3600

Control Data® 362X
Magnetic Tape Controller
Reference/Instruction Manual

Record of Revisions

REVISION	NOTES

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CHAPTER 1
INTRODUCTION

The CONTROL DATA* 362X Magnetic Tape Controller connects and handles computer operations on Control Data 606 or 607 Magnetic Tape Transports. It has capabilities for handling up to four bidirectional input/output data channels. Each channel may communicate with any one of the 16 (maximum) tape transports if the desired unit is not in use or reserved by some other channel. Four channels may communicate with four different tape units simultaneously.

The 362X is available with the following options:

3621	Two Read-Write controls to control one to eight 606/607 magnetic tape transports.
3622	Two Read-Write controls to control one to sixteen 606/607 magnetic tape transports.
3623	Four Read-Write controls to control one to eight 606/607 magnetic tape transports.
3624	Four Read-Write controls to control one to sixteen 606/607 magnetic tape transports.
3625	Three Read-Write controls to control one to eight 606/607 magnetic tape transports.
3626	Three Read-Write controls to control one to sixteen 606/607 magnetic tape transports.

Since all four sets of control logic are identical, this manual covers a typical control. The matrix which enables communication paths between the data channels and the tape transports is discussed in detail in Chapter 2.

Read and similar operations, Write and similar operations, and Function operations are discussed in their respective chapters.

Figure 1-1 shows the 362X fully expanded to handle sixteen 606/607 magnetic tape units. Figure 1-2 shows the 362X as related to the basic 3600 system. Figure 1-3 is a block diagram of the 362X logic and shows signals sent between a 362X control and a data channel. Figure 1-3 also shows the signals transmitted to/from a 362X control and a 606/607 magnetic tape transport. Table 3-1 lists function and status codes used

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with the 362X.

For detailed programming information and capabilities, refer to the 362X section in the 3600 reference manual.

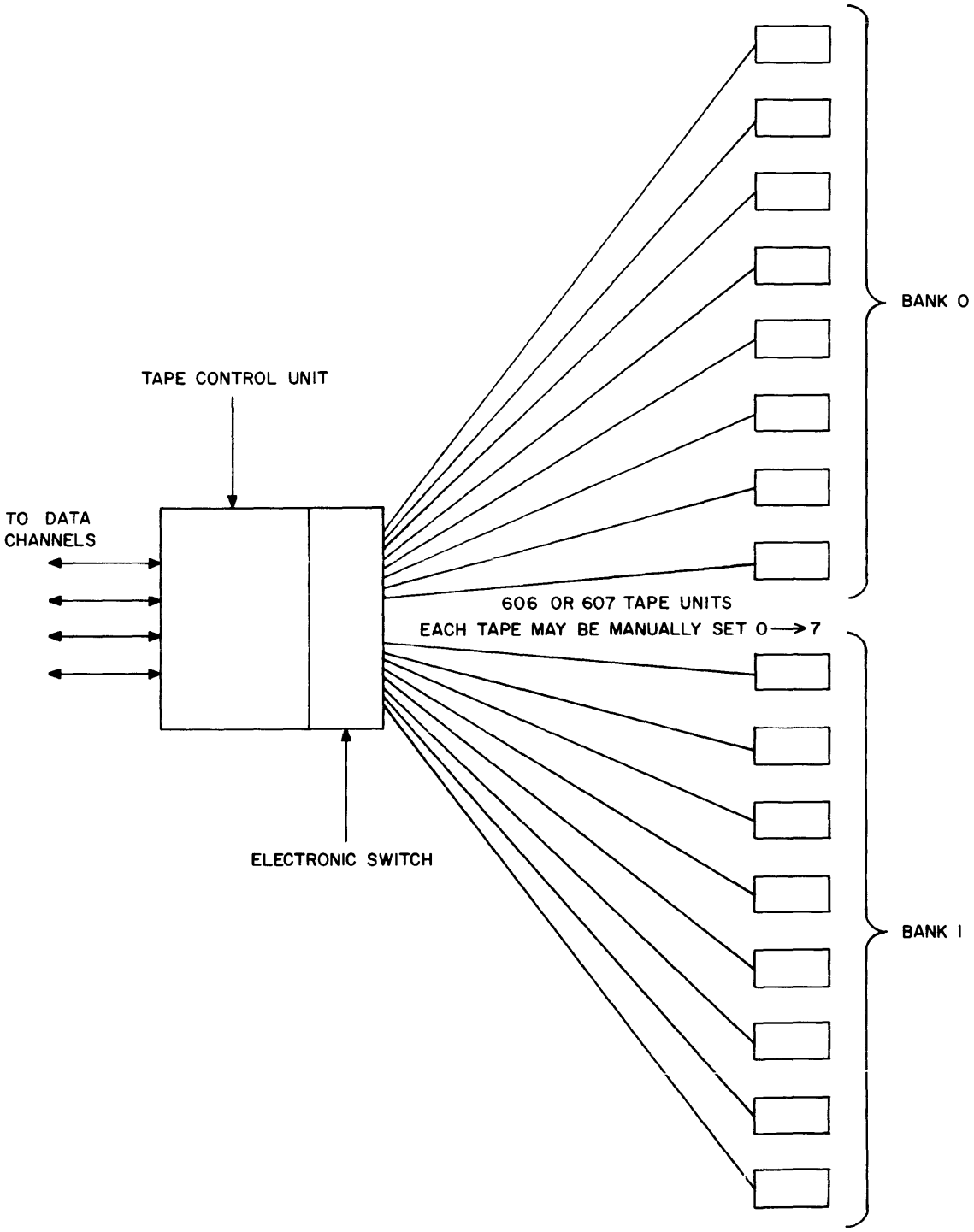


Figure 1-1. 362X Magnetic Tape Controller

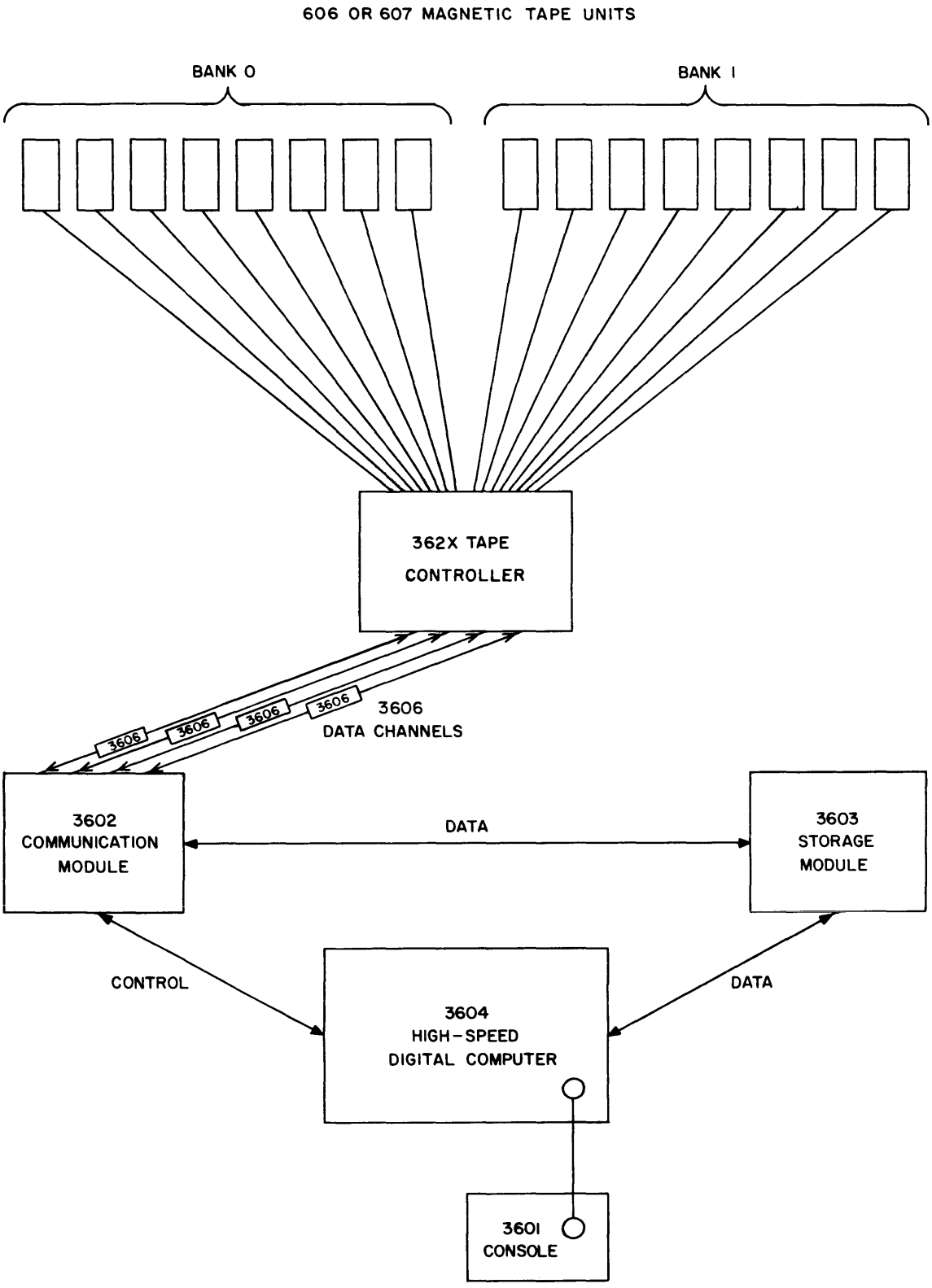


Figure 1-2. 362X as Related to the Basic 3600 System

362X TAPE CONTROLLER

CONTROL A

3606 DATA CHANNEL

(12) INFORMATION BITS
PARITY BIT
CONNECT
FUNCTION
DATA SIGNAL
READ
MC
WRITE
REPLY
REJECT
REVERSE ASSEMBLY
END OF RECORD
(8) INTERRUPT
TRANSMISSION PARITY ERROR
(12) STATUS LINES
NEGATE BCD CONVERSION
CHANNEL BUSY

TO / FROM CONNECT, FUNCTION, READ AND WRITE LOGIC

CONNECT LOGIC
TAPE UNIT CONNECTED
REPLY
REJECT

FUNCTION LOGIC
REPLY
REJECT

READ LOGIC
7 BITS INFORMATION
REPLY

WRITE LOGIC
7 BITS INFORMATION
REPLY

REPLY
REJECT

SWITCHING LOGIC

WRITE SPROCKET
(7) WRITE INFORMATION
WRITE
READ
FORWARD
REVERSE
SEARCH END OF FILE
REWIND
SET DENSITY 556 BPI
SET DENSITY 200 BPI
MC
REWIND UNLOAD
TURN ON RESERVE LIGHT (NO.2)
TURN ON CONNECT LIGHT (NO.1)
READY
BUSY
READ SPROCKET
(7) READ INFORMATION
LOAD POINT
END OF TAPE
DENSITY 556 BPI
WRITE ENABLE
FILE MARK
END OF RECORD
(8) ADDRESS
DENSITY 800 BPI

606 OR 607 TAPE UNIT

TO / FROM A MAXIMUM OF 15 ADDITIONAL 606/607 TAPE UNITS

CONTROL A IS SHOWN IN DETAIL. IDENTICAL LOGIC APPLIES FOR CONTROLS B,C AND D. A MAXIMUM OF 4 DATA CHANNELS MAY BE ATTACHED TO THE 362X.

THIS SWITCH ENABLES ANY CONTROL TO COMMUNICATE WITH ANY OF A MAXIMUM OF SIXTEEN 606 TAPE UNITS.

= INFORMATION
= CONTROL

3606 — CONTROL C
3606 — CONTROL B
3606 — CONTROL D

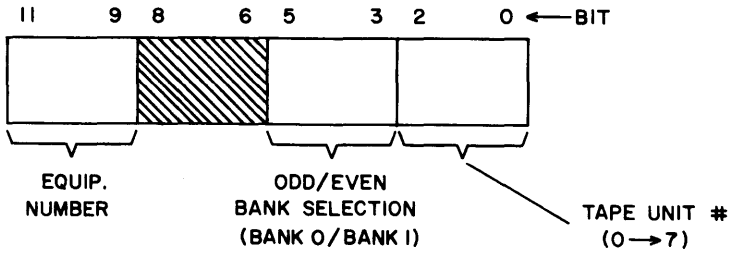
362X BLOCK DIAGRAM

362X
YCP 311301 A
REV. 27 1-5

CHAPTER 2
CONNECT

CONNECT CODE

A connect is initiated by the computer via a communication module and a data channel. The 362X uses a connect sequence to establish a communication path with any one of 16 tape units. The 12-bit connect code is diagrammed below. See the 3600 Reference Manual for a detailed description of the connect instruction.



Refer to figures 2-2, 2-3, 2-4, and 2-5 for logic and events involved during a connect operation. The flow chart (figure 2-1) indicates the approximate order of events in a connect operation. The block diagram in figure 2-2 shows the logic paths for all controls during the connect sequence. Figure 2-3 gives the detailed logic involved for control X which can be any one of the four controls in the tape controller. Figure 2-4 shows the connect chain and scanner which are shared by all four controls. Figure 2-5 shows the connect logic in detail for Control A, Bank 0. Bank 1 logic is identical except for different numeration and letter designations.

NUMERATION

All logic connected with controls A, B, C, or D is reflected in the logic numeration. Thus, K010/011, K110/111, K210/211 and K310/311 refer to the Control A, C, B, and D Connect Address FFs. When x's are used in the diagrams, they indicate any value from $\bar{0}\rightarrow\bar{3}$ or $\bar{0}\rightarrow\bar{7}$. U inverters are used in bank 0 logic, V inverters in bank 1. All terms are similar with the exception that corresponding terms (other than V terms) in bank 1 equal bank 0 terms increased by 50. Thus, K020/021 is the Unit-Control Connect FF for Control A, tape unit 0, bank 0. K070/071 is the corresponding FF for Control A, tape unit 0, bank 1.

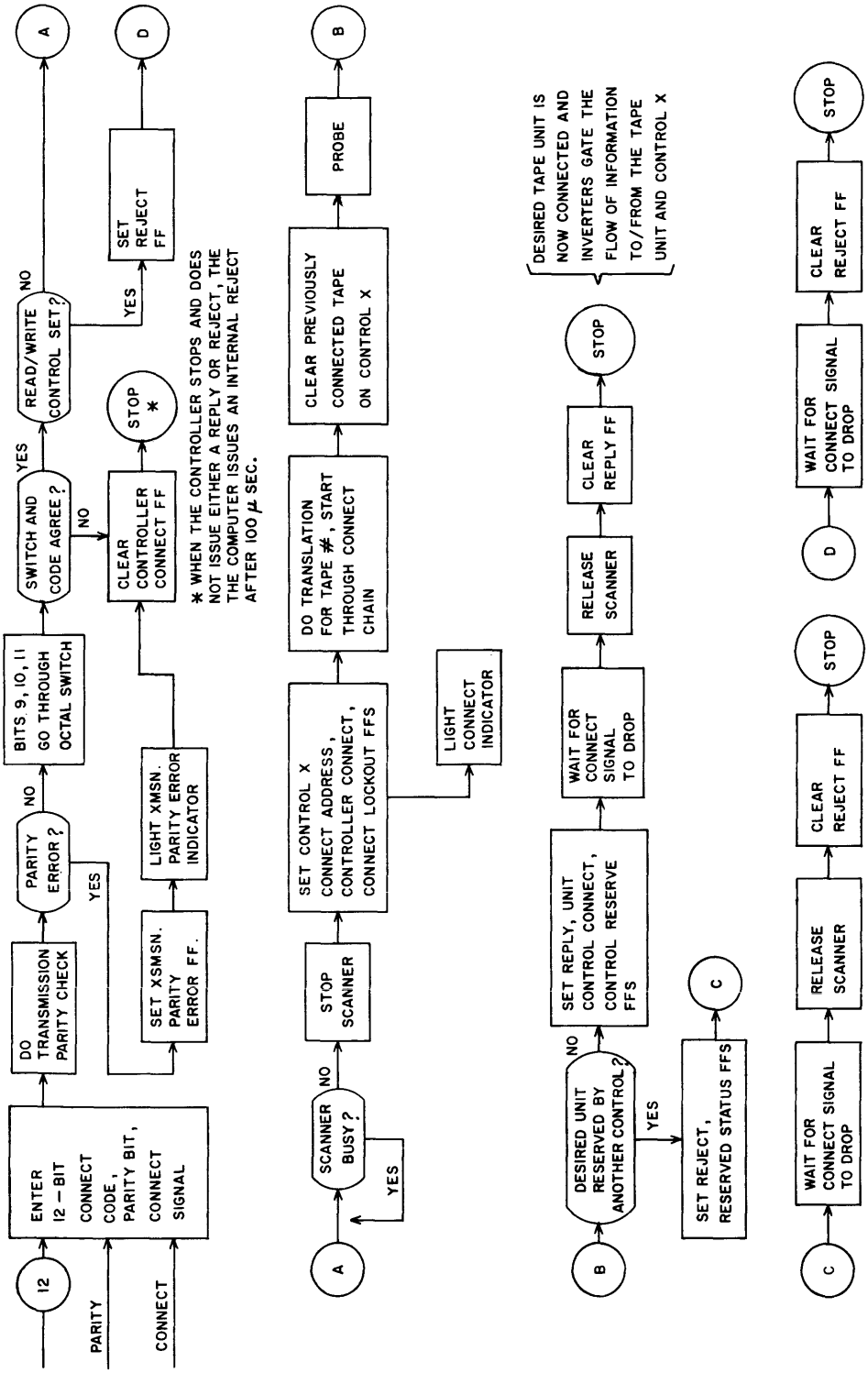


Figure 2-1. Connect Sequence, Control X

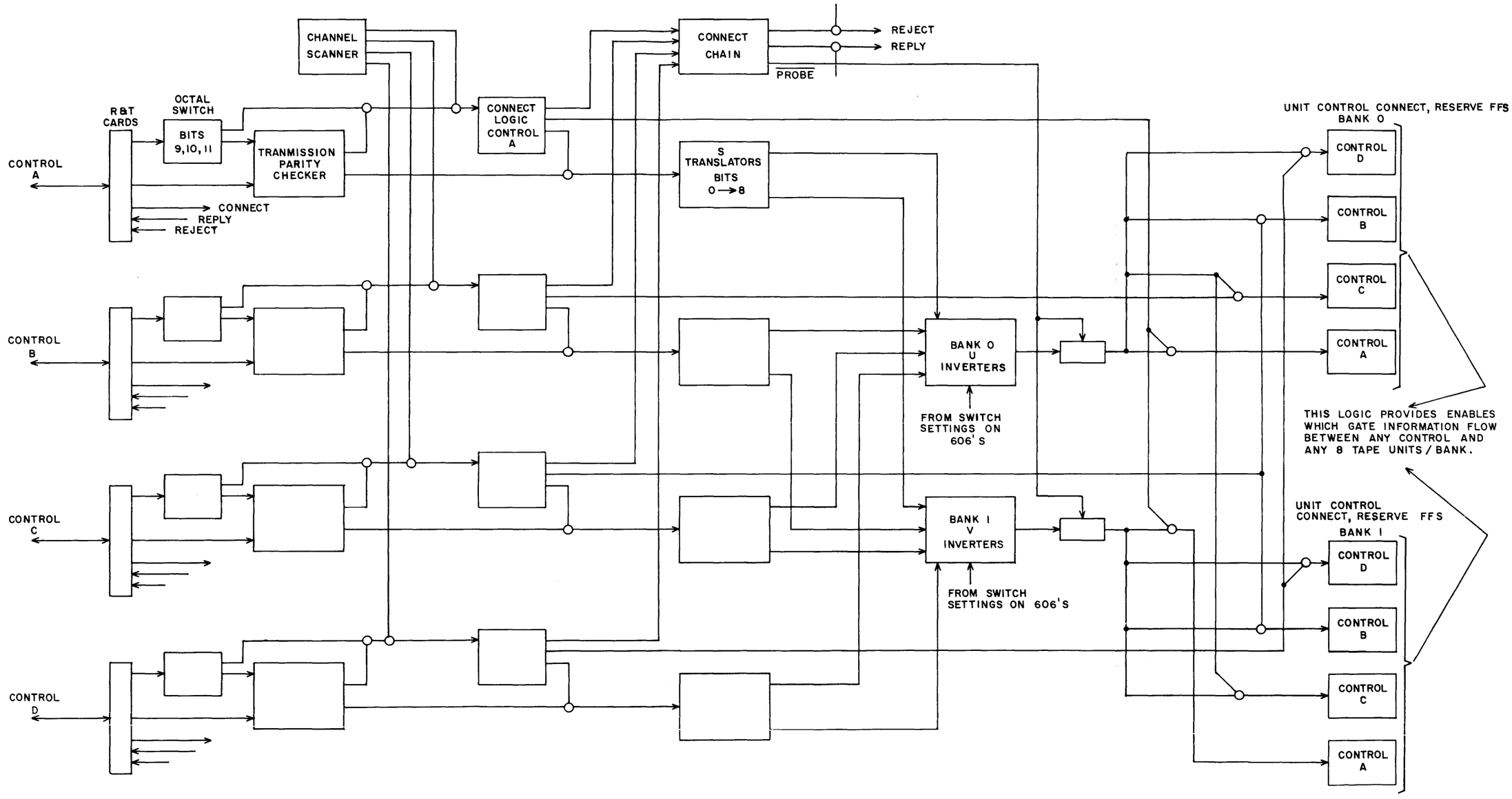


Figure 2-2. Simplified Block Diagram Connect Logic

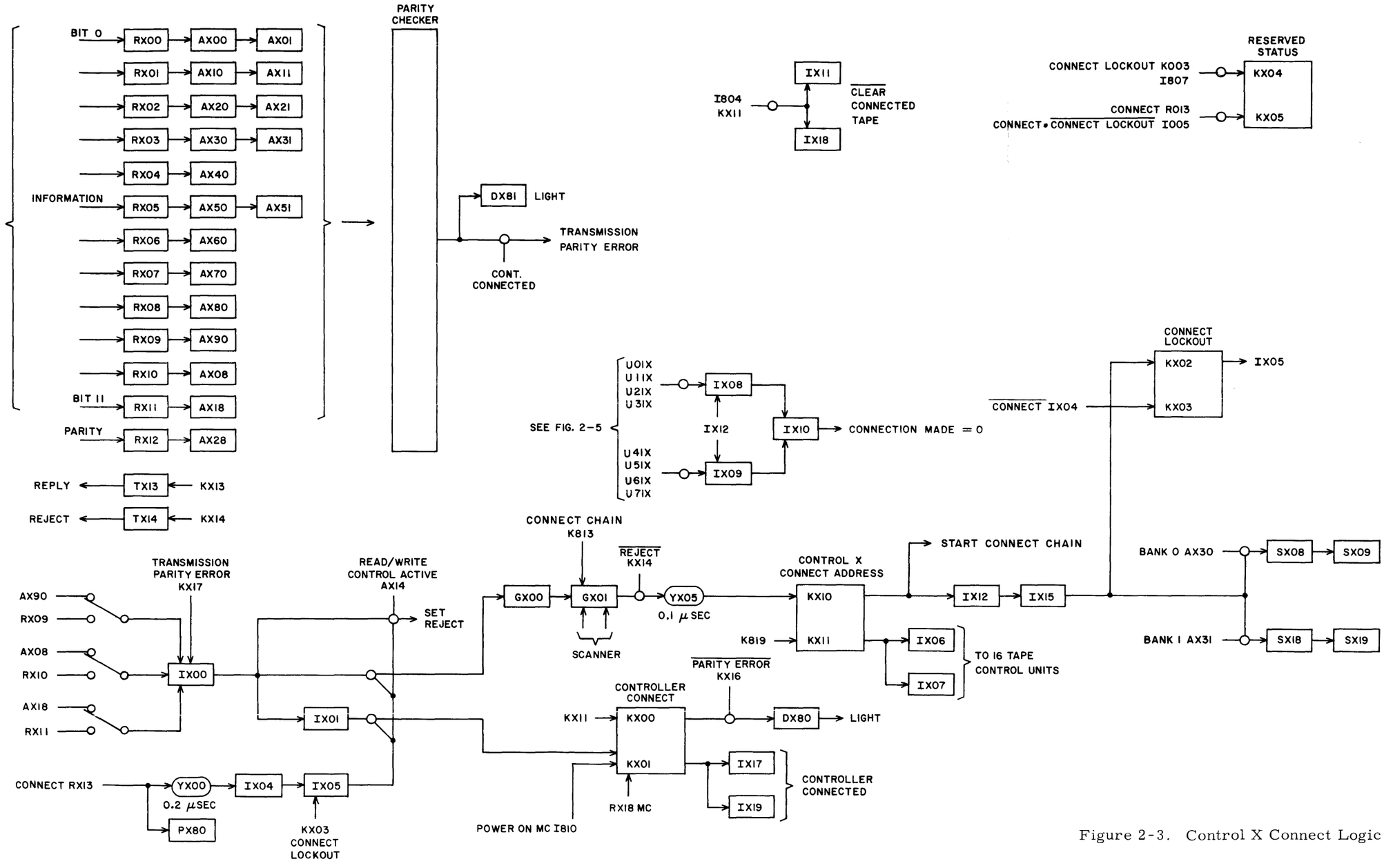


Figure 2-3. Control X Connect Logic

LOGIC SEQUENCE FOR A CONNECT OPERATION

1) a) The 12-bit connect code, parity bit, and connect signal from the data channel (figure 2-3) enter control X on receiver cards Rx00 through Rx13. A parity check is immediately performed on the 12 information bits plus parity bit. The connect signal allows a parity strobe to be made which enables setting the Parity Error FF if a transmission parity error occurs. A transmission parity error indicator on control X of the 362X lights if a parity error occurs during transmission of a connect code.

b) A 0.2 usec delay (Yx00) allows time for the parity check. If a parity error occurs, Kx17 stops the connect sequence. An internal reject is then issued by the computer after 100 usec. No signals are sent back to the data channel from the 362X. Ix00 is held to a "0" and Kx00/x01 is cleared.

c) Bits 9, 10, and 11 also go through an eight-position octal switch, and if the output of Ix00 is "1", the connect operation proceeds. If the switch setting and the code do not match, Ix00 blocks the connect sequence. The Controller Connect FF is cleared and the connect sequence stops. An internal reject is again issued by the computer, and no signals are sent to the data channel by the 3620.

2) a) If the switch settings match the code and no transmission parity error has occurred and the Read/Write control is not active, Gx00 stops the free-running scanner (one scanner and connect chain are shared by all four controls) and sets the Control X Connect Address FF. (If the Read/Write control is active, a Reject is returned to the data channel and the connect sequence halts and waits for the connect signal to drop.) A 0.1 usec delay (Yx05) allows the scanner time to stop and gives the signals on the lines time to stabilize. If the scanner is already stopped, indicating another channel is using the connect chain to make a connection, channel X waits until the scanner is released and then continues with the connect process.

b) When the Control X Connect Address FF sets, Ix06 and Ix07 allow channel X to set the Unit-Control Connect and Control Reserve FFs when the connect chain is in the proper position. The outputs from Ax31 and Ax30 determine which bank (0 or 1) is desired. Inverters Sx09 and Sx19 enable the outputs

of the S translators to begin the tape unit selection.

c) The Controller Connect FF sets and lights an indicator on the control X indicator panel if no transmission parity error has occurred. Information is now available on the status lines.

d) The Connect Lockout FF sets. This prevents accidental clearing of the Controller Connect FF when the connect code and connect signal drop.

e) The outputs from the S translators for all controls feed into the same S inverter for a particular tape unit. When one of the S translator cards has a "1" output (gated with Sx09) the U inverter for a given tape number has a "1" output. Only one of the eight M cards coming from the 606 units will enable the signal into the Ux08 or Ux09 and Ux20 inverters. This determines which stack of unit control and control reserve logic will be set. (Figure 2-5 shows how logic is stacked and the numeration used.)

3) a) The output from the Control X Connect Address FF starts the connect chain by setting K810/K811 (figure 2-4). When this FF sets, I804 and K811 drive Ix11 and Ix18 to "0" outputs. These terms then clear the present Unit-Control Connect FF, i.e., the connect logic for the tape unit that control X may have previously used.

b) When K812/K813 sets, inverters I800, I802 have "0" outputs. This probes the U020 → U720 cards (figure 2-5) and allows the "1" signal coming fron one of these eight inverters to continue into the corresponding U inverter, I inverter, and finally set the proper Unit-Control Connect and Control Reserve FFs. The Ix06 enables determine which control is making the selection. The K terms feeding the AND gates prior to the U and I inverters determine whether the desired tape is available or reserved by some other control.

c) When the connect chain makes the probe, one of the four Ix10 inverters drops to "0", indicating the proper connect logic has set. Since K817 still has a "0" output, I801 and K815 AND together to set the Reply FF and send a Reply signal back from Control X, indicating the connection has been made.

