IBM

Customer Engineering
Instruction – Reference

1014 Remote Inquiry Unit

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IBM 1014 Remote Inquiry Unit

The IBM 1014 Remote Inquiry Unit (Figure 1) connects to a data processing system. The operator of the unit can send information to, and receive information from, the system. Up to eight miles of four-wire cable can be used to connect the unit to the system. The unit consists of an I/O printer and relay control circuits (Figure 2). The I/O printer keyboard is used to enter characters into the system, and magnets are used to print characters received from the system.

Figure 1. IBM 1014 Remote Inquiry Unit

Data Flow

The I/O printer has seven magnets that initiate the printing of a character during output. Transmitting contacts identify the character being printed during input.

The relay control circuits include a seven-bit data register that sends the character in parallel to the output magnets in the I/O printer and receives the character in parallel from the transmitting contacts. Because the characters are sent to and received from the I/O printer in parallel, and are sent to and received from

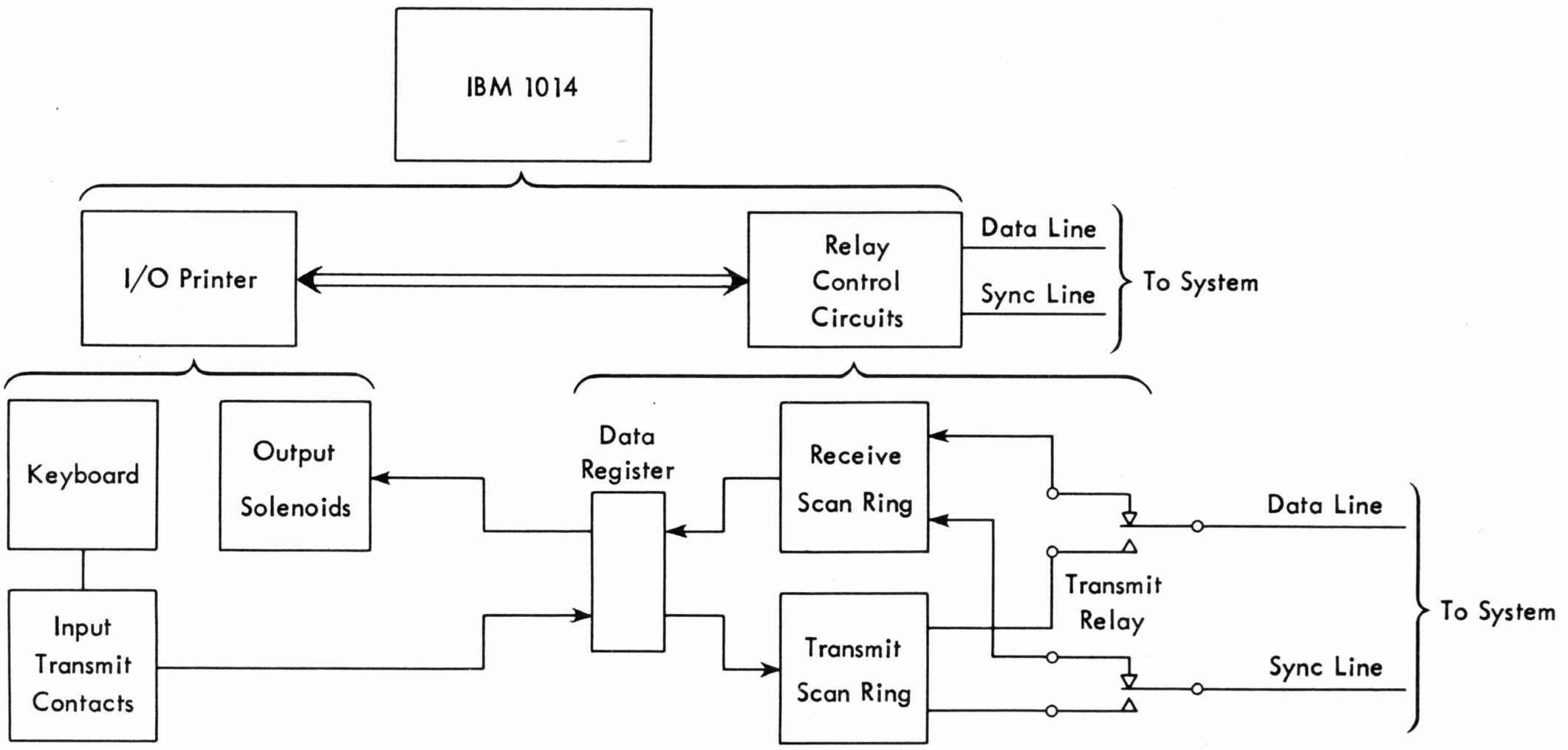


Figure 2. IBM 1014 Data Flow

the system in series, the relay control circuits consist of a receive-scan ring and a transmit-scan ring.

The receive-scan ring gates the bits coming from the system on the data line to the proper position of the data register. The transmit-scan ring gates the character from the data register to the system, bit by bit.

I/O Printer

Information is sent to and received from the system through the I/O printer. The printer prints 44 of the 64 standard binary coded decimal (BCD) characters. The printing element is a ball-shaped typehead containing the 44 characters on one half of the typehead. There are four rows of characters with eleven characters in each row. The printer mechanically rotates and tilts the typehead until the desired character is opposite the printing position. When the typehead is in position, it moves up against the ribbon and paper to print the character (Figure 3).

Figure 4 shows the arrangement of the characters on the typehead. At the beginning of each print cycle the typehead is in the home position, which is the *zero* in the printing position (see Figure 3).

Character Selection

Six latches govern the movement of the typehead. Four latches (R1, R2A, R2, and R5) control rotation of the typehead. The other two latches (T1 and T2) control tilting of the typehead. These latches are operated by magnets during output operations and by the keyboard during input operations.

All these latches, except R5, impart units of motion to the typehead when they are not selected. For example, when no latches are selected, R1, R2A, and R2 cause the typehead to rotate a total of five characters from the home position in a counterclockwise (plus) direction. The T1 and T2 tilt latches cause the typehead to tilt a total of three rows from the home position. The result of rotating the typehead plus five units and tilting the typehead three units is that the *period* is in the printing position (Figure 4).

To print a W requires rotating the typehead plus three units and tilting the typehead one unit. This is done by selecting the R2A and T2 latches. Because the R1 and R2 latches are not selected, the head rotates a total of plus three units. Because the T1 latch is not selected, the head tilts one unit.

Only the R5 latch controls rotation of the typehead when the latch is selected. The R5 latch causes the typehead to rotate five units in a clockwise (minus) direction. For example, to print a 1, all latches including R5 are selected. Because all latches (except R5) cause units of motion when they are not selected, selecting all of the latches causes only the minus five units of motion resulting from the R5 latch. The typehead rotates minus five units and does not tilt, causing the 1 to be in printing position.

To print a character in the *zero* rotate position (0, *, –, or &), either the R1, R2A, and R2 latches can be selected; or the R5 latch can be selected to offset the plus five units of motion caused by the R1, R2A, and R2 latches not selected.

When the magnets are used to print a character, the armature of any magnet operates a common bail to trip the cycle clutch necessary to initiate each print cycle. There is one additional magnet and latch called the *check magnet*. This magnet also operates the common bail to trip the cycle clutch. The check magnet is the only magnet energized to print the *period*.

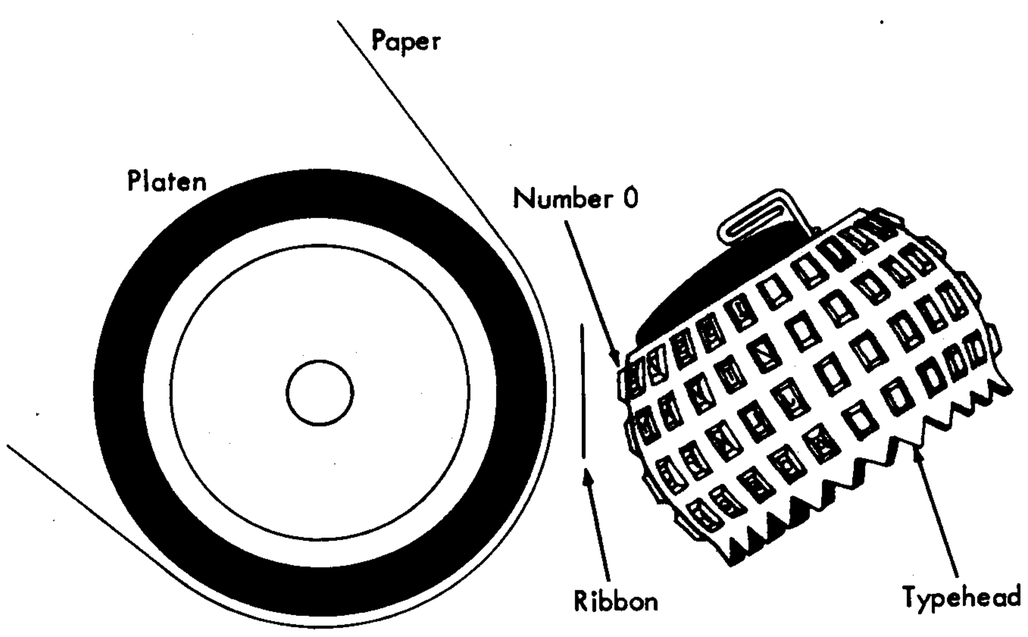
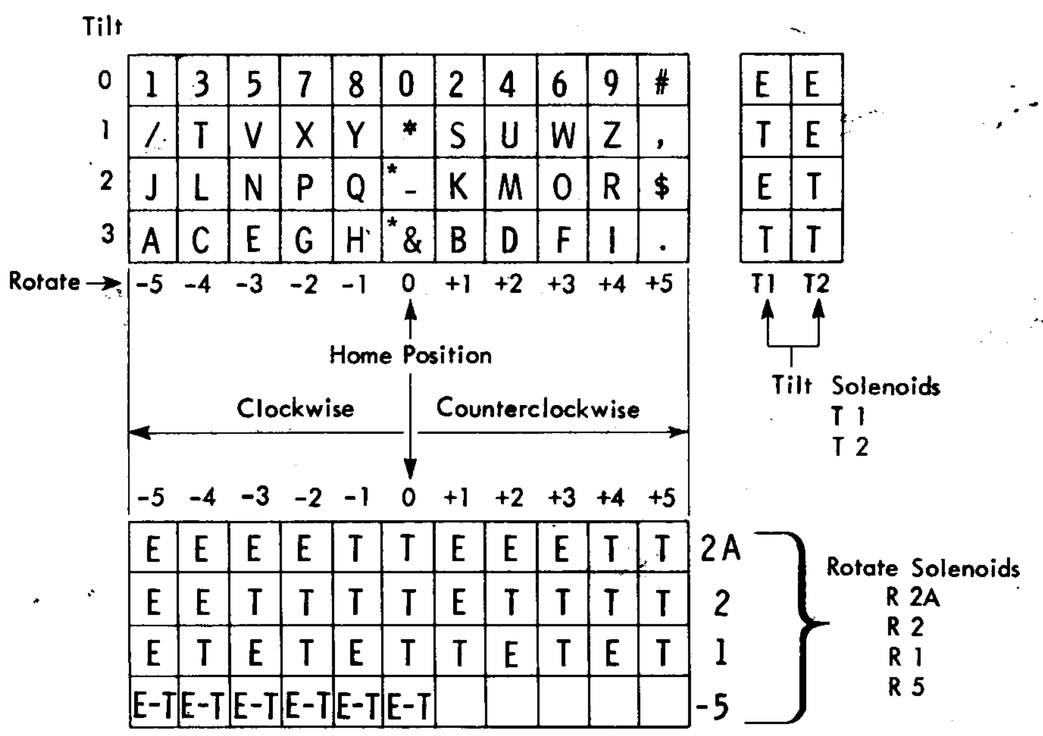


Figure 3. I/O Printer



E = Solenoid energized

T = Contacts transfer

* (&) and (-) energize R1, 2 and 2A. No contacts transfer Manual depression of the 0, *, -, and & operates -5 latch and all contacts transfer.

Figure 4. I/O Printer Character Arrangement

CHARACTER	BCD CODE							I/O PRINTER CODE							NOTES
	C	B	A	8	4	2	1	R1	R2A	R2	R5	T1	T2	C	
	X							X	X	X		X	X		Space
.		X	X	X		X	X							X	
¤	X	X	X	X	X			X		X	X				Carriage Return
(		X	X	X	X		X	X		X				X	No Character-Print #
<		X	X	X	X	X				X	X			X	No Character-Print #
≠ (G/M)	X	X	X	X	X	X	X			X					EOR & Carriage Return
&	X	X	X					X	X	X					
$	X	X		X		X	X					X			
*		X		X	X			X		X	X	X		X	No Character-Print *
)	X	X		X	X		X	X		X		X			No Character-Print #
;	X	X		X	X	X				X	X	X			No Character-Print #
△		X		X	X	X	X			X		X		X	No Character-Print #
-		X						X	X	X		X		X	
/	X		X				X	X	X	X	X		X		
,	X		X	X		X	X						X		
%			X	X	X			X		X	X		X	X	No Character-Print #
= (W/S)	X		X	X	X		X	X		X			X		No Character-Print #
'	X		X	X	X	X				X	X		X		No Character-Print #
"			X	X	X	X	X			X			X	X	No Character-Print #
¢			X					X	X	X			X	X	No Character-Print #
#				X		X	X					X	X	X	
@	X			X	X			X		X	X	X	X		No Character-Print #
:				X	X		X	X		X		X	X	X	No Character-Print #
>				X	X	X				X	X	X	X	X	No Character-Print #
√ (T/M)	X			X	X	X	X			X		X	X		No Character-Print #
?	X	X	X	X		X					X				No Character-Print #
A		X	X				X	X	X	X	X			X	
B		X	X			X			X	X				X	
C	X	X	X			X	X		X	X	X				
D		X	X		X			X	X					X	
E	X	X	X		X		X	X	X		X				
F	X	X	X		X	X			X						
G		X	X		X	X	X		X		X			X	
H		X	X	X				X			X			X	
I	X	X	X	X			X	X							
!		X		X		X					X	X		X	No Character-Print #
J	X	X					X	X	X	X	X	X			
K	X	X				X			X	X		X			
L		X				X	X		X	X	X	X		X	
M	X	X			X			X	X			X			
N		X			X		X	X	X		X	X		X	
O		X			X	X			X			X		X	
P	X	X			X	X	X		X		X	X			
Q	X	X		X				X			X	X			
R		X		X			X	X				X		X	
≠ (R/M)			X	X		X					X		X	X	Tab
S	X		X			X			X	X			X		
T			X			X	X		X	X	X		X	X	
U	X		X		X			X	X				X		
V			X		X		X	X	X		X		X	X	
W			X		X	X			X				X	X	
X	X		X		X	X	X		X		X		X		
Y	X		X	X				X			X		X		
Z			X	X			X	X					X	X	
0	X			X		X					X	X	X		
1							X	X	X	X	X	X	X	X	
2						X			X	X		X	X	X	
3	X					X	X		X	X	X	X	X		
4					X			X	X			X	X	X	
5	X				X		X	X	X		X	X	X		
6	X				X	X			X			X	X		
7					X	X	X		X		X	X	X	X	
8				X				X			X	X	X	X	
9	X			X			X	X				X	X		

Figure 5. I/O Printer Code

Transmitting Contacts

Four sets of transfer contacts, associated with each latch, are operated during a print cycle by the latches controlling movement of the typehead. Therefore, the points of the R5 latch transfer when the magnet is energized, but the points associated with all other latches transfer when their magnet is not energized.

The contacts are tested during both input and output operations to ensure that an odd number of latches has been selected. During input operations the contacts transmit the character to the system.

IBM 1014 Character Code and Control Characters

The remote inquiry unit receives information in the seven-bit I/O printer code (Figure 5) and sends information in BCD code. Figure 6 shows the BCD to I/O printer code conversion.

Forty-three of the forty-four printable characters are converted to the correct combination, of rotate and tilt magnets, to print the character. Normal conversion of the *asterisk* to I/O printer code would select the R1, R2, R5, T1, and check magnets. Because this prints an N, the asterisk must be recognized to energize the desired latches (R5, T2, and C). Also, of the twenty BCD characters that are not printable, four are decoded to perform special functions; the remainder are decoded to print as a pound sign (#).

The four control characters are a blank (C-bit only), a lozenge (□), a record mark (≠), and a group mark (≢). These characters cause a space, a carrier return, a tab, and an end of record with a carrier return, respectively.

The character is received and set into the data register. The register is analyzed to determine if it is one of the 43 printable characters and if it is, the character relay is picked. Character = $\overline{R2} \cdot [R1 + \overline{R5} + T1 \cdot T2] + R2A \cdot [\overline{R1} + R5 + \overline{T2}]$.

When the character is ready to be printed, the character relay and the print-transfer relay gate the data register to the print magnets. If the character relay is not picked, the data register is decoded to energize C, T1, and T2 to print a pound sign; energize C, R5, and T2 to print the asterisk; or energize the space, tab, or carrier-return magnets.

