outputs listed in Table 7-1. The unit incorporates short-circuit protection on the +5 volt and +17 volt outputs, and over-current protection on the +12 volt outputs.

Table 7-1 Power Supply Input/Output Voltages

INPUT AC LINE VOLTAGE	DC OUTPUTS
115 Vac, +15% 47 to 63 Hz	+5 Vdc @ 2 amp max +12 Vdc @ 0.3 amp max -12 Vdc @ 0.3 amp max
230 Vac, +15% 47 to 63 Hz	+17 Vdc @ 3 amp max -17 Vdc @ 3.5 amp max

#### 7.2 FUNCTIONAL DESCRIPTION

The power supply consists functionally of an ac voltage regulator and a dc voltage regulator. The ac regulator contains switching and control circuits which provide input current to a constant voltage transformer (CVT). The CVT outputs are a stepped-down regulated ac supplied to the G9BMT regulator board. The regulator board rectifies the input ac from the CVT, and supplies the required regulated dc outputs.

##### 7.2.1 AC Voltage Regulator

Refer to Figure 7-1. The primary ac input voltage is applied to a line filter which eliminates high frequency noise from the input line. The filter also prevents any internally generated electrical noise from entering the ac line.

7-2

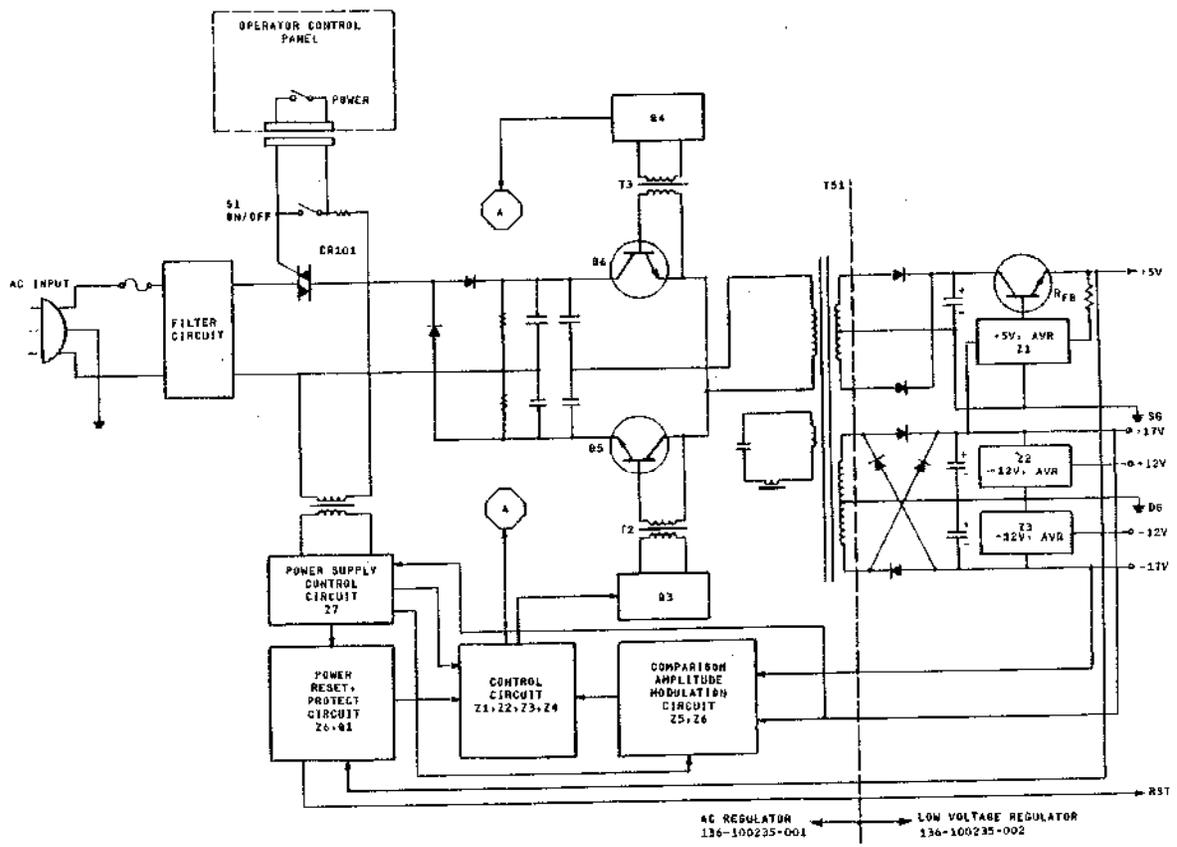


Figure 7-1 Power Supply Simplified Block Diagram

Power on-and-off is controlled by the ON/OFF switch on the power supply. On those printers equipped with an operator control panel, power on-and-off can be controlled by the POWER switch that is wired in parallel with the power supply ON/OFF switch.

The filtered ac input is applied to the CVT input circuit and to the control circuits. When the input line voltage is 115 Vac, it is doubled and rectified to obtain 280 Vdc. When the input line voltage is 230 Vac, it is rectified only to obtain 280 Vdc. This is accomplished by jumpering specific pins during manufacture to bypass the voltage doubler. A 280 Vdc zero volt reference is applied to one end of the CVT primary winding. The opposite end of the CVT primary winding is controlled by power switching transistors Q5 and Q6. The voltage output of the CVT is a function of the direction and amplitude of the current flow in the primary winding. As a result of the switching transistors' operation, the voltage on the CVT primary winding is 280 Vac. The CVT secondary outputs are 6 Vac and 25 Vac.

#### 7.2.2 Control Circuit

The power supply control circuit controls the operation of the power switching transistors, Q5 and Q6. The control circuit monitors the +17 volt outputs from the low voltage regulator and compares them against a reference voltage level. A voltage, representative of the difference detected between the reference level and the +17 volts, causes a modulator circuit to change its frequency of oscillation. This change in modulator frequency alters the switching rate (faster or slower) of the power-switching transistors Q5 and Q6. The input power to the primary of the CVT is controlled and stabilized so that the +17 volt outputs equal the preset voltage reference.

#### 7.2.3. Low Voltage Regulator (G9BMT)

The low voltage regulator circuits are located on the G9BMT plug-in PCB. These circuits supply the regulated dc levels for use in the SPINWRITER. Circuit Z1 in the regulator provides +5 volt from the 6 Vac input from the CVT. The output of Z1 controls an external transistor which improves the current capacity of the regulator circuit. Resistor Rfb provides a feedback loop for output voltage sensing.

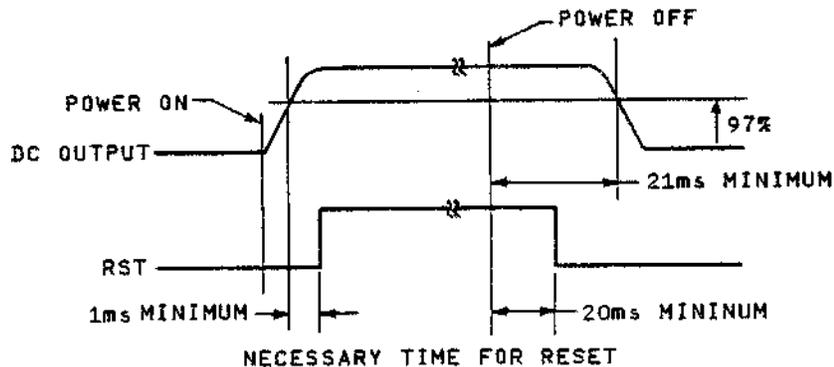
Circuits Z2 and Z3 regulate the +12 volt outputs. These outputs are generated from the 25 Vac input from the CVT.

#### 7.2.4 Protection Circuits

The +5 volt and +17 volt outputs of the low voltage regulator are monitored by the protection circuit of the ac voltage regulator. If either output voltage is short-circuited, the protection circuit will shut off both power-switching transistors, Q5 and Q6. This completely shuts off the low voltage regulator. The +12-volt supplies have over-current protection as a function of their internal regulator circuits.

#### 7.2.5 Power-On Reset/Power Interruption

At initial power-on, the power reset signal, RST, is zero volts. When the dc voltages reach 97% of their rated value, approximately 1 millisecond after power-on, RST will go high allowing the microprocessor clock to start. Figure 7-2 shows the timing relationship for the RST signal.



14-130

Figure 7-2 Power On Reset Timing

If the input ac line voltage is interrupted, +17 volts is supplied from the low voltage regulator to the ac power supply control circuit. This maintains the CVT input oscillation and corresponding output. If the input ac line voltage is not restored after 20 milliseconds, the power reset signal, RST, will go low stopping the microprocessor clock. If power is restored before the 20 milliseconds delay, RST will not be generated.