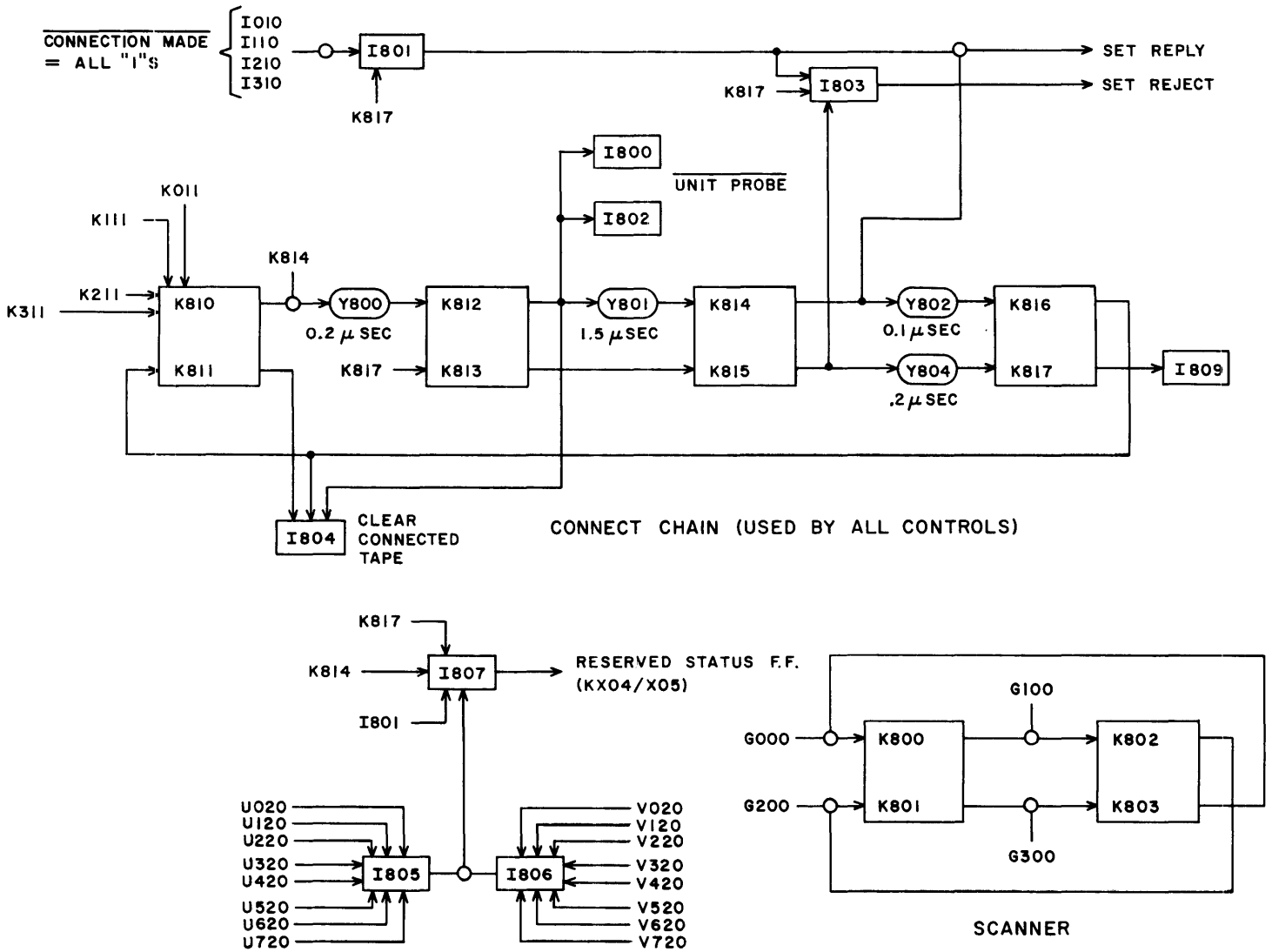


Figure 2-4. Connect Chain, Scanner

d) The Reply drops the connect signal, and the connect signal, together with the $\overline{\text{function}}$ and $\overline{\text{data signal}}/\overline{\text{connected}}$ clears the Reply FF. This completes the normal connect sequence.

e) If the connection is not made because the unit is reserved by another channel, all four Ix10 terms will have "1" outputs, driving I801 to a "0" output. When K814/K815 sets, I803 sets the Reject FF Kx14/Kx15. I807 (figure 2-3) and the Connect Lockout FF set the Reserved Status FF. When the Reserved Status FF sets, a Tape Unit Reserved For Other Control signal is available on a status line. A reject signal is returned from Control X and when the connect drops, the Reject FF is cleared. The connect chain continues until all FFs are cleared and then stops.

Example:
Starting from step 2, assume control A is connecting with tape unit 0 in bank 0.

After the Control A Connect Address FF, K010/K011 sets (figure 2-3), the output of S020 (S009 chooses bank 0) comes into inverter S400 and U000 has a "1" output. Only one of the M cards coming from the 606 units will have a "1" input to the AND gate on each Ux08 inverter (figure 2-5) indicating that one of eight tape units is now designated unit 0. If M000 satisfies this condition, the "1" output from U000 feeds into U008, giving it a "0" output, and breaking the AND gate into U020. When the probe (I800) drops to "0", U020 gives a "1" output which goes out to the logic for all four controls. I006 determines that the connection is desired for control 0. K042, K044, and K046 complete the AND gate unless some other control is reserving tape unit 0, in which case the operation terminates, and a reject signal is returned to the data channel.

Assuming no other channel is reserving tape unit 0, U010 drops to a "0" output. I010 then drops to a "0" output, indicating the connection has been made. This allows I801 together with K011 and K815 to set the Reply FF for control A, K012/013.

When the Unit-Control Connect FF for control A tape unit 0 (K020/021) sets, the outputs of inverters I030 → I034 become "1's". These outputs are the enables which gate all information signals to and from control A and the 606 tape unit designated as tape unit 0.

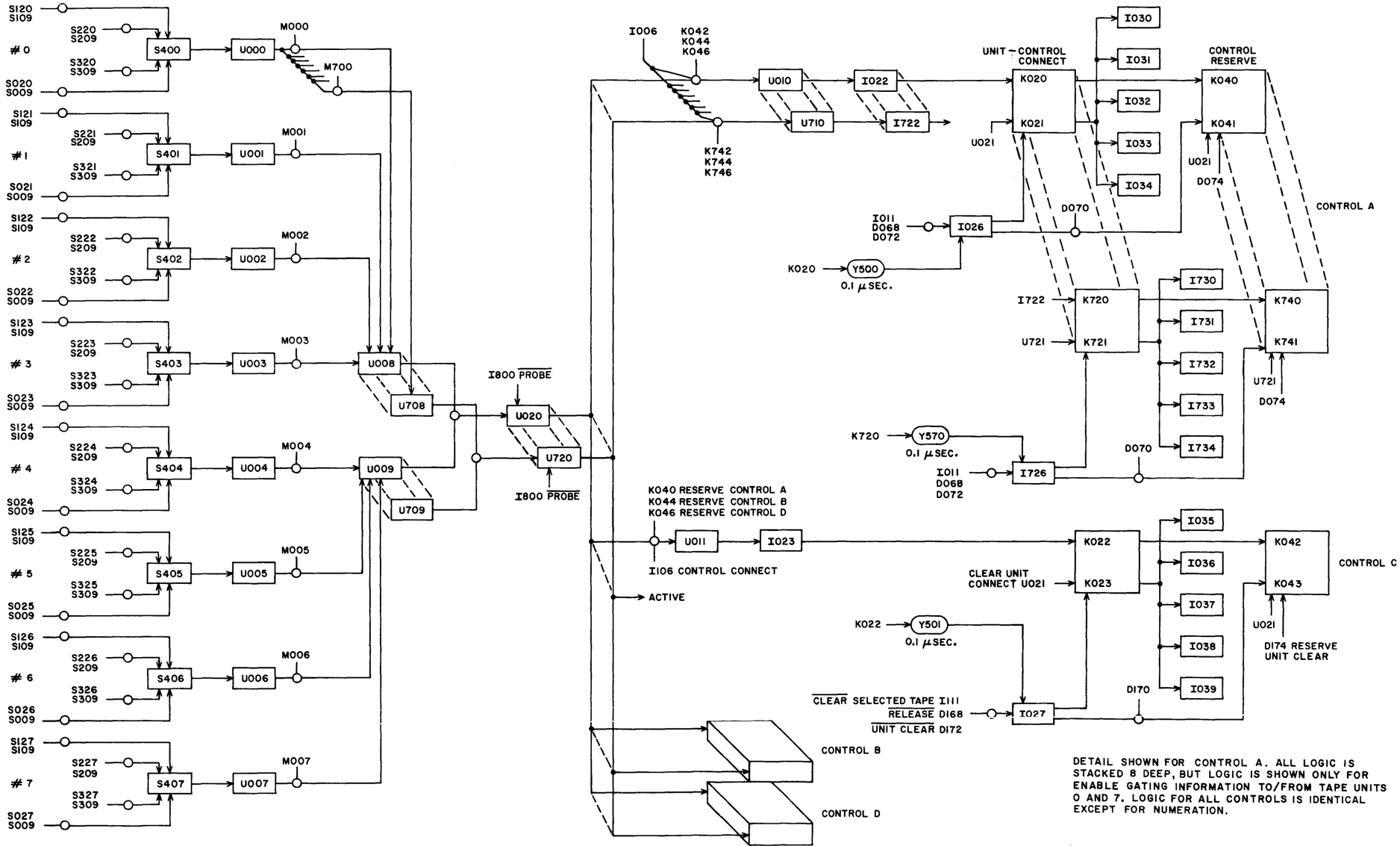


Figure 2-5a. Connect Enable Logic for Bank O

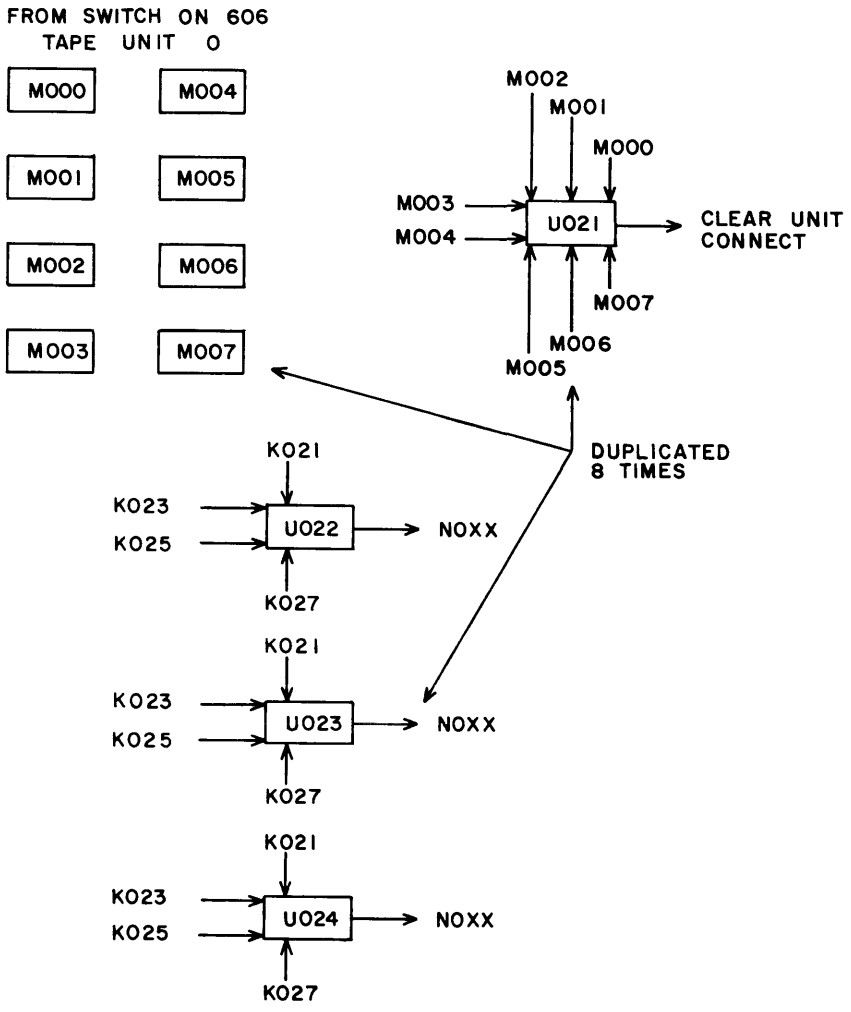


Figure 2-5b

CLEAR ON CHANGING TAPE NUMBER

The eight Ux21 (Clear Unit Connect) inverters (figure 2-5b) give "1" outputs only when the switch settings on the 606 units are changed. These outputs clear the Unit-Control Connect and Control Reserve FFs that were set for a connection to that particular unit number. The same logic applies for bank 1, with the exception that the U terms are replaced by V terms.

CLEAR WHEN NOT IN USE

When no control is connected to a particular tape unit in a bank, the outputs of inverters Ux22, Ux23, and Ux24 (figure 2-5b) go to "1's". These drive the outputs of the N cards feeding the L card to "0" (figure 2-6). Hence a constant clear is held on the output lines when not in use. The same logic applies for bank 1.

Figure 2-6 and 2-8 show how information passes to and from the tape controller and the 606 tape units. The logic in these figures only shows input and output for one line, but the other lines have the same logic configuration.

OUTPUT FROM 362X CONTROLS TO 606 UNITS

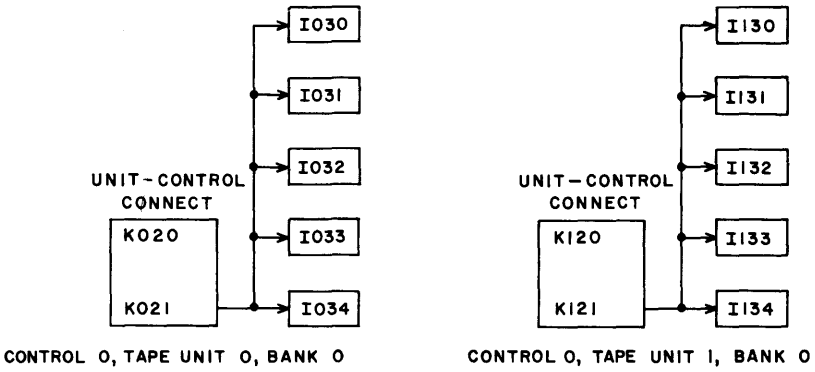
Figure 2-6 shows how the signal from Dx58 ($\overline{\text{Write Sprocket}}$) goes out from any of the four controls to any of eight tape units in bank 0. Similar logic applies for the remaining 16 lines coming from control X. For example, assume control A is connected to tape 0, bank 0, and the Unit Control Connect FF for tape 0 (K020/K021) has been set. I032 gates D058 into N000 and it goes out on L000. Since the logic is inverse, I032 only gates a "1" into N000 when a write sprocket pulse is not present. All the other N cards for tape units 1 → 7 are held to "0" outputs by the Ux22, Ux23, and Ux24 terms if no other control is using them.

I032 gates inputs into cards N000 → N007, I033 gates inputs into N008 → N015, and I034 gates inputs into N017. D058 can go out to any of the eight tape units. D158, D258, and D358 also go out to any unit. The logic for bank 1 is identical except for numeration.

INPUT TO 362X CONTROLS FROM 606 UNITS

Figure 2-8 shows how one line from any of 16 tape units can come into any one of the four controls. The logic is duplicated for all 17 lines coming from each 606 tape unit. For example, again assume control A is connected to tape unit 0, bank 0. The Unit-Control Connect FF inverters (figure 2-6) gate the information from tape unit 0 to control A. I030, I031, and I034 gate the seventeen M card inputs into the U inverters. Any "0" out of these U inverters breaks the four-way AND into the cards feeding control A, giving "1" outputs.

Any of the tape units can come into any one of the four controls when the proper enables



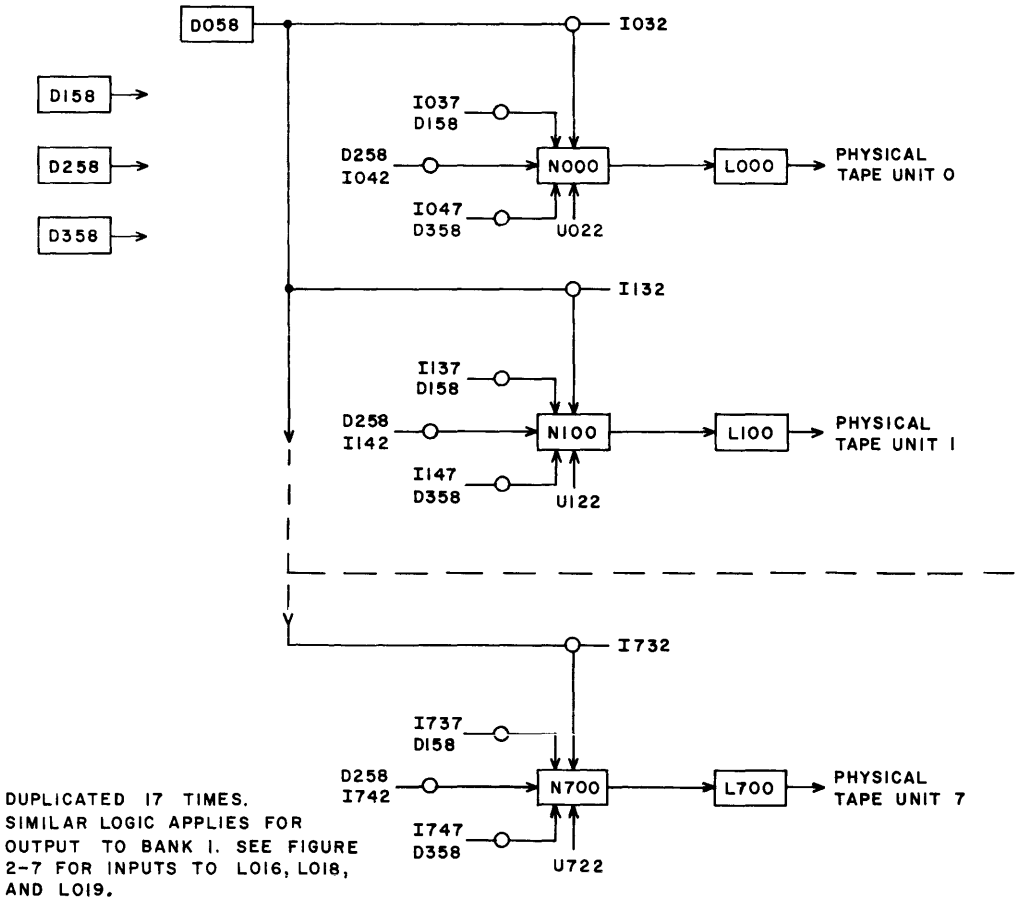


Figure 2-6. Output to Bank 0

are present. In this manner a maximum of four controls can communicate with a maximum of four tape units simultaneously. Table 2-2 lists terms feeding cards for the input and output logic duplications not shown in figures 2-6 and 2-8.

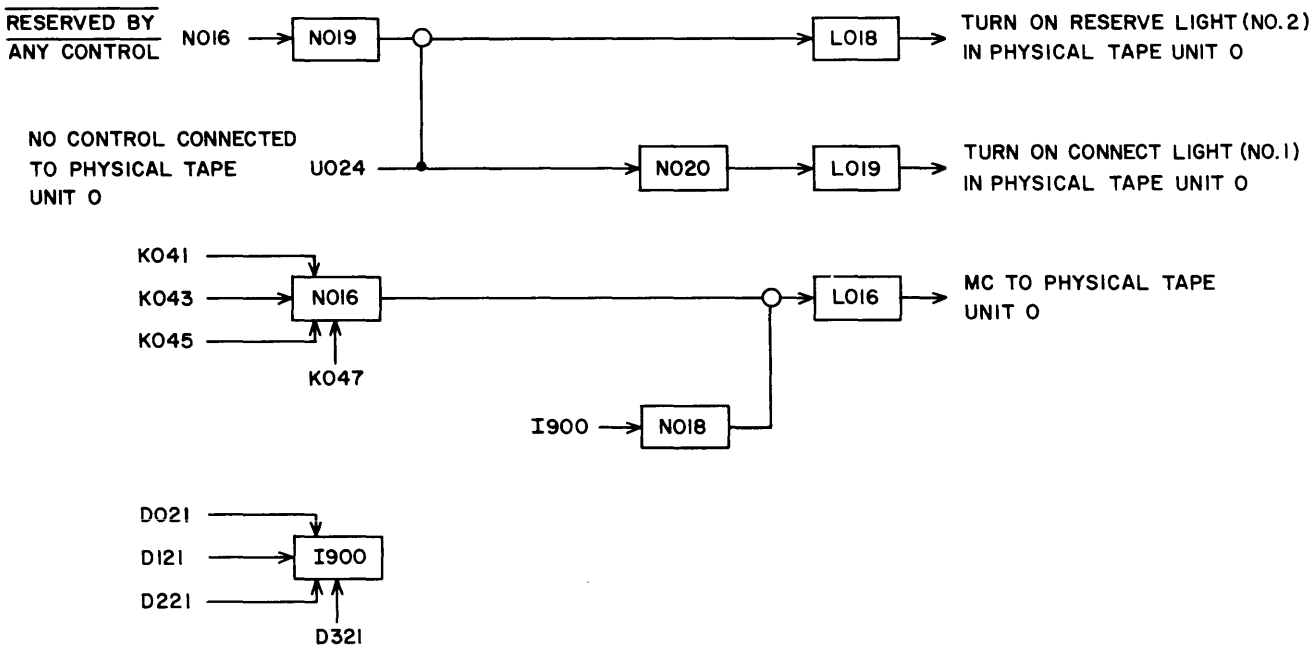


Figure 2-7. MC, Reserve, Connect Light Outputs to Physical Tape Unit 0 (Bank 0).

Figure 2-7 shows cards L016, L018, and L019 which have outputs to physical tape
c unit 0, bank 0. (Duplicated for all eight Tape Units in Bank 0 and Bank 1.)

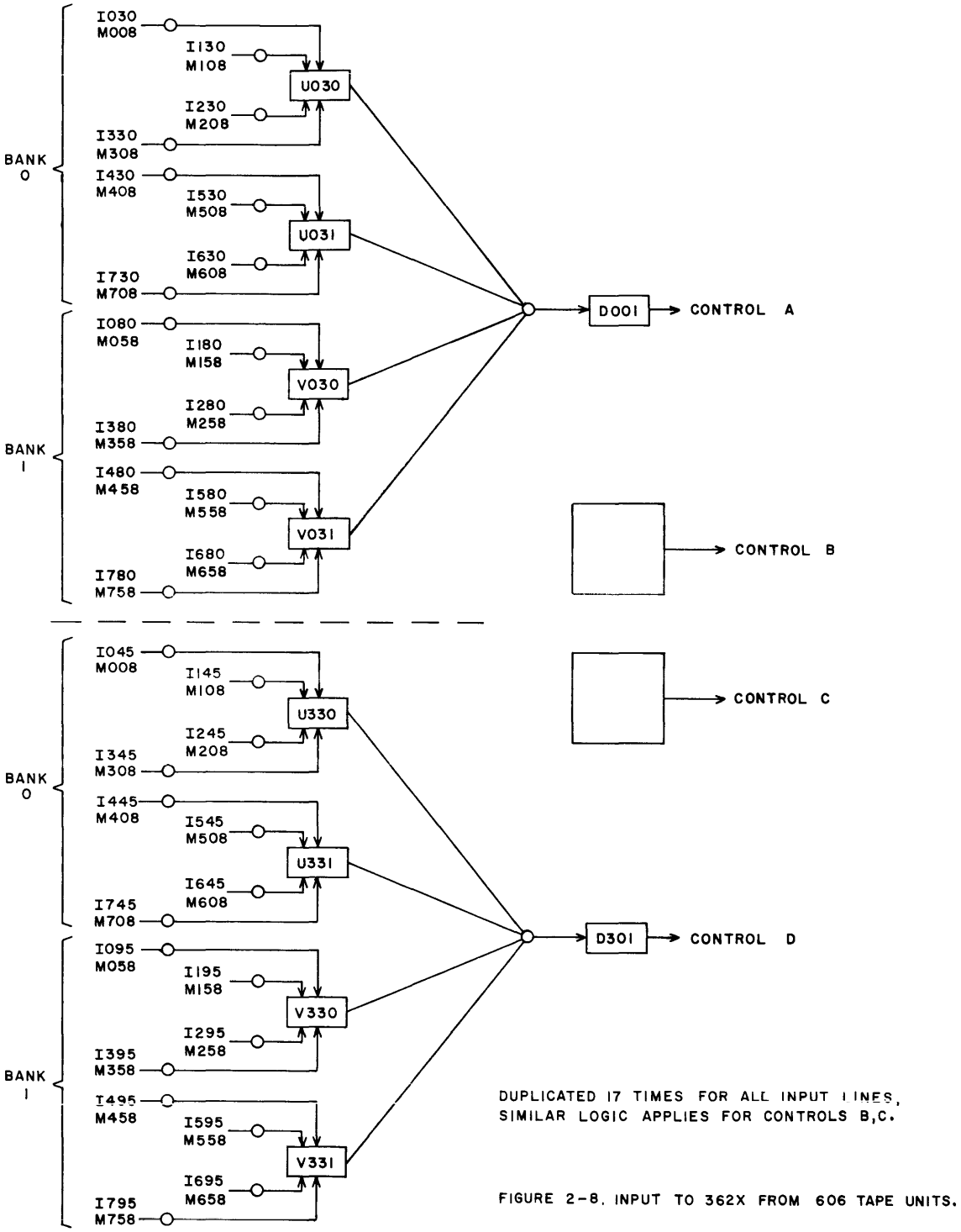


FIGURE 2-8. INPUT TO 362X FROM 606 TAPE UNITS.

Figure 2-8. Input to 362X from 606 Tape Units

MC TO PHYSICAL TAPE UNIT 0

When physical tape unit 0 is not reserved by any control (all reserve logic for tape unit 0 is clear) a master clear of 10 usec or more is held on the tape unit. All tape 0 reserve logic is cleared by:

1) A 362X power on MC
2) Doing a MC on all four controls
3) Executing a clear instruction (05) on each control.

Similar logic applies to the remaining tape units in bank 0 and bank 1.

TURN ON CONNECT LIGHT (NO. 1)

When a tape unit is connected to a control, a white indicator lights on the 606 (figure 2-7). The light goes out when no control is connected to the tape unit. This logic applies for all tape units.

TURN ON RESERVE LIGHT (NO. 2)

When a tape unit is reserved by a control but connected to no control (figure 2-7) a red reserve indicator lights on the 606 or 607. This light goes out when

1) The tape unit is not reserved by any control, or
2) The tape unit is connected to a control.

This logic applies for all tape units.

TABLE 2-1. TERMS FEEDING CARDS NOT SHOWN IN FIGURE 2-6

BANK 0

x=0→3	x=0→7	x=0→7		
Dx58	Nx00	Lx00	Write Sprocket	
Wx04	Nx01	Lx01	Write Information	1
Wx14	Nx02	Lx02		2
Wx24	Nx03	Lx03		3
Wx34	Nx04	Lx04		4
Wx44	Nx05	Lx05		5
Wx54	Nx06	Lx06		6
Wx64	Nx07	Lx07		7
Dx52	Nx08	Lx08	Write	
Dx48	Nx09	Lx09	Read	
Dx46	Nx10	Lx10	Forward	
Dx50	Nx11	Lx11	Reverse	
Dx60	Nx12	Lx12	Search End of File	
Dx54	Nx13	Lx13	Rewind	
Dx62	Nx14	Lx14	Set 556 BPI Density	
Dx64	Nx15	Lx15	Set 200 BPI Density	
Kx41, Kx43, Kx45, Kx47	Nx16	Lx16	Master Clear	
Dx56	Nx17	Lx17	Rewind Unload	
		Lx18	Reserve Light	
		Lx19	Connect Light	

BANK 1

Dx59	Nx50	Lx50	Write Sprocket	
Wx05	Nx51	Lx51	Write Information	1
Wx15	Nx52	Lx52		2
Wx25	Nx53	Lx53		3
Wx35	Nx54	Lx54		4
Wx45	Nx55	Lx55		5
Wx55	Nx56	Lx56		6
Wx65	Nx57	Lx57		7
Dx53	Nx58	Lx58	Write	
Dx49	Nx59	Lx59	Read	
Dx47	Nx60	Lx60	Forward	
Dx51	Nx61	Lx61	Reverse	
Dx61	Nx62	Lx62	Search End of File	
Dx55	Nx63	Lx63	Rewind	
Dx63	Nx64	Lx64	Set 556 BPI Density	
Dx65	Nx65	Lx65	Set 200 BPI Density	
Kx91, Kx93, Kx95, Kx97	Nx66	Lx66	Master Clear	
Dx57	Nx67	Lx67	Rewind Unload	
		Lx68	Reserve Light	
		Lx69	Connect Light	

TABLE 2-2. TERMS FEEDING THE D, E, H, F, AND W CARDS FOR EACH CONTROL IN FIGURE 2-8

READY	Mx08 → Ux30, Ux31	→ Dx01	
	Mx58 → Vx30, Vx31		
BUSY	Mx09 → Ux32, Ux33	→ Dx00	
	Mx59 → Vx32, Vx33		
READ SPROCKET	Mx10 → Ux34, Ux35	→ Ex00	
	Mx60 → Vx34, Vx35		
1	Mx11 → Ux36, Ux37	→ Hx00	
	Mx61 → Vx36, Vx37		
2	Mx12 → Ux38, Ux39	→ Hx10	
	Mx62 → Vx38, Vx39		
3	Mx13 → Ux40, Ux41	→ Hx20	
	Mx63 → Vx40, Vx41		
4	Mx14 → Ux42, Ux43	→ Hx30	
	Mx64 → Vx42, Vx43		
5	Mx15 → Ux44, Ux45	→ Hx40	
	Mx65 → Vx44, Vx45		
6	Mx16 → Ux46, Ux47	→ Hx50	
	Mx66 → Vx46, Vx47		
PARITY	Mx17 → Ux48, Ux49	→ Hx60	
	Mx67 → Vx48, Vx49		
LOAD POINT	Mx18 → Ux50, Ux51	→ Fx10	
	Mx68 → Vx50, Vx51		
END OF TAPE	Mx19 → Ux52, Ux53	→ Dx32	
	Mx69 → Vx52, Vx53		
556 BPI	Mx20 → Ux54, Ux55	→ Wx70	
	Mx70 → Vx54, Vx55		
WRITE ENABLE	Mx21 → Ux56, Ux57	→ Dx34	
	Mx71 → Vx56, Vx57		
FILE MARK	Mx22 → Ux58, Ux59	→ Dx26	
	Mx72 → Vx58, Vx59		
END OF RECORD	Mx23 → Ux60, Ux61	→ Dx28	
	Mx73 → Vx60, Vx61		
800 BPI	Mx24 → Ux62, Ux63	→ Wx06	
	Mx74 → Vx62, Vx63		

CHAPTER 3
FUNCTION CODES

The 362X tape controller connects and handles computer operations on 606 or 607 tape units. It has capabilities for handling up to four bidirectional input/output data channels. Each channel may communicate with any one of the 16 (maximum) tape units if the desired unit is not in use or reserved by some other channel. Four channels may communicate with four different tape units simultaneously.

UNIT SELECTION

Tape units physically attached to the 362X may be in one of three conditions:

1) Connected to a data channel
2) Reserved by a data channel
3) Unconnected and unreserved

Each of the four channel controls contains unit-connect and unit-reserve logic for each 606 or 607 tape unit. Once a channel connects a particular tape unit (i.e., establishes a communication path) that unit remains reserved for that channel, even though the channel connects another tape unit for some operation. No other channel has access to the reserved tape unit until the channel reserve for the tape unit is cleared. An unconnected and unreserved tape unit may be connected and reserved by any channel.