BCD	I/O Printer
$\overline{2}$	R1
$\overline{8}$	R2A
$\overline{4}\cdot\overline{8} + 4\cdot8$	R2
$1\cdot\overline{8} + \overline{1}\cdot8$	R5
$\overline{A}$	T1
$\overline{B}$	T2
$\overline{C}$	C

Figure 6. BCD to I/O Printer Code Conversion

Data and Sync Lines

It takes five bit times to receive a character. Each bit time equals 5.5 milliseconds ± 10 percent. The signals on the data and sync lines vary from zero volts, or ground, to + 48 volts or to — 48 volts.

On the sync line are three negative sync pulses at the first-, third-, and fifth-bit times and a positive pulse at the sixth-, and seventh-bit times. The sync line goes positive between the first and second negative sync pulses if the character requires a T2 bit, and positive between the second and third negative sync pulses if the character requires a check bit. The positive pulses at the sixth- and seventh-bit times initiate feedback voltage, which is maintained by the 1014 until either a print cycle is started or until a functional cycle is complete. The data line goes positive during the odd-bit times (R1, R2, T1) and negative during the even-bit times (R2A, R5) if there is a bit. For example, for the letter V (R1, R2A, R5, T2, and C bits) the sync and data line look as shown in Figure 7.

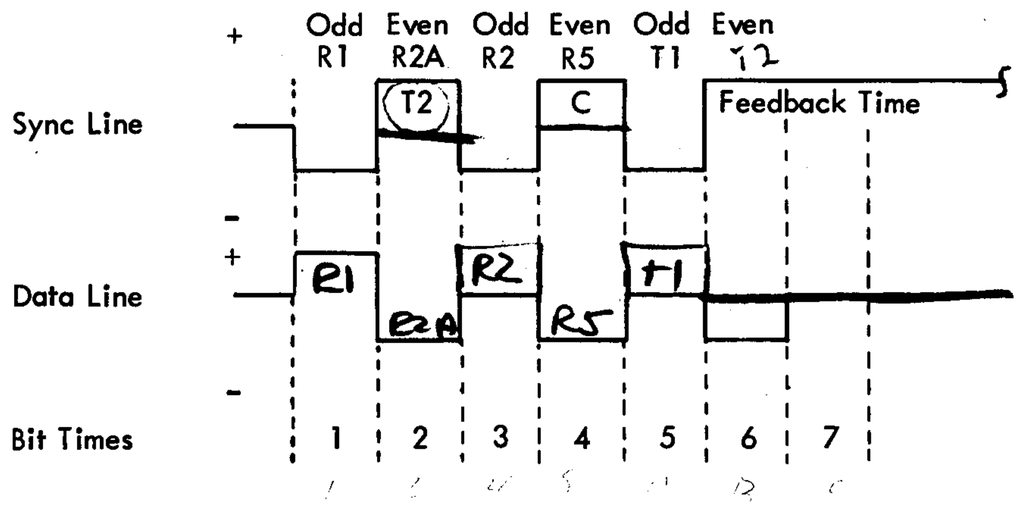


Figure 7. Character 'V' on Sync and Data Lines

The signals on the data and sync lines go through normally closed (N/C) transmit and CE mode relay points to two polarized reed relays in series (Figure 8).

A reed relay is a N/O contact contained in a glass tube. The tube is placed inside the relay coil. When the coil is energized, the center of the coil has the highest concentration of the magnetic field, thus both contacts are attracted toward the center where they make contact. The advantage of this relay is its very

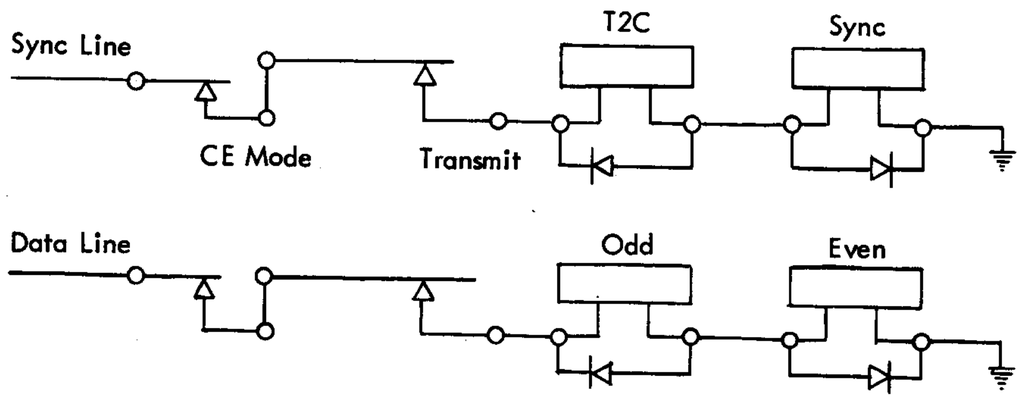


Figure 8. Polarized Relays

high speed. The contact makes and breaks within one millisecond.

As the negative sync pulses appear on the sync line, the current is shunted around the T2C relay by the diode to pick the sync relay. The sync relay advances the receive-scan ring, which identifies each bit time. When the positive pulse appears on the sync line, the diode around the sync relay shunts the current past the relay and through the T2C relay.

Receive Operation

Receive-Scan Ring

The receive-scan ring consists of three relays: receive 1, receive 2, and receive 3. One of the three relays changes its status every bit time, while the other two relays are used to select the position of the data register.

Figure 9 shows the progression of the receive relays through a receive scan.

Receive-Scan-Ring Advance

A mercury-wetted reed relay is used to advance the ring because of its high speed and current-carrying capacities. It picks and drops in less than two milliseconds.

The first sync pulse received on the sync line is shunted around the T2C relay and picks the sync reed relay. The N/O sync-relay point completes the circuit to pick the mercury-wetted reed relay called *receive sync*. The N/O receive sync point completes the circuit through 3 N/C and receive 2 N/C to pick receive 1. Also during this first-bit time, the odd relay picks if the character being received contains an R1 bit. The point of the odd relay transferred and the N/C receive 2 and N/C receive 3 points complete the circuit to pick relay R1 in the data register (Figure 10).

During the second-bit time no sync pulse drops out the receive-sync relay. The mercury-wetted receive-sync relay is a make-before-break relay with a fast drop-out time. It drops out fast enough to establish the hold circuit for the receive 1 relay before it too can drop out. The N/C receive sync also completes the circuit through receive 1 N/O and receive 3 N/C to pick receive 2. If there is a bit being received at this time, the even relay picks to complete the circuit to pick R2A through receive 1 N/O and receive 3 N/C.

During this same time, the sync line goes positive to pick the T2C relay if the character being received contains a T2 bit. If the T2C relay picks with receive 3 N/C and receive 1 N/O, the T2 relay in the data register is picked by completing its pick circuit to dc common.

The sync pulse during the third-bit time holds receive 2 and causes receive 1 to drop out. During this bit time, receive 2 N/O and receive 3 N/C are used to gate the pick of R2 if a bit is received.

Bit Time	Receive 1	Receive 2	Receive 3
R1	Pick	N/C	N/C
R2A and T2	N/O	Pick	N/C
R2	Drop	N/O	N/C
R5 and Check	N/C	N/O	Pick
T1	Pick	N/O	N/O
Feedback	N/O	Drop	N/O

Figure 9. Receive Relays during Scan

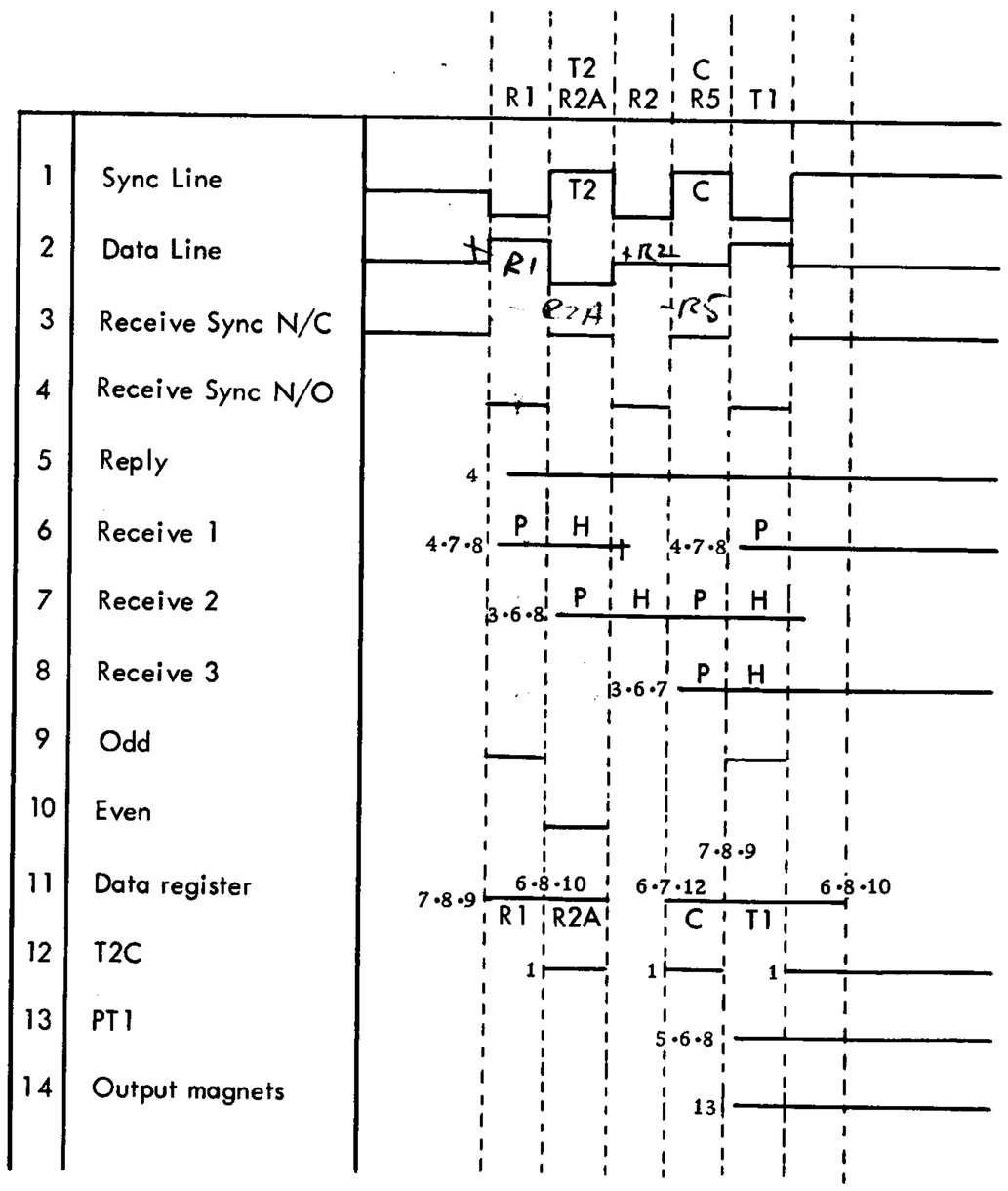


Figure 10. Receive a 4 in the Data Register

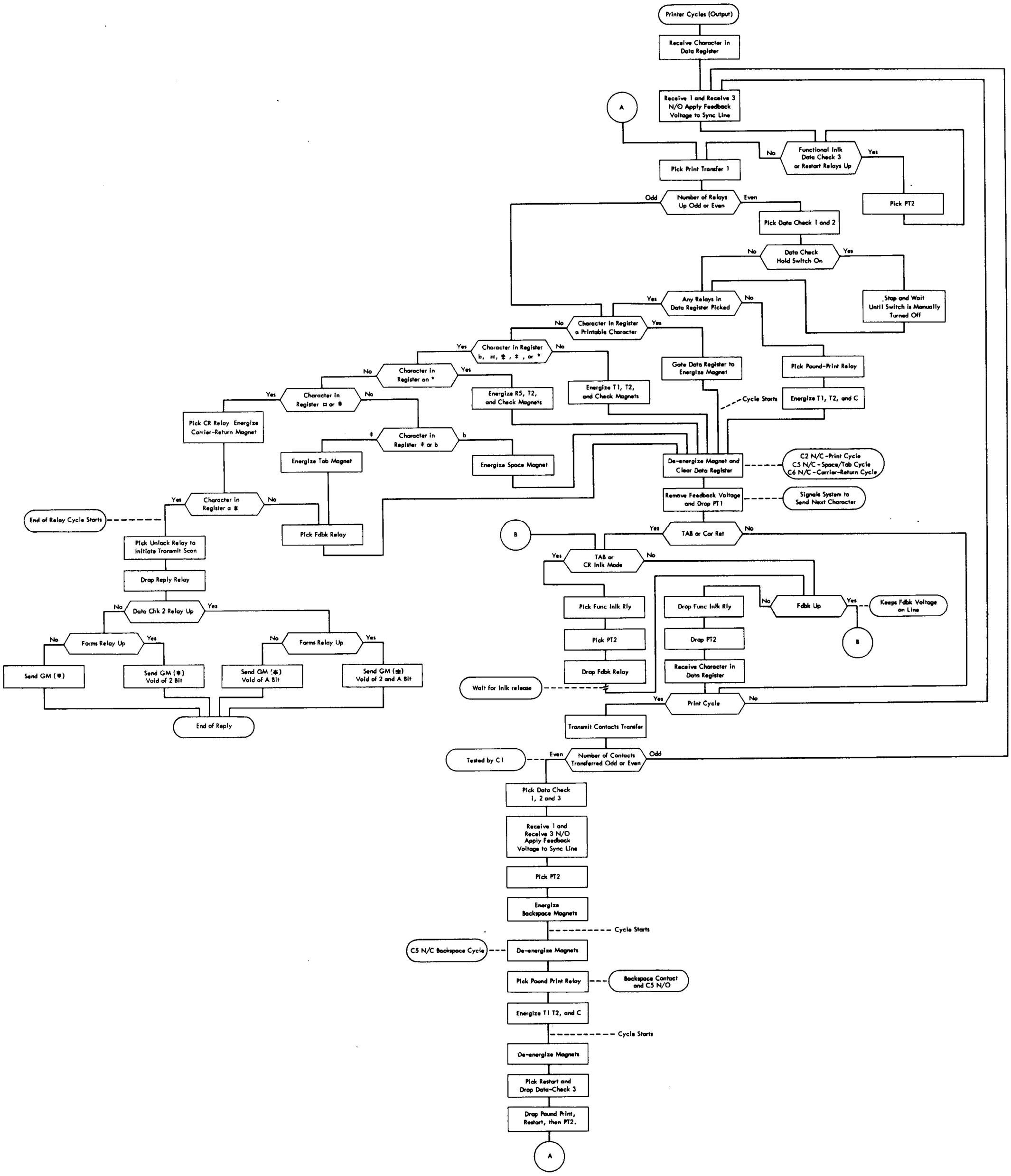


Figure 11. Printer Cycles (Output Operation)

Receive 1 N/C and receive 2 N/O gate R5 while receive 3 picks during the fourth-bit time. Also during this bit time, the sync line goes positive to pick the T2C relay if the character being received contains a check bit. If the print relay picks with receive 1 N/C and receive 2 aux N/O, the check relay in the data register is picked.

Receive 3 N/O and receive 2 N/O gate T1 while receive 1 picks during the fifth-bit time.

During the sixth-bit time, receive 2 drops out and receive 3 and receive 1 stay held through receive sync N/C until either C2, C5, or C6 N/C breaks during the printer operation.

Feedback voltage applied to the sync line through receive 1 and receive 3 N/O inhibits the processor from sending additional characters until an output printer cycle.

Output Printer Cycles

After the character is received, the data register is analyzed to determine whether the character is a printable character or a control character (Figure 11).

A circuit is completed through points reply (44-1 N/O), receive 1 (32-6 N/O), and receive 3 (28-6 N/O) to pick print-transfer 1 (PT 1). This circuit applies primary feedback voltage to the sync line through a receive 1 (32-5 N/O), receive 2 aux (82-1 N/C), and a 300-ohm resistor to notify the system that the data register is full. When PT 1 transfers, it holds through a parallel set of N/O data-register relay points and establishes a secondary feedback voltage originating from the hold circuit of PT 1 through diode 88B1 and PT 1 (42-3 N/O).

The character is now checked for odd parity. If a bit was dropped, even parity causes data-check relays 1 and 2 to pick. The data-check relays light the data-check light and signal the system of the error after the complete reply record is received.

PT1 and the character relay picked complete the circuit to gate the selected data-register relays to the output magnets to print the character through N/O points 42-1, 42-2, 45-1, and 45-2.

PT1 and the character relay not picked energize either the output magnets (*asterisk* or *pound sign* for unprintable characters) or the control magnet (space, tab, or carrier return. If, for some reason, the data register contains no character, the pound-print relay picks to energize T1, T2, and Check to print a pound sign.