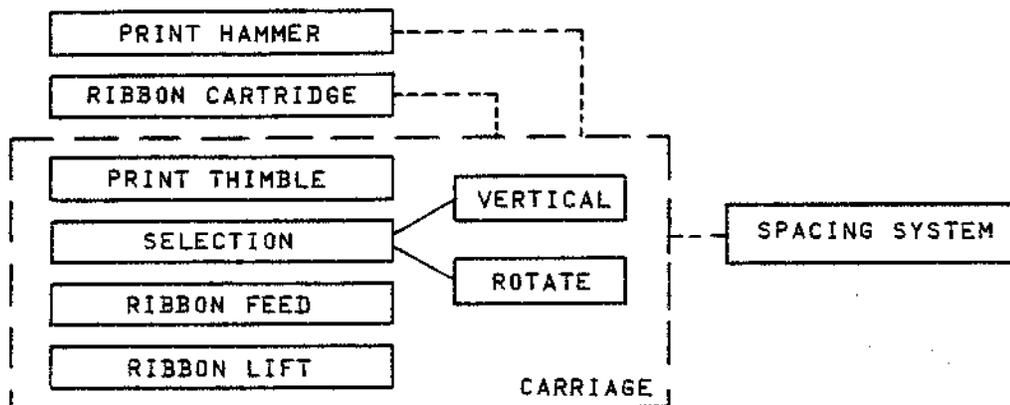
## CHAPTER 8

### MECHANICAL UNITS

This section describes the function and construction of the SPINWRITER carriage mechanism, spacing mechanism, and paper feed mechanism.

#### 8.1 CARRIAGE MECHANISM

The carriage mechanism comprises the functional components shown in Figure 8-1. The integration of these components into a single assembly allows a quick return to on-line status in the event of a carriage mechanism malfunction since the entire assembly can be replaced. The carriage travels the width of the printer chassis in both directions, under control of commands from the spacing mechanism. The print thimble is under control of the selection component. Print thimble rotation is bidirectional to the selected character and is shifted vertically to select which of two characters on a given print thimble finger will be printed. When the proper character is aligned for printing, the print hammer is energized and strikes the print thimble finger driving the finger against the ribbon and paper. Ribbon feed and ribbon lift are controlled by individual components. Ribbon feed moves the ribbon prior to printing a character. Ribbon lift causes the ribbon cartridge to be moved to the position of the desired color.



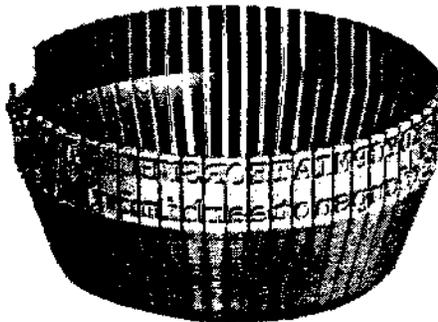
14-114

Figure 8-1 Carriage Mechanism Functional Diagram

### 8.1.1 Print Thimble

The SPINWRITER is equipped with a print thimble which is illustrated in Figure 8-2. For character selection, the print thimble is rotated bi-directionally and/or is moved vertically to the selected character. To print the character, the print hammer is actuated to impinge the print thimble character against the ribbon and onto the paper wrapped around the platen.

The print thimble has 64 fingers. Two characters are arranged vertically on each finger, allowing for a total of 128 characters on a print thimble if required. Five of the fingers located at or near the home position are shortened, thus lacking the top character space or part of the bottom character space. This provides visibility of the last characters printed. A square sequence hole at the bottom of the print thimble accepts the pivot insert from the slide sleeve on which the print thimble is mounted. The rotate motor drives the slide sleeve assembly which in turn rotates the print thimble to the desired character. The sequence hole also aids in determining the correct relative position of the print thimble with respect to the rotate motor.

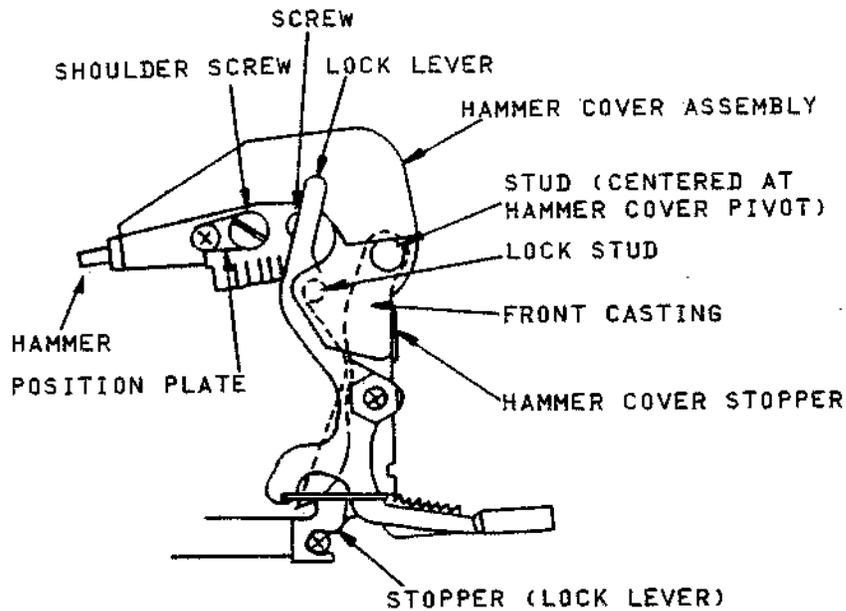


14-115

Figure 8-2 Print Thimble

### 8.1.2 Print Hammer

The plunger-type print hammer is mounted in a housing and is equipped with a magnet. When energized by the action of a solenoid driver, the hammer is driven in free flight and strikes the selected print thimble character. The recoil force and the magnet together reset the hammer to its original position. The print hammer is installed so that its action strikes the inside wall of the print thimble. However, the arrangement allows for easy replacement of the print thimble when required. The hammer assembly is secured to the hammer cover assembly, as shown in Figure 8-3. Manipulation of the lock lever allows the hammer cover assembly to be pivoted away from the print position. This allows access to the print thimble

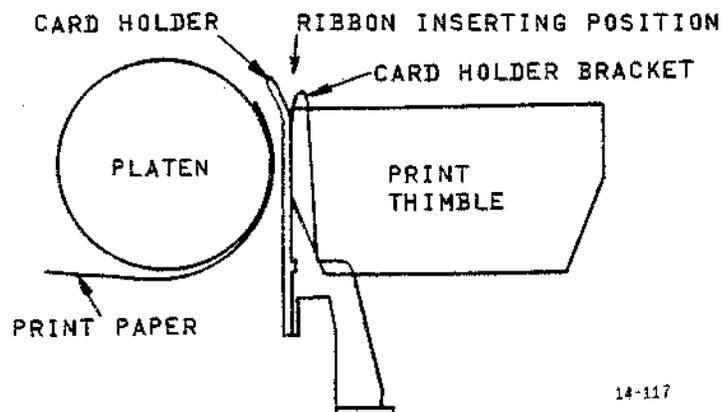


14-116

Figure 8-3 Print Hammer Assembly

for replacement. The shoulder screw and the Phillips screw on the hammer fix the print hammer to the hammer cover, and are used to adjust the print hammer angle. The position plate provides for simple adjustment.

A card holder is used as an auxiliary device to keep the paper and ribbon correctly positioned during hammer operation. This is illustrated in Figure 8-4. The card holder is mounted at the front part of the carriage and holds the paper securely against the platen. The card holder bracket has two arms that allow the ribbon to pass through while maintaining clearance between the ribbon and print thimble. In addition, the card holder is an aid to indicate the present printing position. It also guides the paper during the paper load operation.