It is possible for a channel to reserve all tape units so no other channel may have access to them.

After a channel connects a tape unit and reserves it, any other connections that the channel makes automatically clear the previous unit connection, but not the reservation. If more than one channel attempts a connection simultaneously, a scanner sequentially processes these attempts.

The 16 tape units are divided into banks 0 and 1, and each tape unit is manually set at any number from 0-7 in each bank. (Tapes in bank 0 are referred to as 00-07; bank 1 tapes are referred to as 10-17.) No more than one tape in each bank may be set to any given number. When the setting on a tape unit is changed, the connection and reservation is cleared for that tape unit.

The 362X may be connected to a maximum of four 12-bit data channels from any source. These may be:

1) 3606 data channel.

TABLE 3-1. FUNCTION CODES

TAPE MOTION	
Rewind	0010
Rewind Unload	0011
*Backspace	0012
Search File Mark Forward	0013
Search File Mark Reverse	0014
Write End of File Mark	0015
Skip Bad Spot	0016
FORMAT	
Release	0000
Binary	0001
Coded	0002
556 BPI Density	0003
200 BPI Density	0004
Clear	0005
800 BPI Density	0006
Set Reverse Read	0041
Clear Reverse Read	0040
INTERRUPT	
Interrupt On Ready and Not Busy	0020
Release Interrupt On Ready	0021
Interrupt On End of Operation	0022
Release Interrupt On End of Operation	0023
Interrupt On Abnormal End of Operation	0024
Release Interrupt On Abnormal End of Operation	0025
Clear Interrupt Active	0026

STATUS REPLIES	
XXX1	Ready
XXX2	Channel (and/or) Control (and/or) Unit Busy
XXX4	Write Enable
XX1X	File Mark
XX2X	Load Point
XX4X	End of Tape
X1XX	Density ("1" in bit 6 indicates 556 BPI, "0" in bit 6 indicates 200 BPI)
X2XX	Density ("1" in bit 7 indicates 800 BPI)
X4XX	Lost Data
1XXX	Longitudinal Parity Error
2XXX	Vertical Parity Error
4XXX	Reverse Reject

*If a Backspace operation is executed, when Reverse Read is set, tape is moved in a forward direction.

2) 3681 data channel converter from the 160 or 160-A.

3) Channels with the same characteristics from other equipments.

All four channels do not necessarily have to come from the same equipment.

SWITCHES AND INDICATORS

EQUIPMENT NUMBER SWITCH

An eight-position (0-7) Equipment Number switch is associated with each control. The setting of this switch designates the control as equipment number N. Any interrupts coming from the control will be transmitted on one of the eight interrupt lines corresponding to the setting of the Equipment Number switch.

When a control is connected to a tape unit, a white indicator in the switch lights. (This indicator also lights when a connection cannot be made because the tape unit is reserved for another control.)

If a transmission parity error occurs during a Function, Read, or Write operation, a red indicator in the Equipment Number switch lights.

LONGITUDINAL PARITY

Seven Longitudinal Parity indicators are associated with each control. At the end of an operation involving longitudinal parity checking, none of these indicators should be lit. If one or more are lit, it indicates a longitudinal parity error has occurred.

WRITE

The Write indicator is illuminated during Write and Write End of File Mark operations. The Write indicator remains on until the Write operation terminates.

VERTICAL (VERT)

A Vertical Parity Error indicator lights if a vertical parity error occurs during an operation. This light is illuminated until a new record is begun.

INTERRUPT (INT)

This indicator lights when interrupt occurs. This light is illuminated until the Interrupt signal drops.

BCD

This indicator lights when BCD mode is selected or an end of file mark is written on tape.

DATA TRANSMISSION

Operations on tape include: Read, Reverse Read (607 only), Write, Write End of Record, Write File Mark, Search File Mark Forward or Backward, Backspace, Skip Bad Spot, Rewind, and Rewind Unload. A complete list of Function and Status Reply codes is given in table 3-1.

All information is transmitted between the tape controller and the data channel in odd parity, making a total of 12 information bits plus a parity bit. Information is written on or read from tape in odd transverse (vertical) parity for binary, even transverse parity for BCD. The end of record check character makes the total number of "1" bits in each of the seven longitudinal tracks even. Read or Write operations can be performed at any one of three densities: 200 characters/inch, 33 usec/frame; 556 characters/inch, 12 usec/frame; 800 characters/inch, 8 usec/frame (607 only). Density and binary or BCD formats should be chosen or checked on the status lines before a Read or Write operation.

During a Write operation in BCD mode, the 362X automatically changes any word of all "0's" and writes it as 12_8 on tape. When reading a 12_8 from tape in BCD mode, the 362X changes it to a word of all "0's". If the 5th bit is a "1", the 6th bit is complemented during Read and Write operations on tape (the 5th remains unchanged). This converts internal BCD codes to external BCD codes when writing and vice versa for reading.

If the 3604 is running in 1604 mode, the conversion from internal BCD to external BCD will not occur during a Write operation. Similarly, the conversion from external BCD to internal BCD will not occur during a Read operation.

The tape controller has an interrupt feature which allows any tape unit to interrupt the equipment which is communicating with it. The program may select to be interrupted on occurrence of the following conditions:

1) Ready and Not Busy
2) End of Operation
3) Abnormal End of Operation

In order to read, write, etc., on any tape unit, it is necessary to:

1) Clear the desired control.
2) Connect the tape unit.
3) Sense the status of the connected tape unit.

There may be times when only step 2 is necessary, but normally all three steps are essential.

CLEAR

Prior to the initial use of the tape controller, the system should be cleared. There are five possible ways of clearing the controller:

1) Clear Channel (100 usec)

This instruction:

a. Clears all activity in the data channel.

b. Clears the present connection control X may have with a tape unit.

c. Releases all tapes (i.e., clears reserve logic) which control X may have reserved.

d. Performs a MC on control X Read, Write, and Function logic. (No status signals are available to the data channel after executing this instruction.)

2) Clear (2 usec)

This instruction:

a. Clears the present connection control X may have with a tape unit. Control X remains connected in the sense that Status signals are still available for the data channel.

b. Releases all tape units control X may have reserved.

3) Release

This instruction clears only the connection and the reservation for the connected tape unit. It does not clear the reservations for any other tape units.

The latter two Function instructions (Clear and Release) can only be used after a control is connected to a tape unit.

4) Power On MC

When power is applied to the 362X, all tape units connected and reserved by all controls are cleared. Logic in all controls is also cleared. No Status signals are available to the data channel after power is applied.

5) External MC

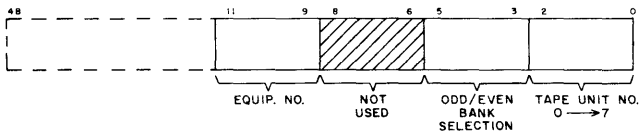
This clears all tape units connected and reserved by all controls. It also clears the logic in all controls. No Status signals are available to the data channel after executing this operation.

All Clear operations (except the Release instruction) place the 362X in binary format.

CONNECT

The computer sends a 12-bit Connect code over a specified data channel to the tape controller which connects the desired unit.

Four manual eight-position switches on the tape controller (one for each channel) lock out all Connect codes except the ones having the correct bit combinations in bits 9, 10 and 11.



Bits 0, 1, and 2 may have octal values of 0-7. These bits determine which of the eight tape units the 362X will communicate with. Bits 3, 4, and 5 determine the bank (0 or 1) of tape units. The value held in bits 9, 10, and 11 must match the switch setting on the 362X or the connection will not be made. Bits 6, 7, and 8 are not used. If none of the controllers or any other equipments physically connected to the communication module via data channels have the proper switch setting, or a parity error occurs in the Connect code, an Internal Reject is generated within the computer.

STATUS

After the desired tape unit has been connected, it is usually necessary to check the status of the connected tape unit before attempting any further operations. This is done with the Copy Status and Bit Sensing instructions.

The 48-bit Copy Status instruction can:

1) Place the 12-bit Status code from the 362X in B^b.
2) Place the control word address in the lower order 18 bits of the Q register.
3) Place the control word in the A register.

The 48-bit Bit Sensing instruction allows the programmer to check the registers in which the Copy Status instruction has placed the information described above. A complete list of Status Reply codes is given in table 3-1. For example: The presence of bit 6 in the Status Reply code indicates that the tape unit is set to operate in 556 BPI density. The programming example in this chapter shows how the Bit Sensing instruction is used. This instruction can also examine the current word count (part of the control word placed in A by the Copy Status instruction) to determine the progress of information transfer.

Ready (XXX1)

A Ready indicator on the tape unit lights when it is in a ready condition; i.e., power has been applied and the tape unit is in Automatic mode. When in Automatic mode, the tape unit is controller.

The Ready signal is not present when an operator manually controls the 606 or 607 from the console of the tape unit.

File Mark (XX1X)

Non-Chaining operations: This signal is present when the tape unit has searched for and located an end of file mark. It is also present immediately after writing an end of file mark. Signal drops when:

1) reading/writing begins on a new record, or
2) a Backspace, Search End of File Mark Forward, or Search End of File Mark Backward operation is initiated.

Chaining operations: If the tape unit "chains over" a file mark during a chaining Read operation, the File Mark signal will appear. This signal will remain up throughout the remainder of the chain operation. This signal drops when:

1) reading/writing begins on a new record (new chaining/non-chaining operation), or
2) a Backspace, Search End of File Mark Forward, or Search End of File Mark Backward operation is initiated, or
3) a MC is executed.

Write Enable (XXX4)

This signal is present only when the file protection ring is on the tape reel. When this signal is absent, it is impossible to write on tape, although information may be read from the tape.

[Channel (and/or) Control (and/or) Unit] Busy (XXX2)

If the tape unit is ready, this signal is present:

1) During and 5 ms after any operation which results in tape motion (Read, Write, etc.)
2) When the data channel begins executing or is executing a Read/Write instruction.

This signal will not be present if:

1) The tape unit is not ready.
2) The channel begins executing or is executing a Read/Write instruction and/or:
   a) Lost data has occurred in a previous operation.
   b) Interrupt On Abnormal End of Operation has occurred in a previous operation and the Interrupt signal is still present.

Load Point (XX2X)

This signal is present when the tape is at load point. The signal drops when tape motion begins again.

End of Tape (XX4X)

This signal is present when the end of tape marker is detected. The signal drops when tape has been rewound past the end of tape marker; i.e., the end of tape marker is sensed during rewind.

Density (X1XX)

See table 3-1.

Density (X2XX)

See table 3-1.

Lost Data (X4XX)

This signal appears during a Write operation if the tape controller is ready to accept information but the Data signal from the 3606 is absent (Write signal present).

When the Lost Data signal appears during a Write operation, tape motion stops. Further Write operations are impossible until the Lost Data signal is cleared with a new Function or Connect code.

The Lost Data signal also appears during a Read operation when the tape controller has data ready for output, but the Data signal from the 3606 is absent (Read signal present).

If the Lost Data signal appears during a Read operation, reading continues until the end of the record. Further Read operations are impossible until the Lost Data signal is cleared with a new Function or Connect code. (Any legal Function code listed in

table 3-1 will clear the Lost Data signal.)

The Lost Data signal is meaningless when the tape controller is attached to a 160/160-A via a 3681 adapter. However, this signal must be cleared if Read/Write operations are to continue.

Longitudinal Parity Error (1XXX)

This signal indicates that a longitudinal parity error has occurred during a Read/Write operation. This signal drops when a new record is read or written. A Clear Channel instruction, external master clear, or a power on master clear causes this signal to drop.

During a chaining operation, the Longitudinal Parity Error signal appears on a status line when an error has occurred during reading/writing a record. This signal will remain up during the remainder of the chaining operation. This signal drops when a new chaining/non-chaining Read/Write operation begins or one of the three types of master clears is executed.

Vertical Parity Error (2XXX)

This signal indicates a vertical (transverse) parity error has occurred during a Read/Write operation. This signal drops when reading begins on a new record. A Clear Channel instruction, external master clear or a power on master clear causes this signal to drop.

If a vertical parity error occurs during chaining, the Vertical Parity Error signal drops when reading/writing begins on a new record during the same chaining operation. The signal also drops when a new chaining/non-chaining Read/Write begins or one of the three types of master clears is executed.

The Vertical Parity Error signal also appears when an end of file mark is read in Binary mode.

Reserve Reject (4XXX)

This signal is present when the last Connect operation performed was rejected because the tape unit to be connected was reserved by another control.

FUNCTION AND FORMAT

The following information refers to the Function and Format codes used with the

Function instruction; i.e., the lower 12 bits which specify the particular operation. An octal 0 in bits 3, 4, and 5 of the Function code indicates format, an octal 1 in bits 3, 4, and 5 indicates tape motion, and an octal 2 in bits 3, 4, and 5 indicates interrupt.

The proper tape unit must be connected before a Function instruction can be issued. If an error occurs in the Function code (assuming the proper unit is connected) a Parity Error signal appears on a transmission parity error line, and the computer issues an internal reject after 100 usec. The program continues at a reject jump address.

Once a function (backspace, rewind, etc.) is initiated on a tape unit on a given channel, it is possible to connect another tape unit on that same channel, perform some operation on the second tape unit, and reconnect the first tape unit before or after the operation on the first tape unit terminates.

Function

Rewind (0010)

A 0010 code rewinds tape at high speed (225-400 inches/second) to load point. Any further Rewind instructions when tape is at load point will have no effect. A Load Point signal appears on a status line when the operation is complete.

Rewind Unload (0011)

A 0011 code rewinds tape at high speed until all the tape is on the supply reel. All further operations on this tape are locked out until the tape has been reloaded manually.

Backspace (0012)

A 0012 code backspaces tape one record length. If the load point occurs other than at the beginning of the tape, this code will backspace tape from load point to one record length behind the load point. It will also backspace tape from an end of record check character back to load point if there are no other record check characters in between. Simultaneous backspace operations are possible on different units, but separate Connect and Backspace instructions are required for each.

Search End of File Mark Forward (0013)
Search End of File Mark Backward (0014)

A 0013/0014 code searches forward/reverse until an end of file mark is detected. A File Mark signal appears on a status line when the operation is complete. If no file

marks are detected, tape motion continues until load point or end of tape markers are reached and then terminates.

Write End of File Mark (0015)

A 0015 code writes 17_8 as an end of file mark (even transverse parity) in both binary and BCD format. Writing an end of file mark does not change the current format.

Skip Bad Spot (0016)

A 0016 code moves and erases tape six inches in a forward direction. Vertical and longitudinal parity checking is performed during the operation to insure that tape is being erased. If a parity error occurs, a Vertical/Longitudinal Parity Error signal will appear on a status line when the operation is complete.

If Interrupt on End of Operation is selected, interrupt will occur when the Skip Bad Spot operation is complete.

All previously mentioned codes (0010-0016) result in a reject if attempted when the read/write control is busy.

Format

Release (0000)

A Release code clears the existing unit connection and reserve logic for a tape unit. It does not clear the reserve logic on any other tape units reserved by the control.

Binary (0001)

A 0001 code allows all information to be written/read in binary notation. A parity generator makes the total number of "1" bits odd in the transverse (vertical) direction on a total of seven separate tracks on tape. The end of record check character makes the longitudinal number of bits in each of the seven tracks even. During Read or Write operations, a constant transverse parity check is made. A parity error is indicated on a status line if a vertical parity error is detected. When the end of record check character is written/read, a longitudinal parity error check is performed.

Coded (0002)

A 0002 code allows all information to be written/read in binary coded decimal notation. A parity generator makes the total number of "1" bits even in the transverse (vertical) direction on the seven tracks on tape. Constant parity checks during Read/Write

operations are performed in the same manner as in binary format.

556 BPI Density (0003)
200 BPI Density (0004)

A 0003/0004 code permits all information to be written or read onto or from tape at 556/200 density (556 density: 556 6-bit characters + parity bit/inch; 200 density: 200 6-bit characters + parity bit/inch).

Clear (0005)

A 0005 code clears all the tape unit reservations a channel has made and the existing unit connection. It is desirable to issue this code when a channel has completed all operations on one or more tape units. This permits other channels to gain access to these units.

800 BPI Density (0006)

A 0006 code permits all information to be written or read onto or from tape at 800 density: 800 6-bit characters + parity bit/inch.

Set Reverse Read (0041)

This code is used for a reverse Read operation. (See Reverse Read section.)

Clear Reverse Read (0040)

This code clears the condition established by the 0041 Format code.

All of the Format codes (0000-0006, 0040, 0041) result in a reject if attempted when the read/write control is busy.

INTERRUPT

All desired interrupt instructions must come before a Read or Write operation, but can occur during any other operation. The eight-position Equipment Selection switch determines which line the Interrupt signal is transmitted on. For example: If the Equipment Selection switch on control X is set to 5, any interrupts coming from control X will be transmitted on interrupt line 5. Any new interrupt instruction clears the existing Interrupt signal. This signal is also cleared by releasing all three possible interrupts, doing a master clear, or executing on 0026 Function Code.

Note: When the selected condition for interrupt occurs in a tape unit, that unit must be

connected. If the tape unit is not connected, the interrupt will not occur.

For example, interrupt on End of Operation is selected and a Rewind is executed. During rewinding, another tape unit is connected to the same control. This disconnects the unit that is rewinding, and it will not interrupt when the operation is complete (load point detected).

If the unit that was rewinding had been reconnected before the rewind was finished, interrupt would have occurred when the operation was complete.

Interrupt on Ready and Not Busy (0020)
Release Interrupt on Ready and Not Busy (0021)

The 0020 code allows a tape unit to send an Interrupt signal out on a channel when this tape unit is in a ready and not busy condition; i.e., when power is applied, the unit is in Automatic mode, and all tape motion has ceased. Release Interrupt on Ready and Not Busy code 0021 clears this condition.

Interrupt on End of Operation (0022)
Release Interrupt on End of Operation (0023)

A 0022 code allows a tape unit to send an Interrupt signal out on a channel approximately 200 usec after an end of record check character is read by a tape unit, a file mark has been located in a search file mark forward or backward operation, load point has been detected during a rewind operation or a Skip Bad Spot operation has been completed. Release Interrupt on End of Operation code 0023 clears this condition.

During a chaining operation, interrupt will not occur until the data channel is not busy; i.e. until the last record has been written/read in the chaining operation.

Interrupt on Abnormal End of Operation (0024)
Release Interrupt on Abnormal End of Operation (0025)

A 0024 code allows a tape unit to send an Interrupt signal out on a channel after an abnormal operation occurs. These abnormal operations are:

End of Tape, File Mark, Load Point, Vertical Parity Error, Longitudinal Parity Error, Lost Data, and Connected Tape Unit Becoming Not Ready. In all but the last case, the interrupt occurs when one or more of these conditions is encountered and an end of record check character is written/read by the tape unit. In the case of interrupt on Connected Tape Unit Becoming Not Ready, interrupt occurs immediately when the

connected tape unit goes from a Ready to a Not Ready condition (e.g. if the power is turned off on the tape unit, etc.). Interrupt on Connected Tape Unit Becoming Not Ready will not occur during:

1) a Connect operation; or

2) when an 0000 Function instruction (Release Connected Unit) is being executed.

During a chaining operation, interrupt will occur at the same time as in a non-chaining operation if one or more abnormal condition arises as described previously.

A new Read/Write operation cannot start until the Interrupt signal is cleared by one of the methods mentioned previously in this chapter under the Interrupt section. Release Interrupt on Abnormal End of Operation code 0025 clears this condition.

If Interrupt on Abnormal End of Operation is selected, chaining is selected, and an interrupt condition occurs during reading a record, the Interrupt signal will be returned to the 3606 when the end of record is read. When the interrupt occurs, the data channel will wait after receiving the last reply.

The 3604 will enter an interrupt routine (see the Interrupt chapter in this manual) and process the Interrupt. A Stop Channel Activity instruction (in the 3604 interrupt routine) will terminate data channel activity and store the present word count, etc. When the Interrupt signal is cleared (in the 3604 interrupt routine), reading may be initiated by a new Read instruction.

If the new Read signal is returned to the tape controller 45 usec or less after the interrupt occured, the Read operation will be non-stop. If the time exceeds 45 usec, tape motion will stop and restart. If no Read instruction is executed by the 3604 after interrupt, tape motion will halt.

If chaining is selected and an interrupt condition occurs during writing a record, the Interrupt signal will be returned to the 3606 when the record is completed. When the interrupt occurs, the data channel will wait after receiving the last reply.

The 3604 will enter an interrupt routine (see the Interrupt chapter in this manual) and process the interrupt. A Stop Channel Activity instruction (in the 3604 interrupt routine) will terminate data channel activity and store the present word count, etc. When the Interrupt signal is cleared (in the 3604 interrupt routine), writing may be initiated by a new Write instruction.

If the new Write signal is returned to the tape controller 2.5 ms or less after interrupt occurred, the Write operation will be non-stop. If the time exceeds 2.5 ms, tape motion

will stop and restart. If no Write instruction is executed by the 3604 after interrupt, tape motion will halt.

WRITE

After the 606 or 607 has been connected and format chosen, the programmer should check status for a Write Enable (bit 2 in the Status Reply code). If this signal is not present, it indicates that the protective ring is missing from the tape reel. It is possible to write on the tape only when this condition no longer exists. (If the Write Enable is not present, the 3606 hangs up.) If the Write Enable is present, accompanied by the Ready signal, the Write operation may begin.

If the Write signal comes up within 2.5 ms after the last Write operation, a non-stop Write is initiated. The total delay before actual writing on tape can begin again in approximately 4 ms, versus a normal delay of approximately 7 ms.

READ

In a Read operation, the order of events is similar to the Write operation. After connecting, checking status, and choosing the proper format, the Read operation begins. It is not necessary to check for a Write Enable since Read operations from tape are possible when the protective ring is not present on the tape reel. The non-stop Read is similar to the non-stop Write operation. (For information on the eight available options when the word count is reduced to 0, refer to the Control Word, Input/Output chapter.)

During Read and Write operations, the programmer may choose to check status periodically. He may also program one or more interrupts to let the computer know when the present operation is complete.

REVERSE READ (607 TAPE UNITS ONLY)

The 362X can read information in a reverse direction from tape. Six-bit frames are read from tape and assembled into 12-bit bytes and sent to the data channel. When a 48-bit word is read in a reverse direction from tape and entered into storage, it is identical to the 48-bit word which was initially written on the tape from storage. There is no change made in the final order of the bits during a Reverse Read operation.

To initiate a Reverse Read operation (assuming format, etc. have already been selected and all tape motion has stopped), a 362X controller must first receive the Function code 0041 (Reverse). When the Read instruction is executed in the 3604, the Reverse Read operation will begin; i.e., data will be available to the data channel. A Reverse

Assembly signal will be sent to the data channel from the 362X to indicate that the 12-bit bytes should be assembled into a 48-bit word in reverse order.

Data transfer will continue until the word count in the control word equals zero. Tape motion continues in a reverse direction and stops at the gap between the current record and the record check character of the next record (unless chaining or non-stop read has been selected).

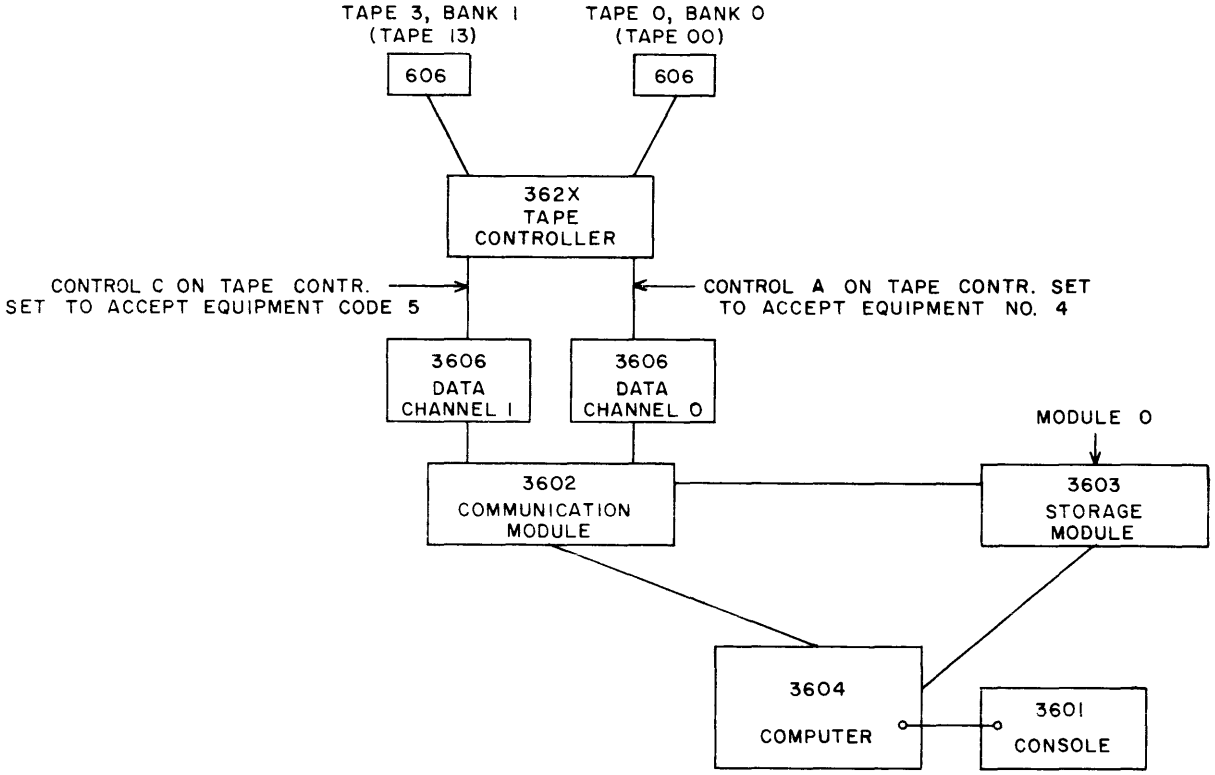
Vertical and longitudinal parity checking occur as in a normal Read operation with one exception: if the first frame read is a record check character, no vertical parity check is made on that character. Vertical parity checking is performed on all remaining frames.

If a Reverse Read is attempted from load point, there will be no tape motion. The Read operation will halt indefinitely.

Parity errors and interrupts may be handled as if the operation were a normal read. An End-of-Record signal is returned to the data channel when a record gap is reached. Chaining and non-stop read operations are also handled as if the operation were a normal read.

The Function code 0040 (Clear Reverse) should be issued when the Reverse Read operation terminates.

PROGRAM EXAMPLE



100_8 words are stored in storage module 0 at locations 00100-00177. Write them on tape 0, bank 0 (556 density, BCD). Tape 00 is at load point. Also, a record of 300_8 words is stored on tape 13 (written in BCD, 556 density). Store the record in storage module 0, starting at location 00200. Tape 13 is also at load point. Rewind both tapes to load point sometime after the Write and Read operations are complete. Halt the program if any of the above operations cannot be executed.

Do console MC.

Start program at address 10000.

Storage Address	Contents of Address	
10000	745-----00------	CLEAR CHANNEL (Channel 0, Comm. Mod. 0)
10001	7402000000--4000	CONNECT Channel 0 Comm. Mod. 0 to Tape 00
10002	74411---00------	COPY STATUS on Tape 00, Load in B^1
10003	BIT SENSE	Sense bit 2 of Status code in B^1 for Write Enable
10004	76000000	HALT
10005	BIT SENSE	Sense bit 0 of Status code in B^1 for Ready
10006	76000000	HALT
10007	7411000400--0002	SET BCD MODE
10010	7411000400--0003	SET 556 DENSITY
10011	7431000400030000	WRITE (Contains control word address)
10012	745-----01------	CLEAR CHANNEL (Channel 1, Comm. Mode. 0)
10013	7402000001--5013	CONNECT Channel 1 Comm. Mod. 0 to Tape 13
10014	74431---01------	COPY STATUS on Tape 13, Load in B^3
10015	BIT SENSE	Sense bit 0 of Status code in B^3 for Ready
10016	76000000	HALT
10017	7411001601--0002	SET BCD MODE
10020	7411001601--0003	SET 556 DENSITY
10021	7421001601030001	READ (Contains control word address)
	Continue with main program. Tapes 00 and 13 remain connected.	
20000	76000000	HALT
30000	10000100--000100	CONTROL WORD (Write operation)
30001	10000300--000200	CONTROL WORD (Read operation)
30004	7413000400--0010	REWIND Tape 00
30005	7413000501--0010	REWIND Tape 13
30006	76000000	HALT (End of program)

Do a console MC. This clears all registers needed in this example. The program starts at address 10000 with a 48-bit Clear Channel instruction. This clears all equipment connected to communication module 0, data channel 0. The Connect instruction (address 10001) connects tape unit 00 to communication module 0, data channel 0. (The switch on control A on the tape controller is set to accept equipment #4.) The Copy Status instruction (address 10002) loads the 12-bit Status code into B^1.

A Bit Sense instruction (address 10003) senses bit 2 of the Status code for a Write Enable. (If this signal is not present when attempting a Write operation it indicates that the protective ring is not present on the tape reel.) Another Bit Sense instruction (address 10005) senses bit 0 of the Status code for a Ready signal. The program halts if either a Write Enable or a Ready signal is not present.

The two Function instructions (addresses 10007, 10010) set the control A logic in the tape controller to BCD mode and 556 density. When the computer executes the Write instruction (address 10011) it sends the 18-bit control word address to the communication module. The 3602 reads the 48-bit control word from address 30000 and initiates output from storage module 0 to tape 00.

The main program continues at address 10012 when the control word address has been transmitted to the communication module. The same procedure as above follows for tape 13, except that the operation is a Read from Tape 13 on data channel 1, and there is no need to sense for a Write Enable. The Set BCD Mode instruction is necessary since the Clear Channel instruction has set control C logic in the tape controller to the Binary mode. The switch on the 362X on control C is set to accept equipment code 5.

When the computer reaches address 10021, it executes the Read instruction and sends the 18-bit control word address to the communication module. Then the communication module begins the Read operation, and the main program continues.

When the program reaches address 30004, it sends the 12-bit Rewind instruction (0010) to tape 00. If tape 00 is busy (indicated by a Reject signal in this case) the program halts at this step and executes reject jumps to address 30004. When the Reply is returned (indicating tape 00 is in a rewind condition) the program continues at address 30005. When the instruction to rewind tape 13 is completed, the program stops at address 30006.