The receive 1 (32-3 N/O) point in the pick circuit to pound print prevents it from picking when the data register drops out at the end of a print cycle.

Energizing a magnet initiates the printer cycle (print, space, tab, or carrier return). As the corresponding operational shafts turn, a N/C cam contact opens. This de-energizes the magnets and breaks the hold to the relays in the data register (C2 during a print cycle, C5 for space and tab, and C6 for a carrier-return cycle).

If the operation is a print or space cycle, the + 48 volts feedback voltage is removed from the sync line as soon as all the data-register relays drop out. This allows the next character to be received while the printer completes the initiated print or space cycle.

During the print cycle, the latches controlling the typehead are operated to transfer their respective transmitting contacts. After the contacts are transferred, cam contact C1 N/O makes and tests for an odd number of transmitting contacts transferred. An odd number of contacts transferred indicates a valid print cycle, which allows PT 1 to pick and initiate the next operation.

If the operation is a tabulate or carrier-return cycle, the C5 cam N/C or C6 cam N/C, respectively, de-energize the operational magnet and break the hold circuit to the data register relays. The + 48 volts feedback voltage, however, is not removed from the sync line as soon as all the data-register relays drop out. Instead, feedback voltage is maintained by a N/O feedback relay point (100-4), which is picked at the start of the tabulate or carrier-return cycle by the respective magnet pulse through the diode OR circuit using diodes 89A1 and 2A4. By means of a sequential circuit involving the tabulate and carrier-return interlock contacts, feedback voltage is maintained until the tabulate or carrier-return cycle is completed. The interlock contacts transfer during their respective cycle, pick the functional-interlock relay R99, and stay transferred until the carrier movement is completed. The coincidence of relay points, feedback (100-2 N/O), and functional interlock (99-4 N/O), pick the PT 2 relay (R41). Point 41-6 N/O provides a parallel-feedback-voltage circuit, and point 41-3 N/C drops out feedback relay R100. The PT 2 relay remains held through points 99-1 N/O, 41-1 N/O, 42-5 N/C, diode 39B2, and 44-1 N/O until the respective interlock contact drops out. This drops the functional interlock relay (R99), which drops PT 2 and removes the feedback voltage.

Output Error Routine

If the number of transmitting contacts transferred is even when C1 N/O makes, three data-check relays are picked. Data-check 1 causes the data-check lamp to light. This relay is held until the operator acknowledges the error by pressing the cancel key. Data-check 2 is used after the complete record has been received to signal the system that a failure was detected during the reply. This operation is covered later in the manual. Data-check 3 causes the printer to backspace to

the character in error and to print a pound sign over the character. Note that data-check 3 was not picked when the error was detected before the print cycle, but if the parity was wrong then the number of contacts transferred during the cycle should be even.

Figures 11 and 12 show the circuits of the output error routine. C1 tests the transmitting contacts while the next character reads into the relay register.

At feedback time, the coincidence of receive 1 and receive 3 N/O picks the print-transfer 2 (PT2) relay instead of PT1 because data-check 3 is picked. PT2 (41-5 N/O) and data-check 3 (33-2 N/O) complete the circuit to energize the backspace magnet. PT2 also gates + 48 volt feedback onto the sync line to prevent the system from sending the next character.

During the backspace cycle, the backspace contact transfers to pick the pound-sign relay. C5 N/C opens during the backspace cycle to break the impulse to the backspace magnet.

When C5 N/C makes at the end of the cycle, the pound-sign relay completes the circuit to energize T1, T2, and Check which print the pound sign. Because PT2 (41-5 N/O) is held transferred, it establishes a hold for the next character, which is still in the relay register.

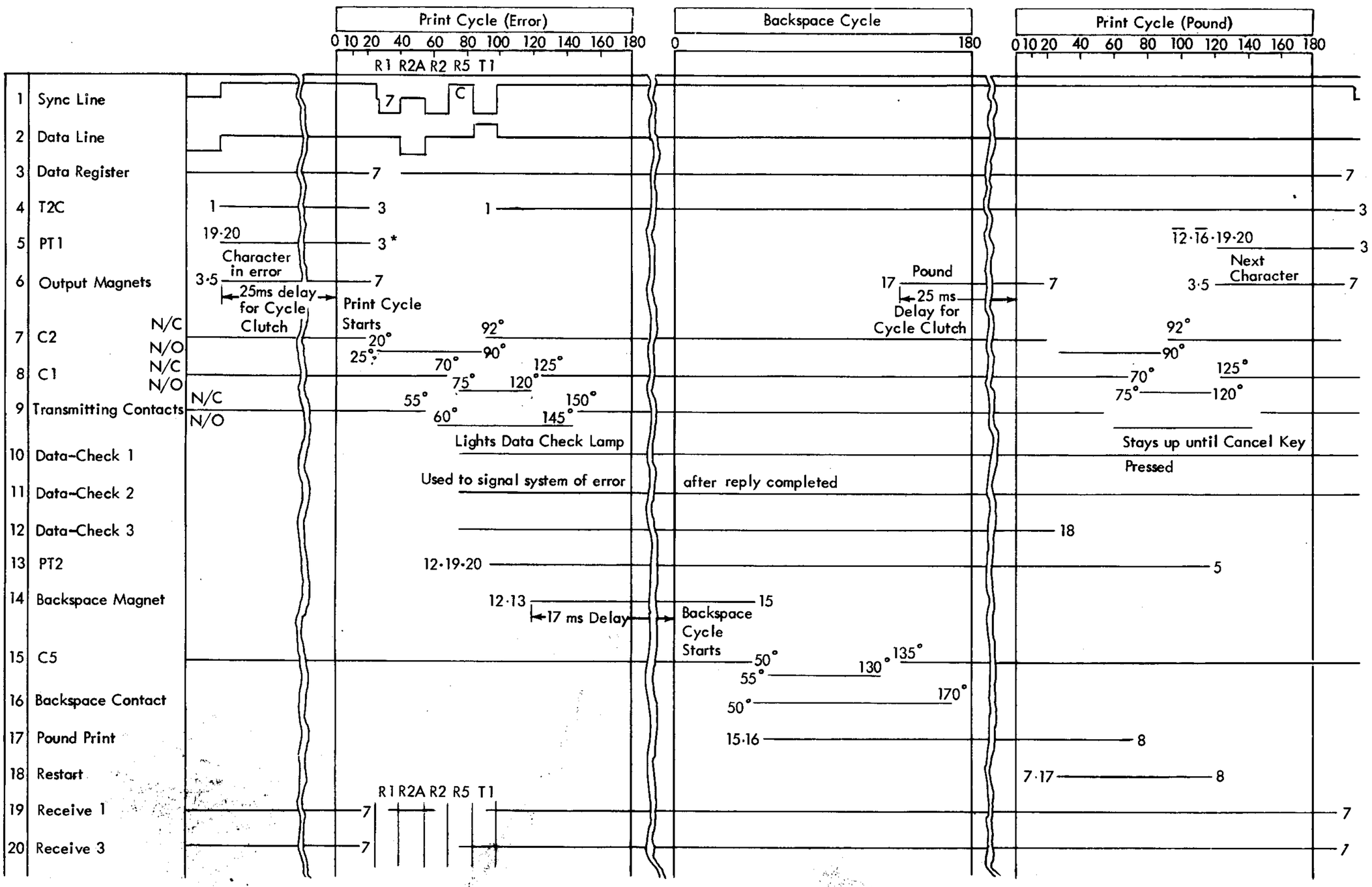
When C2 N/O makes during the printing of the pound sign, it and the pound-sign relay (47-1 N/O) pick the restart relay. The restart relay (37-2 N/C) drops the data-check 3 relay. C1 N/O holds the restart relay until the end of the print cycle. When the restart relay (37-1 N/O) drops, it causes PT1 to pick and PT2 to drop. PT1 (42-1, 42-2 N/O) and the character relay (45-1, 45-2 N/O) gate the character in the register to the output magnets, and the next character prints.

Transmit Operation

To enter data into the processing system, the operator presses a key on the I/O printer keyboard. As the character prints, the transmitting contacts transfer and set the character into the data register. The transmit-scan ring now scans the character in the data register, translates it into BCD, and gates it onto the data line, one bit at a time (1, 2, 4, 8, A, B, C).

Transmit-Scan Ring

The transmit-scan ring consists of three relays: TX1, TX2, and TX3. One of the three relays changes its status every bit time, while the other two relays are used to gate the bits to the data line.



* PT1 drops after all of the data register relays are down.

Figure 12. Output Error Routine

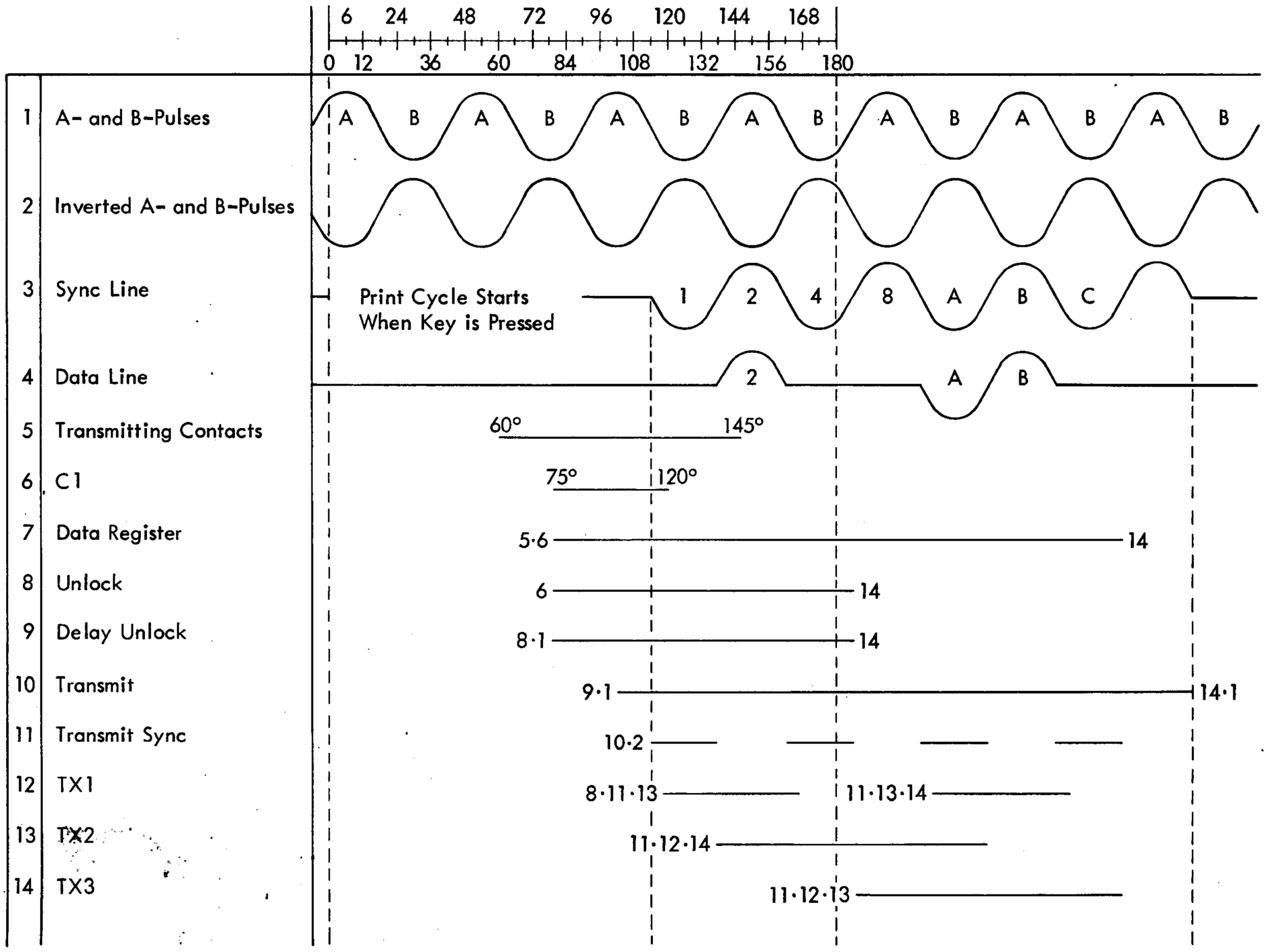


Figure 13. Transmit a B-Character

The 60-cycle sine wave, tapped off the secondary winding of the power-supply transformer, provides the timing pulses for the transmit scan. The positive portion of the sine wave, tapped off terminal bar TD3-4, is called an *A-pulse*. The negative portion is the *B-pulse*. The sine wave tapped off of TB3-5 provides inverted A- and B-pulses (Figure 13).

When a transmit scan is required, the unlock relay is energized. After the unlock relay transfers, the first B-pulse pick the delay-unlock relay through 85-2 N/O and diode 89A2. This synchronizes the A- and B-pulses with the transmit scan. The diode in series with the delay-unlock (DUL) relay conditions the relay to pick on the negative B-pulse only.

The following A-pulse picks the transmit relay. When the transmit relay transfers, the next inverted B-pulse picks the transmit-sync mercury-wetted reed relay. Transmit sync N/O completes the circuit through 85-1 N/O unlock and 76-3 N/C TX2 to pick TX1. At the same time, TX2 (73-1 N/C) and TX3 (70-1 N/C) gate a B-pulse to the data line if the character in the data register contains a one bit when translated from the I/O printer to the BCD code. The unlock (85-11 N/O) and transmit (79-2 N/O) relay points also gate this B-pulse onto the sync line.

During the next bit time (A-pulse) transmit sync drops. The TX1 (77-1 N/O) and TX3 (70-3 N/C) points analyze the data register to gate the two-bit onto the data line and, along with transmit sync N/C, complete the circuit to pick TX2.

Figure 14 shows the progression of the transmit relays through a transmit scan.

Bit Time	Pulse	TX1	TX2	TX3
1	B	Pick	N/C	N/C
2	A	N/O	Pick	N/C
4	B	Drop	N/O	N/C
8	A	N/C	N/O	Pick
A	B	Pick	N/O	N/O
B	A	N/O	Drop	N/O
C	B	Drop	N/C	N/O

Figure 14. Transmit Relays during Scan

Input Printer Cycles

The operator initiates a space, tab, or print cycle by pressing a key on the I/O printer keyboard. During the cycle, the space, tab, or transmitting contacts transfer. When C5 (space or tab cycle) or C1 (print cycle) transfers, it completes the circuit to pick the relays in the data register. The space and tab contacts cause their respective control characters (blank and record mark) to be entered into the data register.

The cam contacts (C1 and C5) also pick the unlock relay which starts a transmit scan. The unlock and TX3 relays overlap to hold the relays in the data register until the transmit scan is complete.

Exceed Speed

The speed of an I/O printer cycle is faster than the time required to transmit a character (see Figure 13). If an operator presses the second key too fast, it causes the second cycle to start immediately after the first cycle. The data register still contains the first character when the second character is read in. The first character can be wrong, depending on the bit configuration of the second character.

The exceed-speed condition is recognized in any one of three ways:

1. C1 or C5 transfers before the transmit relay drops from the previous cycle. This picks the exceed-speed relay (51) through 79-12 N/O and 85-3 N/C.
2. C1 and C5 both transfer at the same time. (This can happen when a character follows a space too closely.) This picks the exceed-speed relay through 52-3 N/O and 101-3 N/O.
3. The cancel or release key is pressed while C1 or C5 is still transferred from the previous cycle. This picks the exceed-speed relay through 101-4 N/O and 48-5 N/O; or 52-3 N/O, 101-4 N/C, and 48-5 N/O.

This relay lights the exceed-speed lamp. It is reset when the operator presses the cancel key. The exceed-speed relay also locks the keyboard and prevents a release from being initiated.