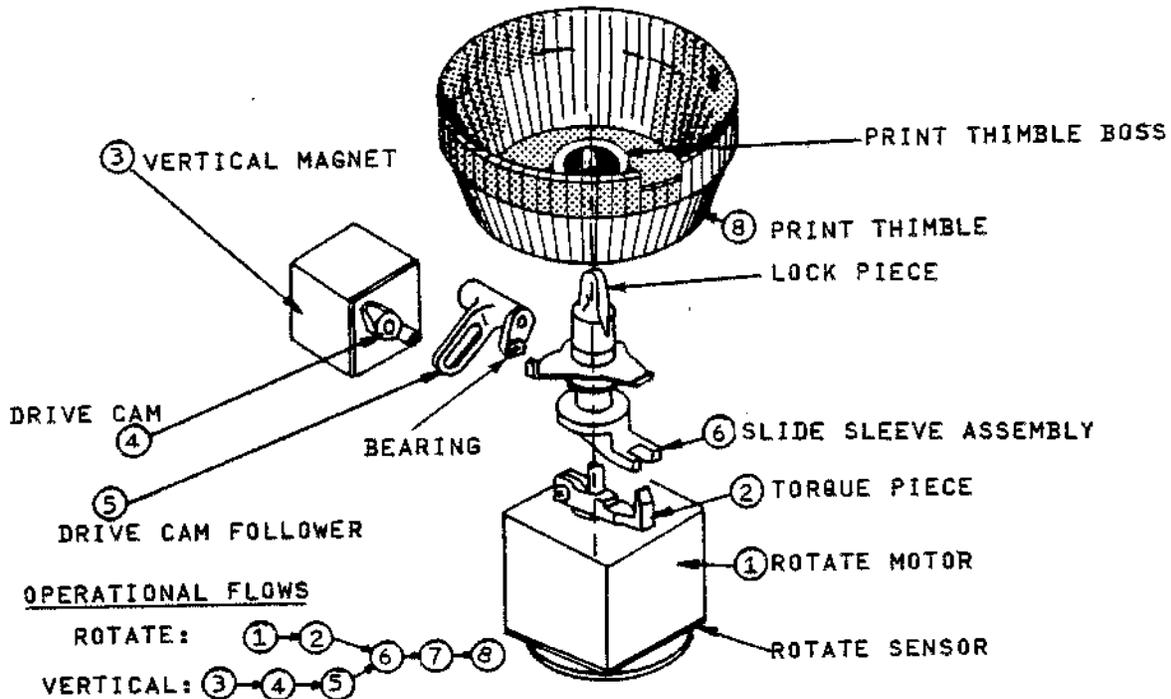


14-117

Figure 8-4 Card Holder Mounting

### 8.1.3 Character Selection

To accomplish character selection, mechanical movement is performed in both rotational and vertical directions. To accomplish this function, a servomotor and a magnet are used in the carriage assembly. Figure 8-5 illustrates the character selection assembly.



14-118

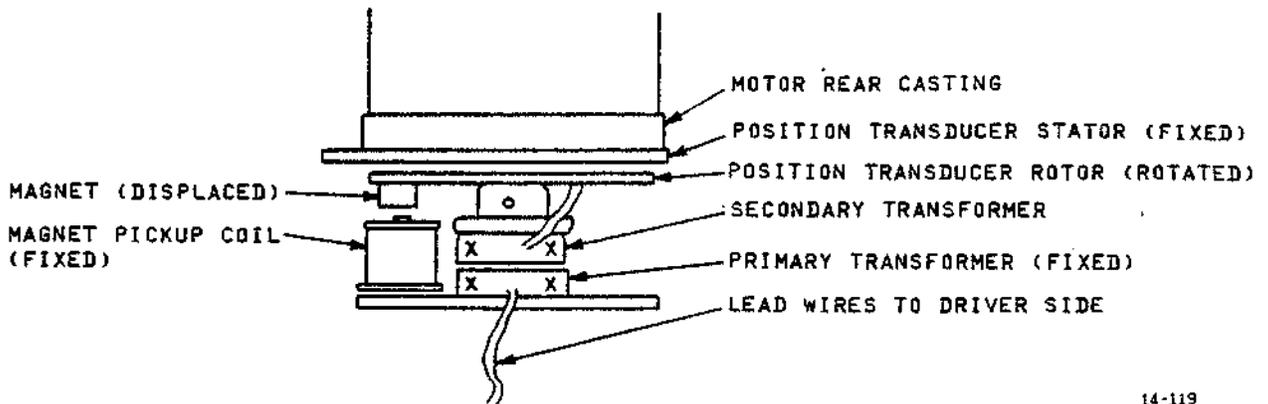
Figure 8-5 Character Selection Assembly

#### 8.1.3.1 Print Thimble Mounting

The print thimble is installed onto the slide sleeve assembly and secured with the lock piece as shown in Figure 8-5. The lock piece is made of an elastic material and has an elongated hole. A pin is installed through the hole and prevents the lock piece from being pulled out. With the print thimble installed, the lock piece lies horizontally across the cut portion of the slide sleeve and presses against the print thimble boss, thus securing the thimble in place. When the print thimble is to be removed, the lock piece is pulled up and raised to the vertical position. The slide sleeve assembly has three arms spaced 120 degrees apart. The bottom of the print thimble rests against these arms. As described previously, one of the arms has a pivot which fits into the square hole on the bottom of the print thimble. This is the means by which the rotate motor imparts torque through the slide sleeve assembly to rotate the print thimble.

### 8.1.3.2 Rotate Selection

The rotate motor selects one of the 64 positions located on a circle at even intervals. The motor rotation is directly transmitted to the slide sleeve through the torque piece mounted on the motor shaft. With the set screw loosened, the torque piece and motor shaft are disengaged. This allows the motor position to be set to correspond with the print thimble character position. The angle of motor rotation is detected by a position transducer mounted on a shaft at the bottom of the rotate motor. The transducer, shown in Figure 8-6, consists of a rotor and a fixed stator. Position information from the transducer is transformer coupled to the servo board. Home position is detected by a magnetic pick-up coil located under the position transducer rotor. The home position signal results when a magnet mounted on the rotor board passes over the pick-up coil.



14-119

Figure 8-6 Rotate Position Transducer

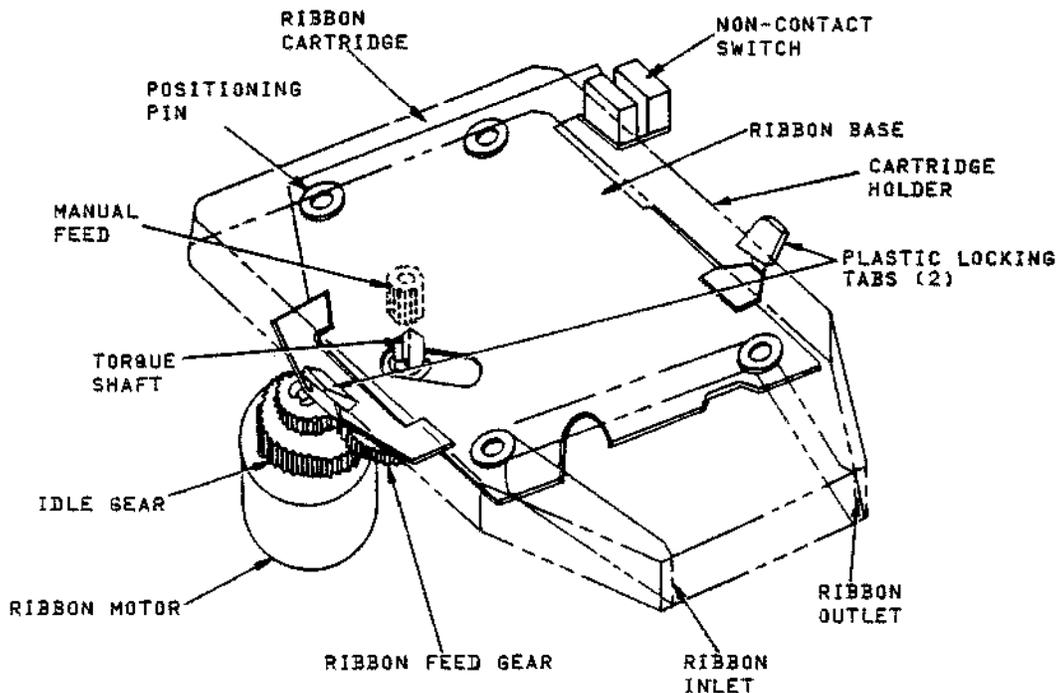
### 8.1.3.3 Vertical Selection

Refer to Figure 8-5. A rotary-type vertical magnet selects one of two print thimble positions, (up or down) and latches the thimble into position. A drive cam (4) is secured onto the vertical magnet shaft which rotates freely. A bearing at the end of the drive cam fits inside an elongated hole in the drive cam follower (5). The drive cam follower is supported by a stud and rotates freely around this stud. This provides a stud-centered rotation which is restricted by the drive cam movement. A bearing installed at the end of the drive cam follower engages a fitting on the slide sleeve (6). The slide sleeve is inserted into the rotate motor shaft and moves upward or downward dependent upon the cam follower displacement. Since the slide sleeve and print thimble are fixed, the print thimble will be moved up or down according to the vertical magnet rotation.