FUNCTION CODE FLOW CHARTS

This chapter uses flow charts to show the sequence of events involved in all conditions and operations established by function codes. Figure 3-1 through 3-7 show functions which result in tape motion. Figures 3-8 through 3-15 show functions which deal with tape format. Figure 3-16 shows functions which deal with interrupt conditions. Table 3-1 lists these function and status codes employed by the 362X.

The 362X returns a Reject to the data channel in the case of any codes other than those listed in table 3-1. Codes 0026 and 0027 simply clear the Interrupt Active FF (see Chapter 6) and return a Reply to the data channel.

Refer to the 362X logic diagrams for detailed logic; refer to the 362X section in the 3600 Reference Manual for additional information on function codes and status replies.

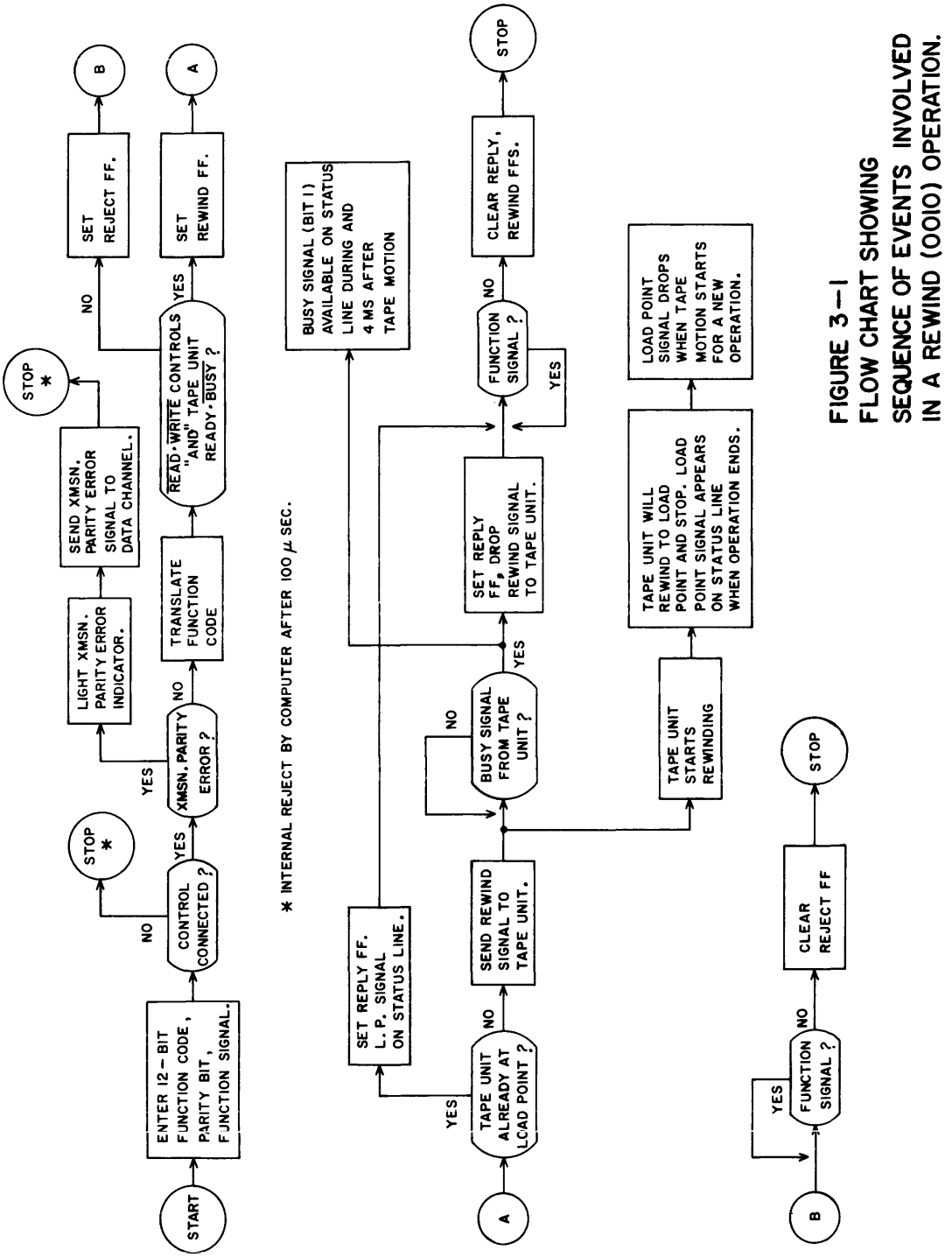


Figure 3-1 Flow Chart Showing Sequence of Events Involved in a Rewind (0010) Operation

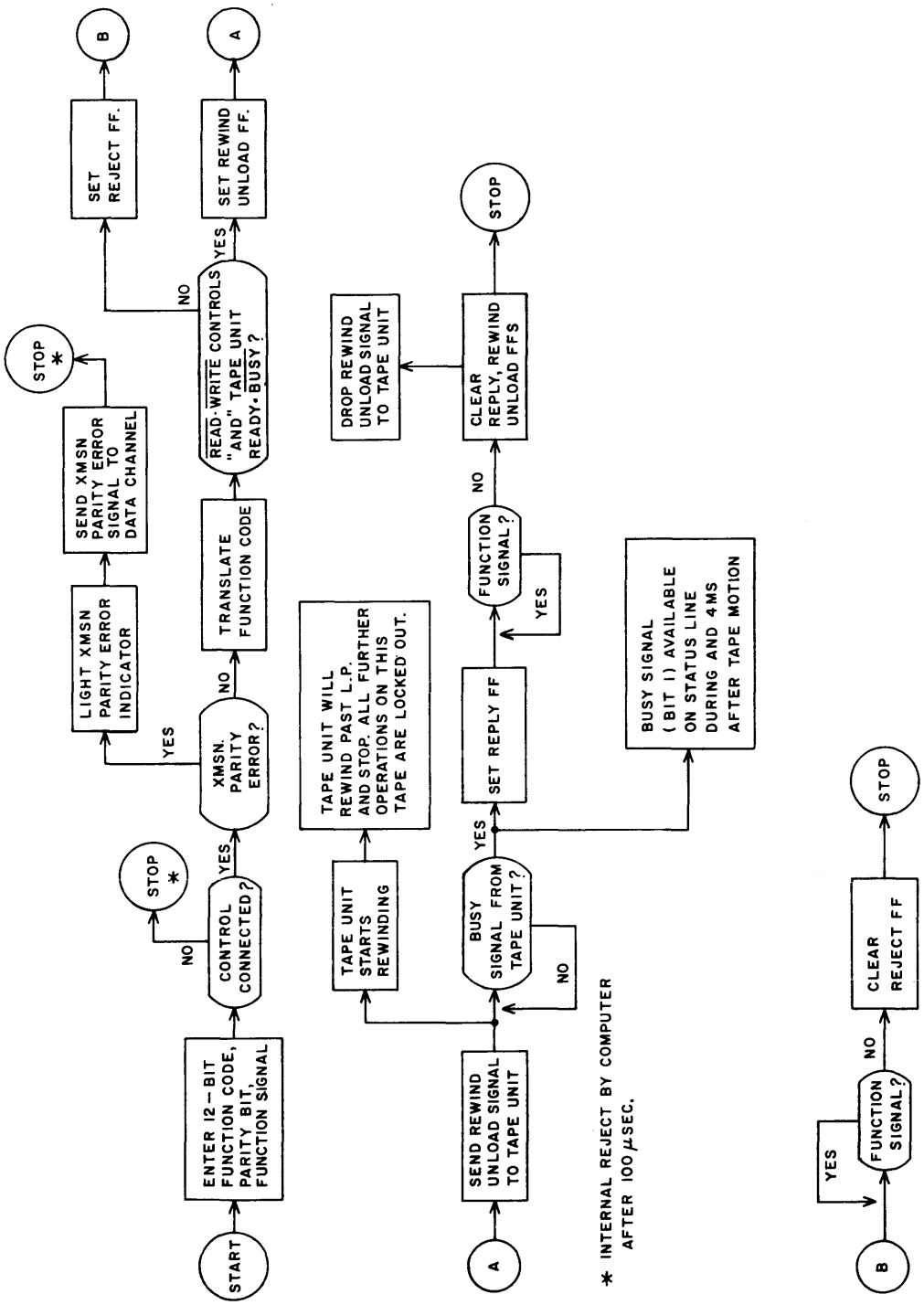


Figure 3-2 Flow Chart Showing Sequence of Events Involved in a Rewind Unload (0011) Operation

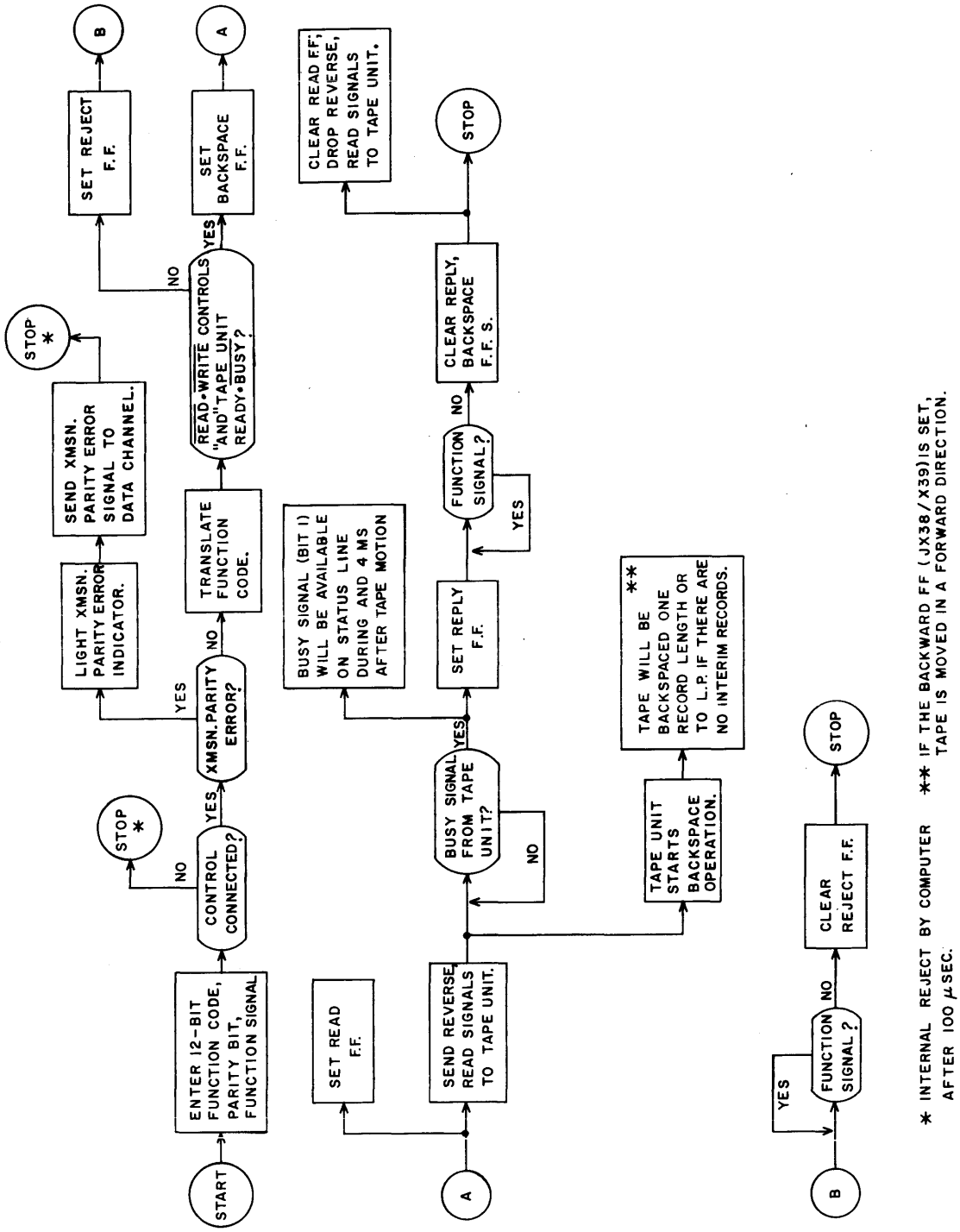


Figure 3-3. Flow Chart Showing Sequence of Events Involved in a Backspace (0012) Operation

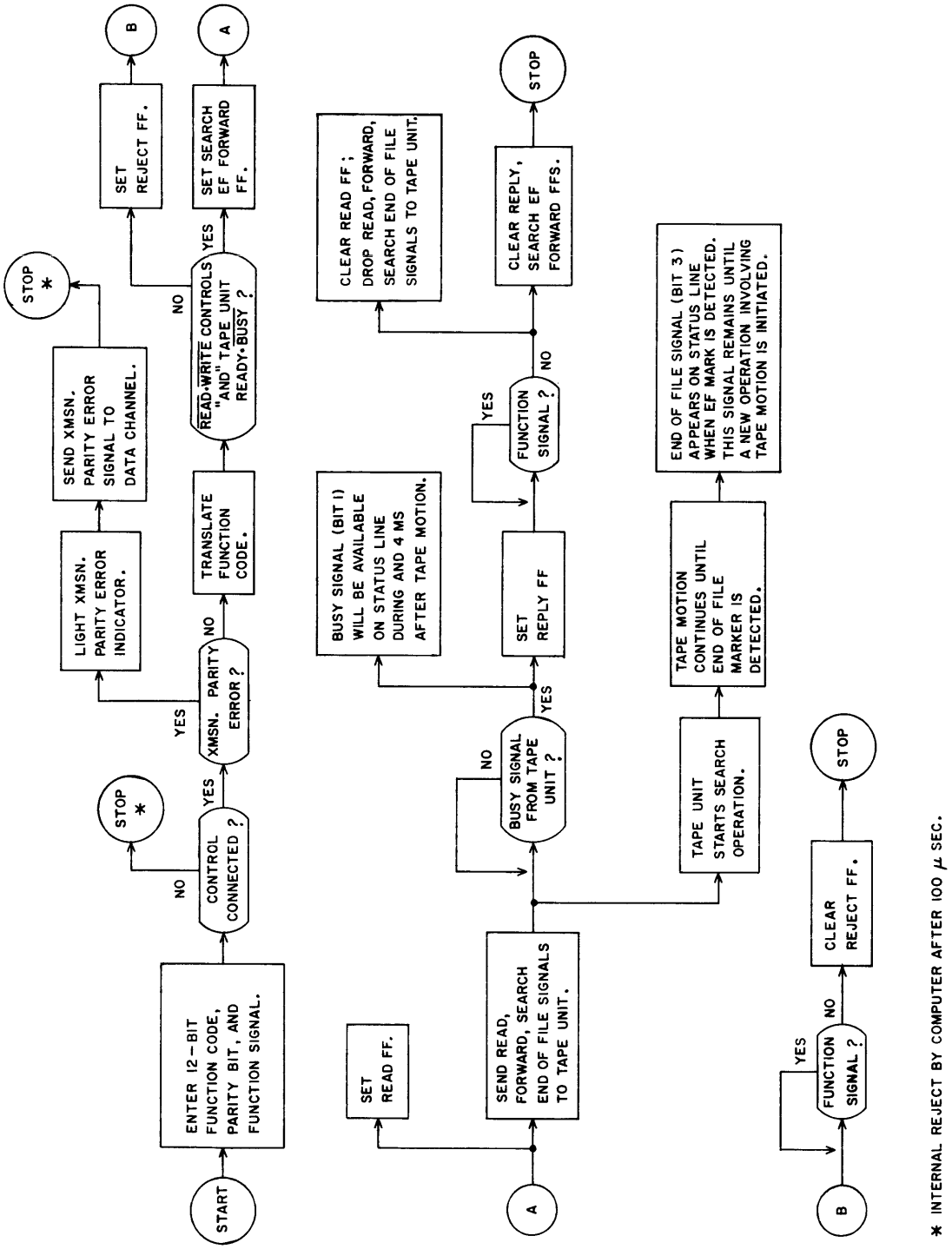


Figure 3-4. Flow Chart Showing Sequence of Events Involved in a Search End of File Forward (0013) Operation

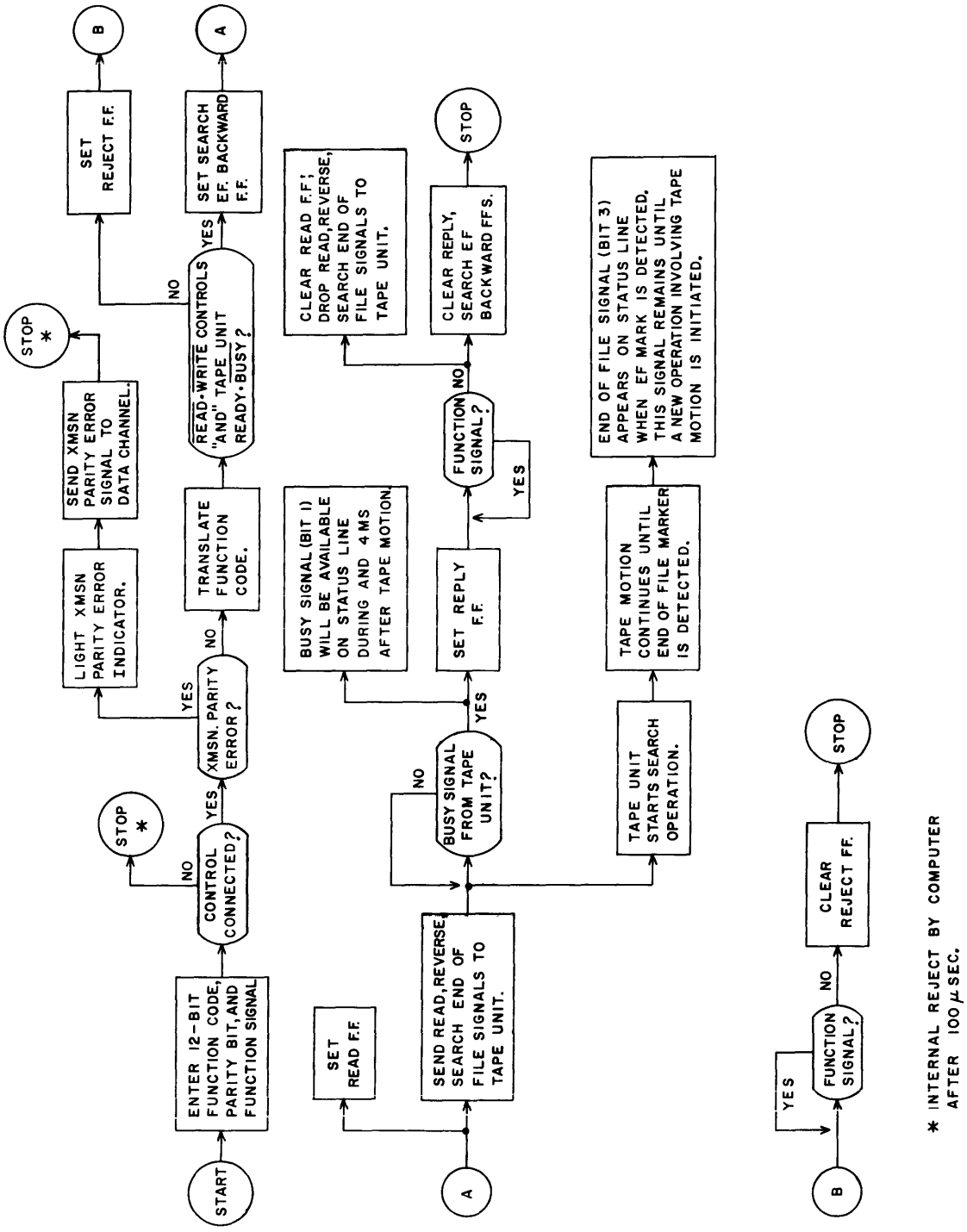


Figure 3-5. Flow Chart Showing Sequence of Events Involved in a Search End of File Backward (0014) Operation

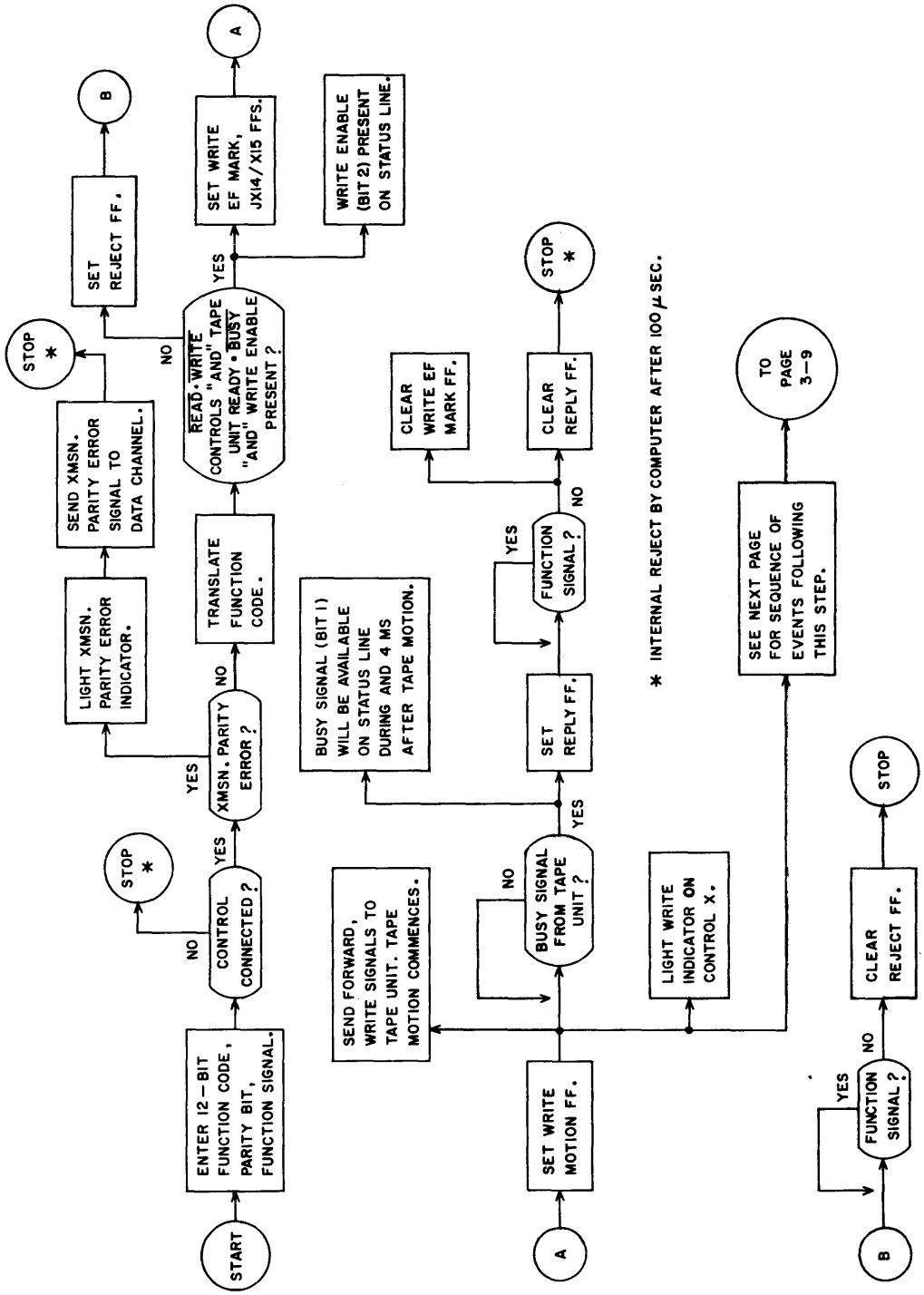


Figure 3-6. Flow Chart Showing Sequence of Events Involved in a Write End of File Mark (0015) Operation

WRITE EF MARK

The output of Jx15 sets DK_1 (Zx16/x17) of the disassembly counter. The following sequence of events then occurs:

1) a) The Write Control FF sets after 30 ms; Clear W drops.
   b) Fx02 (End of Record Clear) drops.
   c) Jx15 also drives Wx66. R→O (Zx10/Zx11) sets 0.1 ms after Fx02 drops.
   d) The Write Resync sets 0.1 usec after R→O sets.
2) When the write oscillator is in the proper position, the Write Gate sets.
3) The normal write sequence begins. Dx23 drives the outputs of the B inverters such that 17_8 will be written on tape. Dx23 prevents any information from entering the O register. Jx15 prevents adding a parity bit when in Binary mode by driving Dx29 to a "0" output.
4) During B→W_1, 17_8 is gated into the Write register.
5) a) Wx81 sets Zx08/Zx09, a sprocket pulse is generated, and the file mark is written on tape.
   b) Wx81 also clears Jx14/Jx15.
6) The normal End of Record sequence begins since Write and Data signals are not present. (See Chapter 4 for additional information on the Write and Write Record CC sequences.)
7) A record check character is written (17_8) and tape motion stops.

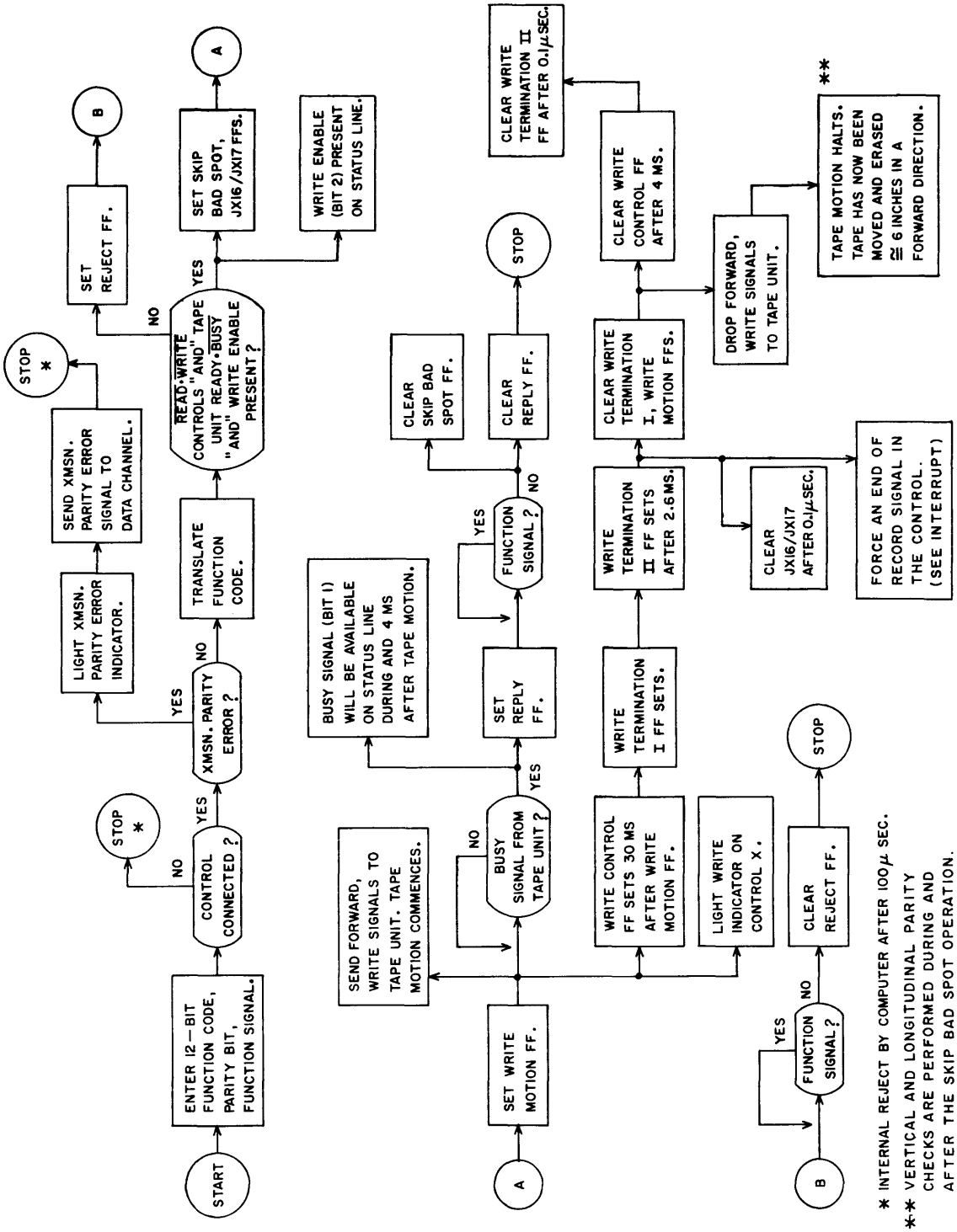


Figure 3-7. Flow Chart Showing Sequence of Events Involved in Skip Bad Spot (0016) Operation