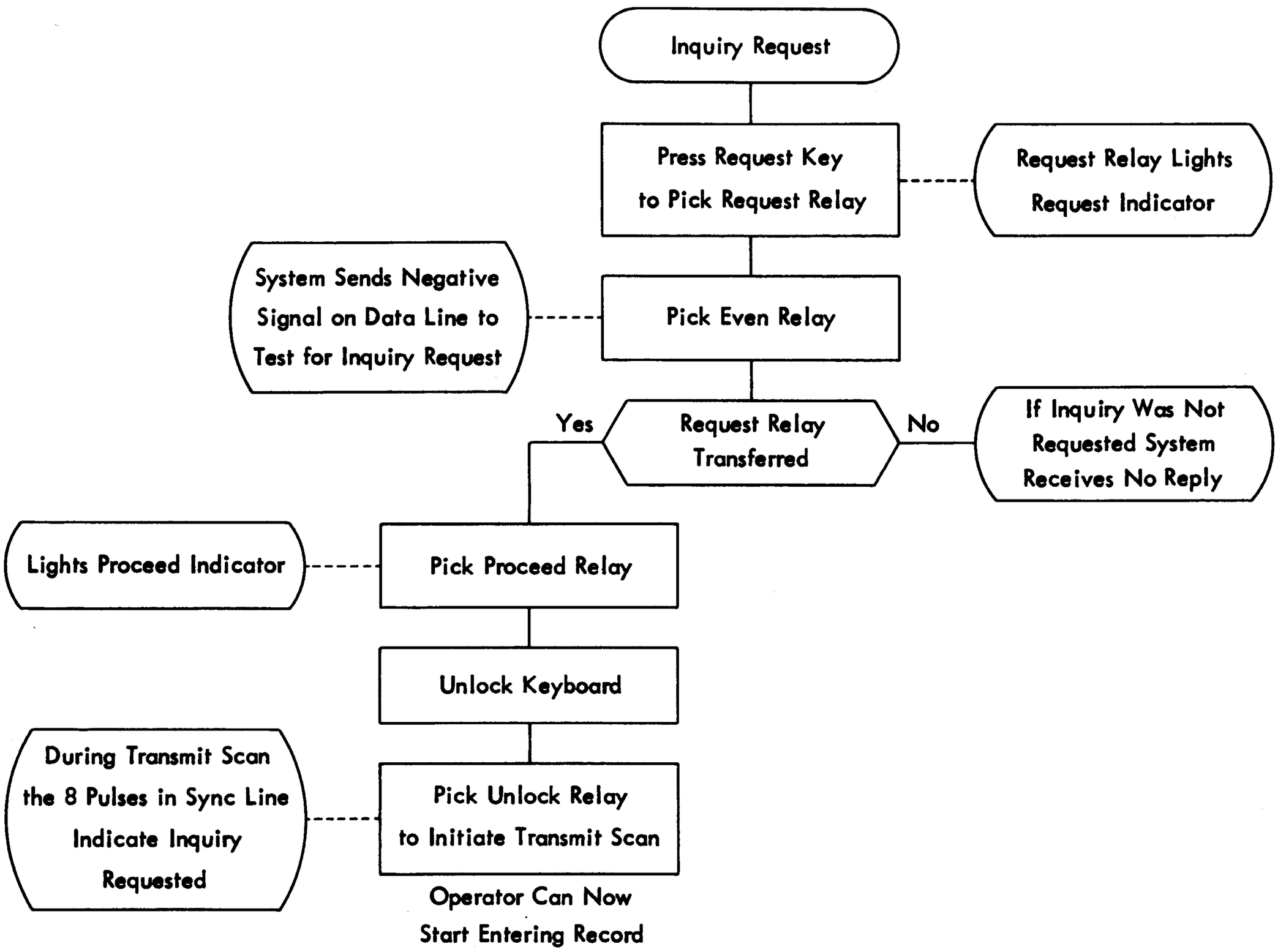


Figure 15. Inquiry Request

Inquiry

The inquiry operation consists of three parts: request, transmit, and reply.

During the request, the operator presses the request key to inform the system that the operator wants to make an inquiry. The system must recognize this request and signal the operator to proceed.

When the operator receives the proceed signal, he types the message on the I/O printer. As each character is typed, it is transmitted to and stored in the system. When the message is complete, the operator presses the release key. The operator should not press RELEASE after a space or tab character. If he does, a check condition results, forcing him to cancel the message.

Pressing RELEASE transmits a release character (group mark) indicating that the message is complete. The system responds to the release by sending a negative pulse (called *cancel or release response)* on the data line. When the pulse is received, a carrier return is initiated, the proceed light goes off, and the transmit operation is complete. If at any time during the transmit operation the operator does not wish to complete the inquiry, he presses the cancel key.

The cancel key initiates the transmission of the cancel character, all bits but the A-bit and 2-bit, and also the printing of an asterisk following the last character of the cancelled message. The system responds to the cancel signal by sending the cancel or release response signal. The asterisk print cycle is initiated by energizing the R5, T2, and Check print selection magnets through relay point 73-10 N/O, transmit 2.

The system takes the message received from the inquiry unit and compiles a reply. The reply is then sent to the inquiry unit and printed out on the I/O printer.

Request

The operator presses the request key, which picks the request relay and lights the request lamp (Figure 15). The system sends a negative pulse on the data line, which tests the unit for a request. The negative pulse picks the even relay. If the request relay is transferred, the even relay completes the circuit to pick the proceed relay. As soon as the proceed-relay points transfer, they pick the unlock relay through 79-6 N/C transmit, 25-11 N/C CE mode, and 63-3 N/O request. This initiates a transmit scan. The eight pulses on the sync line signal the system that an inquiry is desired. The TX2 relay (73-9 N/C) causes the request relay to drop. The proceed relay also unlocks the keyboard and lights the proceed indicator to signal the operator to start typing the message (Figure 16).

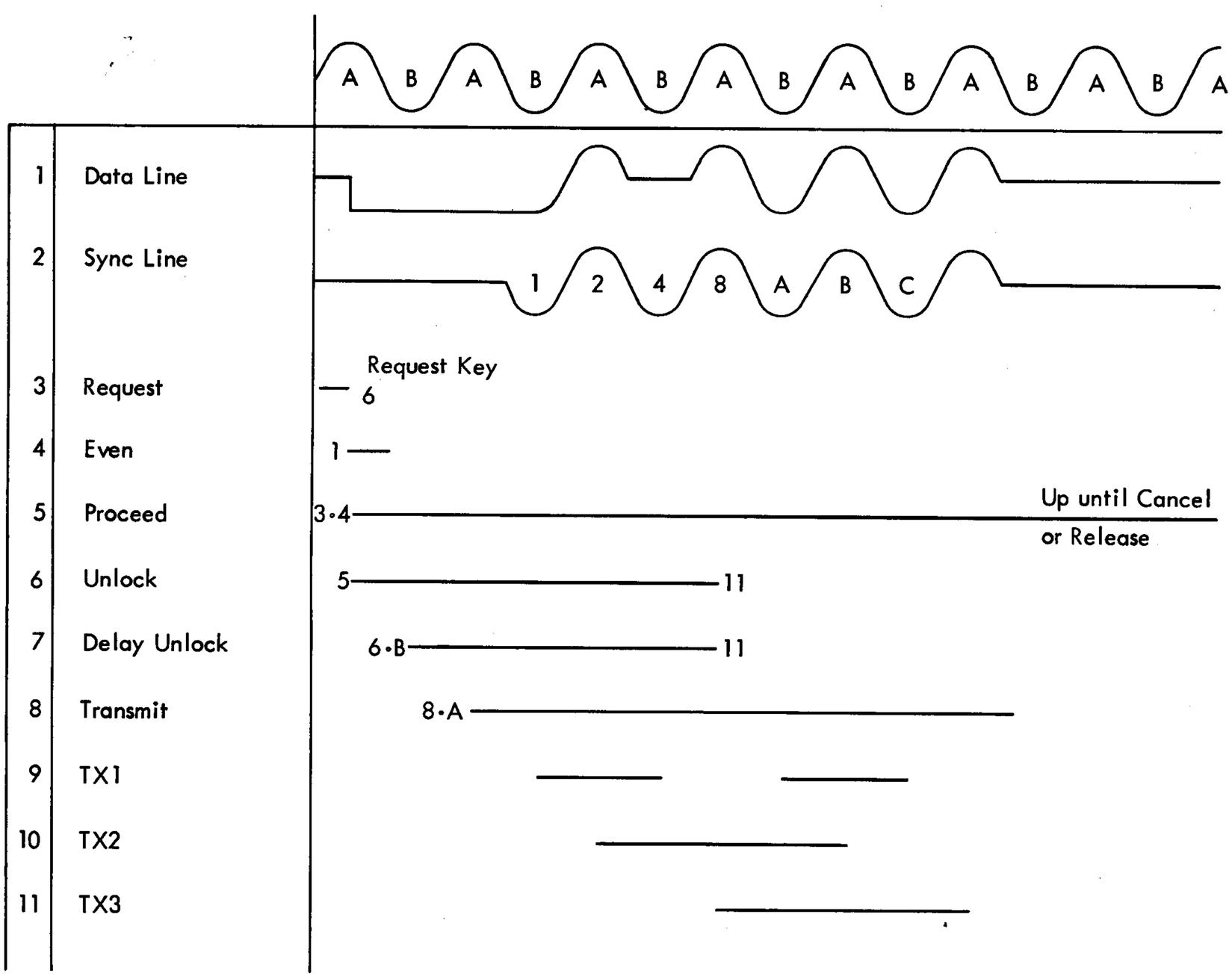
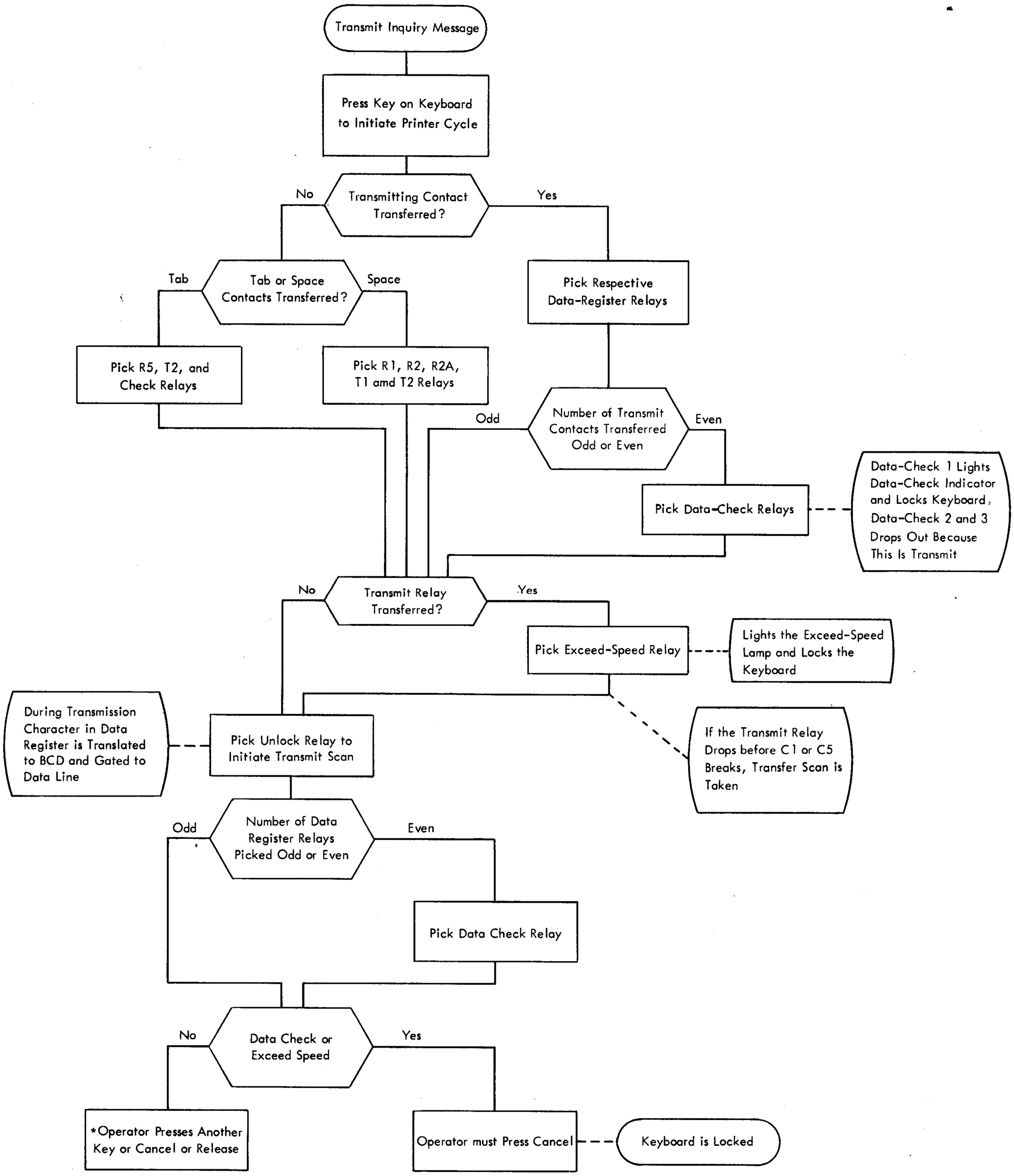


Figure 16. Inquiry-Request Timing Chart



* If the operator presses Release and the last character was either a space or a tab, the release character is not sent. Instead, the check light comes on, the Keyboard is locked, and the operator must cancel the message.

Figure 17. Transmit Inquiry Message

Transmit

The operator enters the message as covered under *Transmit Operations*. If the operator does not initiate a transmit scan within thirty seconds after the proceed relay picked, the time-delay relay picks. The time-delay relay completes the circuit to pick the cancel relay. This prevents an operator from tying up the system by pressing the request key and not completing the operation (Figure 17).

When the first character, following a proceed, is entered from the keyboard, the time-delay control relay (R102) is picked. This indicates that at least one

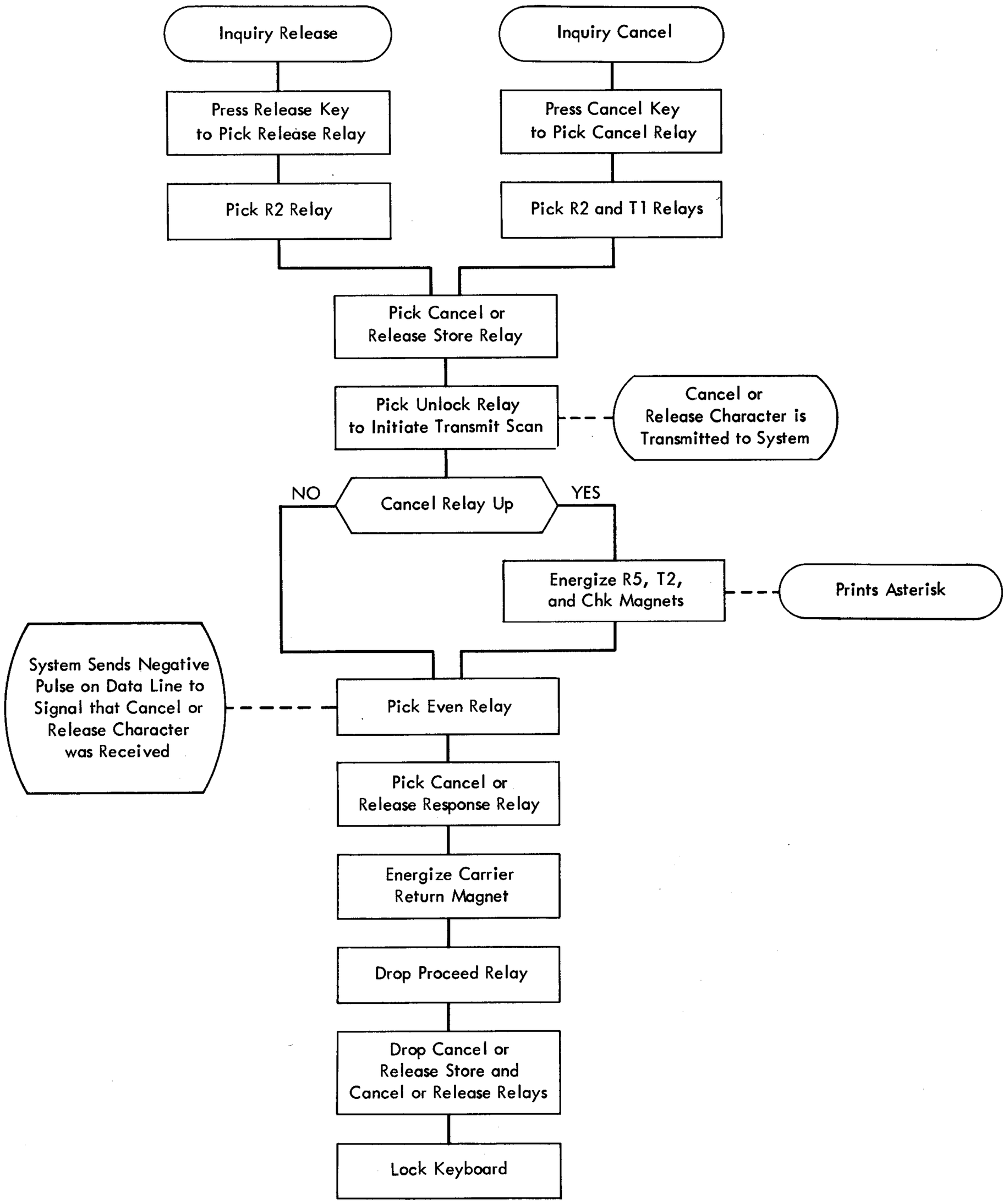


Figure 18. Inquiry Release and Cancel

character has been transmitted to the system. The N/C time-delay control relay point, 102-2, prevents the time-delay relay from picking, since the operator has initiated a transmit scan within thirty seconds after proceed.

The character store relay (R57) is used to inhibit the release of a proceed if no characters have been entered, or if the last character was a space or tabulate. A printable-character cycle picks the character-store relay (R57) through C1 auxiliary (101-2 N/O). The character-store relay, however, is dropped out during a space or tabulate cycle by relay C5 auxiliary (52-3 N/C).