#### 8.1.4 Ribbon Cartridge/Ribbon Feed

The ribbon cartridge houses 16 meters of endless fabric ribbon (red/black or black). Two rubber rollers in the cartridge wind the ribbon into the cartridge and move it out of the ribbon outlet as shown in Figure 8-7. One of these rubber rollers has a knob outside the cartridge housing to enable manual ribbon feed. When using a multi-strike ribbon, the ribbon is passed through a non-contact switch groove so that the ribbon end can be detected. When this occurs, the printer stops printing characters. Two pins on the bottom of the ribbon cartridge fit into two positioning holes in the ribbon base. The cartridge is held in place by two plastic locking tabs, one on each side of the cartridge base.

The ribbon feed mechanism transfers ribbon motor rotation to the cartridge rubber rollers. An idle gear on the ribbon motor assembly engages the ribbon feed gear. This movement is transferred to the ribbon cartridge torque shaft which engages the rubber rollers for ribbon feed.



14-120

Figure 8-7 Ribbon Cartridge

### 8.1.5 Ribbon Change Mechanism

The ribbon change mechanism, Figure 8-8, positions the ribbon cartridge base to red, black, or character-visible positions. The base is shifted to any one of these positions dependent on the print color selected and visibility setting. The ribbon cartridge is loaded onto the base with the red ribbon half up, the black ribbon half down. The base is usually held in the up or black position by spring tension. When the red position is selected, a solenoid on the base assembly is energized pulling the base down to allow printing in red.

For character visibility position, the ribbon mode slider, located at the front end of the ribbon base (accessible when the ribbon cartridge is removed), is moved to the black position. This keeps the ribbon base in the down position and prevents the ribbon from covering the last character printed. This position does not allow the printing of red and black characters. Characters will print all black or all red, depending on the type of ribbon used.

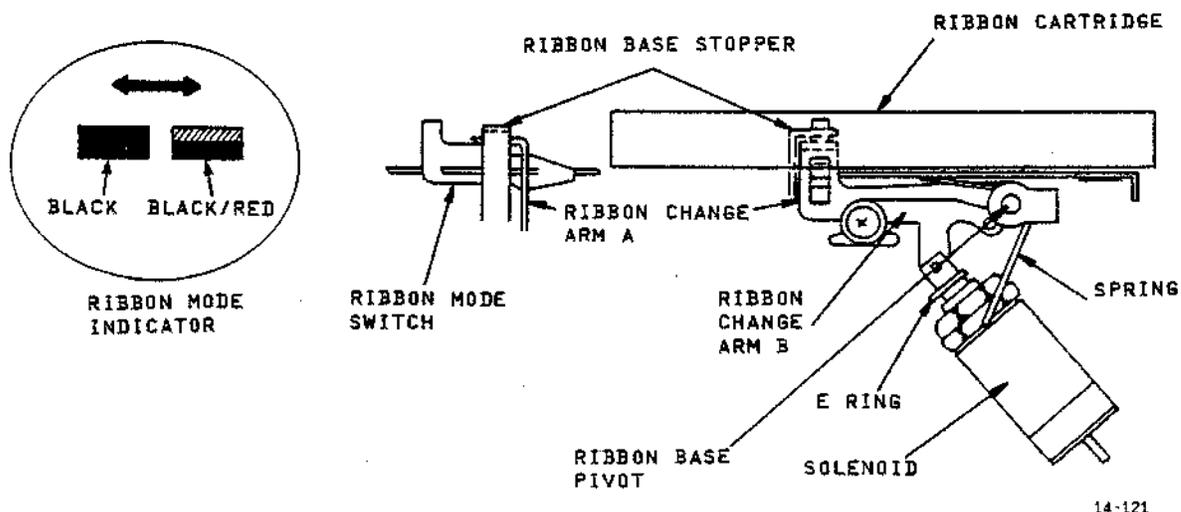


Figure 8-8 Ribbon Change Mechanism

### 8.1.6 Guide System

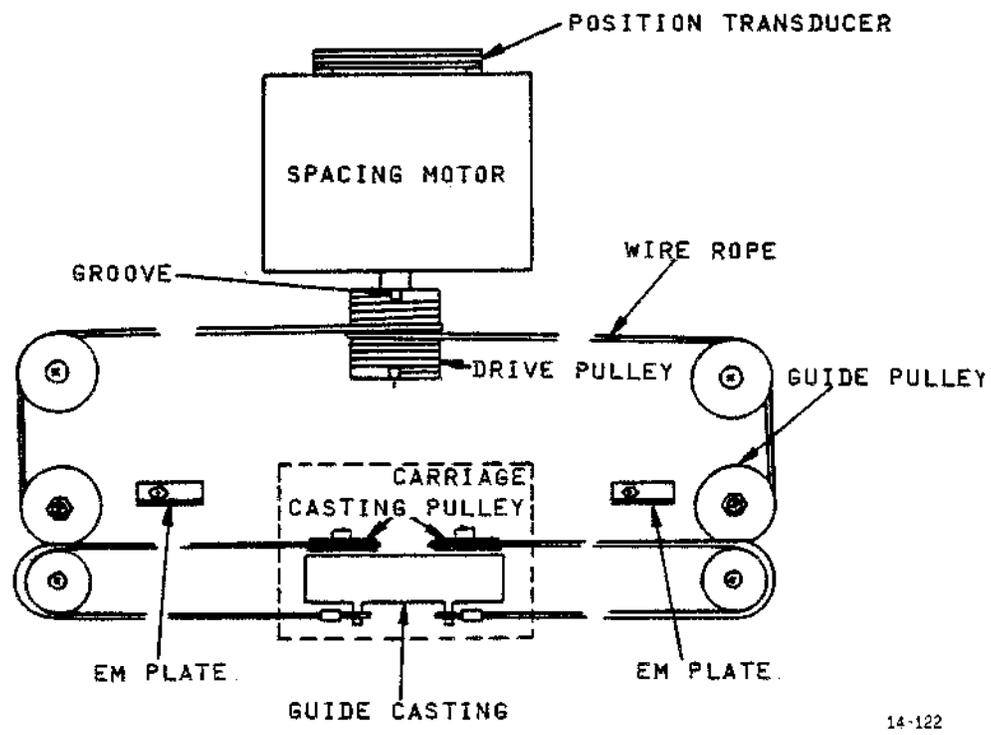
The guide system guides the horizontal movement of the carriage mechanism within the printer chassis. The system consists of a guide casting assembly with six rollers and two guide rails, front and rear. In addition, two hooks and two grooved pulleys are attached to the guide casting assembly to accommodate the wire rope. Four of the rollers are arranged on top of the front rails in two pairs with each pair arranged at a 45-degree

angle to the left and right of the carriage assembly. The remaining two rollers are mounted beneath the angled pairs, and traverse the bottom side of the front rail. The bottom rollers are under spring tension.

Two rollers are mounted on the rotate motor assembly. These rollers traverse the rear guide rail - one on top and the other on bottom. The bottom roller is under spring tension. The carriage assembly is secured to the guide casting with three screws, thus allowing easy removal of the carriage assembly, leaving the wire drive ropes and guide casting assembly intact.

8.2 SPACING MECHANISM

The spacing mechanism controls the horizontal movement of the carriage. This unit, shown in Figure 8-9, consists of the spacing motor, wire rope system, and guide pulleys. The initial carriage position, and left and right carriage travel limits are controlled by the EM plates shown in Figure 8-9.

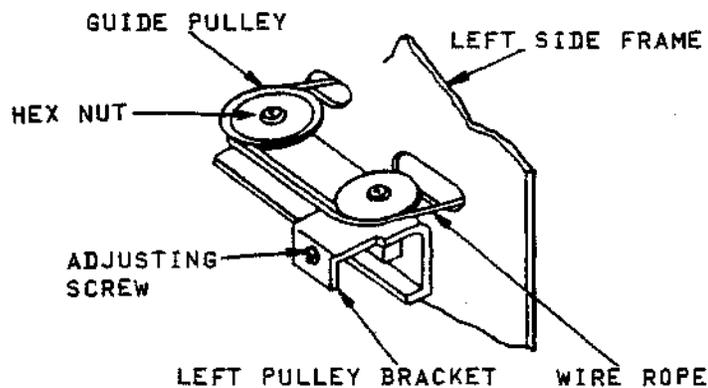


14-122

Figure 8-9 Spacing Mechanism

### 8.2.1 Wire Rope System

The carriage is moved column-by-column or a specified number of columns on command of the spacing motor. Column movement is transmitted to the carriage assembly through the wire rope system. There are two wire ropes, and each rope is routed as follows. One end is hooked into a groove on the spacing motor drive pulley. The wire is wrapped around the pulley, and passed through two guide pulleys to a casting pulley. From the casting pulley the rope is passed through a third guide pulley, and the end is secured to the guide casting assembly. The wire ropes are adjusted to the proper tension by an adjusting screw located on the left pulley bracket on the left side of the printer. This is illustrated in Figure 8-10.