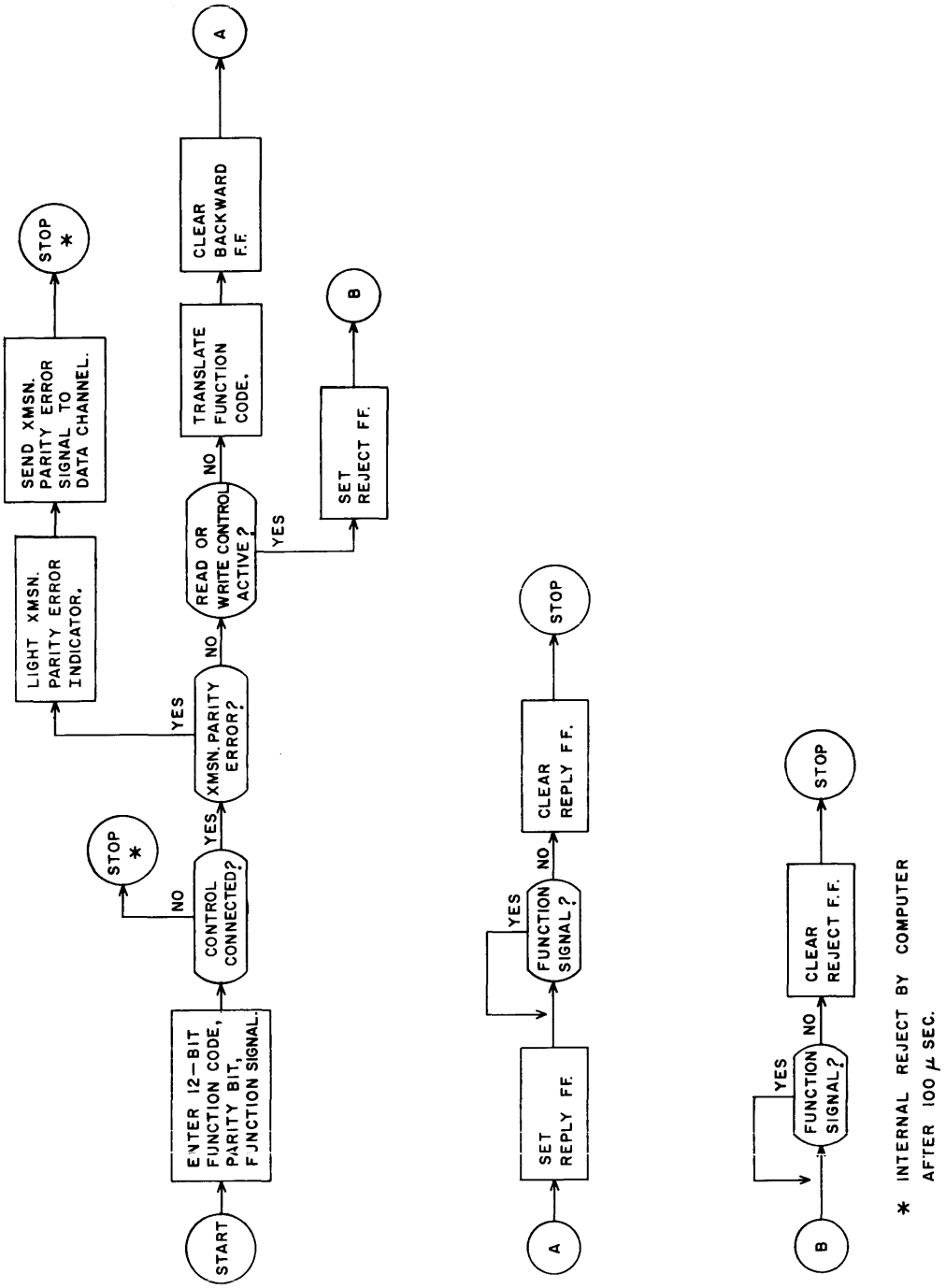


Figure 3-8. Flow Chart Showing Sequence of Events Involved in a Clear Reverse (0040) Operation

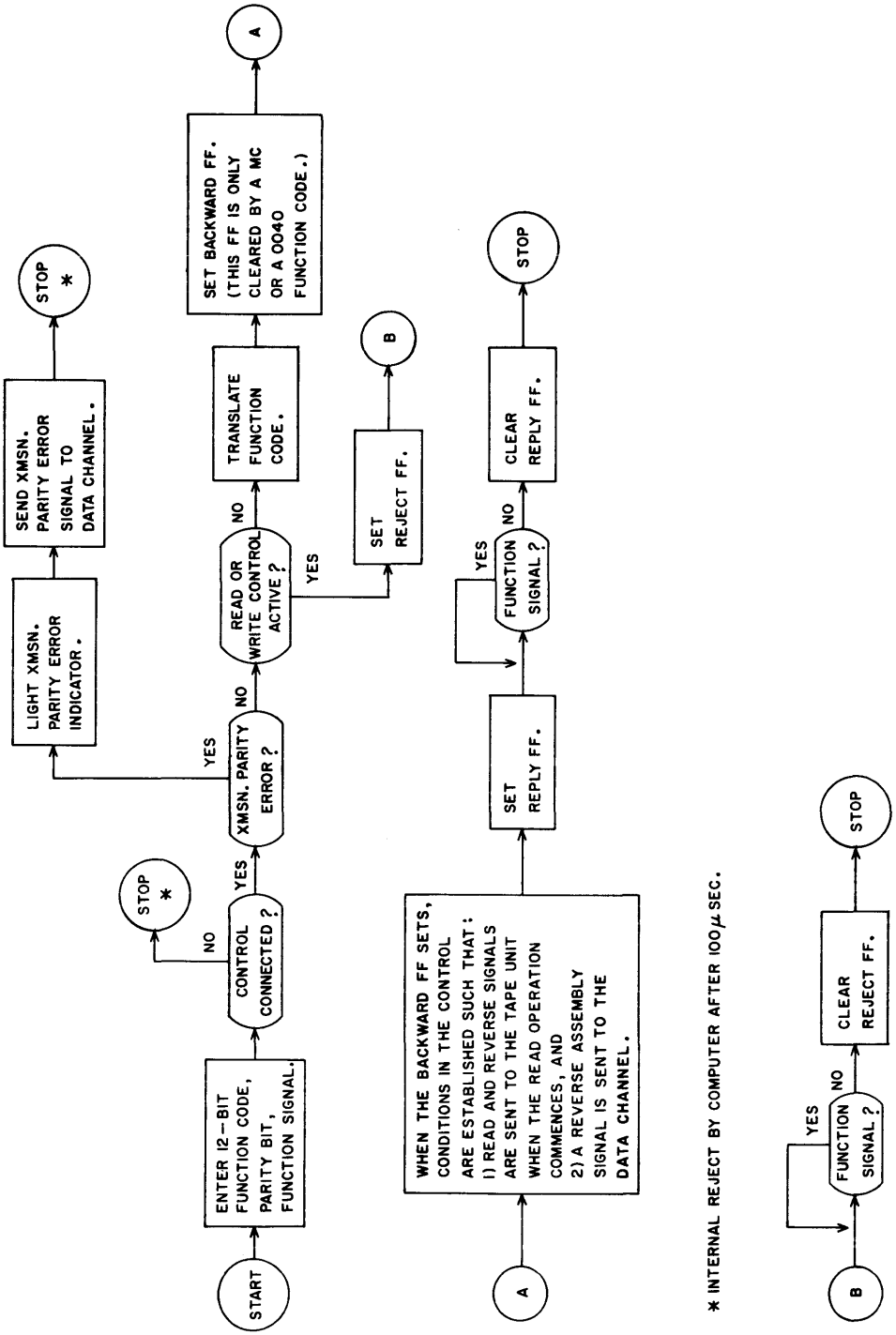


Figure 3-9 . Flow Chart Showing Sequence of Events Involved in a Reverse (0041) Operation

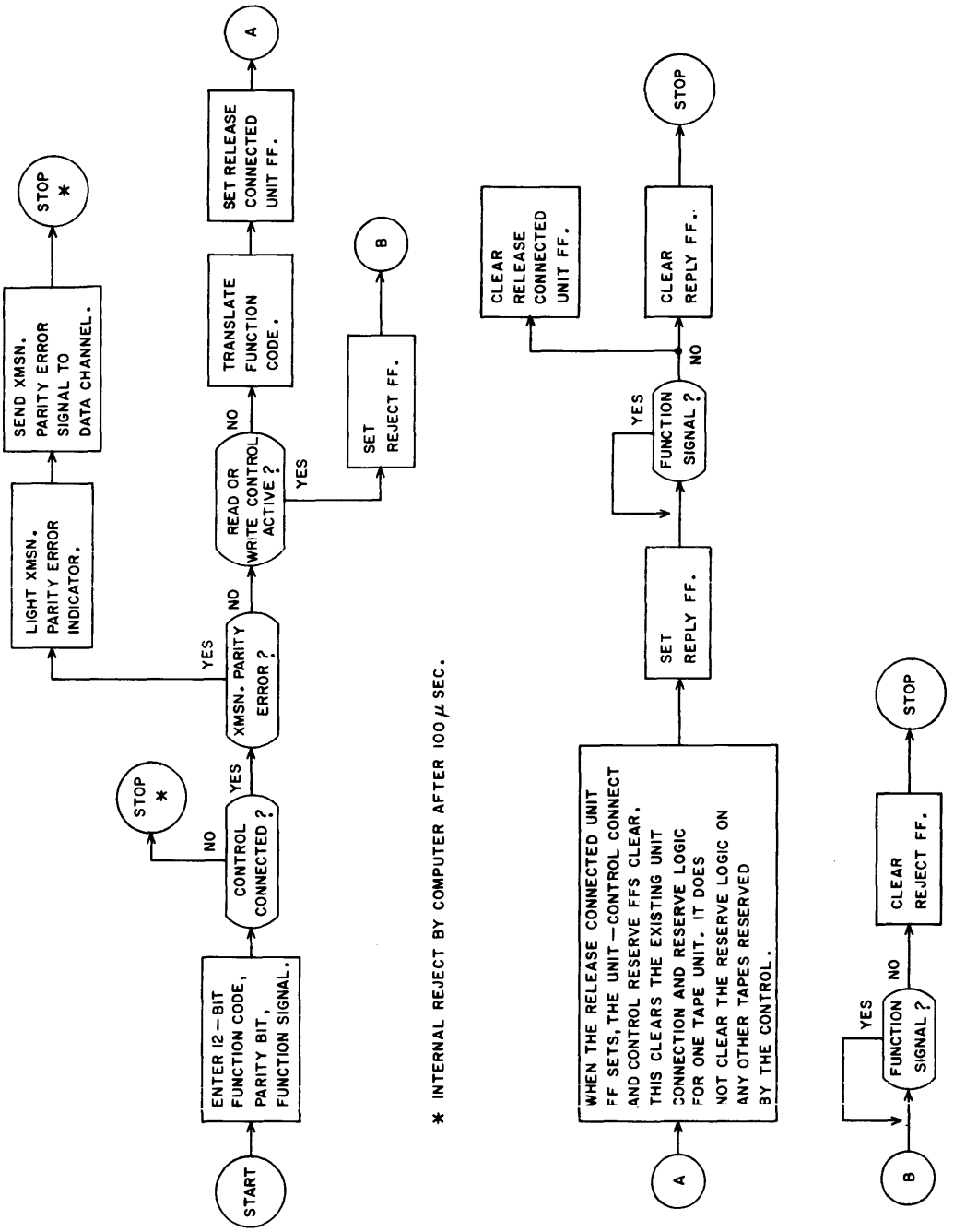


Figure 3-10. Flow Chart Showing Sequence of Events Involved in a Reverse (0000) Operation.

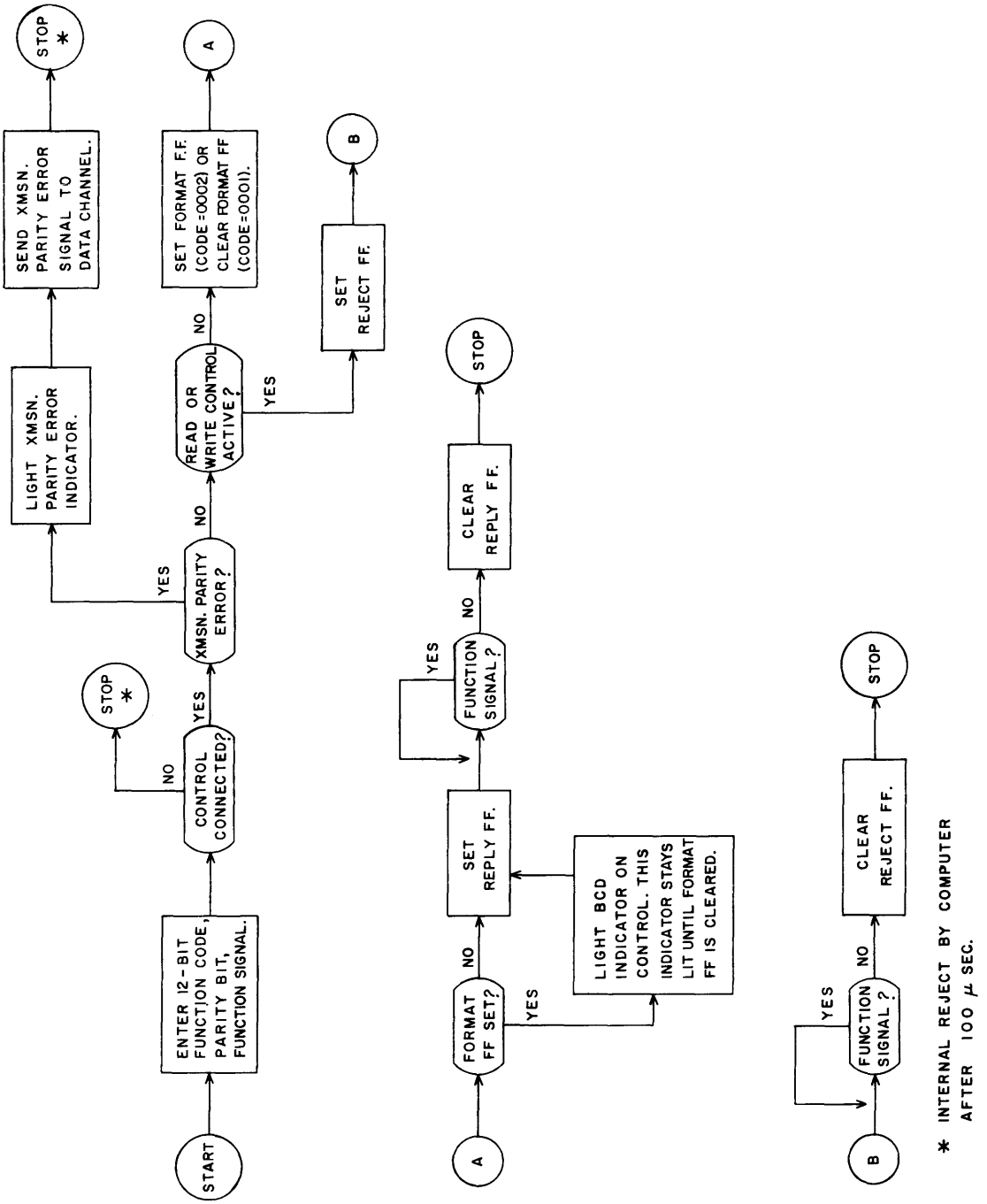


Figure 3-11. Flow Chart Showing Sequence of Events Involved in a Format (0001 or 0002) Operation.

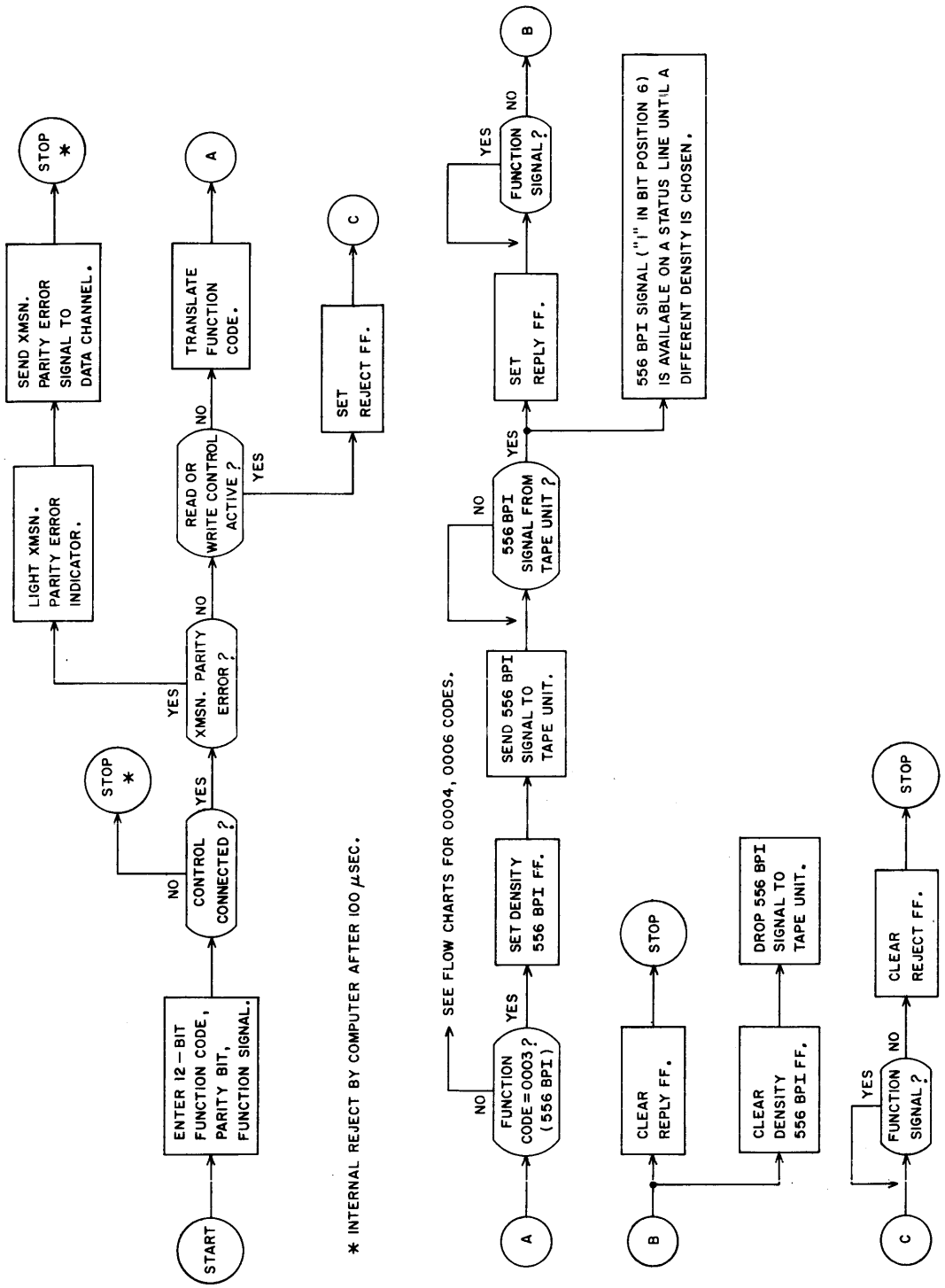


Figure 3-12. Flow Chart Showing Sequence of Events Involved in Selecting 556 BPI Density (Function Code = 0003).

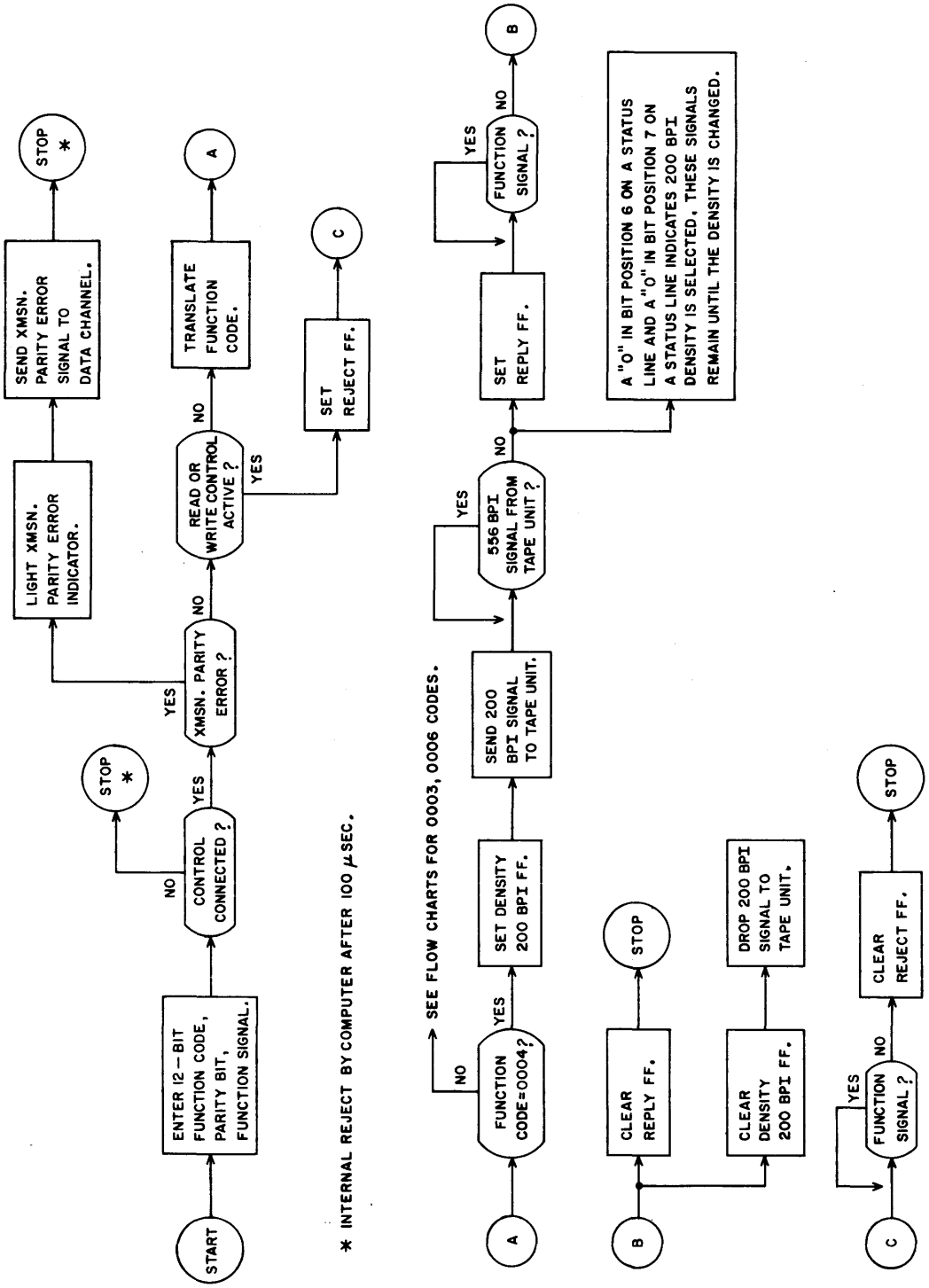


Figure 3-13. Flow Chart Showing Sequence of Events Involved in Selecting 200 BPI Density (Function Code = 0004).

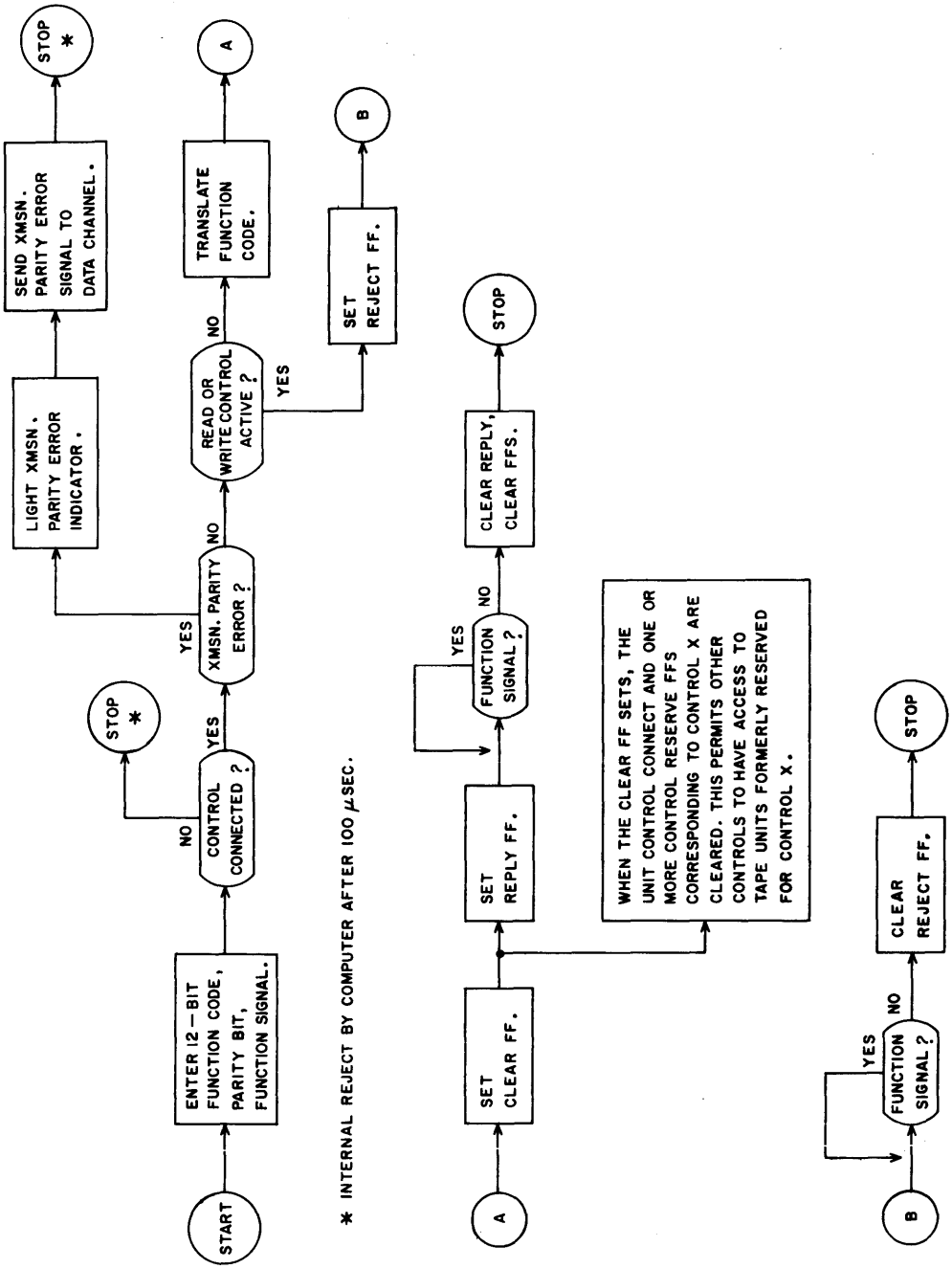


Figure 3-14. Flow Chart Showing Sequence of Events Involved in a Clear Operation. (Function Code = 0005).

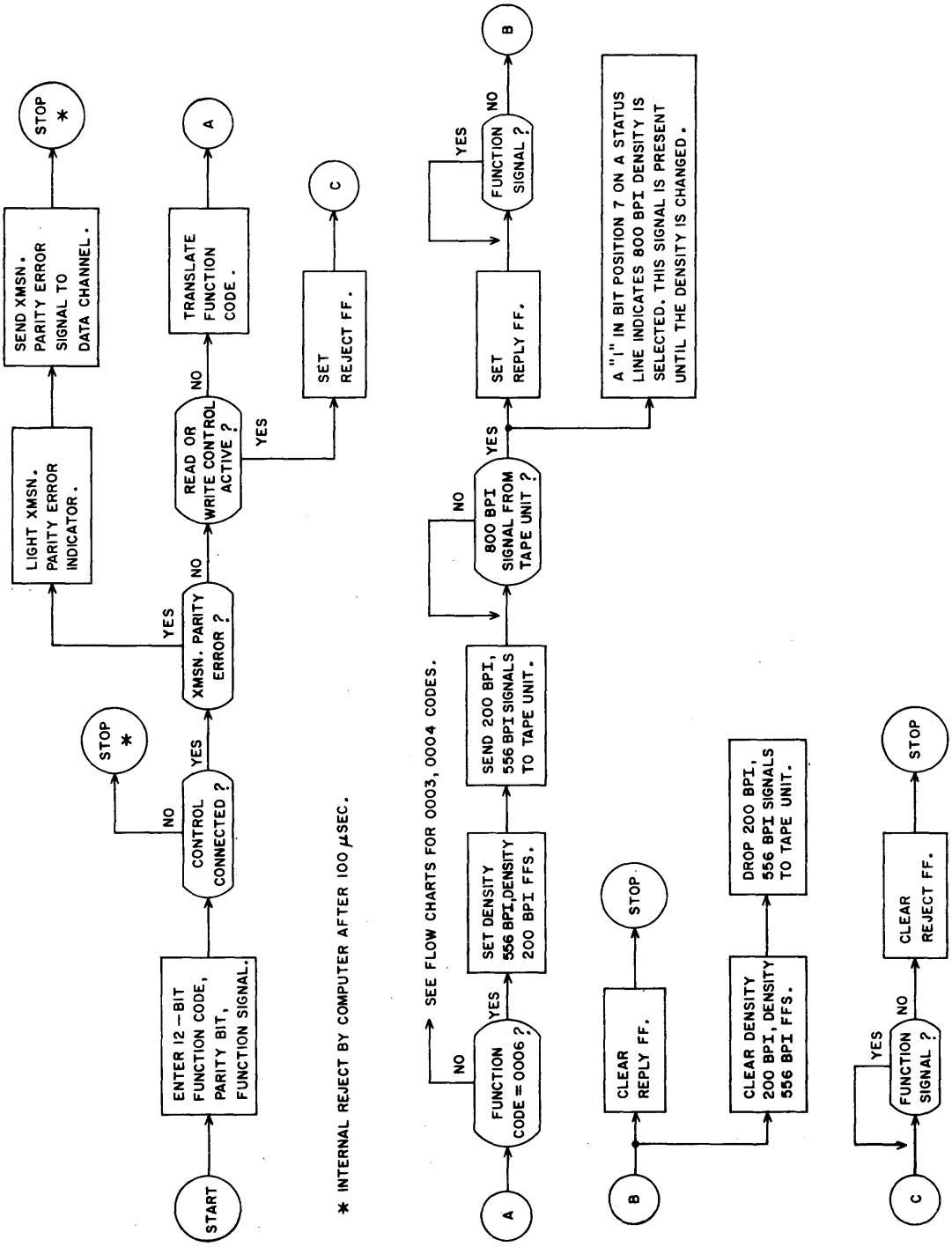


Figure 3-15. Flow Chart Showing Sequence of Events Involved in Selecting 800 BPI Density. (Function Code = 0006).