When the operator presses the cancel or release key, the corresponding relay picks (Figure 18). The release relay cannot pick if the exceed-speed or data-check 1 relay is up. The character-store relay must also be up to pick the release relay. The release relay cannot

be picked unless at least one character has been sent. The release relay completes the circuit to pick the R2 relay, and the cancel relay picks R2 and T1 relays (all BCD bits but A and 2). Both the cancel and release relays pick the unlock relay to initiate a transmit scan. During the transmit scan, the cancel or release character is transmitted to the system. When the system recognizes the cancel or release characters, it sends a negative pulse on the data line. This pulse picks the even relay, which completes the circuit to pick the cancel-or-release-response relay (R59) through 32-2 N/C, 82-4 N/C, 63-2 N/C, 24-4 N/C, and 60-1 N/O.

The cancel-or-release-response relay energizes the carrier-return magnet and drops out the proceed relay. The keyboard is locked, and the unit is ready for the inquiry reply.

The system can ititiate a release by sending a negative pulse on the data line to pick the even relay. This completes the circuit to pick the cancel or release response to initiate a carrier return, drop out proceed, and lock the keyboard.

Power-Off Reset

During an inquiry proceed mode the inquiry system controls and polling circuitry are locked on an inquiry unit with the proceed. The power-off reset relay (R 106) provides a reset for the system controls if power is turned off at the inquiry unit, while in a proceed and without an operator-initiated cancel or release. The power-off reset relay is picked at power on and a 10 ufd (TB 90-1) capacitor is charged to +48 volts through the power-off reset relay point, 106-2 N/O. At power-off time the power-off reset relay drops out and a positive pulse appears on the data line, generated by discharging the capacitor on the data line through the power-off reset, relay point (106-2 N/C). The system controls are designed to recognize a data line signal with no accompanying sync line signal, as a reset. During inquiry reply, the characters are received as described under *Receive Operations*. If the end-of-line (EOL) contact transfers during a reply operation, the end-of-line relay, R107, is picked at C2 or C5 cam time by relay point C2 or C5 interlock, 103-3 N/O and held through the N/C carrier-return interlock contact. Then the functional-interlock relay is picked by relay point 107-4 N/O. When the next character is received in the data register, the PT 2 relay is picked instead of PT 1 through functional interlock point 99-4 N/O. PT 2 relay point 41-4 N/O completes the circuit to the capacitively coupled carrier-return relay, R98.

During the carrier-return cycle when the EOL contact returns to normal, the carrier-return interlock contact has transferred to keep the circuit to hold functional interlock and PT2, and keep the feedback voltage on the sync line. When the carrier stops at the left-hand margin, the interlock contact returns to normal, dropping functional interlock, which picks PT1. PT1, transferring, drops PT2 and allows the character in the data register to print.

The last character of the reply is a group mark. The group mark is the end-of-record character (EOR). When the EOR character is received, it energizes the carrier-return relay (R98). Also, through a N/O reply relay point (44-5) the EOR character picks the unlock relay to initiate a transmit scan. During the transmit scan, the EOR character still contained in the data register is sent back to the system to indicate the EOR character was received.

During record transmission, if there is a data check or the forms contact indicates no more forms, the character sent during this transmit scan is:

Data check—all bits but A

Forms—all bits but 2

Data check and forms—all bits but A and 2.

The data-check 2 relay is picked when the error character is recognized, and the relay is held until the transmit-scan relays are operated.

CE Panel

The CE panel (Figure 19) on the remote inquiry unit enables the customer engineer to simulate the various operations without tying up the system. A list of the switches on the panel and their functions follows.

CE BIT SWITCHES

These switches complete the circuit to pick the corresponding data-register relay and print the character selected by the CE.

CE MODE SWITCH

This switch removes the unit from the system and sets up controls for CE operations. It also lights the forms light to indicate to the operator that the units are not ready for normal operations.

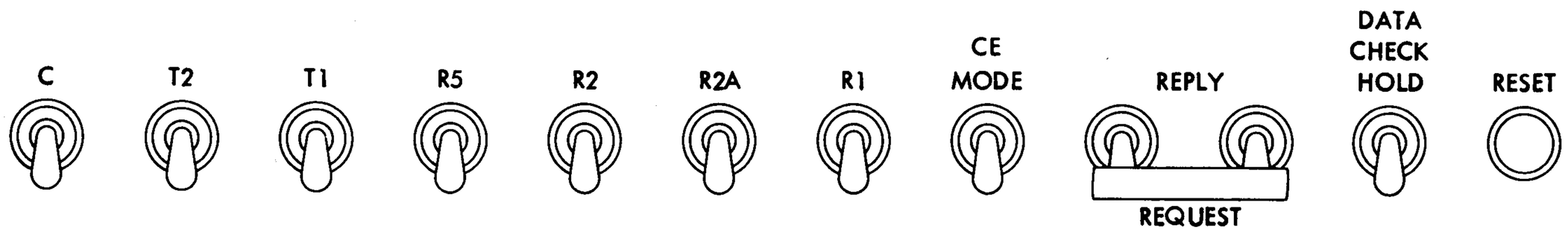
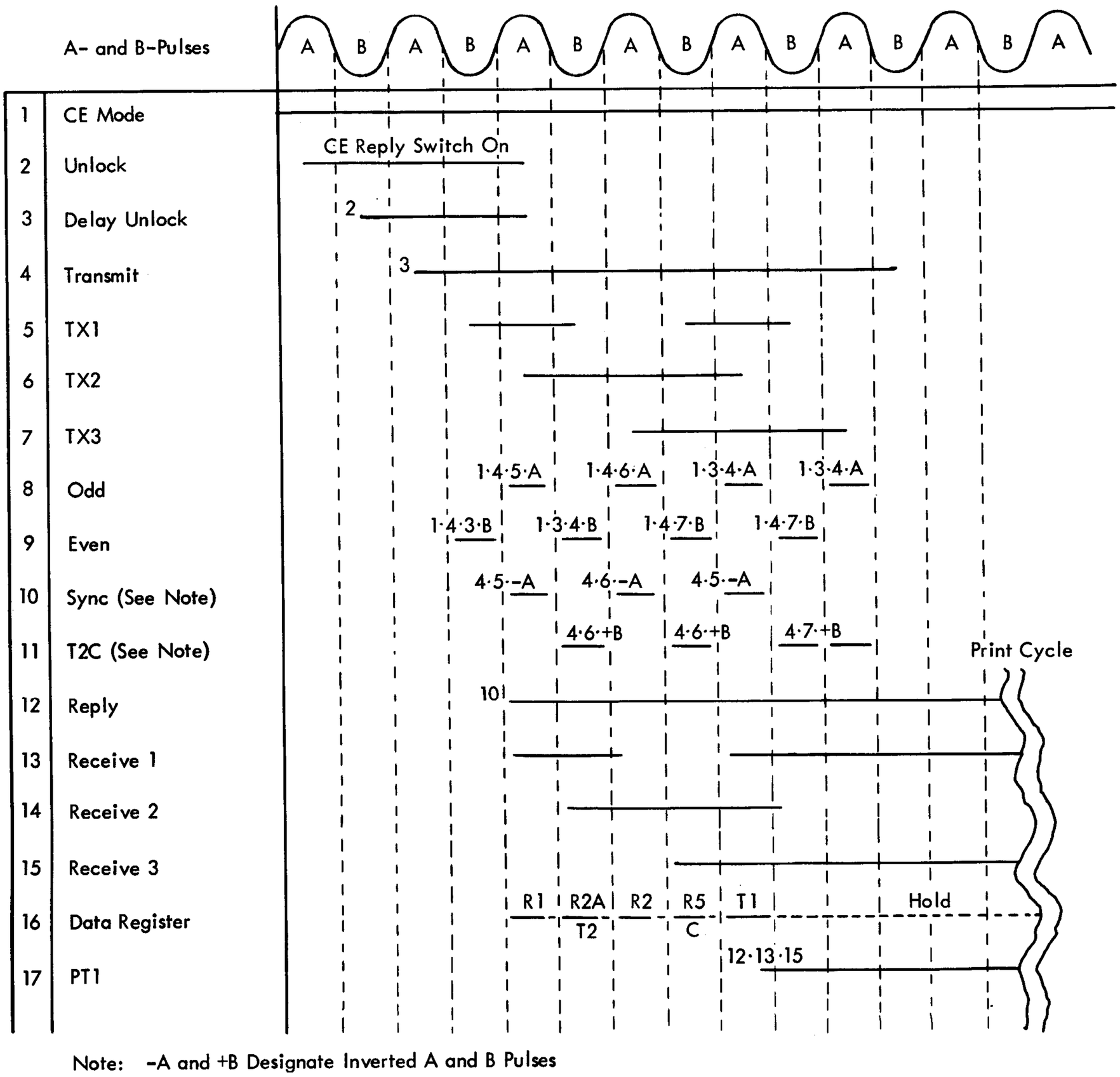


Figure 19. CE Panel



Note: -A and +B Designate Inverted A and B Pulses

Figure 20. CE Reply Operation

CE REQUEST AND REPLY SWITCH

This switch is only operative when the CE mode switch is on. In the REQUEST position this switch completes the circuit to pick the proceed relay when the CE presses the request key. This enables the CE to type characters and scope the transmit operation.

In the REPLY position this switch causes the unit to print the character set up in the bit switches. Output errors cause a normal output error routine.

DATA-CHECK HOLD

This switch can be used in either normal or CE mode. When the switch is on, it puts the parity network in series with the circuit that energizes the output magnets. The number of data-register relays must be odd or the print cycle will not start. This enables the CE to scan the relays after receiving an invalid character to see what made it invalid. The unit remains with the invalid character in the data register until the data-check-hold switch is turned off.

CE RESET SWITCH

This switch breaks the + 48 volts to the unit and interrupts the A- and B-pulses to reset any relays that are picked.

CE Reply Operation

To accomplish a reply operation in the CE mode requires controlling the character received and simulating the three negative and three positive pulses on the sync line (Figure 20). This requires taking a transmit scan during which inverted A- and B-pulses are gated to the sync line to pick the sync and T2C relays. The sync relay advances the receive-scan ring the same as during a normal reply operation. The eight pulses normally gated to the sync line during a transmit scan are gated to the data line in this operation. These pulses pick the odd or even relays every bit time. The bit switches control the character being received by completing the circuit to the data-register relays.

Installation Procedure

Follow this installation procedure after the initial unpacking instructions have been completed. Be sure to remove the shipping cradle from the printer.

Procedure Before Power On

1. Inspect the relay gate for upset wire contacts and permissive-make relays.
2. Install SMS reed-relay cards.
   a. Dry-reed relay card (4/card), position CS08.
   b. Mercury-wetted relay card (2/card), position CS10.
3. Connect the 1014 power cable to terminal block 1 on the power supply. Refer to page 1 of the wiring diagram. Note that the power cable is first fed up through the rubber grommeted hole and then clamped.
4. Connect the 1014 external 2-pair system cable depending on one of the following types of installation. Note that the system-cable end with the four ring-lug connectors must first be fed down through the rubber grommeted hole from the inside of the unit and then clamped. Excess cable can be coiled up inside the 1014. Mate the female end of the system-cable 5-prong connector to the male end in the 1014 and tighten by twisting.
   a. Local installation:

   Connect the system-cable free end (four ring-lug connectors) to the 1414 I/O inquiry attachment wall-mounted terminal-box binder posts. Refer to the 1414 inquiry installation procedure for correct wiring.

   b. Remote installation:

   Connect the system-cable free end (four ring-lug connectors) to the wall-mounted terminal-block as indicated on page 1 of the 1014 wiring diagram. Note the wire color coding.
5. Move the 1014 ON/OFF rocker switch to OFF and plug the power cable to an appropriate power outlet (110-volt ac, 60cps).
6. Flip the CE mode toggle switch on (up) and the CE request/reply ganged toggle switch to its request position (down).

Procedure After Power On

Request Mode Check-Out in CE Mode

1. Check the display indicators for correct wiring as follows:
   a. The forms indicator is turned on by the CE mode toggle switch.
   b. The proceed indicator is turned on by pressing REQUEST. It is turned off by pressing CANCEL or RELEASE.
   c. The exceed-speed indicator is turned on by obtaining a proceed status and pressing the space bar and M key simultaneously. Press CANCEL to extinguish the indicator.
   d. The check indicator is turned on by obtaining a proceed status and pressing RELEASE. Press CANCEL to extinguish the indicator.
   e. The request indicator is turned on momentarily by pressing REQUEST in CE mode. As a result, it may not be visible. While checking the CE reply mode as described in the following instructions, press REQUEST to cause the request indicator to glow steadily.
2. Obtain a proceed status and continue to press REQUEST. A single carrier-return cycle is initiated with each depression of the request key.
3. Obtain a proceed status. Following the proceed, do not operate the keyboard. The automatic timed-delay cancel should occur within 30 seconds ± 15 seconds. After an automatic cancel, wait at least 10 seconds before obtaining another proceed. Also check to make sure that the automatic cancel does not occur after the first character of an inquiry is keyed.

Reply Mode Check-Out in CE Mode

1. The CE reply mode allows the printing of any printable character or the exercising of any functional operation (tabulate, space, or carrier return) determined by the seven bit switches located on the CE panel. When setting up the desired I/O printer bit combination, use the following procedure.
   a. Move the ganged request/reply toggle switch to its request position (down).

b. Flip the CE mode toggle switch on.
c. Press RESET.
d. Set up the bit switches.
e. Move the ganged request/reply switch to its reply position (up). This starts the reply operation. Returning the request/reply switch to its request position (down) stops the reply operation.

2. Check out the following I/O reply operations using the above procedure. Only procedure steps *1c*, *d*, and *e* are necessary to repeat after steps *1a* and *b*. Refer to Figure 5 for the correct bit combination of the desired character.
a. Set up the character I. Check for correct printing. Allow printing to continue and move the right-hand margin stop to several positions. Each time the margin stop is reached, a single carrier return is initiated.
b. Set up the character 1. Check for correct printing.
c. Repeat for the character N.
d. Set all the bit switches off and initiate a CE reply. Check for the printing of a pound sign (#) and the turning on of the check light.
e. Set up the functional characters for tabulate, space, and carrier return, and check for correct operation.
f. Set up the character I, however, this time insert a C-bit. This should cause the check light to turn on, the carrier to backspace, and a pound sign to print over the character printed with even parity. Allow the backspace and pound-print cycles to continue and flip the data-check-hold toggle switch on (up). This switch stops printing and holds the character in error in the 1014 I/O data register. Flip the data-check-hold switch off, and printing resumes.

This completes the 1014 off-line installation checkout procedure. Return the 1014 to its on-line status by flipping the CE mode switch off (down), and pressing RESET.

Check the end-of-forms microswitch located in the bottom of the internal paper tray by placing several sheets of forms on the tray. The forms indicator should be extinguished. Remove the paper and the forms indicator should be on.

Scheduled Maintenance

Safety

Due to the positive action of the typewriter, working in certain areas is particularly hazardous if safe working practices are not followed. Because it is not possible to forsee each individual area of exposure, the following general rules should be used as a guide when working on this equipment.

1. At the completion of a service call, gear guards and dust shields must be replaced. These safety guards are installed to prevent the operator from placing her hands into moving parts. Because most operators have little knowledge of the mechanical workings of the machine, the only way they can be adequately protected is to place these guards over exposed areas. Use caution when servicing this machine during the time the gear guards and dust shields are removed.
2. When lubricating or replacing parts, be sure the machine is turned off. It is a good idea either to remove the plug from the wall socket or disconnect the switch link after turning the switch to the OFF position. This eliminates the possibility of turning the machine on accidentally.
3. Exercise caution when handling the motor. The shaded-pole motor used in this machine runs considerably hotter than the capacitor-type motor used in the Model C typewriter.
4. Be particularly careful when picking up and handling all machines to avoid injury to the hands from sharp edges on stamped parts, springs, links, etc. While the safety of the operator and the CE is one of the prime considerations in the design of a product, mass-production techniques do not permit separate operations on each part to provide a smooth edge.
5. Wear safety glasses when performing any work that could possibly result in parts, lubricants, cleaning solvents, or any other material coming in contact with the eyes.

Control Unit

1. Every 12 months measure the + 48 volt power supply at the terminal block (TB1-6 and TB1-7). It should measure between 43.2 and 52.8 volts.
2. Every 12 months check PT1-1 and PT1-2 points for burning or pitting.
3. Every inspection check the line cord for safe conditions and proper grounding.

Printer

For scheduled maintenance of the printer, refer to *I/O Printer (Modified IBM Selectric®), CE Reference Manual (225-1726).*

Diagnostic Aids

Scoping Hints

1. The scope must be grounded to the power-supply ground because the frame and power-supply grounds are not common. Ground point TB 90 is common.
2. When scoping relay circuits, use a 10K ½ watt resistor (P/N 300721) jumpered to the power-supply ground to return the scope trace to ground when a relay point opens. Without the jumper, the trace returns slowly to ground and causes a wrong picture of the circuit.
3. Don't ignore scoping the data and sync lines when the trouble appears to be in the 1014. The information contained on these lines often gives some clue about the trouble in the 1014.
4. The check relay is difficult to scope because + 48 volts is always applied to the pick side of the relay, with pick control being on the pick common side of the relay. When the pick common side of the relay goes from + 48 volts to 0 volts, the relay is picked. To scope the check relay, look for this voltage shift on the pick common side of the relay.