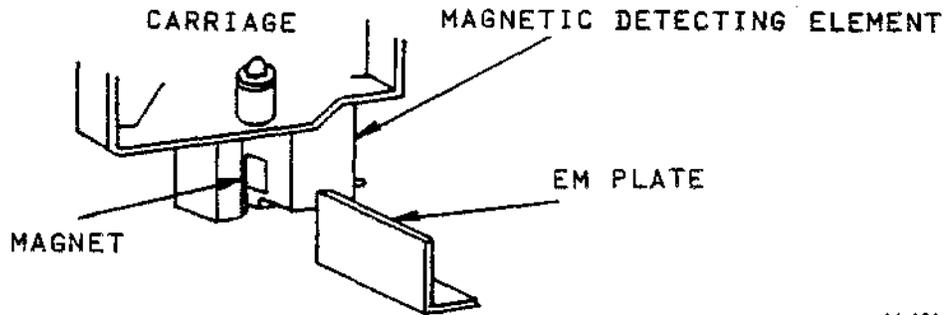
14-123

Figure 8-10 Wire Rope Adjustment

### 8.2.2 Emergency (EM) and Initialize Functions

The emergency (EM) function causes the spacing motor to stop when the carriage exceeds the printing area. This prevents the carriage from hitting the frame and possibly being damaged. There are two EM plates mounted on the left and right sides of the bottom of the frame under the carriage. A magnetic detection element is mounted under the carriage assembly. When the left or right EM plate passes through the magnetic element (Figure 8-11), the detected output is sent to the micro-processor which issues a DVLOCK command to shut off the drive current to the spacing motor.

The initialize function determines the first printing position. The left EM plate passing through the magnetic detection element detects the carriage position when the printer is turned on. This causes the carriage to move to the first printing position as specified by the control unit. Once the first printing position is set, it will not change unless it is reset or the printer is powered OFF.



14-124

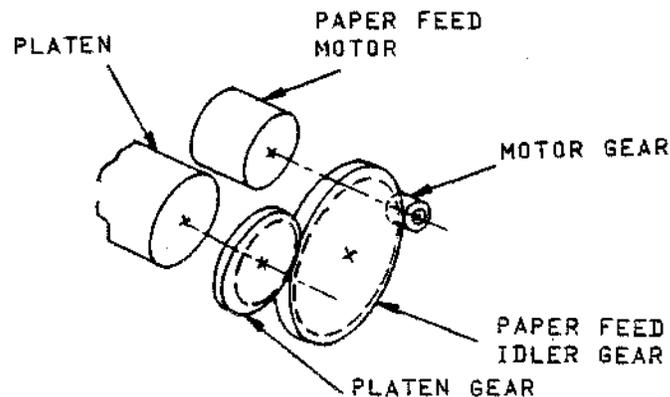
Figure 8-11 Spacing Magnetic Detection Element

### 8.2.3 Spacing Motor Position

The rotation angle of the spacing motor is detected by a position transducer assembly mounted on the spacing motor shaft. This transducer assembly is similar to that mounted on the rotate motor (see Figure 8-6).

### 8.3 PAPER FEED MECHANISM

The paper feed mechanism advances the print paper to the desired line position. The mechanism is driven by the paper feed motor. The motor gear drives the paper feed idler gear which in turn drives the platen gear as shown in Figure 8-12. The reduction ratio of the paper feed motor gear to the platen gear is such that an eight pulse drive to the motor causes a paper feed of 1/6-inch at the platen. Therefore, paper feed amounts equal to 1/48-inch multiplied by any integer can be obtained.

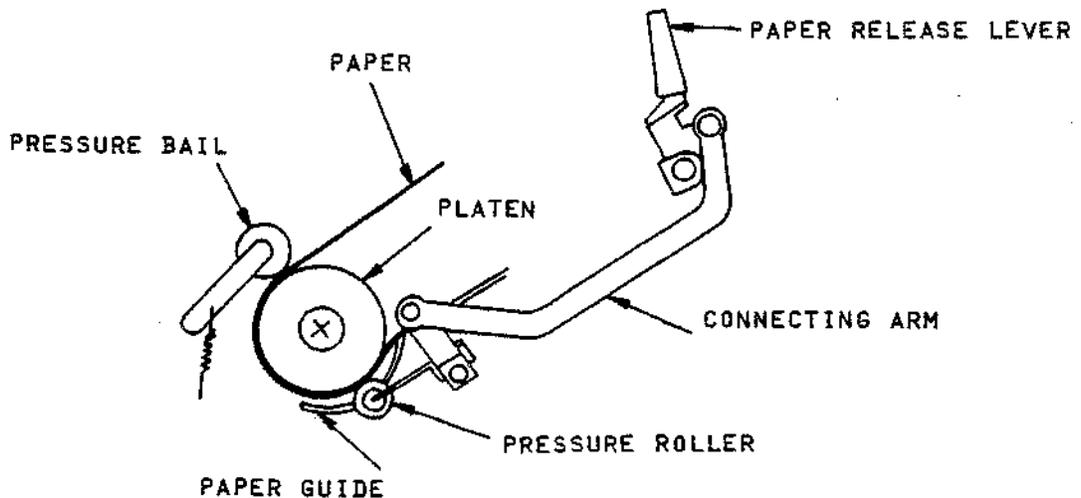


14-125

Figure 8-12 Paper Feed Mechanism

### 8.3.1 Pressure Roller Assembly

The paper is held against the platen by the pressure roller assembly (Figure 8-13). When the paper release lever is pushed backward, the pressure roller assembly is pressed against the platen by spring force. When the platen rotates, the paper is advanced through the pressure rollers and around the platen. The pressure bail holds the paper against the platen just above the printing area as the paper is advanced.



14-126

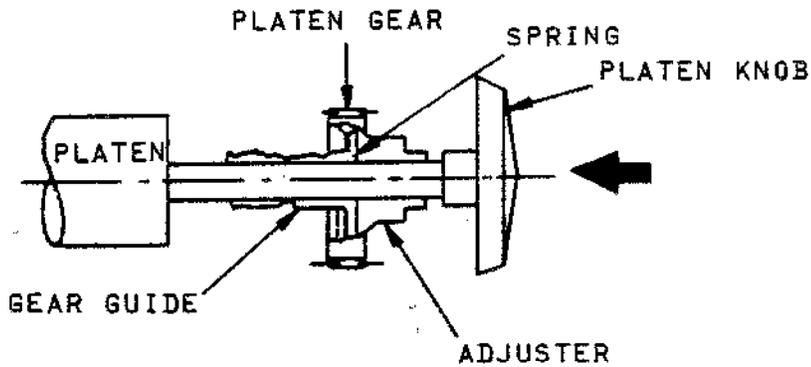
Figure 8-13 Pressure Roller Assembly

### 8.3.2 Manual Feed

The platen gear engages the adjuster as shown in Figure 8-14. Both the gear and the adjuster have fine teeth which mesh and are held by spring pressure. If the platen knob is depressed in the direction of the arrow in Figure 8-13, the teeth on the platen gear and adjuster are disengaged. This allows manual rotation for fine positioning of the platen, regardless of the stepping motor rotational position.