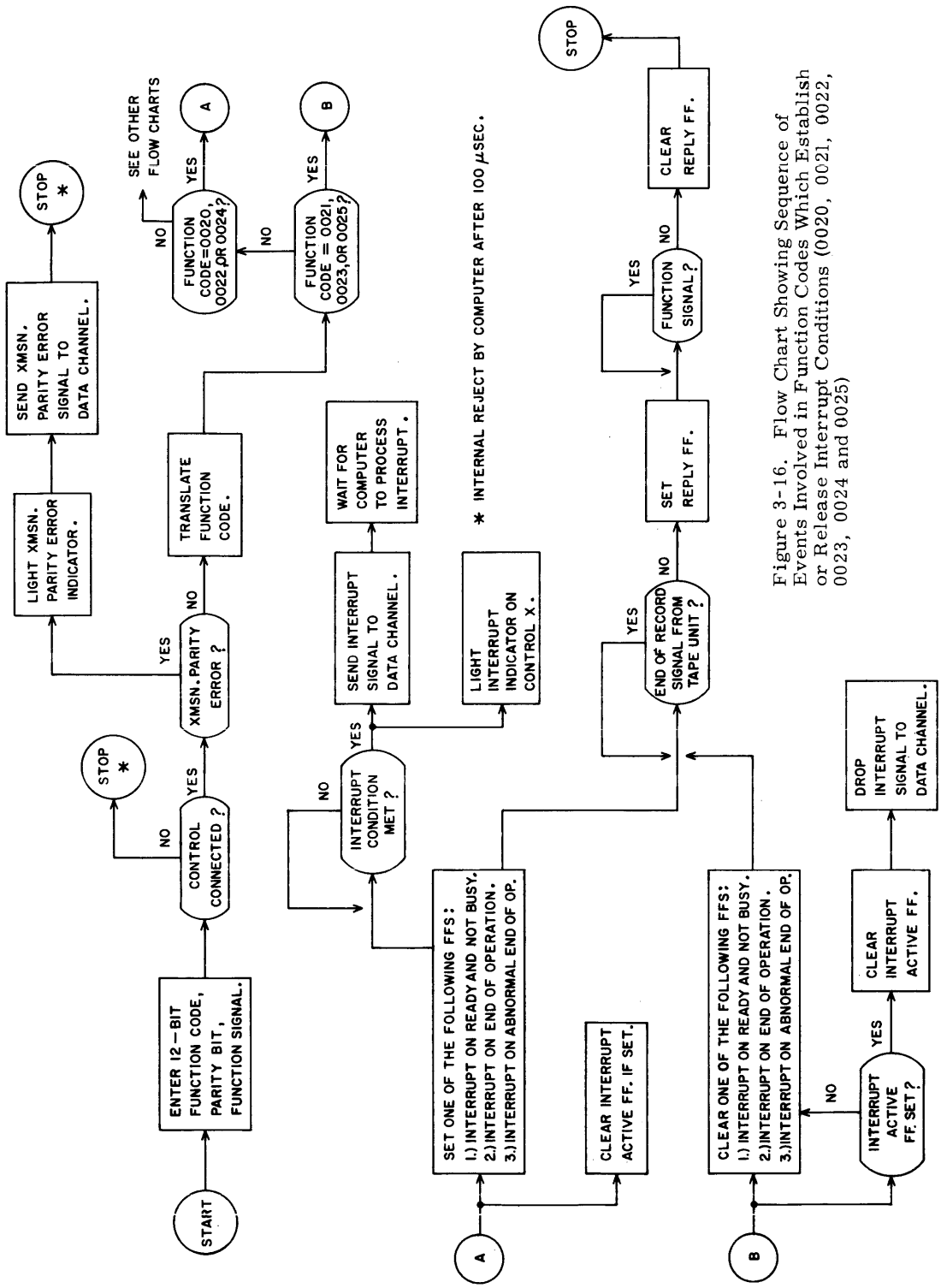


Figure 3-16. Flow Chart Showing Sequence of Events Involved in Function Codes Which Establish or Release Interrupt Conditions (0020, 0021, 0022, 0023, 0024 and 0025)

Figure 3-16. Flow Chart Showing Sequence of Events Involved in Function Codes Which Establish or Release Interrupt Conditions (0020, 0021, 0022, 0023, 0024 and 0025)

CHAPTER 4
WRITE AND SIMILAR OPERATIONS

GENERAL

This chapter contains a discussion of logic and events involved in Write, Write Record Check Character, and Write Non-stop operations.

Refer to figure 4-1 for a block diagram of the Write operation. The 362X logic diagrams contain detailed logic. See the appendix of this manual for write timing diagrams. Logic is identical for all four controls.

Information is received from the 3606 and gated into the O register (see figure 4-1) by the write control logic. The contents of O are gated into the B inverters and the W Write Toggle register 6 bits at a time. A parity bit is generated during the $B \rightarrow W_1$ transfer, making a total of 7 bits. The outputs of W_1 drive the write logic in the tape unit.

During the $O_2 \rightarrow B$ and $O_1 \rightarrow B$ transfers, the B inverter logic converts internal BCD codes to external BCD codes if the Write operation is in BCD mode. This is done by complementing bit 6 if bit 5 is a "1". The only exception is the character 00_8. It is written as 12_8 on tape.

The data is read back into the C Read register from tape approximately 2 ms after is has been written. A constant vertical parity check is performed and a signal appears on a status line if a vertical parity error is detected.

When the Write operation is complete, a longitudinal parity check is performed and a signal appears on a status line if such an error is detected.

WRITE OPERATION

Function instructions prior to the write instruction set control X to BCD/binary and density modes.

Data and Write signals initiate the Write operation. The Write signal (provided the proper enables are present) sets the Write Motion FF. After a delay of 3.5 or 30 ms (depending on the position of the tape) the Write Control FF sets. This drops the End of Record Clear signal which allows the Data signal to set the R→O FF. After a delay of

0.1 usec the Write Resync FF sets. Enables from a free-running write oscillator timing chain (pages 4 and 5 in the 362X diagrams) along with the selected density enable set the Write Gate FF.

When the Write Resync initially sets, a Reply is returned to the 3606, the Data signal drops, and the Reply drops. (Dropping the Data signal clears the R→O FF.) The Write Gate enables the write oscillator slaves to gate information into the proper registers, advance the disassembly (DK) counter, set and clear the Write Sprocket FF, and clear the Write Gate FF. (The Write Gate FF clears and sets every 6-bit frame; the Write Resync clears and sets every two frames.)

A Reply Sprocket pulse is returned from the tape unit when it reads the information. This pulse starts the Reply Read timing chain which gates the information into the C Read register. When the Write operation is complete, the contents of C_1 should be 0; if not, a Longitudinal Parity Error FF sets and a Longitudinal Parity Error signal appears on a status line.

SEQUENCE OF EVENTS IN A WRITE OPERATION

This sequence of events assumes a start from a MC, 556 BPI density. Refer to pages 5, 14, and 15 in 362X prints for detailed logic.

STEP	EVENT
1.	Write signal sets Write Motion FF. This starts tape motion in a forward direction by sending Write and Forward signals to the tape unit. Data signal comes up approximately 2→60 usec later.
2.	a) A delay of 3.5 or 30 ms occurs; Write Control FF sets. b) The Clear W signal drops. c) End of Record Clear signal drops. d) Data signal comes up. e) R →O FF sets.
3.	a) Write Resync sets 0.1 usec after R→O FF sets. R→O transfer of data occurs. A Reply is returned to the 3606. This drops the Data signal which drops the Reply and clears the R→O FF. (Clear O drops when the Write Resync sets.)

362X WRITE LOGIC FOR A TYPICAL CONTROL

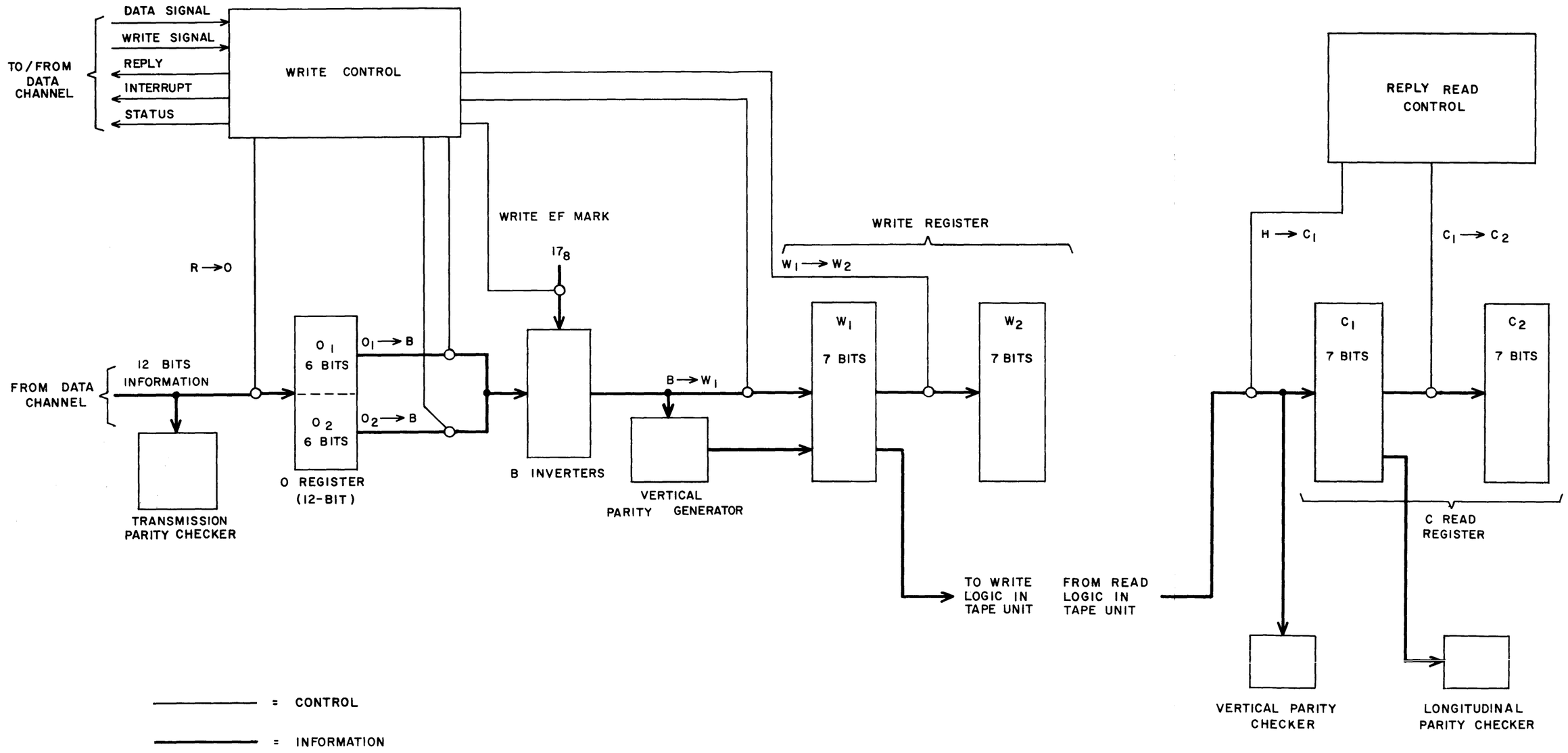


Figure 4-1. Block Diagram Write Logic

b) The Write Gate sets when the write oscillator is in the proper position. From this point on, the Write operation is clocked.

4. a) The free-running write oscillator (12 usec cycle, 2 cycles/12-bit word) transfers $O_2 \rightarrow B$.
   b) $W_1 \rightarrow W_2$, $DK_1 \rightarrow DK_2$.

5. a) During $O_2 \rightarrow B$ but after $W_1 \rightarrow W_2$, $B \rightarrow W_1$ occurs.
   b) The Write Sprocket sets during $O_2 \rightarrow B$ but after $B \rightarrow W_1$. This signals the tape unit to accept and write the upper 6 bits and parity bit on tape.

6. Advance DK (DK cleared on MC); i.e., set DK_1.

7. Clear Write Sprocket; clear Write Gate 0.1 usec after Write Sprocket clears.

8. Write Gate sets again when write oscillator is in the proper position.

9. a) $O_1 \rightarrow B$, $W_1 \rightarrow W_2$, $B \rightarrow W_1$ in same order as above ($O_1 \rightarrow B$ replaces $O_2 \rightarrow B$).
   b) Write Sprocket sets after $B \rightarrow W_1$. This signals the tape unit to accept and write the lower 6 bits plus parity bit on tape.

10. a) Advance DK (clear DK_1).
    b) Clear O register during advance DK time.

11. a) F→O FF sets for word two. (The Data signal came up again sometime after it dropped, indicating another 12-bit word was on the lines. If the Data signal were not present, R→O would not set and the End of Record sequence would begin.)
    b) Clear Write Resync, Write Gate, Write Sprocket.

12. Write Resync sets 0.1 usec after R→O FF sets. Write Gate sets when write oscillator chain is in the correct position.

13. Reply is returned when Write Resync sets. This drops the Data signal which drops the reply. R→O clears when the Data signal drops.

14. Word two is now written in the same manner as word one. If the Data signal is present when writing word two, it indicates that word three is on the lines.

REPLY SEQUENCE OF EVENTS

Refer to page 16 of the 362X diagrams for detailed logic.

STEP		EVENT
1.	a)	Information is read back from tape and a Read Sprocket pulse is generated (about 2000 usec after the Write Sprocket pulse) which starts the Reply Read timing chain by setting Zx54/Zx55.
	b)	$C_1 \rightarrow C_2$
2.	a)	Zx56/Zx57 sets.
	b)	The Reply Timing Chain Lockout (Zx52/Zx53) sets.
3.	a)	$H \rightarrow C_1$. Information is gated into the C Read register. A vertical parity check is performed during $H \rightarrow C_1$. If a parity error occurs, an indicator on the control lights and a vertical parity error signal (bit 10) is present on a status line.
	b)	Continue through the timing chain until all FFs have set and cleared.
4.		Sprocket drops from tape unit which clears Zx52/Zx53.
5.		Repeat steps 1a through 3b for each 6 bit frame of information written on tape.

LOST DATA

During step 10a in the Write operation (Advance DK) the Lost Data FF (Zx70/Zx71) sets if the Write signal is extant and the Data signal has not been present for two frames. A normal End of Record sequence is performed. No other write operations are possible until the Lost Data FF is cleared by either a Function, Connect, or MC. A Lost Data signal (bit 8) appears on a status line when the Lost Data FF sets. This will also cause an interrupt if Interrupt on End of Abnormal operation is set.

END OF RECORD SEQUENCE (WRITE RECORD CHECK CHARACTER)

Refer to 5, 14, 15, 16, and 18 of the 362X logic diagrams for detailed logic. Steps 1 through 10 are the same as in the normal Write sequence.

STEP	EVENT
11.	a) If Data and Write signals are not present during the last oscillator interval (n) the R→O FF does not set. R→O is not executed. Write Data Lockout FF (Zx36/x37) sets. b) Write Resync and Write Gate clear and remain clear.
12.	On Advance DK during the last oscillator interval (n), Zx00/Zx01 of the check character counter sets.
13.	On the start of oscillator cycle n+1, Zx02/Zx03 of the CC counter sets.
14.	Zx04/Zx05 sets 2 usec after Zx03 sets.
15.	On the start of oscillator cycle n+2 Zx02/Zx03 clears, Zx06/Zx07 sets 2 usec later.
16.	On the start of oscillator cycle n+3, Zx02/Zx03 sets; Zx04/Zx05 clears 2 usec later.
17.	On the start of oscillator cycle n+4 a) Zx02/Zx03 of the CC Counter clears. b) Write Termination I sets (Zx30/Zx31). c) Clear W_1 (Wx98) comes up. d) A Write Sprocket pulse is generated, the record check character is written, and the normal reply sprocket enables gating the record CC into C_1. When the current operation is complete, an End of Operation signal from the 606 allows setting the Longitudinal Parity Error FF (Px54/Px55) if a bit is present in any stage of the C_1 register. A Parity Error signal is present on a status line (bit 10) if a longitudinal parity error has occurred.
18.	a) In the time of 2.6 ms after Write Termination I sets, Write Termination II sets. b) Write Termination I clears when Write Termination II sets. c) Write Motion (Zx20/Zx21) clears when Write Termination II sets. This drops Write and Forward signals to the tape unit.
19.	a) Write Control (Zx22/Zx23) clears 4 ms after Write motion clears.

STEP	EVENT
	b) The End of Record Clear signal again comes up when the Write Control clears. Write Data Lockout FF clears.
	c) Four ms + 0.1 usec after Write Termination II sets, it clears.

NON-STOP WRITE

This operation permits writing a series of two or more separate records without stopping tape motion. After the Reply (step 13 in the normal Write operation), the Write signal drops for approximately 1 usec and reappears. This sets the Write Data Lockout FF (Zx36/x37). (Steps 1 through 13 are the same as in the normal Write sequence.)

STEP	EVENT
14.	Write Termination I (Zx30/Zx31) sets and the normal record check character is written. The normal longitudinal parity error check is performed.
15.	Write Termination II (Zx32/Zx33) sets 2.6 ms after Write Termination I. (Since the Write signal is up again, the Write Motion FF does not clear.)
16.	a) Non Stop Write FF (Zx34/Zx35) sets 3 ms after Write Termination II.
	b) End of Record Clear (Fx02) comes up. It clears Write Termination II, Non-Stop Write, and Write Data Lockout, and drops again.
17.	A new record is started (Data and Write signals present) after having inserted a 5 ms record gap. The contents of C_1 and W_1 are cleared before starting the new record.

CHAPTER 5
READ AND SIMILAR OPERATIONS

GENERAL

This chapter discusses logic and events involved in Read, Read End of Record Check Character, Read Non-stop, and Reverse Read Operations.

Refer to figure 5-1 for a block diagram of information flow. Refer to the 362X diagrams, pages 16, 17 and 18, for detailed read logic. Also see the read timing diagram in the appendix of this manual. Logic is identical for all four controls.

Seven-bit frames (6 data bits + parity bit) are read from tape and a vertical parity check is performed on each frame. The parity bit is discarded and two 6-bit frames are assembled in the 12-bit X Read register. A parity bit is generated and the 13 bits of information are sent to the data channel. A longitudinal parity check is performed at the end of the read operation by checking the contents of the C_1 Read register.

During a Read operation in BCD mode, external BCD codes from tape are converted into internal BCD codes during assembly in the X Read register. This is done by complementing bit 6 if bit 5 is a "1". The only exception is the character 12_8. It is converted into 00 (the internal BCD code for zero).

Read and Data signals initiate tape motion by setting the Read Motion and Read Control FFs. A sprocket pulse, generated when the data is read from tape, starts the Reply Read timing chain. This timing chain gates data from the H inverters into the X and C registers. The timing chain, assembly counter, and other signals enable the Data signal to set the Reply FF at the proper time.

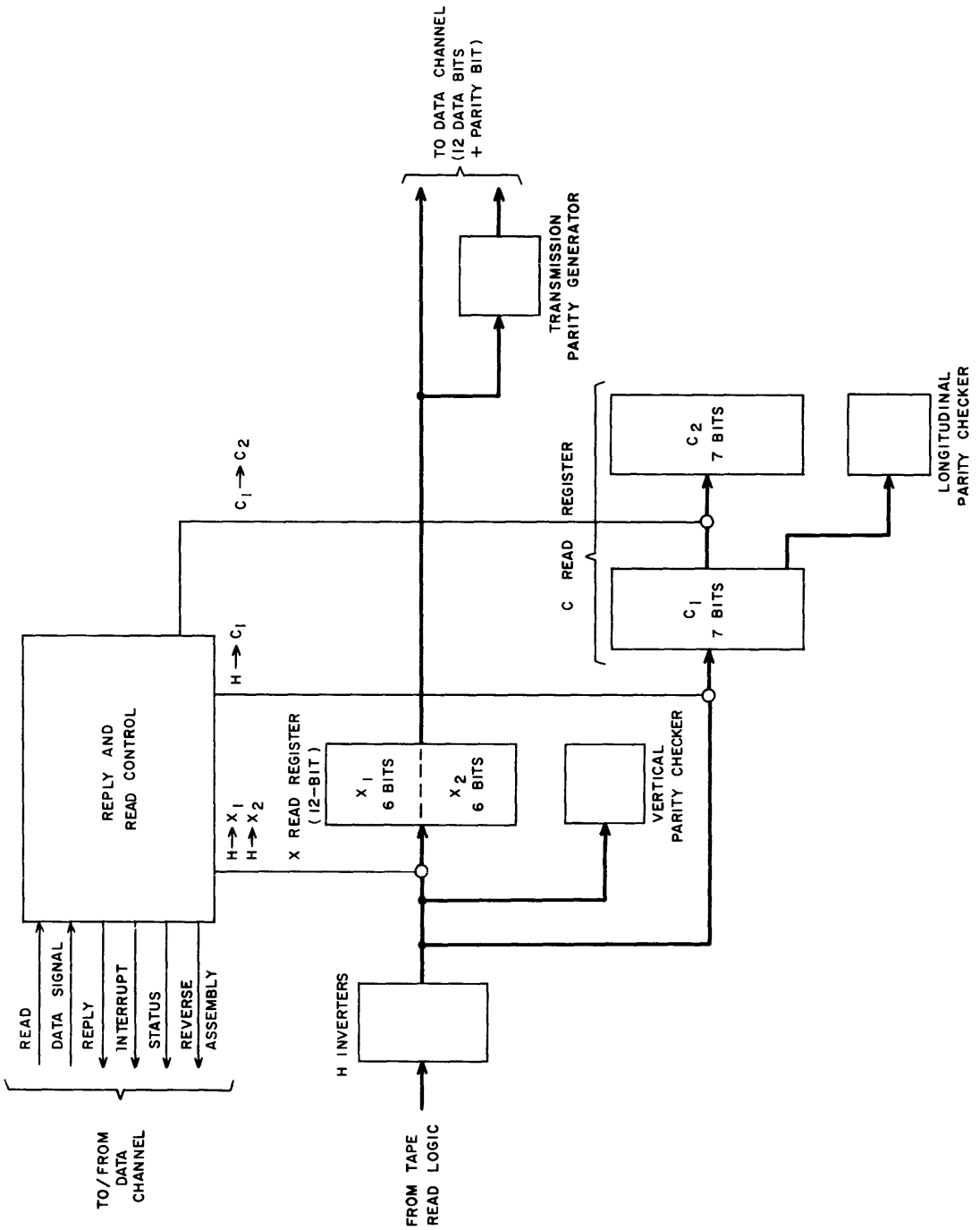


Figure 5-1. Block Diagram - Read Logic

SEQUENCE OF EVENTS IN A READ OPERATION

Assume a start from a MC.

STEP		EVENT
1.	a)	A Read signal with proper enables sets the Read Motion FF (Zx42/x43). This sets a Read FF (Dx42/x43) which sends Forward and Read signals to the tape unit.
	b)	Ex26 (Clear C_1) comes up.
	c)	Ex32 (Start New Record) clears the assembly (AK_1) counter. Note: Steps b and c occur only when starting the read operation, or reading non-stop from one record to another.)
	d)	The Data signal comes up approximately 1 usec after the Read signal.
2.	a)	A delay of 1 or 10 ms occurs (10 ms if tape is at Load Point, 1 ms if tape is not at Load Point), after which the Read Control FF (Zx44/x45) sets.
	b)	Ex26 and Ex32 drop.
	c)	Ex21 (Read/Write Active) comes up.
3.	a)	When the first 7-bit frame of information is read, a sprocket pulse is generated.
	b)	The delayed sprocket pulse, ANDed with Read/Write Active and Reply Timing Chain Lockout, starts the Reply Read timing chain by setting Zx54/x55.
	c)	When Zx54/x55 sets, Read FF (Dx42/x43) clears. This drops the Forward and Read signals to the tape unit.
	d)	Clear X register (Ex28, Ex29).
	e)	$C_1 \rightarrow C_2$, $AK_1 \rightarrow AK_2$ (Ex30, Ex31).
	f)	Read Data Lockout FF (Zx40/x41) clears.
4.	a)	Zx56/x57 of the Reply Read timing chain sets 0.2 usec after Zx54/x55 sets.
	b)	The Reply Timing Chain Lockout FF (Zx52/x53) sets and clears 1 usec after the sprocket pulse drops.
	c)	Begin Record I FF (Zx60/x61) sets.
	d)	Clear X and $C_1 \rightarrow C_2$ signals drop.

STEP	EVENT
5.	a) Zx58/x59 of the Reply Read timing chain sets. b) H→C_1 (Ex42/Ex43). c) H→X_2 (Ex46).
6.	In the time of 0.2 usec after Zx58/x59 sets, the Reply Read timing chain starts to clear.
7.	When Zx56/x57 clears, AK_1 (Zx64/x65) sets.
8.	a) Another sprocket pulse is generated when the next frame of information is read from tape. b) The Reply Read timing chain starts again and steps 4a→5b repeat. In addition, Begin Record II (Zx62/x63) sets when the Reply Read timing chain starts. The Reply is returned to the data channel of the timing chain when Zx56/x57 clears; AK_1, (Zx64/65) clears. c) H→X_1 (Ex44).
9.	The Reply drops the Data signal which drops the Reply.

One 12-bit word has now been read from tape. The sequence repeats for each additional 12-bit words read from tape, when accompanied by a steady Read signal and a rising and falling Data signal.

READ END OF RECORD CHECK CHARACTER

Read and Data signals drop. Because of the gap between the last word and the Record Check Character, no sprocket pulse is received for approximately 48 usec (assuming 556 BPI density).

STEP	EVENT
1.	Read Data Lockout (Zx40/Zx41) sets when the Read signal drops. This holds a constant clear on the X register, keeping out the Record Check Character.
2.	After approximately 28 usec have elapsed since the last sprocket pulse, the End of Record FF (Zx46/Zx47) sets. When the End of Record signal is received from the tape unit, the End of Record II FF (Zx76/x77) sets.
3.	The Read Motion FF clears 45 usec after the End of Record II FF sets. The contents of the C Read register are checked for a longitudinal parity error. If

STEP EVENT

any stage of $C_1 \neq 0$, the Longitudinal Parity Error FF sets (Px54/x55) when the End of Record signal is received from the tape unit. A Parity Error signal (bit 10) is available on a status line until reading begins on a new record.

a) 3.5 ms after the End of Record FF sets, the Read Control, Begin Record I, Begin Record II, and End of Record FFs have cleared.

Tape motion halts and the operation is complete.

EXCEPTIONS

1. If the End of Record FF (Zx46/x47) sets when both Read and Data signals are present, an End of Record signal is sent to the Data Channel by Zx72/Zx73. This signal drops when the Data signal drops. Tape motion halts.

2. If Read and Data signals drop before the End of Record Check Character is read, reading continues until the Check Character is read. Data is not entered into the X register after the Read signal drops. (The Read Data Lockout FF holds a constant clear on the X register.)

LOST DATA

Normally the Data signal and the Read Ready FF enable thereby setting the Reply FF when the second frame of information is being read. If the Read signal is up at this time, but the Data signal is absent (the operation being normal in all other respects) the Lost Data FF (Zx70/Zx71) sets when the next sprocket pulse occurs. A Lost Data signal (bit 8) appears on a status line. (An interrupt occurs 5 usec after the End of Record signal is received from the tape unit if Interrupt on Abnormal End of Operation is selected.)

The Lost Data FF also sets the End of Record Disconnect FF (Zx72/Zx73) if the Read control is set. This sends an End of Record signal back to the data channel. Tape motion continues to the End of Record Check Character and stops.

Further Read operations are impossible until the Lost Data FF is clear. A Function (Ix21), Connect (Ix05) or MC (Dx19) signal clears the Lost Data FF.

READ NON-STOP

Refer to figure 2-5.

Events follow the normal End of Record sequence through step 2.

3. a) The Record Check Character is read; a longitudinal parity check is performed in the normal manner.
   b) If Read and Data signals reappear within 45 usec after they have dropped, Ex10 prevents the End of Record II FF from clearing the Read Motion FF.

4. Read Non-Stop I (Zx48/x49) sets 45 usec + 2 usec after the End of Record sets.

5. a) Read Non-Stop II sets 1 ms after Read Non-Stop I.
   b) Clear C_1 (Ex26) comes up.

6. When Non-Stop II sets, Begin Record I, Begin Record II, and End of Record FFs clear.

7. a) When the End of Record II FF clears, Read Non-Stop I clears.
   b) Read Non-Stop II clears 1 usec after Read Non-Stop I clears.

Tape motion continues and reading begins on the next record.

REVERSE READ

Refer to figure 5-1 and pages 9, 10, 16, 17, and 18 of the 362X logic diagrams. Also refer to the reverse read timing diagram in the appendix of this manual. To perform a Reverse Read operation, the Backward FF (Jx38/x39) must first be set with an 0041 Function code. (See chapter 3, figure 3-9.)

STEP	EVENT
1.	a) A Read signal with the proper enables sets the Read Motion FF (Dx42/x43) which sends Read and Reverse signals to the tape unit.
	b) Ex26 (Clear C_1) comes up.
	c) Ex32 (Start New Record) clears the assembly (AK_1) counter.
	Note: Steps b and c occur only when starting the read operation or reading non-stop from one record to another.
	d) A Reverse Assembly signal is returned to the data channel.
	e) The Data signal comes up approximately 1 usec after the Read signal.
2.	a) A delay of 1 ms occurs, after which the Read Control FF (Zx44/x45) sets.
	b) Ex26 and Ex32 drop.
	c) Ex21 (Read/Write Active) comes up.

STEP	EVENT
3.	a) When the first 7-bit frame is read, a sprocket pulse is generated.
	b) The sprocket pulse, ANDed with Read/Write Active and Reply Timing Chain Lockout starts the Reply Read timing chain by setting Zx54/x55.
	c) When Zx54/x55 sets, the Read FF (Dx42/x43) clears. This drops the Read and Reverse signals to the tape unit. Read Data Lockout FF (Zx40/x41) clears.
	d) Clear X register (Ex28, Ex29) comes up for 0.2 usec.
	e) $C_1 \rightarrow C_2$, $AK_1 \rightarrow AK_2$ (Ex30, Ex31).
4.	a) Zx56/x57 of the Reply Read timing chain sets 0.2 usec after Zx54/x55 sets.
	b) The Reply Timing Chain Lockout FF (Zx52/x53) sets and clears 1 usec after the sprocket pulse drops.
	c) Begin Record I FF (Zx60/x61) sets.
	d) Clear X and $C_1 \rightarrow C_2$ signals drop.
5.	a) Zx58/x59 of the Reply Read timing chain sets.
	b) $H \rightarrow C_1$ (Ex42, Ex43).
	c) $H \rightarrow X_1$ (Ex46).
6.	In a time of 0.2 usec after Zx58/x59 sets, the timing chain starts to clear.
7.	When Zx56/x57 clears, AK_1 (Zx64/x65) sets. At this point a decision must be made to discard the frame just read or continue reading. If another sprocket pulse follows the first within 12 usec (assuming 556 BPI density) reading continues since the record check character was equal to all "0's". An $H \rightarrow X_2$ transfer is made, and the assembled 12-bit word plus parity bit and a Reply is sent to the data channel.
	If no sprocket pulse is received for 28 usec after the first sprocket pulse, the frame read was a record check character. Then the following sequence of events occurs:
8.	AK_1 (Zx64/x65) is cleared. The Vertical Parity Error FF (Px50/x51) is also cleared since the record check character is not written with attention to parity and may have set the Vertical Parity Error FF.
9.	a) When the next sprocket pulse occurs, the Reply Read timing chain starts. The X register which contains the record check character in $X_1 = X_{lower}$

is cleared when Zx54/x55 sets.

b) $AK_1 \rightarrow AK_2$, $C_1 \rightarrow C_2$ (Ex30, Ex31).

c) Begin Record II sets when Zx54/x55 sets.