Relay Timing

The following relay timings and expected tolerances are shown for reference during initial installation and for suspected trouble in the receive- or transmit-ring relays.

1. Carrier-return relay-capacitor timing (Figure 21).
   a. Circuit
   b. Voltage wave form.
2. Transmit-sync relay timing (Figure 22). The durations of the transmit-sync mercury-wetted relay points are shown with maximum and minimum make and break duration times.
3. Receive-sync relay timing (Figure 23). The durations of the receive-sync mercury-wetted relay points are shown with maximum and minimum make and break duration times.
4. Power-off reset signal timing (Figure 24).

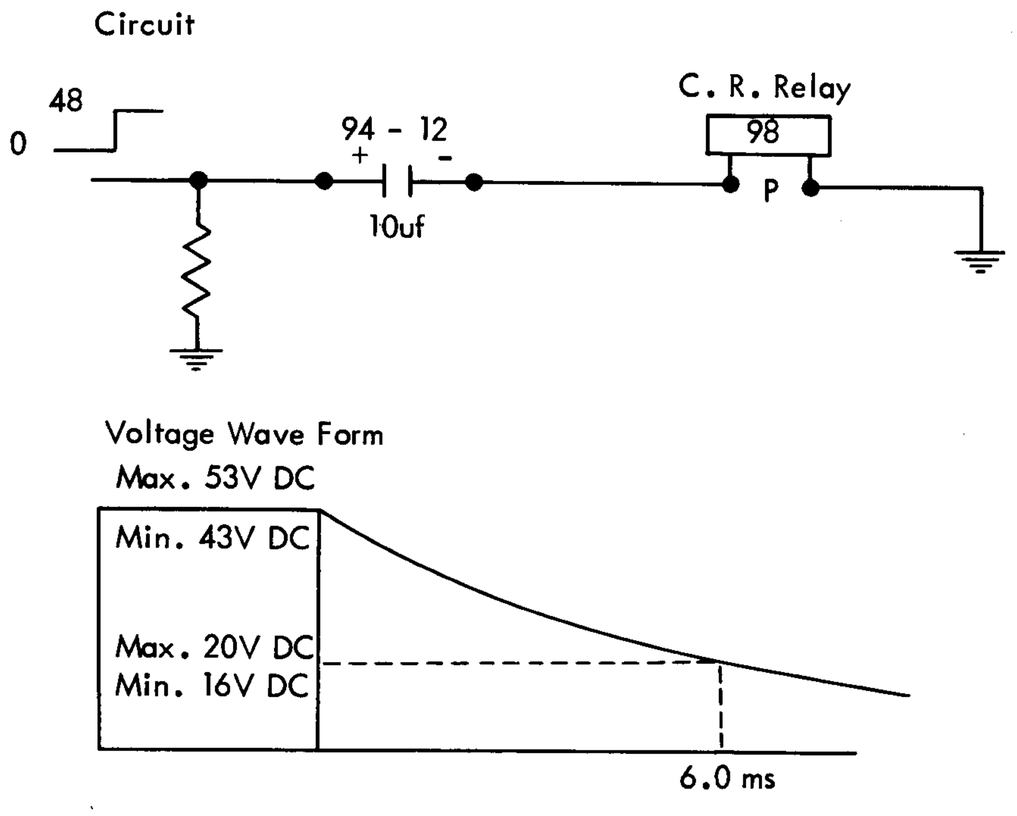


Figure 21. Carrier-Return Relay-Capacitor Timing

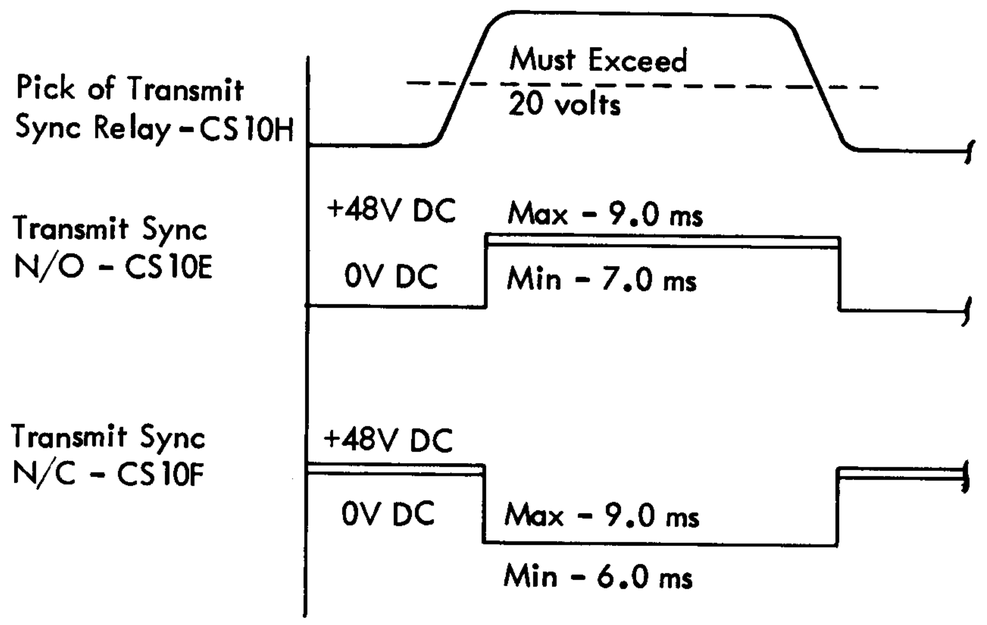


Figure 22. Transmit-Sync Relay Timing

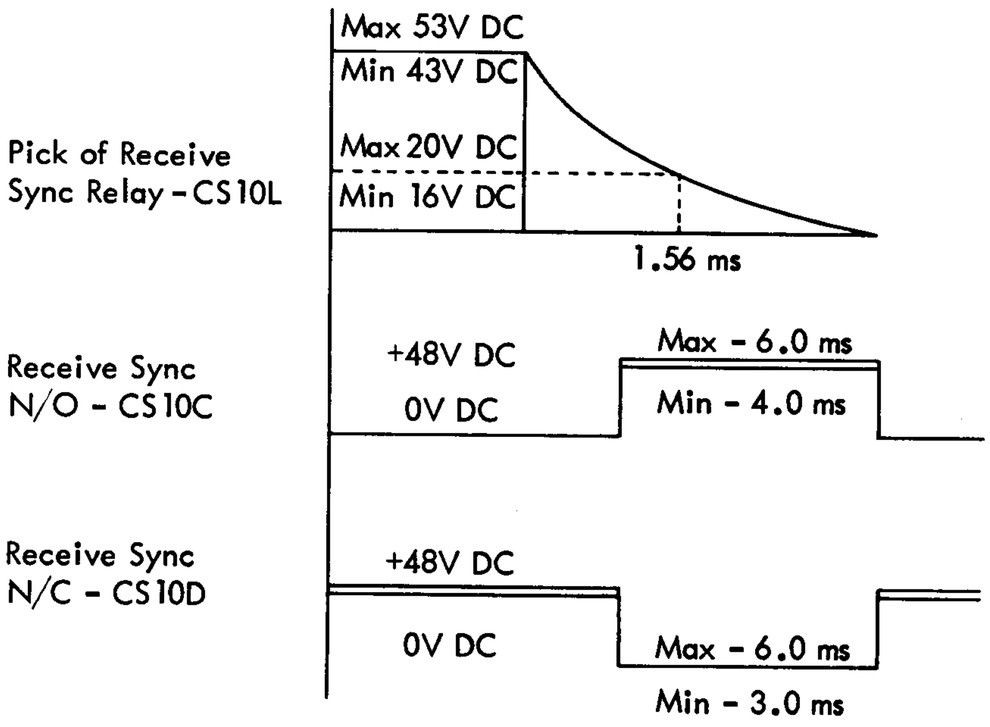


Figure 23. Receive-Sync Relay Timing

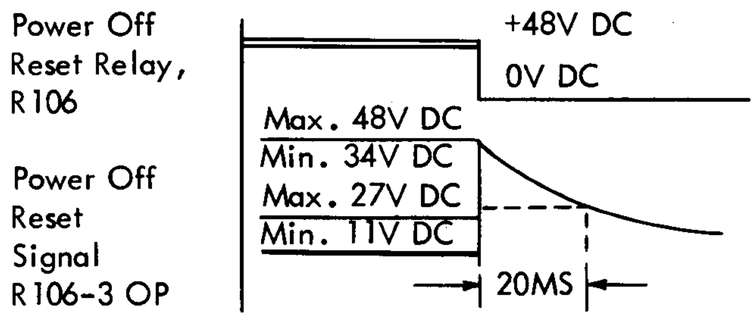
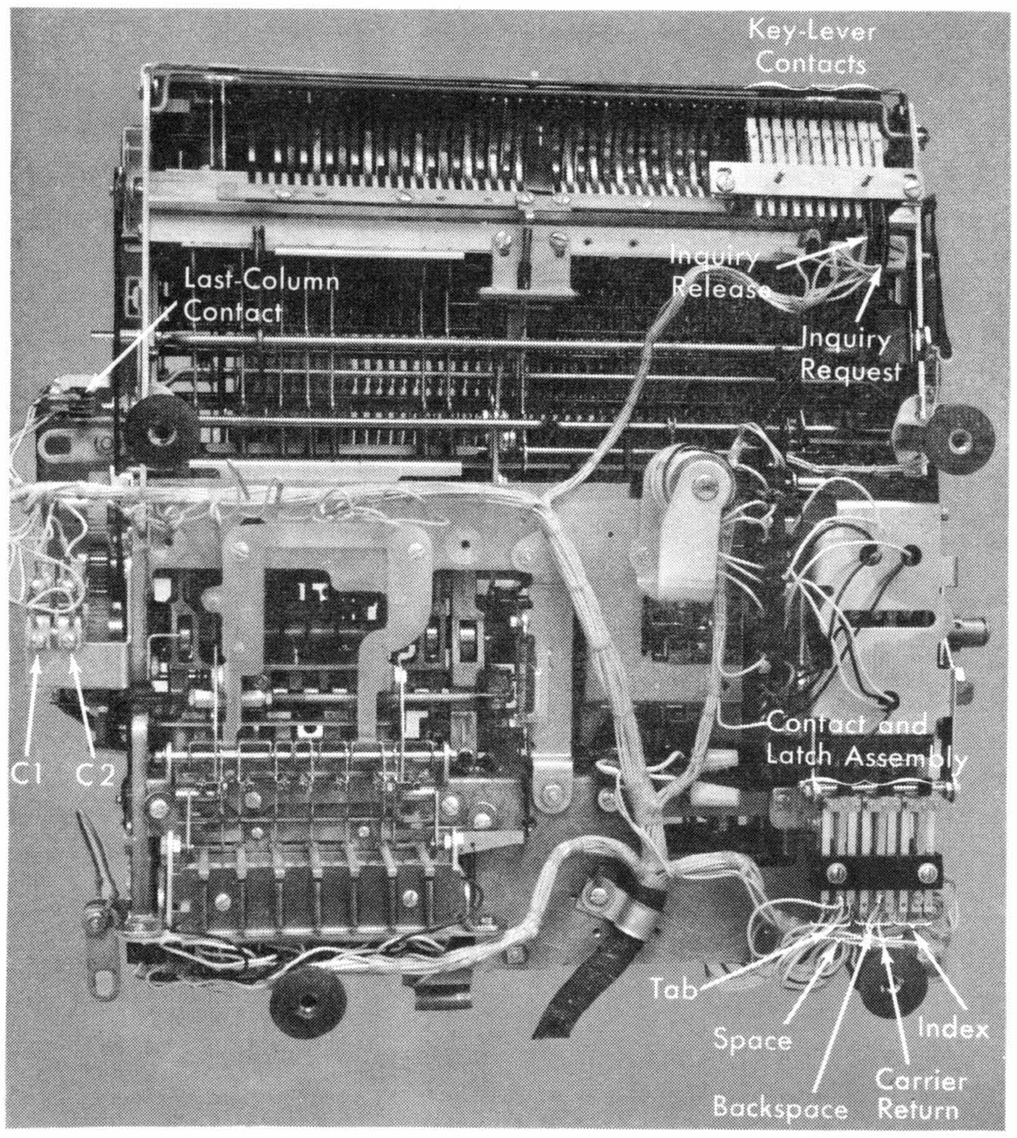
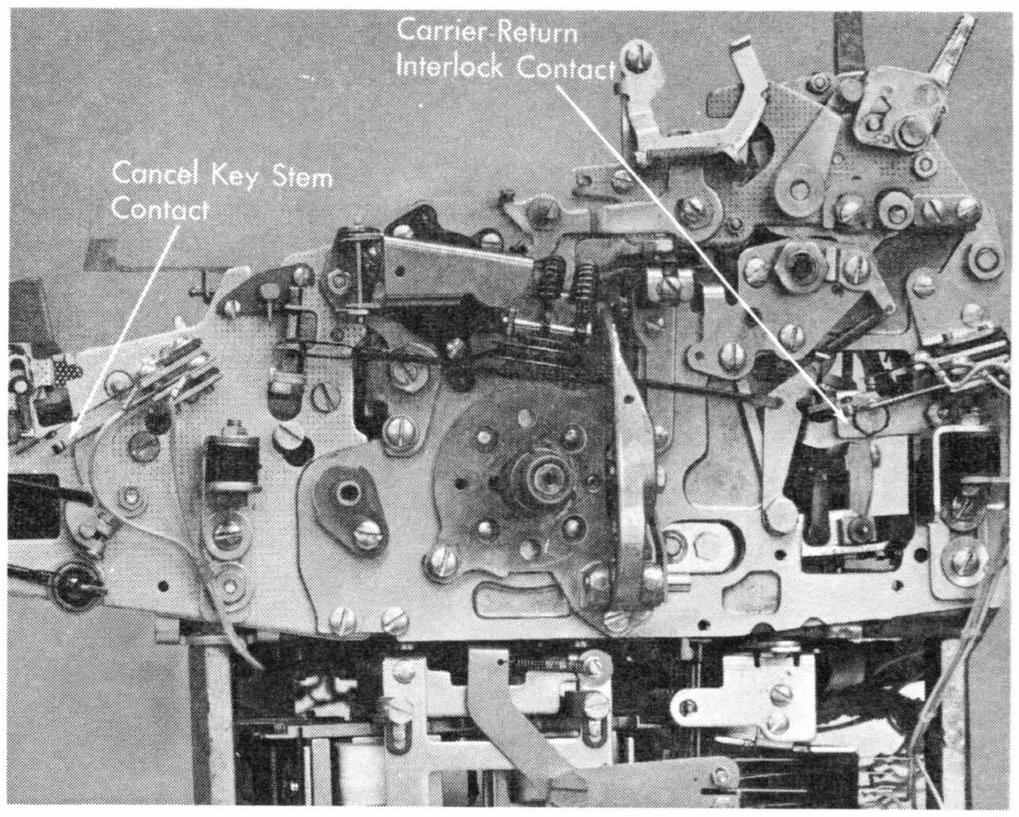


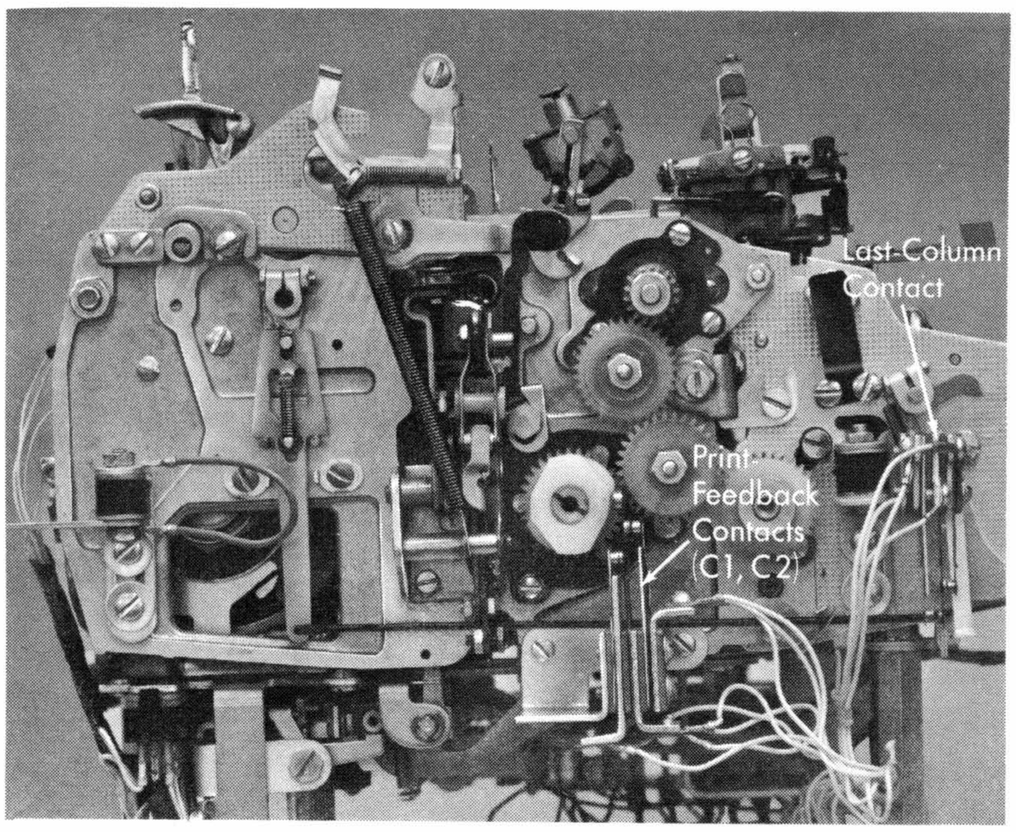
Figure 24. Power-Off-Reset Signal Timing