### 8.3.3 Tractor Feed

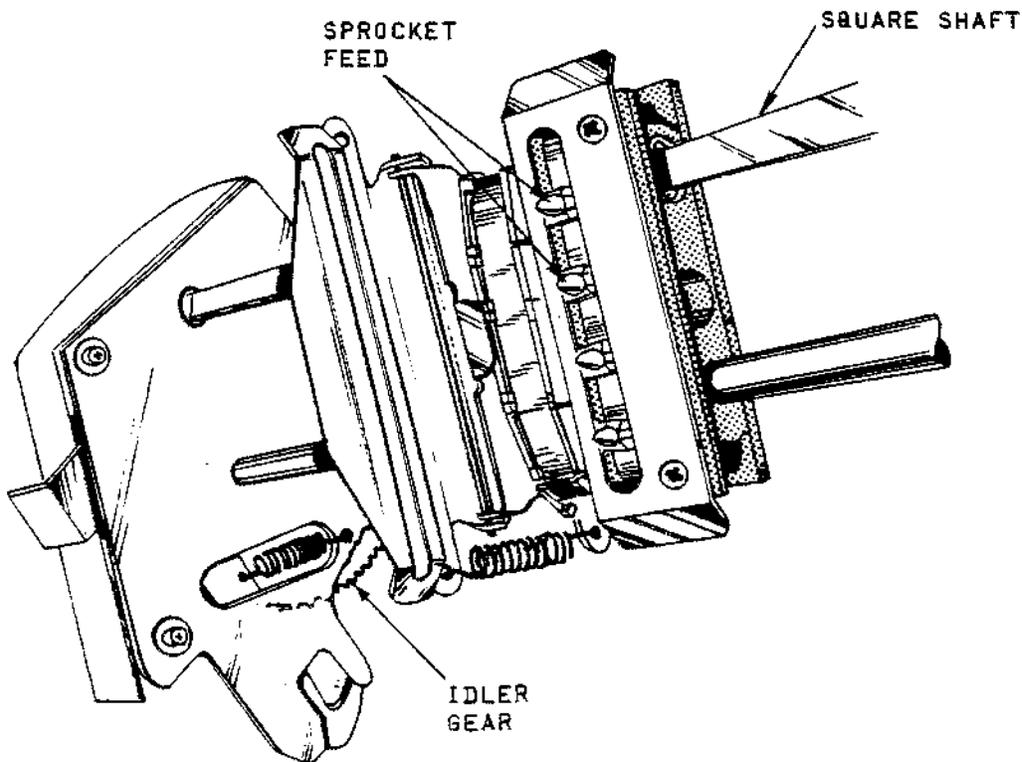
Tractor feed, an optional paper feed assembly used with a friction plate, is equipped with adjustable sprocket drives to feed paper with sprocket holes at the edge. This assembly allows variable width, multi-part forms to be advanced precisely,



14-127

Figure 8-14 Manual Feed Mechanism

without slippage or misalignment. A drive gear on the left side of the friction platen meshes with an idler gear on the tractor assembly. The drive supplied to the tractor simultaneously causes the tractor to feed as much paper as the platen would. The tractor idler gear causes a square shaft to rotate and this in turn, rotates the drive pulley on the two tractors. The drive pulley engages a rubber belt (as shown in Figure 8-15) which causes the drive pins to rotate the sprocket feed pins.



14-128

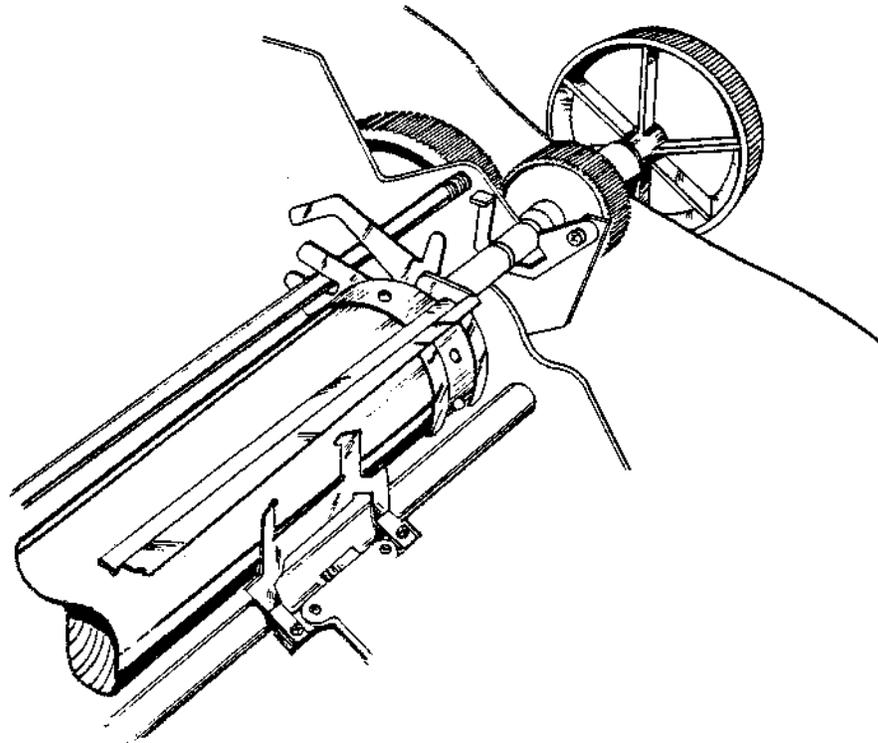
Figure 8-15 Tractor Feed Assembly

NOTE

Paper release lever should be pulled forward to disengage pressure rollers when using tractor feed assembly.

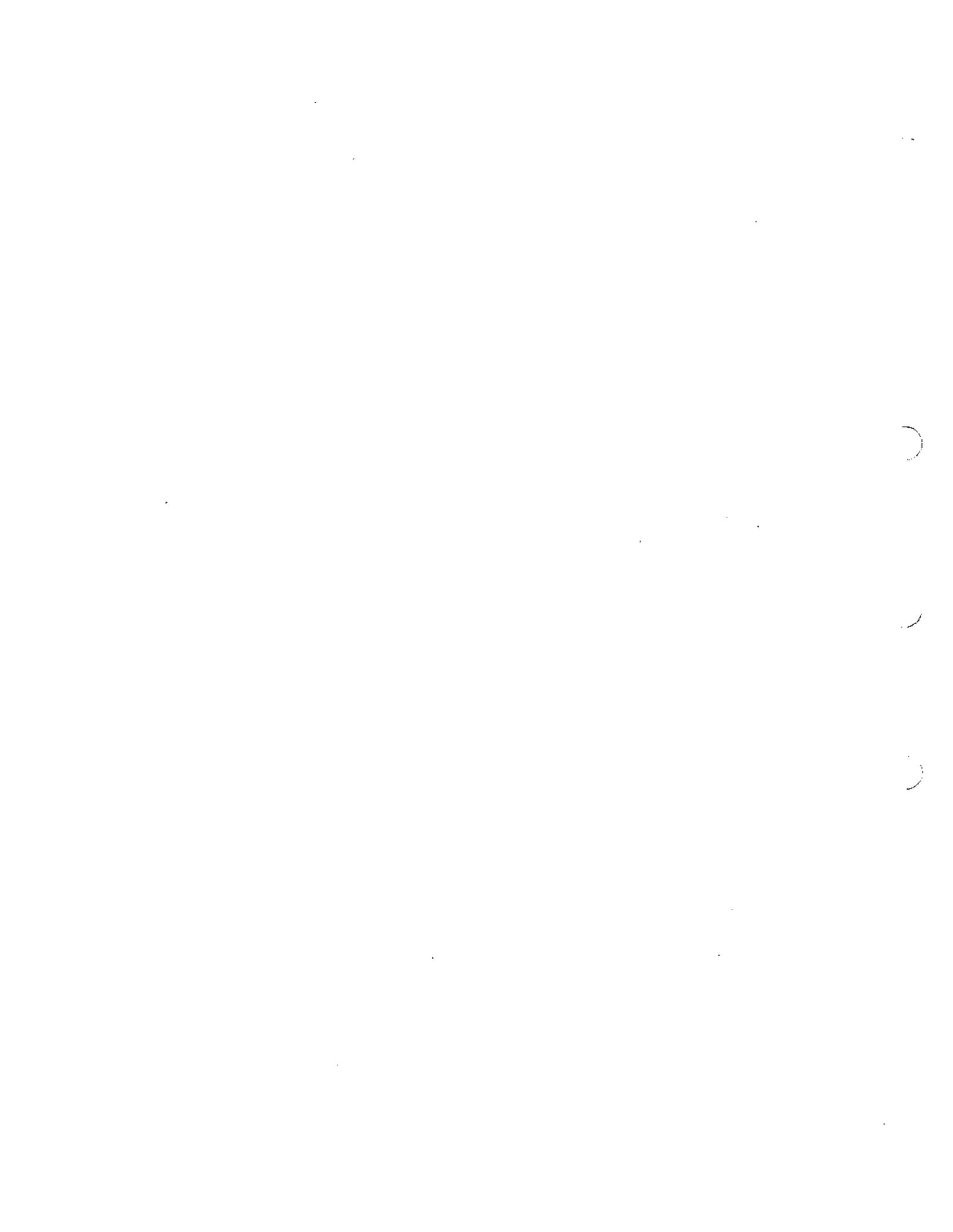
8.3.4 Pin Feed Platen

Pin feed (Figure 8-16) is another optional paper feed assembly equipped with fixed position sprocket pins to feed paper with sprocket holes at the edge. It is available for various paper widths up to 16 inches wide. Sprocket pin assemblies on the left and right side of the platen engage the holes in the paper. The sprocket pins pass over an eccentric cam and pop out at the correct point as the platen rotates. The platen is equipped with a paper cutter which facilitates cutting the paper when desired.