10. a) When Zx56/57 sets, the Reply Timing Chain Lockout FF sets and clears 1 usec after the sprocket pulse drops.

b) When Zx58/x59 sets, $H \rightarrow C_1$ and $H \rightarrow X_1$ pulses are present. The frame read is sent to the C read register and the lower half of the X register.

c) The timing chain completes its cycle and stops.

11. When the next sprocket pulse is received, the timing chain starts again. This frame is transferred to X_2, a transmission parity bit is added to the 12 bits in X, and a Reply is returned to the data channel. When the Data signal drops, the Reply FF is cleared.

12. Reading continues on the next frame if the Read signal is present and the Data signal has reappeared. A vertical parity check is performed on each frame read (during $H \rightarrow C_1$ transfer). If a vertical parity error occurs in a frame (other than the record check character) a Vertical Parity Error signal is available on a status line (bit 10). This signal remains until a new record is read or the control is no longer connected to the tape unit. Lost data checking is identical to the checks made in a normal read operation.

ENDING THE REVERSE READ OPERATION

If Read and Data signals drop after reading the last word in a record, the following sequence of events occurs:

STEP		EVENT
1.	a)	The Read Data Lockout FF (Zx40/41) sets when the Read signal drops.
	b)	If there is no sprocket pulse for 28 usec, the End of Record FF (Zx46/x47) sets.
	c)	Clear X comes up when Zx46/x47 sets.
	d)	A longitudinal parity check is performed when the End of Operation signal (= End of Record) is returned from the tape unit (approximately 250 usec after the last frame is read). A Parity Error signal is available on a status line (bit 10) if a longitudinal parity error is present; i.e., a stage of C_1 is set. This signal remains until reading starts on a new record or

the control is no longer connected to the tape unit.

c) End of Record II (Zx76/x77) sets when the End of Record signal is received from the tape unit.

2. Forty-five usec later the Read Motion FF (Zx42/x43) clears.

3. a) The Read Control FF (Zx44/x45) clears, 3.5 ms after the Read Motion FF clears.

b) When the Read Control FF clears, Begin Record I, Begin Record II, and End of Record FFs clear. Tape motion halts.

EXCEPTIONS IN A REVERSE READ OPERATION

1. If the last frame is read and Read and Data signals request more information (the Read signal has not dropped) an End of Record signal is sent to the data channel by setting the ER Disconnect FF (Zx72/x73). This signal drops (Zx72/x73 clears) when the Data signal drops or the tape unit is no longer connected to the control.

2. If Read and Data signals drop before the last frame is read, reading continues to the last frame and stops. Data is not entered into the X register after the Read Data Lockout FF sets. (Read Data Lockout sets when the Read signal drops.)

3. If at the time when Read and Data signals drop and the tape unit detects a record gap, Read and Data signals reappear within 45 usec; tape motion does not stop. The record gap is skipped and the tape unit starts reading the next record.

CHAPTER 6
INTERRUPT

Figure 6-1 shows the interrupt logic used in Control A. (Interrupt logic is identical for all controls except for numeration.) See chapter 3, figure 3-16 for a detailed flow chart showing how the Interrupt FFs are set or cleared.

INTERRUPT ON READY AND NOT BUSY

The Interrupt Active FF sets when Ready and Not Busy signals are received from the tape unit (assuming the Interrupt On Ready and Not Busy FF is set). The Interrupt Active FF lights an interrupt indicator on Control A of the 362X and sends an Interrupt signal to the data channel.

The Interrupt Active FF is cleared when:

1) The Interrupt On Ready and Not Busy FF is cleared by an 0021 Function code.
2) The control receives a MC signal from the data channel.

INTERRUPT ON END OF OPERATION

The Interrupt Active FF sets when:

1) An End of Record signal is received from the tape unit (assuming the Interrupt On End of Operation FF is set).
2) The Data channel goes from a busy to not busy condition (i.e., Jx40/x41 must be set).

The End of Record signal is received by the control about 250 usec after:

1) A Record Check Character is read.
2) A File Mark has been detected in a Search End of File Mark Forward or Backward operation.
3) Load point has been detected during a rewind operation.

It should be noted that during a chaining operation, this interrupt will not occur until the data channel is not busy, (i.e., until the last record has been written/read in the chaining operation (see J040/041 in figure 6-1).

The Interrupt Active FF is cleared when:

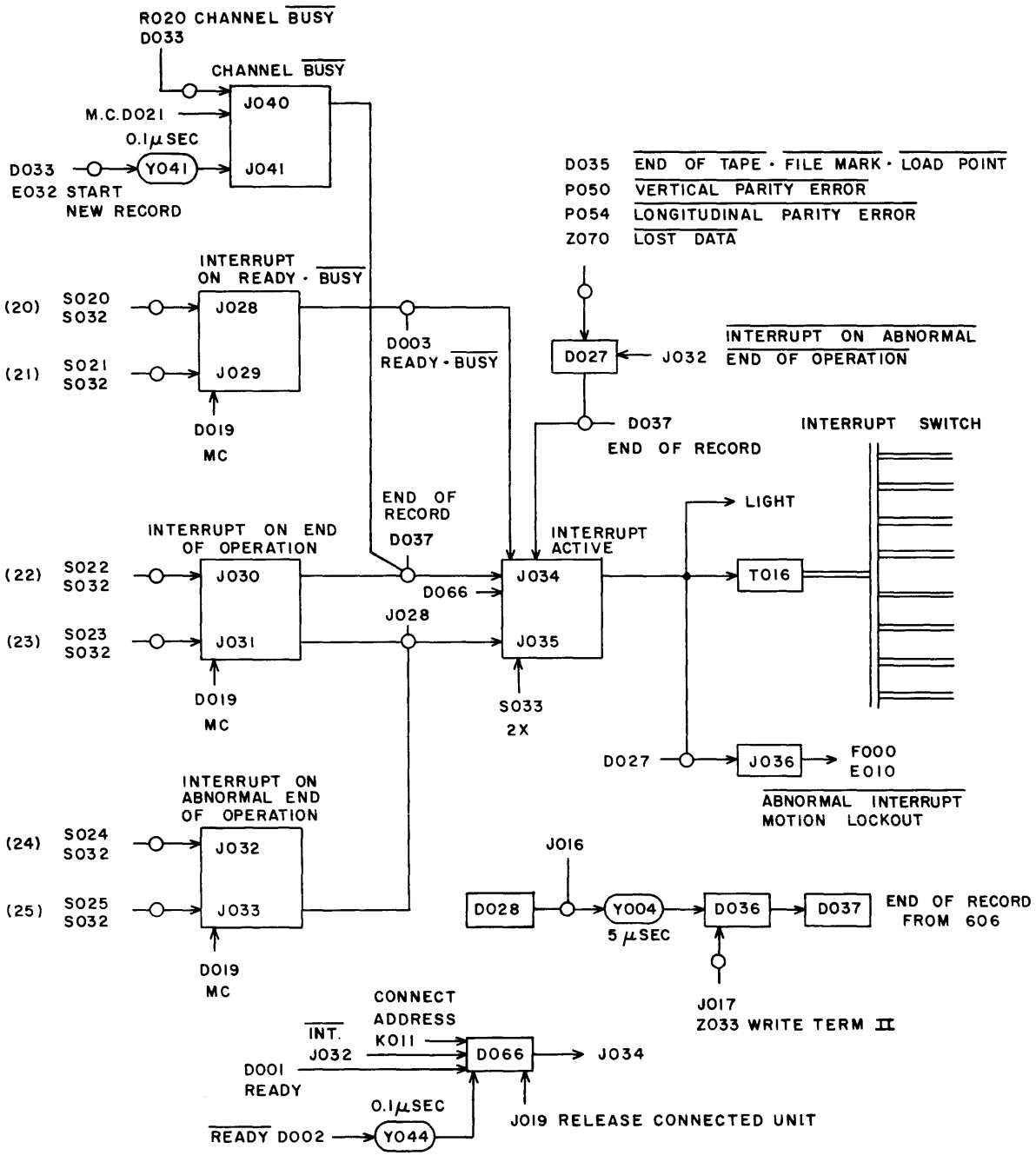


Figure 6-1. Control A Interrupt Logic

1) The Interrupt On End of Operation FF is cleared by an 0023 Function code.
2) The control receives a MC signal from the data channel.

INTERRUPT ON ABNORMAL END OF OPERATION

The Interrupt Active FF is set when an End of Record signal is received from the tape unit and one or more of the following conditions are present: (assuming the Interrupt On Abnormal End of Operation FF is set)

1)	End of tape	The end of tape marker is sensed.
2)	File mark	And end of file mark has been detected in a search end of file mark forward/backward operation.
3)	Load point	Tape is at load point.
4)	Vertical parity error	A vertical parity error has occurred during reading/writing information on tape.
5)	Longitudinal parity error	A longitudinal parity error has occurred during reading/writing information on tape.
6)	Lost data	Data has been lost during reading/writing information on tape.
7)	Ready to Not Ready	The connected tape unit has become not ready (i.e., power is turned off, etc.)
8)	Skip Bad Spot error	A longitudinal (and/or) vertical parity error has occurred during a Skip Bad Spot operation. This indicates the tape has not erased properly.

When the Interrupt Active FF sets as a result of an Abnormal End of Operation condition arising, further read/write operations on tape are impossible until the Interrupt Active FF is cleared with an 0025 Function code (Clear Interrupt On Abnormal End of Operation) or a MC signal from the data channel.

It should also be noted that any 002X Function code will clear the Interrupt Active FF.

During a chaining operation, interrupt will occur at the same time as in a nonchaining operation if one or more abnormal conditions arise as described previously.

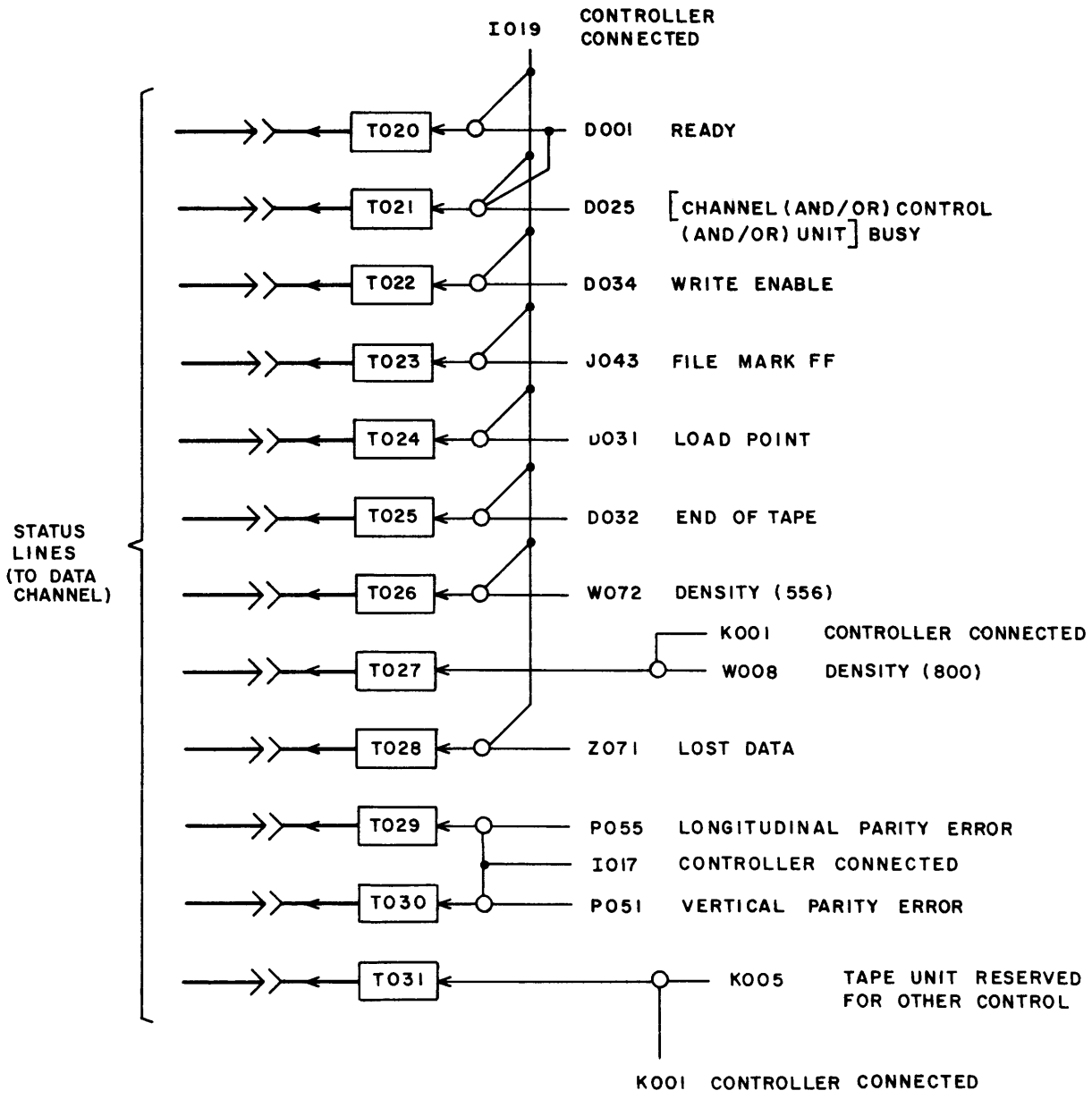


Figure 6-2. Control A Status Lines

STATUS LINES

Figure 6-2 shows the 12 status lines associated with Control A. (Status lines are identical for controls B, C, and D except for numeration.) When the Controller Connect FF sets (see the connect sequence in chapter 2), information on these status lines is available to the data channel.

CHAPTER 7
LOGIC CABLING

Figure 7-1 shows a typical 362X cabling diagram. The cable connectors on the right and left sides of the chassis attach to the 606/607 magnetic tape transports. Table 7-1 gives the pin numbers associated with signals in the two cables going to/from the 362X and each tape transport. The pages following table 7-1 give a brief description of each of the signals listed in table 7-1.

The cable connectors at the bottom of the 362X chassis attach to data channels and terminators. The leftmost connector (1A1) attaches to a Data I/O cable. Connector 1A2 is either terminated or attached to another Data I/O cable going to some other piece of external equipment. Connector 1B1 is attached to a Control I/O cable. Connector 1B2 is either terminated or attached to another Control I/O cable going to some other piece of external equipment.

The remaining three sets of connectors in chassis 1 and 2 are connected in exactly the same manner; i.e., the leftmost connector is attached to a Data I/O cable, etc.

Table 7-2 lists signal and pin assignments for Data and Control I/O cables. The pages following table 7-2 give a brief description of each of the signals listed in table 7-2.

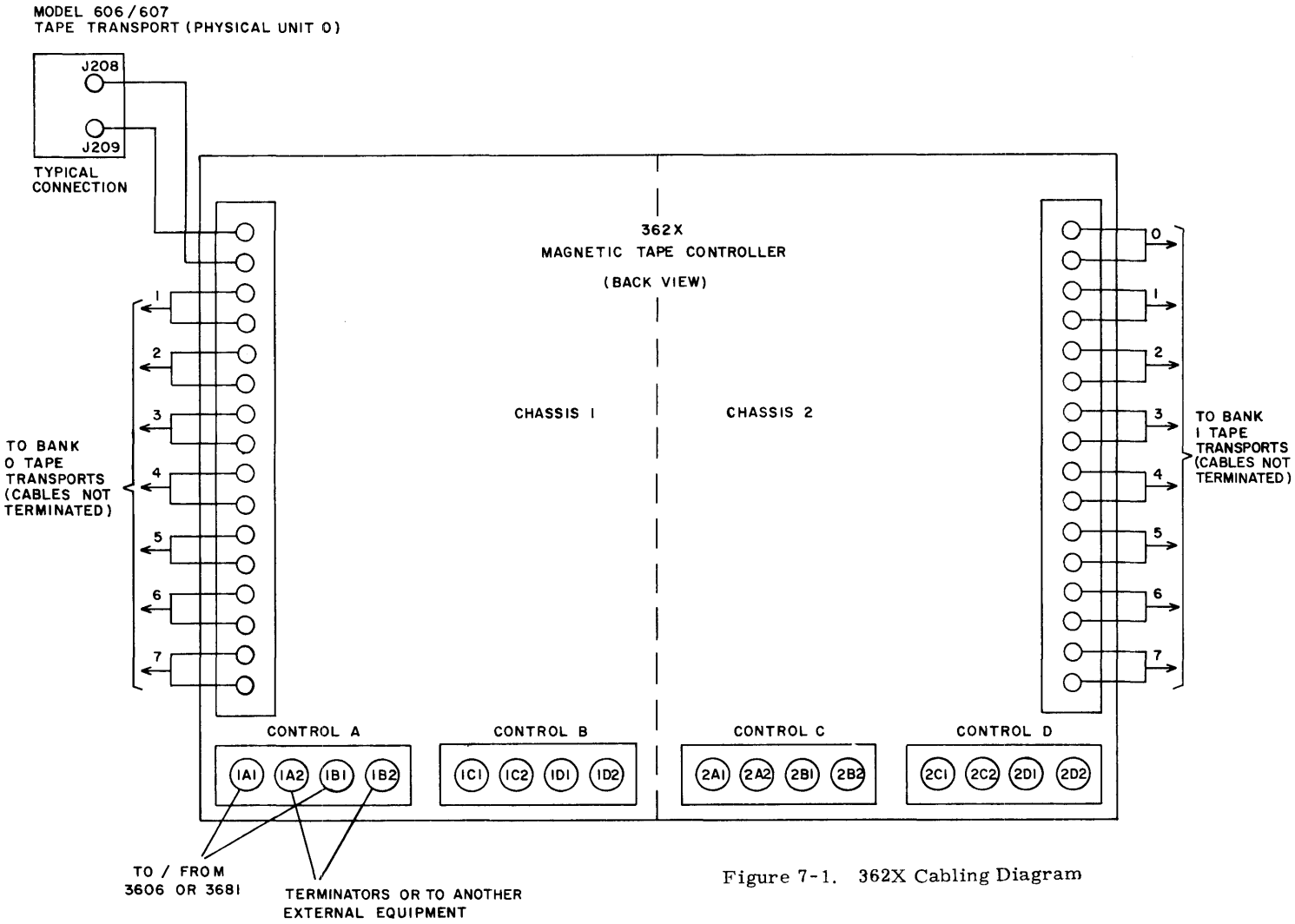


Figure 7-1. 362X Cabling Diagram

Figure 7-1. 362X Cabling Diagram

TABLE 7-1. SIGNAL AND PIN ASSIGNMENTS: OUTPUT CABLE FROM 362X to 606/607

Note: Terms in parenthesis give signal nomenclature used in 606 manuals and specifications.

Output Connector #J208	Pin		Signal
	*A		2^0 Write
	*B		2^1 Write
	*C	7	2^2 Write
	*D	Write	2^3 Write
	*E	Information	2^4 Write
	*F		2^5 Write
	*H		Parity Write
	*J	Write Sprocket	
	**K	Address 6	
	**L	Address 7	
	*M	Forward	
	*N	Reverse	
	*P	Search End of File (Stop On File Mark)	
	*R	Set 556 BPI Density (Select Hi Density)	
	*S	Set 200 BPI Density (Select Lo Density)	
	*T	Write (Write Select)	
	*U	Read (Read Start)	
	*V	MC (Master Clear)	
	*W	Rewind Unload	
	*X	Rewind	
	**Y	Address 5	
	*Z	Turn On Connect Light (Unit Select Light #1	
	*a	Turn on Reserve Light (Unit Select Light #2)	
	b	Ground	

*From 362X to 606
**From 606 to 362X

TABLE 7-1 (Cont'd)

SIGNAL AND PIN ASSIGNMENTS: INPUT CABLE TO 362X FROM 606/607.

Note: Terms in parenthesis give signal nomenclature used in 606 manuals and specifications.

Input Connector #J209	Pin		Signal
	**A		2^0 Read
	**B		2^1 Read
	**C	7	2^2 Read
	**D	Read	2^3 Read
	**E	Information	2^4 Read
	**F		2^5 Read
	**H		Parity Read
	**J	Read Sprocket	
	**K	Write Enable (Write Ready)	
	**L	Address 4	
	**M	End of Record (End of Operation)	
	**N	File Mark	
	**P	Address 0	
	**R	Address 1	
	**S	Address 2	
	**T	Address 3	
	**U	Busy	
	**V	Density ("1" = 556 BPI)	
	**W	Load Point	
	**X	End of Tape	
	**Y	Ready	
	Z	Density ("1" = 800 BPI)	
	a	Not Used	
	b	Ground	

*From 362X to 606
**From 606 to 362X

Signal Definitions: Output cable from 362X to 606

7 Write Information	Seven lines which carry information from the Write register in the 362X control. Six lines carry data; one line carries a parity bit.
Write Sprocket	A 4 usec pulse which gates the information on the seven data lines into the 606 write circuitry.
Address 5, 6, and 7	Three address lines (eight total) which correspond to a setting on the 606 unit select switch. A static "1" signal appears on the address line corresponding to the unit select setting. When the switch is rotated, all address lines have a momentary "0" output.
Forward	A "1" signal which initiates forward tape motion at 150 ips.
Reverse	A "1" signal which initiates reverse tape motion at 150 ips.
Search End of File	A "1" signal which initiates tape motion forward/backward. Tape motion stops when an end of file character is detected.
Set 556 BPI Density	A "1" signal which selects 556 BPI density operating mode (556 lines per inch).
Set 200 BPI Density	A "1" signal which selects 200 BPI density operating mode (200 lines per inch).
Write	A "1" signal which enables Write and Read Verify operations.
Read	A "1" signal which enables a Read operation.
MC	A "1" signal which establishes initial operating conditions by clearing all select conditions. Immediately stops tape motion.
Rewind Unload	A "1" signal which initiates tape motion in a reverse direction at 225 ips to a tape unload condition (all tape on supply reel) and stop.
Rewind	A "1" signal which initiates tape motion at 225 ips to the nearest load point marker.

Signal Definitions: Output cable to 362X from 606

Turn on Connect Light	A "1" signal which turns on unit select light 1. This light indicates a particular tape transport is connected to a data channel.
Turn On Reserve Light	A "1" signal which turns on unit select light 2. This light indicates a particular tape transport is reserved by a data channel.
Ground	

Signal Definitions: Input cable to 362X from 606

7 Read Information	Seven lines which carry information from the 606 to the 362X control. Six lines carry data; one line carries a parity bit.
Read Sprocket	A "1" pulse which signals the 362X to sample the 7 bits of read information from the 606/607.
Write Enable	A "1" signal which indicates that the file protect ring is in and tape has been loaded. Write and Read Verify operations may now be performed.
Address 0, 1, 2, 3, 4	See address 5, 6, and 7.
End of Record	A "1" signal which indicates an end of record check character, file mark, or load point has been detected.
File Mark	A "1" signal which indicates a file mark has been detected.
Busy	A "1" signal which indicates that tape is in motion. Signal drops 4 ms after tape motion stops.
Density	A "1" signal which indicates 556 BPI density is selected. If this signal is absent, 200 BPI density is selected.
Load Point	A "1" signal which indicates tape is at load point.
End of Tape	A "1" signal which indicates the end of tape marker has been sensed.
Ready	A "1" signal which indicates the 606 is under 362X control and is prepared for the next operation. The tape unit is always ready when the Ready indicator on the tape unit is illuminated. The tape unit is not ready when power is off or the tape unit is being manipulated from the 606/607 switch panel.
Density	A "1" signal which indicates 800 BPI density is selected.
Ground	

TABLE 7-2. DATA I/O CABLE, SIGNAL AND PIN ASSIGNMENTS (MATES A 362X CONTROL AND A 3606 OR A 3681 CONVERTER)

Pin (two used)	Signal
A1-2	Data Bit 00
A3-4	Data Bit 01
A5-6	Data Bit 02
A7-8	Data Bit 03
A9-10	Data Bit 04
B1-2	Data Bit 05
B3-4	Data Bit 06
B5-6	Data Bit 07
B7-8	Data Bit 08
B9-10	Data Bit 09
C1- 2	Data Bit 10
C3-4	Data Bit 11
C5-6	Parity Bit
C7-8	Channel Busy
C9-10	Reverse Assembly
D1-2	Read
D3-4	Write
D5-6	Connect
D7-8	Function
D9-10	Data Signal
E1-2	Reply
E3-4	Reject
E5-6	End of Record
E7-8	Parity Error
E9-10	(Unused)
F1-2	
F3-4	Master Clear
F5-6	(Used Internally)
F7-8	(Used Internally)
F9-10 (Not in cable. See note)	Termination Power

NOTE: The 29-pair cables terminate in 61-pin connectors. Pins F9-10 of each connector are used to provide power to the terminal assembly and do not connect to lines in the I/O cable.

TABLE 7-2 (Cont'd)

Pin (two used)	Signal
A1-2	Status Bit 00 Ready
A3-4	Status Bit 01 R/W Control (and/or) Busy
A5-6	Status Bit 02 Density ("1" = 556 BPI)
A7-8	Status Bit 03 File Mark
A9-10	Status Bit 04 Load Point
B1-2	Status Bit 05 End of Tape
B3-4	Status Bit 06 Write Enable
B5-6	Status Bit 07 Density ("1" = 800 BPI)
B7-8	Status Bit 08 Lost Data
B9-10	Status Bit 09 Longitudinal Parity Error
C1-2	Status Bit 10 Vertical Parity Error
C3-4	Status Bit 11 Tape Unit Reserved for Other Control
C5-6	Computer Running (Unused)
C7-8	Negate BCD Conversion
C9-10	(Unused)
D1-2	Interrupt Line 0
D3-4	Interrupt Line 1
D5-6	Interrupt Line 2
D7-8	Interrupt Line 3
D9-10	Interrupt Line 4
E1-2	Interrupt Line 5
E3-4	Interrupt Line 6
E5-6	Interrupt Line 7
E7-8	(Unused)
E9-10	(Unused)
F1-2	(Unused)
F3-4	(Unused)
F5-6	(Unused)
F7-8	(Unused)
(Not in cable. See Note) F9-10	Termination Power

**Data Signal	Static "1" signal received by the 362X during both Read and Write operations. Signal drops when 362X returns a Reply to the 3606. 1) In a Read operation, Data signal indicates that 362X may begin reading information and transmitting it to the data channel. 2) In a Write operation, Data signal indicates that information is available on the data lines and the Write operation may begin.
***Reply	Static "1" signal produced by the 362X in response to a Connect, Function, or Data signal. Signal drops when Connect, Function, or Data signal drops. 1) If connection can be made when Connect signal is received, the 362X connects the desired tape unit and returns a Reply. 2) If specified function can be performed when Function signal is received, the 362X executes the function and returns a Reply. 3) In a Read operation, the 362X sends a Reply as soon as it has placed a 12-bit word on the data lines in response to the Data signal. In a Write operation, the 362X sends a Reply as soon as it samples the data lines in response to the Data signal.
***Reject	Static "1" signal produced by the 362X in response to a Connect or Function signal, if the connection cannot be made or the function cannot be performed at the time that the 362X receives the respective signal.
***End of Record	Static "1" signal produced by the 362X during a Read operation. This signal is produced in response to the Data signal, if the end of the specified block of data has been reached.
*Data Bits	The 12 lines which carry data are bidirectional, and perform as follows: 1) In a Read (input) operation, data is read from tape in 6-bit frames, and assembled into 12-bit bytes. These 12-bit bytes are sent to the 3606 data channel. 2) In a Write (output operation), data is received from the 3606 in 12-bit bytes. The 362X disassembles these 12-bit bytes into 6-bit frames and writes them on tape. 3) The Connect code and Function code are received by the 362X via the 12 data lines.
**Channel Busy	Static "1" signal which indicates the data channel is performing a read/write operation.

*Bidirectional signal flow.
**Signal flow from 3606 to 362X.
***Signal flow from 362X to 3606.

*Parity Bit	Accompanies each 12 bits of data transmitted between the 362X and the 3606 data channel. Odd parity is used; thus the total number of "1's" transmitted is always an odd number.
**Read	Static "1" signal received by the 362X from the 3606 during a Read operation.
**Write	Static "1" signal received by the 362X from the 3606 during a Write operation.
**Connect	Static "1" signal received by 362X when 12-bit Connect code is available on data lines. Signal drops when 362X returns a Reply or Reject.
**Function	Static "1" signal received by 362X when 12-bit Function code is available on data lines. Signal drops when 362X returns a Reply or Reject.
***Parity Error	Static "1" signal produced if the total number of "1's" in the 12 data bits plus the parity bit is not an odd number. This signal will be returned to the 3606 only if the 362X is connected to some tape unit.
**Master Clear	"1" signal from computer which returns channel and 362X to zero initial conditions and clears all connections and reservations for tape units.
***Reverse Assembly	A signal which directs the data channel to reverse the byte positions while receiving a 48-bit word from the 362X. The bytes are thus assembled as follows: Byte 1 Bits 11-00 Byte 2 Bits 23-12 Byte 3 Bits 35-24 Byte 4 Bits 47-36
***Status Bits	The 362X uses twelve status lines to indicate its condition.
***Negate BCD	Static "1" received by the 362X. This signal disables the automatic internal to external BCD conversion during a Write operation in BCD mode. It also disables the automatic external to internal BCD conversion during a Read operation in BCD mode.
***Interrupt Lines	A "1" signal on an interrupt line indicates a tape unit connected to the 362X has reached a predetermined condition. Each of the four controls in the 362X has an interrupt line corresponding to the setting of the equipment number switch.

*Bidirectional signal flow.
**Signal flow from 3606 to 362X.
***Signal flow from 362X to 3606.