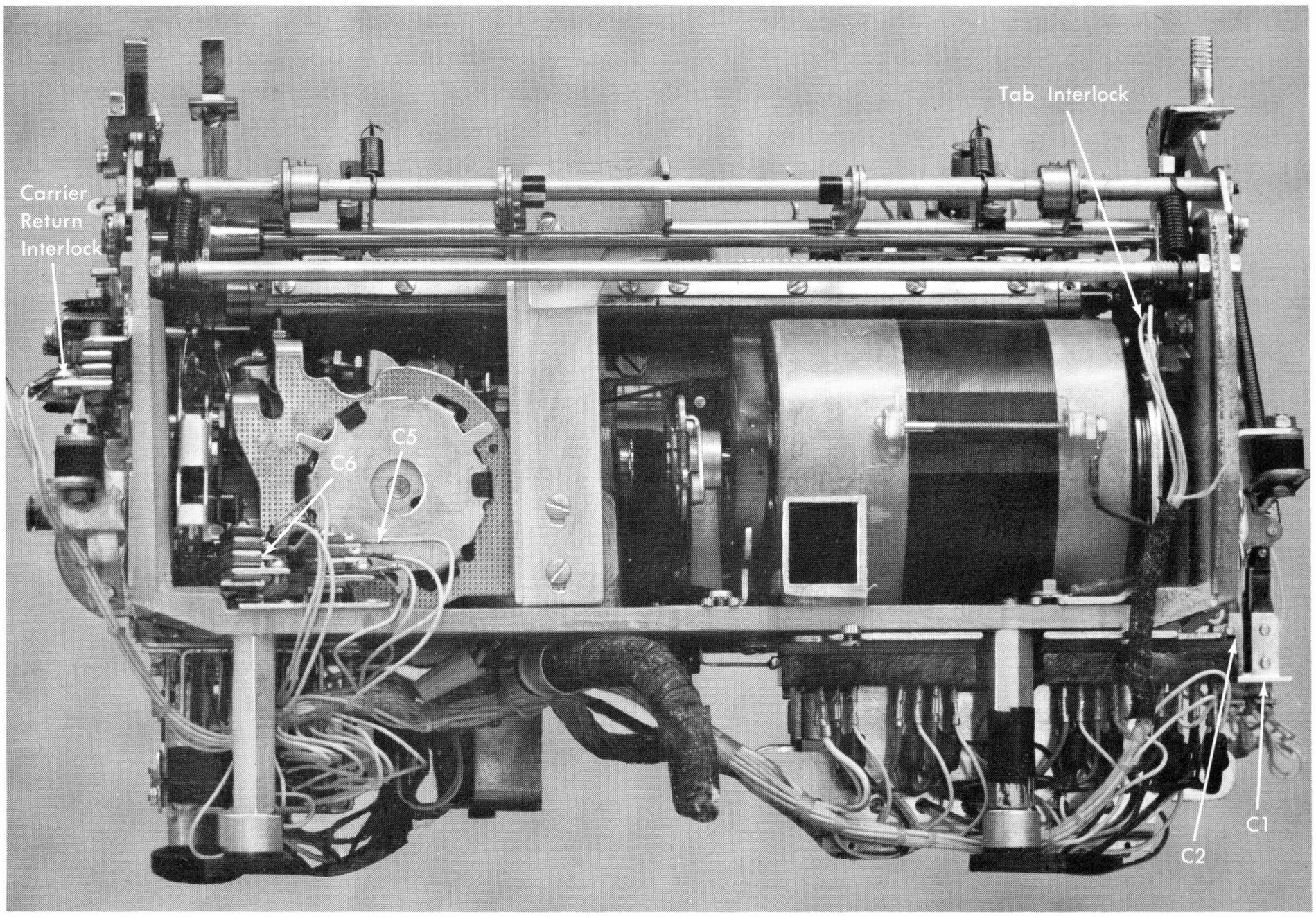
Appendix

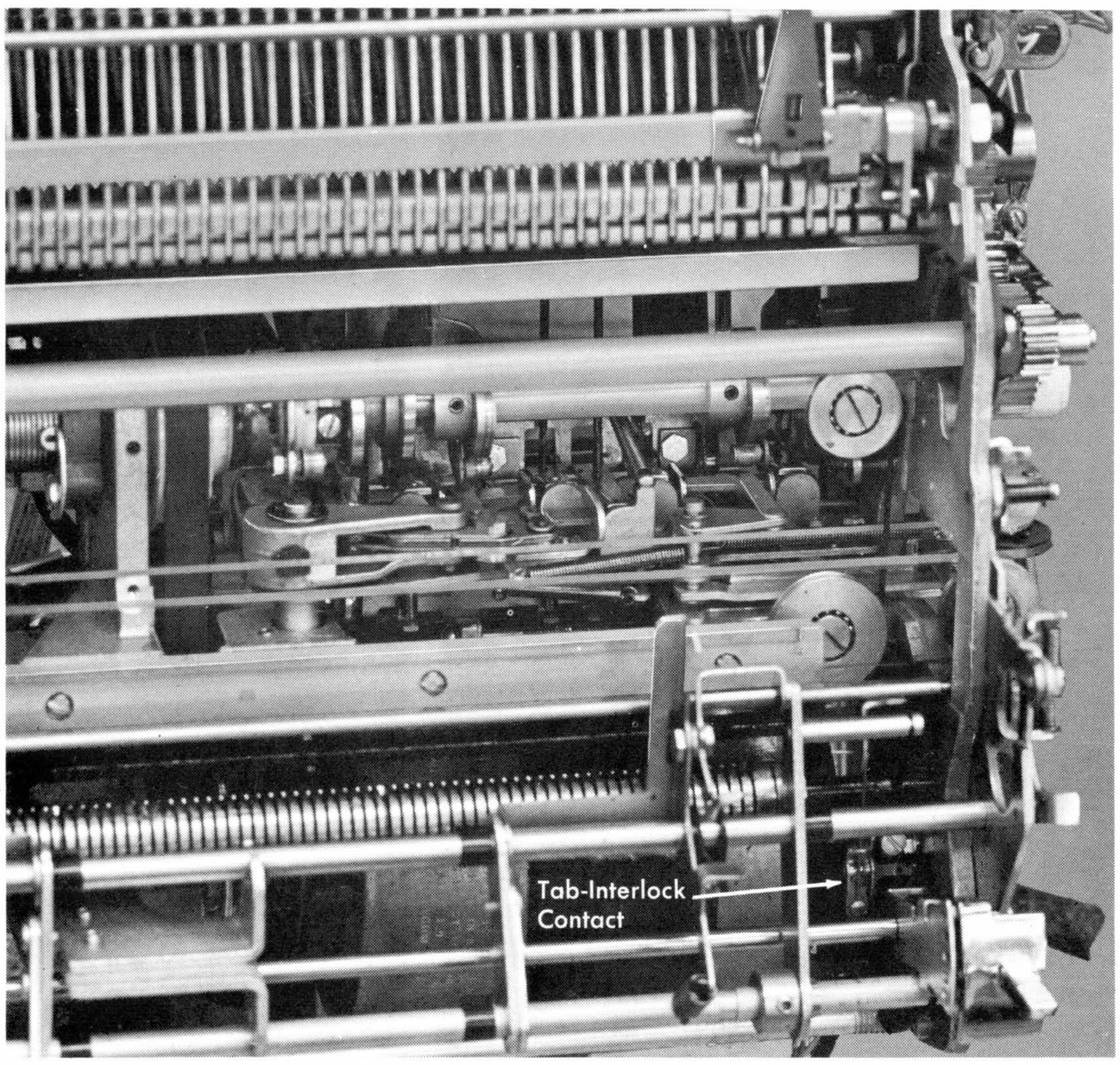
Printer Contact Locations



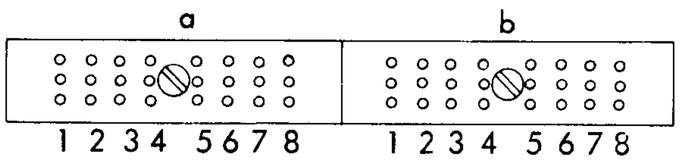




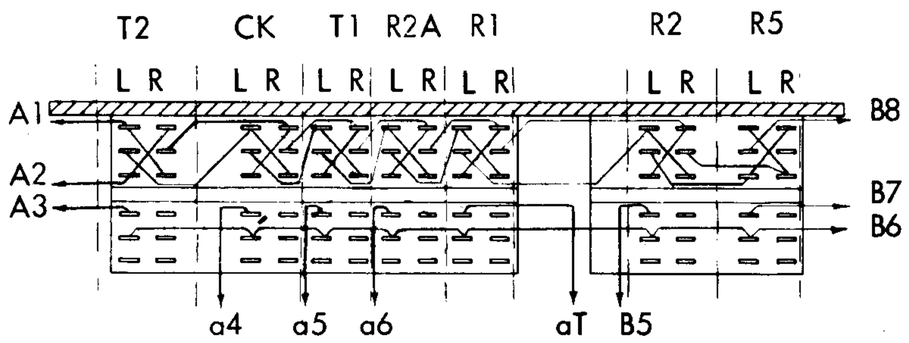

Carrier
Return
Interlock
Tab Interlock
C5
C6
C2
C1


Tab-Interlock
Contact

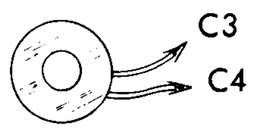
Printer Component Locations (Viewed from Below)



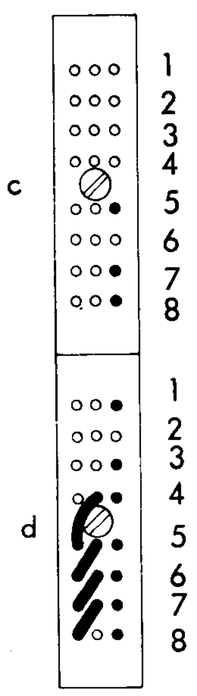
SEL CONT TERM BLOCK



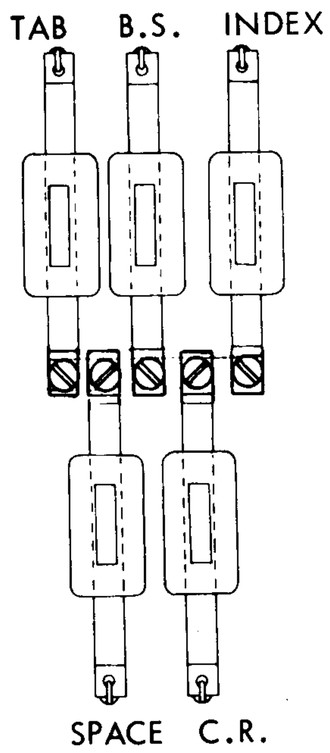
TERMINAL END VIEW OF SEL CONT



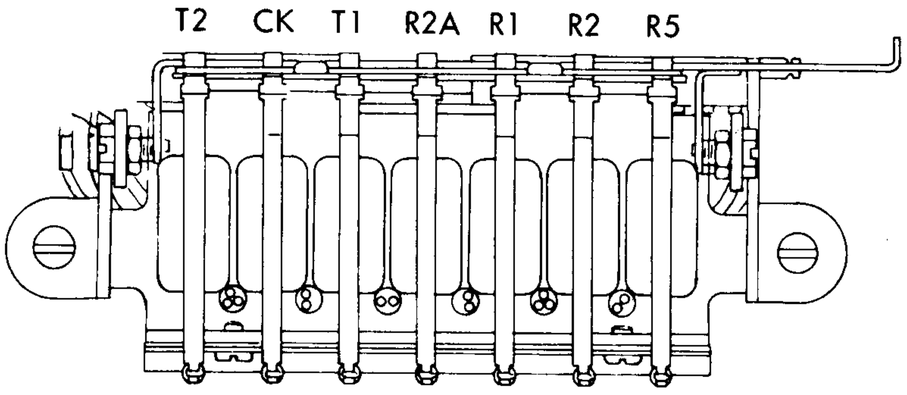
KEYBOARD LOCK SOLENOID



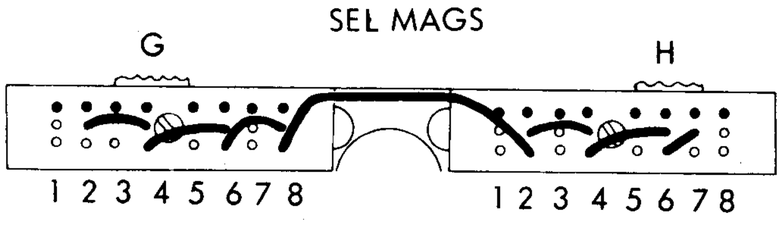
OPER TERM BLOCK



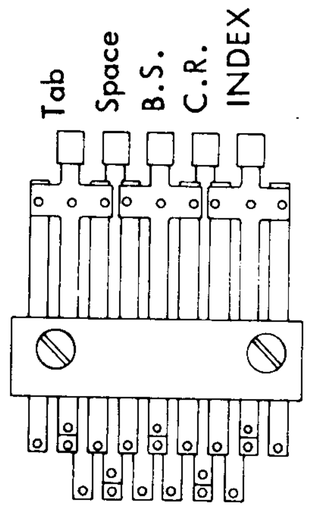
OPER MAGS



SEL MAGS



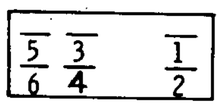
SEL MAG TERM BLOCK



OPER MAG CONTACTS

WIRING CHART		
COIL	BLACK LEAD	WHITE LEAD
T2	g-2	g-1
CHECK	g-4	g-3
T1	g-6	g-5
R2A	g-8	g-7
R1	h-2	h-1
R2	h-4	h-3
-R5	h-6	h-5

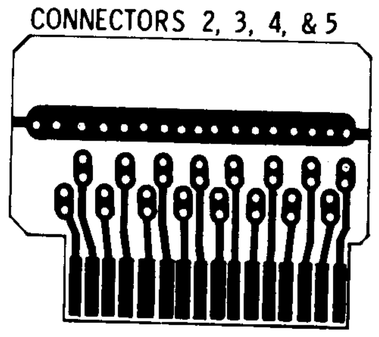
MAGNET WIRING CHART		
COIL	BLACK LEAD	WHITE LEAD
TAB	d-4	c-5
SPACE	d-5	c-7
BACKSPACE	d-6	c-8
CARRIER RETURN	d-7	d-1
INDEX	d-8	d-3