14-129

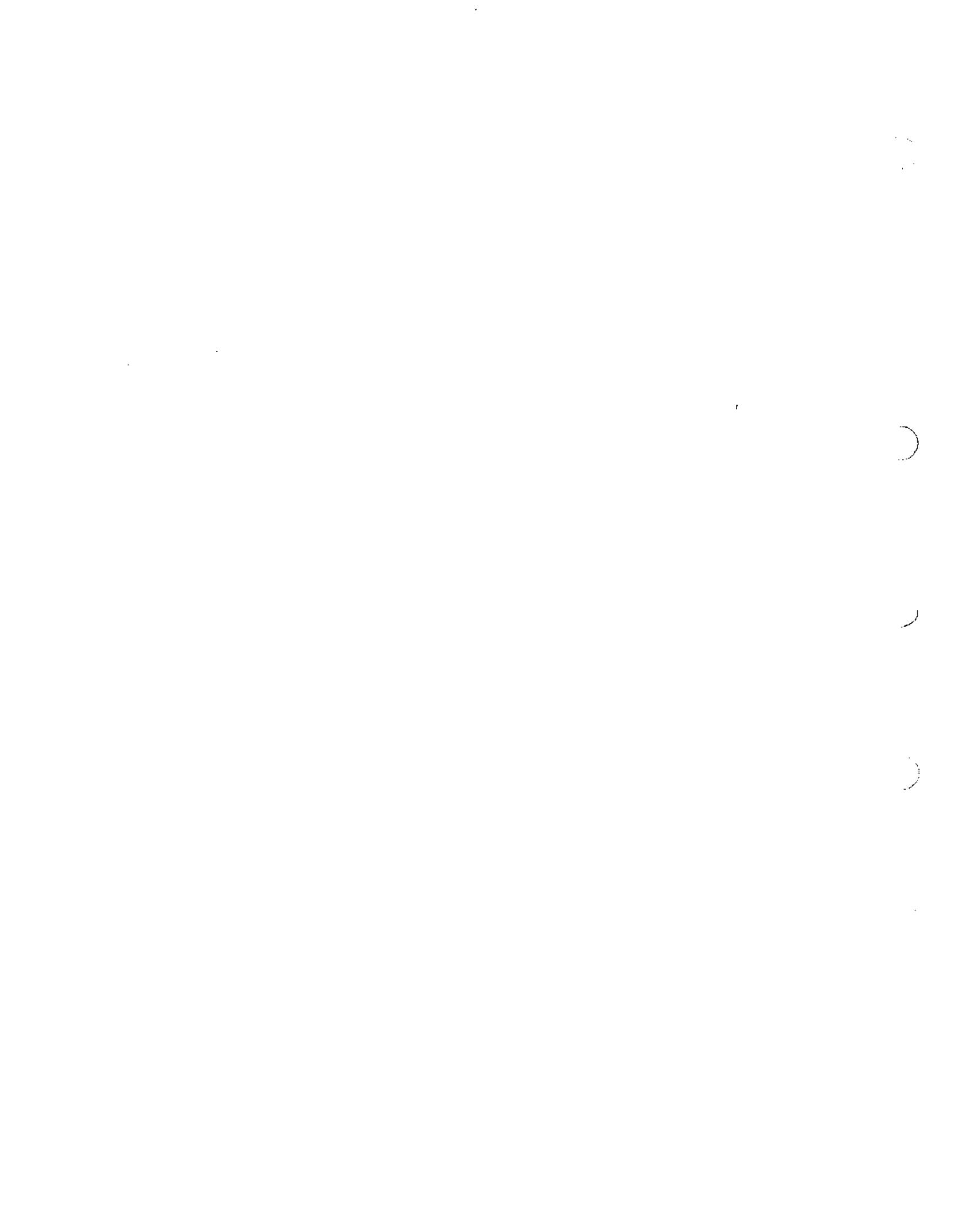
Figure 8-16 Pin Feed Platen Assembly



## APPENDIX A ASCII CODE TABLE

MSB		0		1		2		3		4		5		6		7	
LSB	0000	000	001	010	011	100	101	110	111								
0	0000	NULL	DL* ESCAPE	SP	0	@	P	`	p								
1	0001	START HDG	DC† 1	!	1	A	Q	a	q								
2	0010	START TEXT	DC† 2	"	2	B	R	b	r								
3	0011	END TEXT	DC† 3	#	3	C	S	c	s								
4	0100	END TRANS	DC† 4 (STOP)	\$	4	D	T	d	t								
5	0101	ENQUIRY	NEG ACK	%	5	E	U	e	u								
6	0110	ACK	SYNC IDLE	&	6	F	V	f	v								
7	0111	BELL	END TRANS BLK	'	7	G	W	g	w								
8	1000	BACKSPACE	CANCEL	(	8	H	X	h	x								
9	1001	HORIZ TAB	END MEDIUM	)	9	I	Y	i	y								
A	1010	LINE FEED	SUBSTITUTE	*	:	J	Z	j	z								
B	1011	VERT TAB	ESCAPE	+	;	K	[	k	{								
C	1100	FORM FEED	FILE SEP	,	<	L	\	l									
D	1101	RETURN	GROUP SEP	-	=	M	]	m	}								
E	1110	SHIFT OUT	RECORD SEP	.	>	N	^	n	~								
F	1111	SHIFT IN	UNIT SEP	/	?	O	_	o	DELETE								