JONES PLUG J

NUMBERS ARE PIN CONNECTORS AS SEEN FROM OUTSIDE OF MALE CONNECTOR

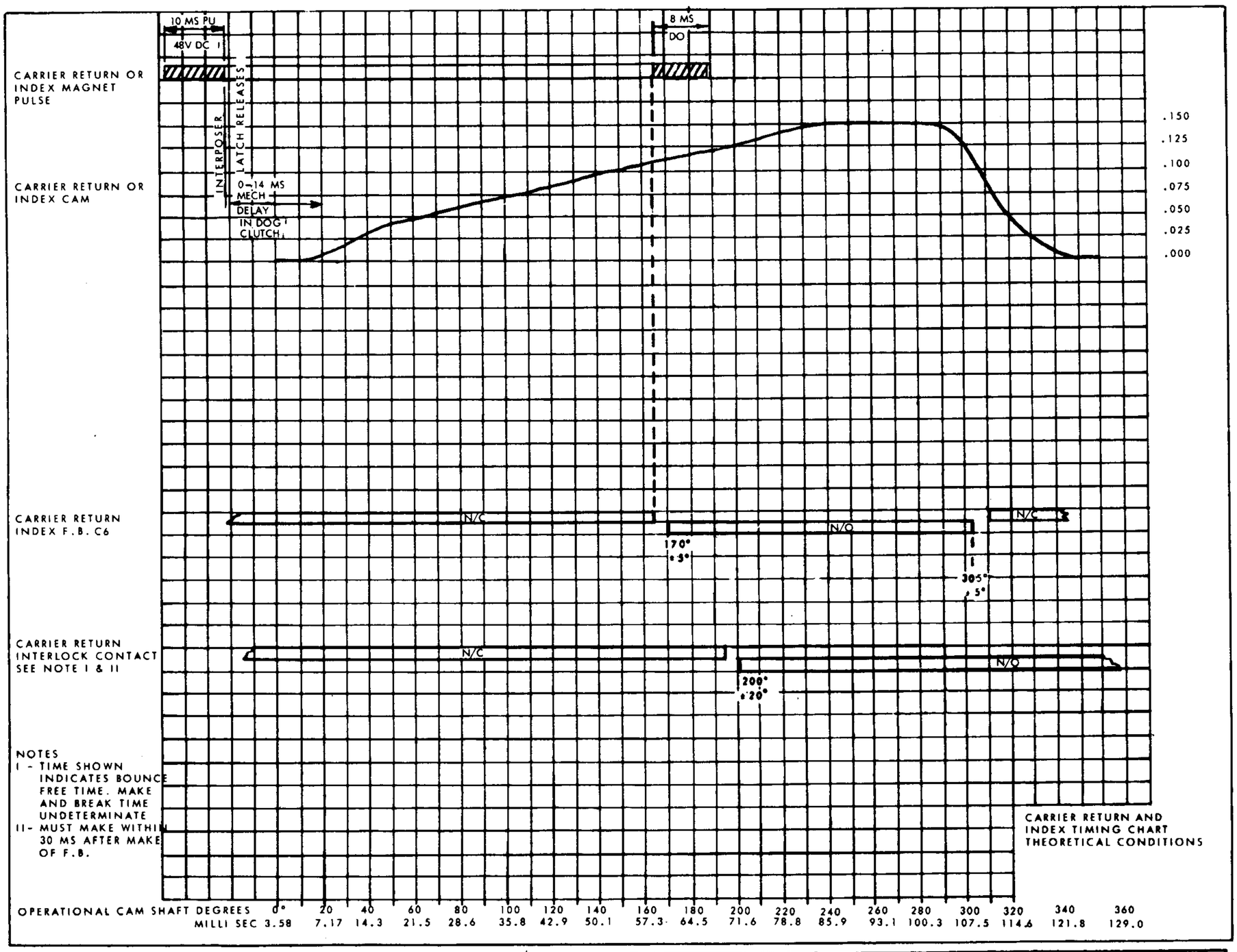
CONNECTORS 2, 3, 4, & 5

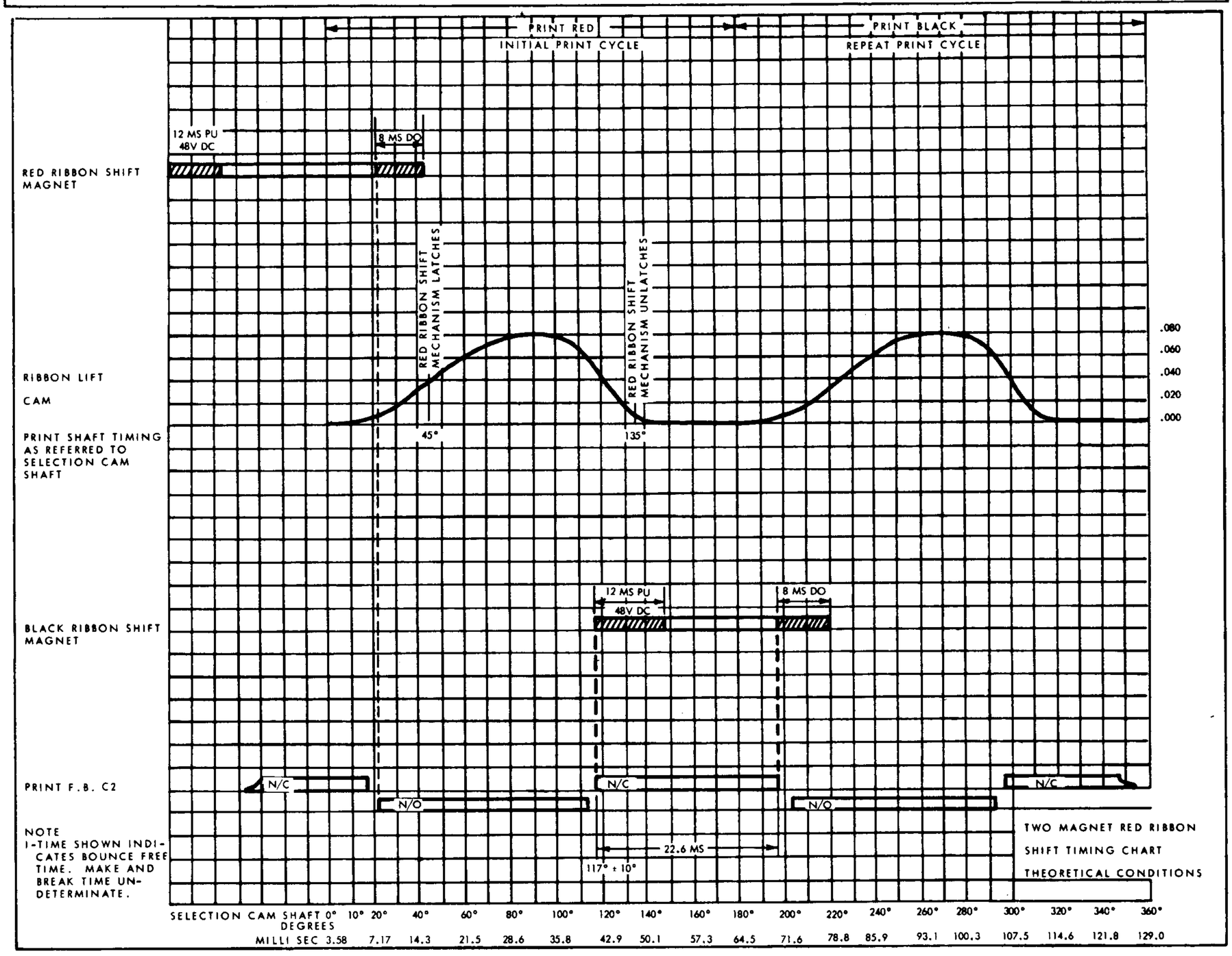


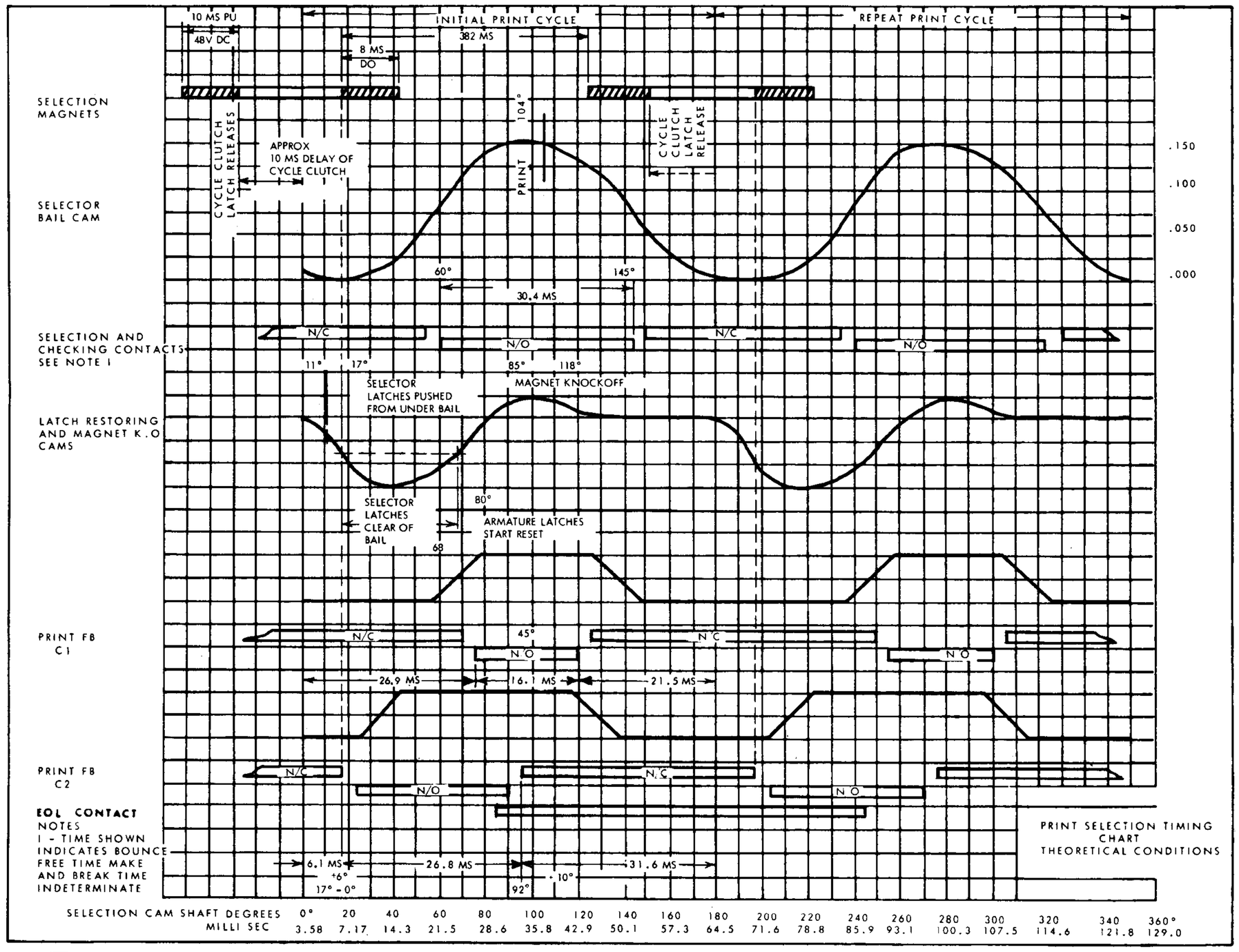
A B C D E F G H J K L M N P Q R

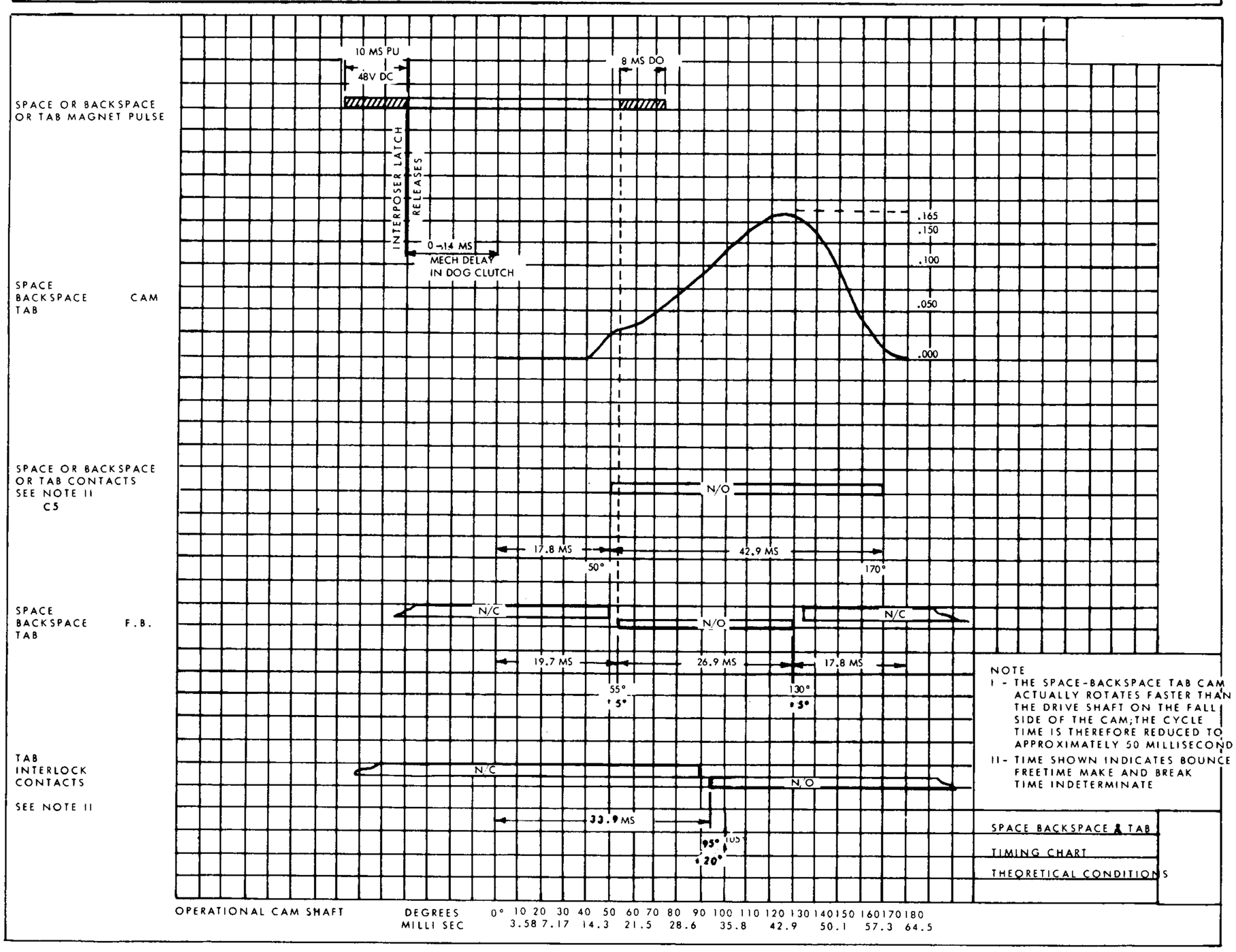
PADDLE CONNECTORS NUMBERED PROGRESSIVELY ACCORDING TO POSITION LACED OUT OF CABLE. NUMBER 2 IS NEAREST THE JONES PLUG.

Printer Timing Charts






10 MS PU
48V DC
INITIAL PRINT CYCLE
382 MS
8 MS DO
REPEAT PRINT CYCLE
SELECTION MAGNETS
CYCLE CLUTCH LATCH RELEASES
APPROX 10 MS DELAY OF CYCLE CLUTCH
104°
PRINT
CYCLE CLUTCH LATCH RELEASE
SELECTOR BAIL CAM
.150
.100
.050
.000
60°
145°
30.4 MS
SELECTION AND CHECKING CONTACTS SEE NOTE I
N/C
N/O
N/C
N/O
11°
17°
85°
118°
SELECTOR LATCHES PUSHED FROM UNDER BAIL
MAGNET KNOCKOFF
LATCH RESTORING AND MAGNET K.O CAMS
SELECTOR LATCHES CLEAR OF BAIL
80°
ARMATURE LATCHES START RESET
68
PRINT FB C1
N/C
45°
N/C
N/O
N/O
26.9 MS
16.1 MS
21.5 MS
PRINT FB C2
N/C
N/O
N/C
N/O
EOL CONTACT
NOTES
I - TIME SHOWN INDICATES BOUNCE FREE TIME MAKE AND BREAK TIME INDETERMINATE
6.1 MS
+6°
17° - 0°
26.8 MS
92°
+10°
31.6 MS
PRINT SELECTION TIMING CHART
THEORETICAL CONDITIONS
SELECTION CAM SHAFT DEGREES 0° 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360°
MILLI SEC 3.58 7.17 14.3 21.5 28.6 35.8 42.9 50.1 57.3 64.5 71.6 78.8 85.9 93.1 100.3 107.5 114.6 121.8 129.0


SPACE OR BACKSPACE OR TAB MAGNET PULSE
10 MS PU
48V DC
8 MS DO
INTERPOSER LATCH RELEASES
0 -.14 MS MECH DELAY IN DOG CLUTCH
SPACE BACKSPACE TAB CAM
.165
.150
.100
.050
.000
SPACE OR BACKSPACE OR TAB CONTACTS SEE NOTE II C5
N/O
17.8 MS
50°
42.9 MS
170°
SPACE BACKSPACE TAB F.B.
N/C
N/O
N/C
19.7 MS
55°
±5°
26.9 MS
17.8 MS
130°
±5°
TAB INTERLOCK CONTACTS
SEE NOTE II
N/C
N/O
33.9 MS
95°
105°
±20°
NOTE
I - THE SPACE-BACKSPACE TAB CAM ACTUALLY ROTATES FASTER THAN THE DRIVE SHAFT ON THE FALL SIDE OF THE CAM; THE CYCLE TIME IS THEREFORE REDUCED TO APPROXIMATELY 50 MILLISECOND
II - TIME SHOWN INDICATES BOUNCE FREETIME MAKE AND BREAK TIME INDETERMINATE
SPACE BACKSPACE & TAB
TIMING CHART
THEORETICAL CONDITIONS
OPERATIONAL CAM SHAFT DEGREES 0° 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
MILLI SEC 3.58 7.17 14.3 21.5 28.6 35.8 42.9 50.1 57.3 64.5

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