\*DATA LINK, † DEVICE CONTROL



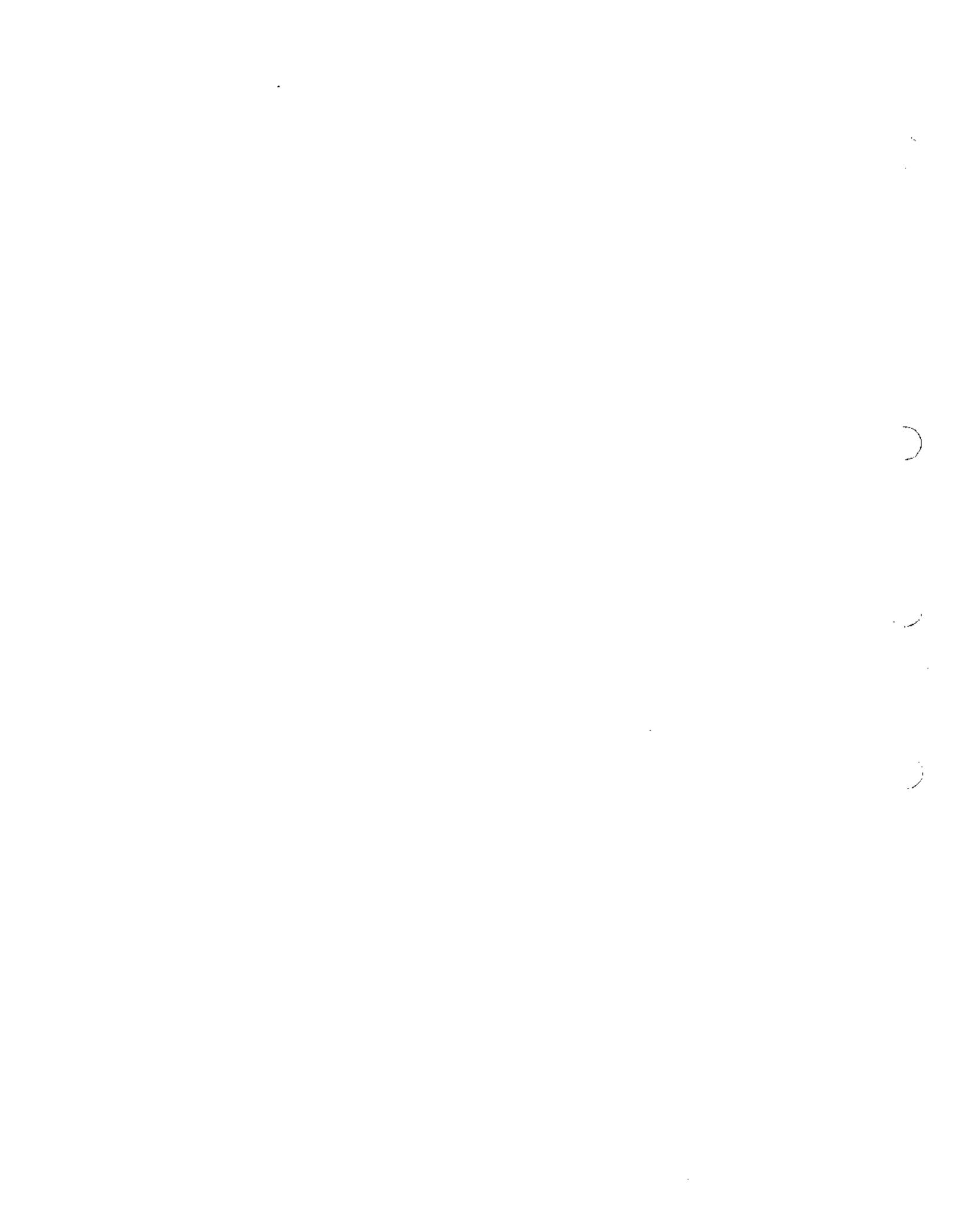
## APPENDIX B

### ABSOLUTE ADDRESS CODE

ROW	COLUMN				0	1	2	3	4	5	6	7
	Absolute Address				b7	b6	b5					
					b4	b3	b2	b1				
0	0	0	0	0		H	X	]	'	m	g	
1	0	0	0	1		N	?	[	^	i	x	
2	0	0	1	0		S	*	)	^	h	&	
3	0	0	1	1		R	#	(	~	r	;	
4	0	1	0	0	-	O	"	/		a	:	
5	0	1	0	1	.	E	!	%		e		
6	0	1	1	0	,	T	¢	7		t		
7	0	1	1	1	Q	A	]	6		o		
8	1	0	0	0	Z	I	\	3	q	n		
9	1	0	0	1	V	M		1	z	s		
A	1	0	1	0	B	P	\$	φ	Y	P		
B	1	0	1	1	G	C	@	2	j	u		-
C	1	1	0	0	J	Y	>	5	w	c		
D	1	1	0	1	W	D	<	4	l	d		=
E	1	1	1	0	L	K	}	9	v	k		
F	1	1	1	1	U	F	{	8	f	b		+

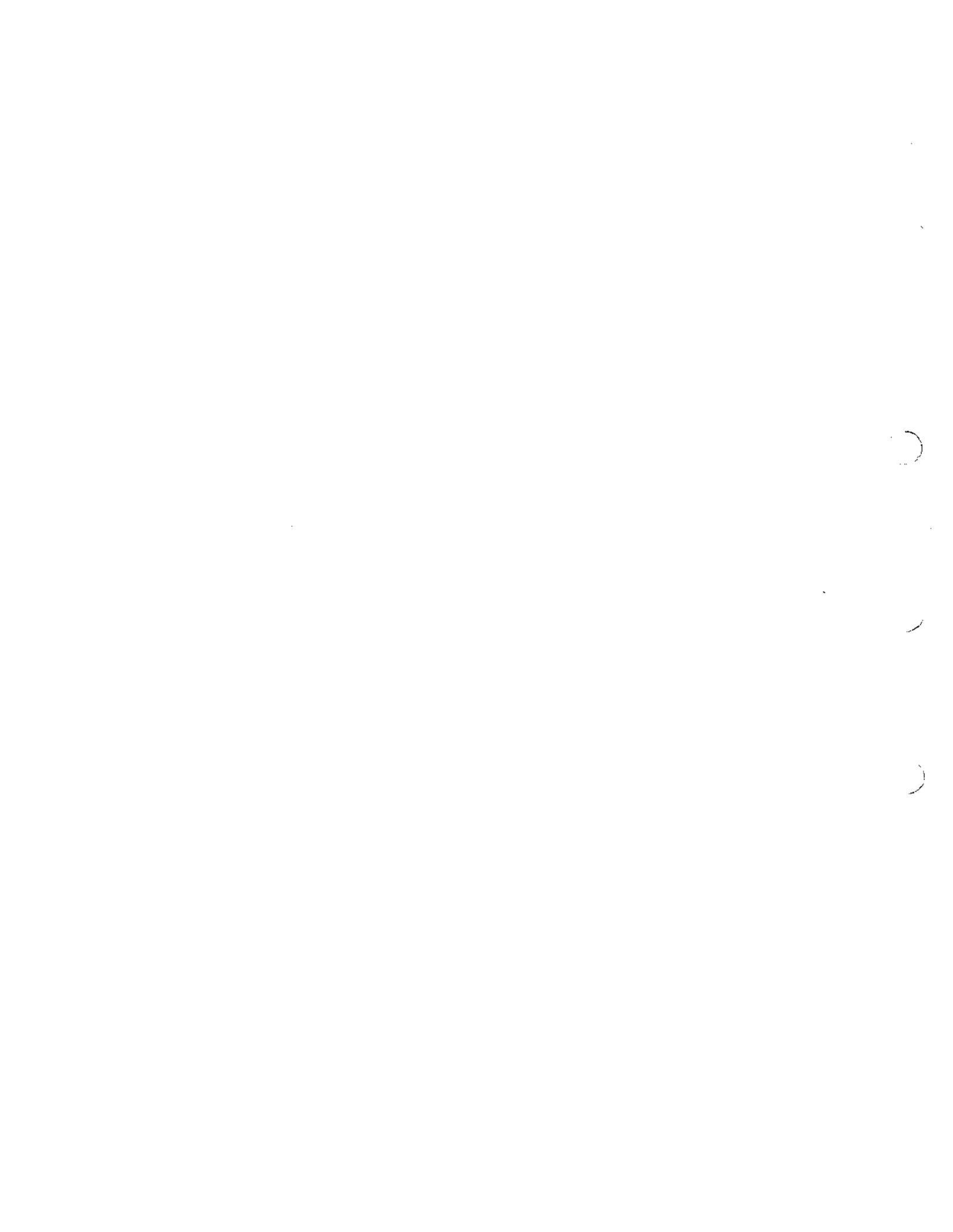
NOTE 1: Chart depicts Courier-72 characters,

2: Column/Row addresses electrical position of character on the print thimble. Example: for Courier-72, Column 1, Row E addresses upper case character K.



## APPENDIX C APL CODE TABLE

MSB LSB		0	1	2	3	4	5	6	7
		000	001	010	011	100	101	110	111
0	0000			SP	0	-	P	◇	*
1	0001			::	1	A	Q	⊗	?
2	0010			)	2	B	R	⊥	⊔
3	0011			<	3	C	S	⊎	⊓
4	0100			≤	4	D	T	⊍	⊕
5	0101			=	5	E	U	⊎	⊖
6	0110			>	6	F	V	-	⊗
7	0111			]	7	G	W	▽	⊘
8	1000			√	8	H	X	△	⊙
9	1001			^	9	I	Y	?	⊕
A	1010			≠	(	J	Z	°	⊖
B	1011			÷	[	K	↑	°	⊗
C	1100			⋅	::	L	T	□	⊥
D	1101			+	x	M	→		}
E	1110			•	::	N	←	—	\$
F	1111			/	\	O	⊕	○	DELETE



## GLOSSARY

ABS	absolute
ALMLPDRV	alarm lamp drive
BAUD	one bit per second
CG	carriage
CGRDY	carriage ready
CHAR	character
DG	device ground
DIP	dual-in-line-package
DVLOCK	drive lock
EIA	Electronics Industries Association
FF	form feed
FG	frame ground
HM	hammer (print hammer)
HAMDRV	hammer drive
HMIMP	hammer impression
LF	line feed
LFHOLD	line feed hold
LSI	large scale integration
MCS	microprocessor control system
MDLLPDRV	media low lamp drive
MPS	microprocessor system
MPU	microprocessor unit
MSI	medium scale integration
OPOUT	operator panel output

## GLOSSARY (contd)

PF	paper feed
PNLI	panel interface
PW	print wheel
RBCDRV	ribbon change drive
RBCH	ribbon change
RBF	ribbon feed
RBLFT	ribbon lift
RDYLPDRV	ready lamp drive
RST	reset
RT	rotate
RTCONT	rotate count
RTXXCW	rotate clockwise
RTXCCW	rotate counterclockwise
RTHOME	rotate home
RTVEL	rotate velocity
RTVREF	rotate voltage reference
RX	receive
RXRDY	receiver ready
SG	signal ground
SP	space
SPCONT	space count
SPXFWD	space forward
SPXREV	space reverse
SPVREF	space voltage reference
SSI	small scale integration
STB	strobe

## GLOSSARY (contd)

SWCOV	switch cover
SWGTT	switch gate
SWIMP	switch impression
TOF	top of form
TX	transmit
UC	upper case
USART	Universal Synchronous/Asynchronous Receiver/Transmitter
VT	vertical
VTDWN	vertical down
VTENAB	vertical enable
VTLIFT	vertical lift
VTSEN	vertical sense