CHAPTER 8
SWITCHES, INDICATORS AND POWER WIRING

SWITCHES AND INDICATORS

Figure 8-1 shows the switch and indicator panels associated with controls A and B. (An identical switch and indicator panel applies for controls C and D.)

EQUIPMENT NUMBER SWITCHES (S01, S02)
An eight-position (0-7) equipment number switch is associated with each control. The setting of this switch designates the control as equipment number N. Also, any interrupts coming from the control will be transmitted on one of the eight interrupt lines corresponding to the setting of the equipment number switch.

When a control is connected to a tape unit, a white indicator in the switch lights. (This white indicator also lights when a connection cannot be made because the tape unit is reserved for another control).

If a transmission parity error occurs during a function, read, or write operation, a red indicator in the equipment number switch lights.

LONGITUDINAL PARITY (DS01→DS07, DS12, DS18)
Seven longitudinal parity indicators are associated with each control. These are driven by the C Read register FFs and will light when bits in the register equal "1's". At the end of an operation involving longitudinal parity checking, none of these indicators should be lit. If one or more are lit, it indicates a longitudinal parity error has occurred.

WRITE (DS08, DS19)
The Write indicator is driven by the Write Motion FF (Zx20/x21). When this FF sets, the Write indicator is illuminated. The Write indicator remains on until the Write Motion FF is cleared.

VERTICAL (VERT.) (DS09, DS20)
A Vertical Parity Error indicator lights if a vertical parity error occurs during an operation. This light is driven by the Vertical Parity Error FF (Px50/x51) and is illuminated whenever Px50/x51 is set.

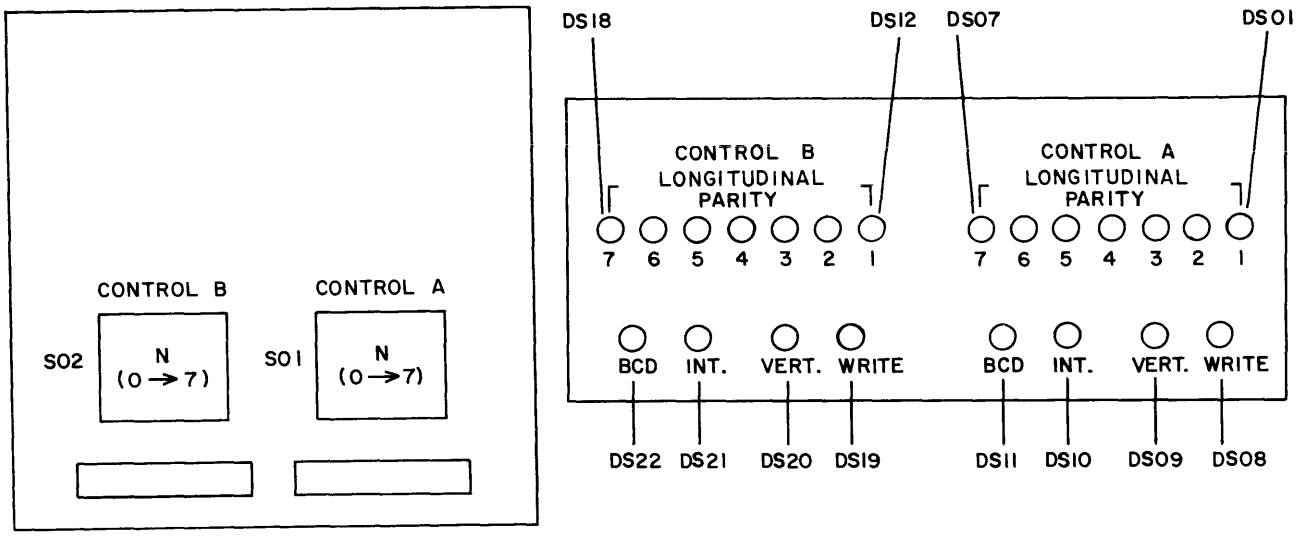


Figure 8-1. 362X Equipment Number Switch and Indicator Panel

INTERRUPT (INT.) (DS10, DS21)
An Interrupt indicator light is driven by the Interrupt Active FF (Jx34/x35). This indicator lights whenever the Interrupt Active FF is set.

BCD (DS11, DS22)
A BCD indicator is driven by the Format FF (Jx20/x21) and Write EF Mark FF (Jx14/x15). This indicator lights when BCD mode is selected (Jx20/x21 is set) or an EF Mark is written on tape (Jx14/x15 is set).

POWER WIRING

Four wires bring 208v, 400 cycle power to terminal board TB01 located at the bottom of chassis 1 of the 362X (figure 8-2). (Refer to pages 19, 20, and 21 of the 362X logic prints for detailed power wiring diagrams.)

When power relay K01 is pulled, power is applied to the two autotransformers T01 (+20v) and T02 (-20v) located on the hinged panel (A05) to the left of chassis 1. (Chassis 1 is the

left chassis when the 362X is viewed from the rear.) Power is also applied to an identical pair of autotransformers T01 (+20v) and T02 (-20v) located on the hinged panel (A06) to the right of chassis 2.

Each pair of autotransformers feeds a power supply which provides the +20v and -20v power for the tape controller logic. The outputs of each power supply are sampled by meters M01 (+20v) and M02 (-20v). Adjusting the autotransformers will vary the voltages applied to the logic.

POWER RELAYS (2)

A 24v, 60 cycle line is brought into chassis 1 from the 3601 console. When this line is energized, the power relay K01 is pulled and power is applied to the controller logic, providing none of the normally closed, high-temperature thermostats are open due to overheating.

The 24v interlock line coming from the console is energized when the console Interlock Bypassed switch is depressed. As a result, relay K02 is pulled which provides a jumper circuit that applies power to the system by bypassing relay K01.

LOW-TEMPERATURE THERMOSTATS (2)

A low-temperature, normally open thermostat is contained in each blower assembly of the 362X cabinet. If the temperature in the blower assembly exceeds $80^{o}F$, this thermostat will close, thereby lighting an amber indicator on the 3601 console. The console indicator will remain lit and the console speaker will sound a continuous warning signal until both of the thermostats are open.

HIGH-TEMPERATURE THERMOSTATS (2)

Two high-temperature, normally closed thermostats are contained in the top of the 362X cabinet. If the temperature in the cabinet reaches a point which may harm the equipment, ($110^{o}F$) one or more of these thermostats will open. When one or more thermostats open, the power relay K01 opens and power drops. A red indicator on the 3601 console lights and will remain lit as long as a thermostat is open, and the console speaker will sound a continuous warning signal.

CIRCUIT BREAKERS (2)

In each chassis, power flows through circuit breaker CB01 when going from power relays K01 or K02 to the autotransformers. If a circuit breaker opens because of an overload, logic power drops. A red circuit breaker indicator on the console will light

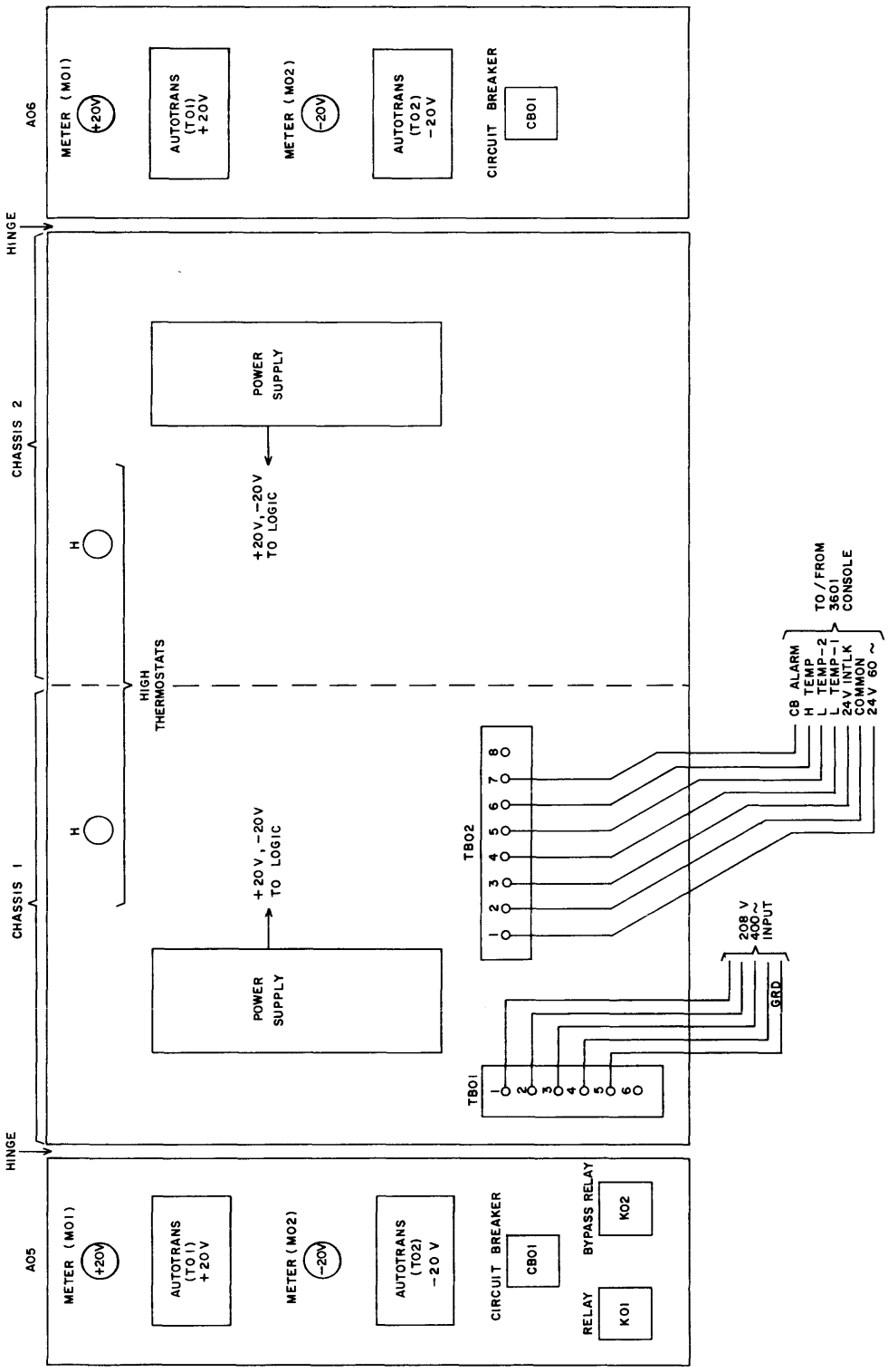


Figure 8-2. 362X Main Power Component Layout (Rear View)

and remain illuminated until the circuit breaker closes. The console speaker will sound a continuous warning signal.

CONVENIENCE OUTLETS (2)

A convenience outlet is contained at the bottom of each 362X chassis. These outlets are fed by 110v, 60 cycle power brought in at TB02 in chassis 2.

BLOWER ASSEMBLY (2)

A blower assembly is mounted below each chassis of the 362X. This assembly contains three blower motors, three pressure-sensing microswitches, and a low temperature normally-open thermostat. If a blower fails, or blower power is shut down before power is shut down on the rest of the system, one or more of the microswitches will close. An amber indicator on the 3601 console will light and the console speaker will sound a continuous warning signal. The indicator light and speaker will remain on until all microswitches in the blower assembly are open. The same sequence of events will also occur if the temperature in the blower assembly exceeds $80^{o}F$ and the low temperature thermostat closes.

TERMINATOR POWER

+40v and -40v terminator power is brought into chassis 1 at TB02 from the external terminator power supply. Terminator power is independent of logic power and operates on a separate switch. Terminator power must be turned off when working on connectors that use terminator power (logic power also off).

CHAPTER 9
DELAYS

Certain adjustable delays in the 362X are critical to proper timing in each control. These delays and the order in which they must be set are as follows:

1) Yx14 Write (not from Load Point) delay
2) Yx15 Write Stop delay
3) Yx11 Write Termination I to Write Termination II delay
4) Yx38 Delay from Sprocket
5) Yx23 Reply Read Timing Chain delay
6) Yx24 Reply Read Timing Chain delay
7) Yx28 Reply Read Timing Chain Lockout delay
8) Yx19 200 BPI delay
9) Yx18 556 BPI delay
10) Yx34 800 BPI delay
11) Yx20 End-of-Record delay
12) Yx04 End-of-Record from Tape Unit delay
13) Yx13 Write from Load Point delay
14) Yx12 Non-Stop Write delay
15) Yx17 Read (not from Load Point) delay
16) Yx29 Read Stop delay
17) Yx16 Read from Load Point delay
18) Yx22 Read Non-Stop delay
19) Yx32 Lost Data delay

If one or more of these delays is set to an incorrect value, the control logic will not function properly, e.g., if the delay(s) feeding the End-of-Record FF is set incorrectly, the control may sample the Record Check character and detect a vertical parity error, when in reality there is no vertical parity error.

Table 9-1 lists the adjustable delays for each control and their locations. The page numbers refer to the 362X logic diagrams.

The delays should be set as close to the specified delay times as possible. Sync times are given for a "1" to "1" change, e.g., Y004: The trigger input is D028. When D028 goes to a "1", D037 will go to a "1" 5 usec later. The delay time for Y004 will appear on the scope as the time it takes D037 to go to a "1" after D028 is a "1".

The programs listed after each delay show how to generate a repetitive operation for checking the delay.

TABLE 9-1. ADJUSTABLE DELAYS

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y014	14A(1G61A)		3.5 ms	F005(1G62B) F007(1G57A)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. 4. Loop to Step 2.
Y114	14C(2G11A)			F105(2G12B) F107(2G07A)	
Y214	14B(1Q61A)			F205(1Q62B) F207(1Q57A)	
Y314	14D(2Q11A)			F305(2Q12B) F307(2Q07A)	
Y015	14A(1G56A)		4 ms	F009(1G63B) Z022(1G55A)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. 4. Loop to Step 2.
Y115	14C(2G06A)			F109(1G13B) Z122(1G05A)	
Y215	14B(1Q56A)			F209(1Q63B) Z222(1Q55A)	
Y315	14C(2Q16A)			F309(2Q13B) Z322(2Q05A)	
Y011	14A(1H53A)		2.6ms	Z031(1H54B) Z033(1H52B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. Any write pattern may be used. 4. Loop to Step 2.
Y111	14C(2H03A)			Z131(2H04B) Z133(2H02B)	
Y211	14B(1R53A)			Z231(1R54B) Z233(1R52B)	
Y311	14D(2R03A)			Z331(2R04B) Z333(2R02B)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y038	16A(1J92A)		1.0 usec	E000(1H94A) Z055(1H84B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a continuous record on tape (any write pattern may be used).
Y138	16C(2J42A)			E100(2H44A) Z155(2H34B)	
Y238	16B(1T92A)			E200(1R94A) Z255(1R84B)	
Y338	16D(2T42A)			E300(2R44A) Z355(2R34B)	
Y023	16A(1H81A)		0.2 usec	Z055(1H84B) Z057(1H80B)	Same program as used for setting Y038.
Y123	16C(2H31A)			Z155(2H34B) Z157(2H30B)	
Y223	16B(1R81A)			Z255(1R84B) Z257(1R80B)	
Y323	16D(2R31A)			Z355(2R34B) Z357(2R30B)	
Y024	16A(1H78A)		0.5 usec	Z057(1H80B) Z059(1H77B)	Same program as used for setting Y038
Y124	16C(2H28A)			Z157(2H30B) Z159(2H27B)	
Y224	16B(1R78A)			Z257(1R80B) Z259(1R77B)	
Y324	16D(2R28A)			Z357(2R30B) Z359(2R27B)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y028	16A(1H85A)		1 usec	E001(1H93A) Z052(1H86A)	Same program as used for setting Y038.
Y128	16C(2H35A)			E101(2H43A) Z152(2H36A)	
Y228	16B(1R85A)			E201(1R93A) Z252(1R86A)	
Y328	16D(2R35A)			E301(2R43A) Z352(2R36A)	
Y019	16A(1H90A)		72 usec	E004(1H92B) E005(1H89B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Select 200 BPI density. 4. Write a short record (e.g. one 48-bit word) on tape. 5. Check status (wait for $\overline{\text{Busy}}$). 6. Backspace one record length. 7. Check status (wait for $\overline{\text{Busy}}$). 8. Read the record that was written. 9. Check status (wait for $\overline{\text{Busy}}$). 10. Loop to Step 4.
Y119	16C(2H40A)			E104(2H42B) E105(2H39B)	
Y219	16B(1R90A)			E204(1R92B) E205(1R89B)	
Y319	16D(2R40A)			E304(2R42B) E305(2R39B)	
Y018	16A(1H91A)		28 usec	E002(1H92A) E005(1H89B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Select 556 BPI density. 4. Write a short record (e.g. one 48-bit word) on tape. 5. Check status (wait for $\overline{\text{Busy}}$). 6. Backspace one record length. 7. Check status (wait for $\overline{\text{Busy}}$). 8. Read the record that was written. 9. Check status (wait for $\overline{\text{Busy}}$). 10. Loop to Step 4.
Y118	16C(2H41A)			E102(2H42A) E105(2H39B)	
Y218	16B(1R91A)			E202(1R92A) E205(1R89B)	
Y318	16D(2R41A)			E302(2R42A) E305(2R39B)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y034	16A(1I94A)		20 usec	E003(1H89A) E005(1H89B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Select 800 BPI density. 4. Write a short record (e.g. one 48-bit word) on tape. 5. Check status (wait for $\overline{\text{Busy}}$). 6. Backspace one record length. 7. Check status (wait for $\overline{\text{Busy}}$). 8. Read the record that was written. 9. Check status (wait for $\overline{\text{Busy}}$). 10. Loop to Step 4.
Y134	16C(2I44A)			E103(2H39A) E105(2H39B)	
Y234	16B(1S94A)			E203(1R89A) E205(1R89B)	
Y334	16D(2S44A)			E303(2R39A) E305(2R39B)	
Y020	16A(1H63A)		45 usec	Z077(1I63B) E018(1H62B)	Same program as used for setting Y034 delay.
Y120	16C(2H13A)			Z177(2I13B) E118(2H12B)	
Y220	16B(1R63A)			Z277(1S63B) E218(1R62B)	
Y320	16D(2R13A)			Z377(2S13B) E318(2R12B)	
Y004	9A(1E89A)		5 usec	D028(1E88B) D037(1E90B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. Any write pattern may be used. 4. Loop to Step 2.
Y104	9C(2E39A)			D128(2E38B) D137(2E40B)	
Y204	9B(1O89A)			D228(1O88B) D237(1O90B)	
Y304	9D(2O39A)			D328(2O38B) D337(2O40B)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y013	14A(1G59A)		30 ms	F003(1G62A) F007(1G57A)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Rewind to load point. 4. Check status (wait for $\overline{\text{Busy}}$ and Load Point). 5. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. 6. Loop to Step 2.
Y113	14C(2G09A)			F103(2G12A) F107(2G07A)	
Y213	14B(1Q59A)			F203(1Q62A) F207(1Q57A)	
Y313	14D(2Q09A)			F303(2Q12A) F307(2Q07A)	
Y012	14A(1H51A)		3.0 ms	Z033(1H52B) Z035(1G51B)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record (e.g. one 48-bit word = 8 six-bit frames) on tape. Any write pattern may be used. 4. Loop to Step 3 (must use another write instruction).
Y112	14C(2H01A)			Z133(2H02B) Z135(2G01B)	
Y212	14B(1R51A)			Z233(1R52B) Z235(1Q51B)	
Y312	14D(2R01A)			Z333(2R02B) Z335(2Q01B)	
Y017	16A(1H70A)		1 ms	E014(1H71B) E016(1H66A)	Move tape forward from Load Point using switches on 606/607 before starting program. 1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record on tape. 4. Check status (wait for $\overline{\text{Busy}}$). 5. Backspace one record length. 6. Check status (wait for $\overline{\text{Busy}}$). 7. Read the record that was written. 8. Loop to Step 2.
Y117	16C(2H20A)			E114(2H21B) E116(2H16A)	
Y217	16B(1R70A)			E214(1R71B) E216(1R66A)	
Y317	16D(2R20A)			E314(2R21B) E316(2R16A)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y029	16A(1H72A)		3.5 ms	E007(1H73B) Z044(1H65A)	Move tape forward from Load Point using switches on 606/607 before starting program. 1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Write a short record on tape. 4. Check status (wait for $\overline{\text{Busy}}$). 5. Backspace one record length. 6. Check status (wait for $\overline{\text{Busy}}$). 7. Read the record that was written. 8. Loop to Step 2.
Y129	16C(2H22A)			E107(2H23B) Z144(2H15A)	
Y229	16B(1R72A)			E207(1R73B) Z244(1R65A)	
Y329	16D(2R22A)			E307(2R23B) Z344(2R15A)	
Y016	16A(1H69A)		10 ms	E012(1H71A) E016(1H66A)	1. Connect control 2. Check status (wait for Ready and Busy). 3. Rewind to Load Point. 4. Check status (wait for Busy and Load Point). 5. Write a short record on tape. 6. Check status (wait for $\overline{\text{Busy}}$) 7. Rewind to Load Point. 8. Check status (wait for $\overline{\text{Busy}}$). 9. Read the record that was written. 10. Loop to Step 2.
Y116	16C(2H19A)			E112(2H21A) E116(2H16A)	
Y216	16B(1R69A)			E212(1R71A) E216(1R66A)	
Y316	16D(2R19A)			E312(2R21A) E316(2R16A)	

TABLE 9-1. (Cont'd)

Delay	Page and Location	✓	Time	Sync Points	Program for Setting Delay
Y022	16A(1H59A)		1 ms	Z049(1H60B) Z048(1H60A)	1. Connect control. 2. Check status (wait for Ready and $\overline{\text{Busy}}$). 3. Select 556 BPI density. 4. Write a short record (e.g. 8 frames) on tape. 5. Check status (wait for Ready and $\overline{\text{Busy}}$). 6. Loop to Step 4. Continue writing until about half of the tape contains short records. 7. Rewind tape to Load Point. 8. Check status (wait for $\overline{\text{Busy}}$). 9. Read a record from tape. 10. Read another record from tape using a new read instruction. 11. Continue reading non-stop.
Y122	16C(2H09A)			Z149(2H10B) Z148(2H10A)	
Y222	16B(1R59A)			Z249(1R60B) Z248(1R60A)	
Y322	16D(2R09A)			Z349(2R10B) Z348(2R10A)	
Y032	14A(1H68A)		1 ms	F010(1G70B) Z071(1G69B)	The time for this delay is not critical.
Y132	14C(2H18A)			F110(2G20B) Z171(2G19B)	
Y232	14B(1R68A)			F210(1Q70B) Z271(1Q69B)	
Y332	14D(2R18A)			F310(2Q20B) Z271(2Q19B)	

CHAPTER 10
GENERAL MAINTENANCE PROCEDURE

In the 362X system, which includes the 362X and associated tape units, the problem may be in the Read/Write control, the logic matrix which gates information to the tape unit, or the tape unit itself. The following steps may be used to localize the problem:

1. Check the tape unit:
   a) Change the switch setting on the tape unit and use a new connect code. Try several positions and connect codes. If the unit now works, the problem is in the switch logic.

   b) Cable another tape unit that is known to be working place of the suspect tape unit. Remove power from the tape units when recabling. If the program runs using the new tape unit, the problem is in the original tape unit.

   c) If the problem still exists, recable the tape units to their original positions and continue with step 2.

2. Check the logic matrix:
   a) Recable the tape unit to the next higher or lower cable connectors. If the program runs, the problem is in the L and M cards and associated logic that feed the tape unit. If the problem still exists, recable the tape unit and continue with step 3.

3. Check the control logic:
   a) Check out the connect logic as shown in the flow chart figure 2-1 of this manual.

   b) Check out the function logic as shown in the flow charts in chapter 3.

   c) Check out the write logic using the sequence of events listed in chapter 4 and the timing diagrams on pages A-7 and A-8.

   d) Check out the read logic using the sequence of events listed in chapter 5 and the timing diagrams on pages A-9 and A-10.

   e) If the failure seems intermittant, try varying the voltage margins with the autotransformers on each chassis.

CARD LOCATIONS

Figure 10-1 shows the general card location layout in the 362X. The controls only contain logic related to the control. All logic related to the gating of information to/from the control and the tape units is located in the matrix card locations: e.g., Unit-Control Connect and Control Reserve FFs; N and L cards carrying signals to the tape units; and M cards and U, V inverters receiving signals from the tape unit.

OUTPUT TO TAPE UNITS

Pages 11 and 12 of the 362X logic diagrams show the N and L cards which feed the tape units. Locations are given for all N and L cards feeding physical tape unit 0, bank 0; and physical tape unit 0, bank 1. Locations for cards feeding physical tape units 1 through 7 may be found by looking up the corresponding N or L term in the table and changing the letter in the location. For example, suppose the location for N215 (Set 200 BPI density, physical tape unit, bank 0)is desired. The location for N015 is 1D26A, the location for N200 is 1H11A. Change the D to an H, and the location for N215 is 1H26A. This method applies to both pages 11 and 12.

INPUT FROM TAPE UNITS

Page 13 of the 362X logic diagrams show the U and V inverters feeding the four controls. Bank 0 tape units feed U inverters; bank 1 tape units feed V inverters. Physical tape units 0 through 3 in each bank feed inverters with an even last digit; physical tape units 4 through 7 in each bank feed inverters with an odd last digit.

Thus M008 (Ready line, physical tape unit 0, bank 0) and M058 (Ready line, physical tape unit 0, bank 1) feed inverters U030 and V030 respectively. For example, suppose the location is desired for the inverter fed by the Write Enable line coming from physical tape unit 5, bank 0 and going into control D. The table on page 13 of the 362X diagrams shows that the inverter is U357 since physical tape units 4 through 7 feed inverters with odd last digits. (Bank 0 tape units feed U inverters). Consult the equation file for the location of U357.

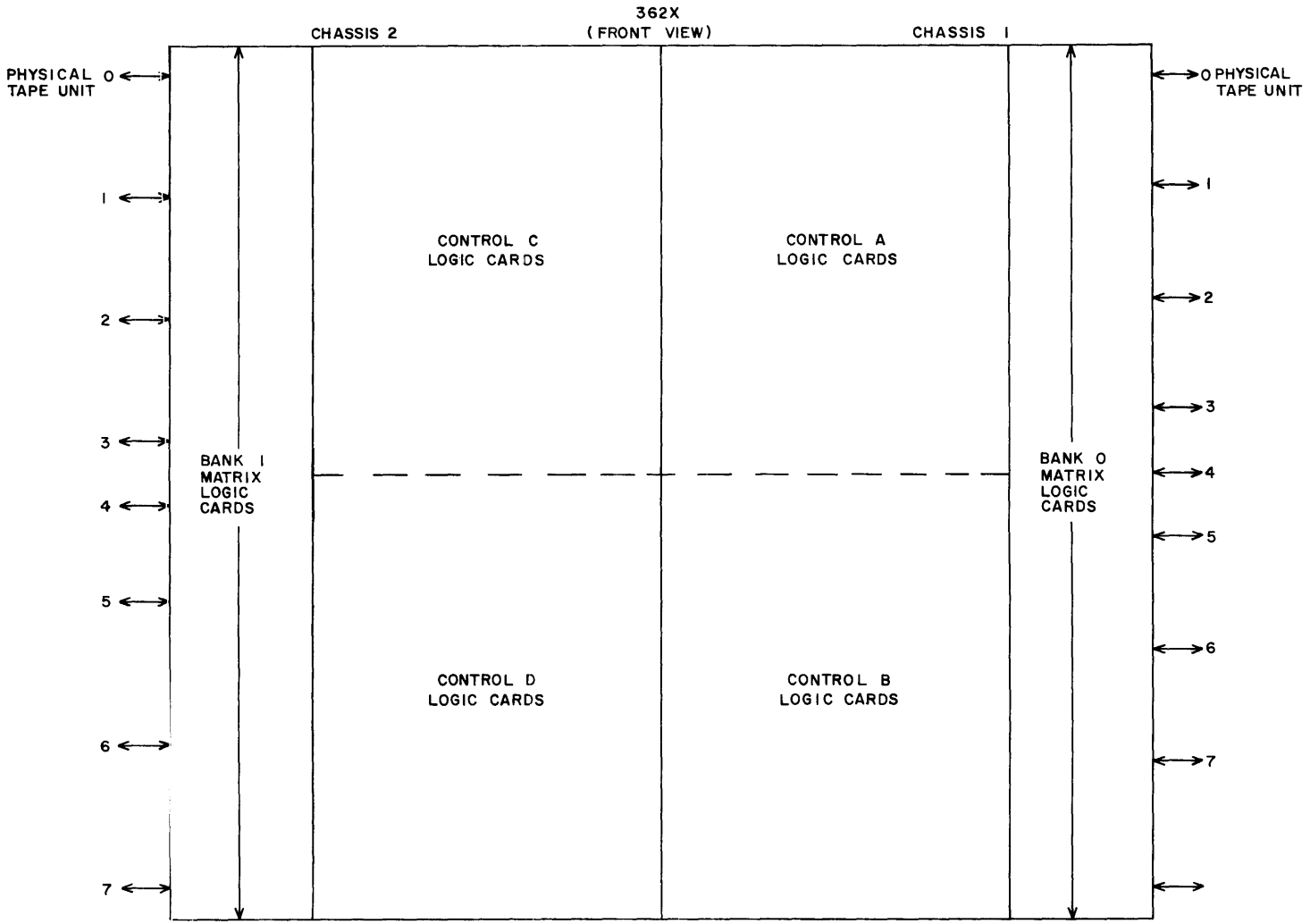


Figure 10-1. General Card Location Layout

APPENDIX A

3621 MAGNETIC TAPE CONTROLLER EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3621
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	4900
Power consumption, 400 cycle, 208 volt, three phase	1 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	3 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

3622 MAGNETIC TAPE CONTROLLER
EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3622
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	4900
Power consumption, 400 cycle, 208 volt, three phase	1 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	3 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

3623 MAGNETIC TAPE CONTROLLER
EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3623
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	8500
Power consumption, 400 cycle, 208 volt, three phase	2.0 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	5.5 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

3624 MAGNETIC TAPE CONTROLLER
EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3624
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	8500
Power consumption, 400 cycle, 208 volt, three phase	2.0 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	5.5 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

3625 MAGNETIC TAPE CONTROLLER
EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3625
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	6700
Power consumption, 400 cycle, 208 volt, three phase	1.5 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	4.2 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

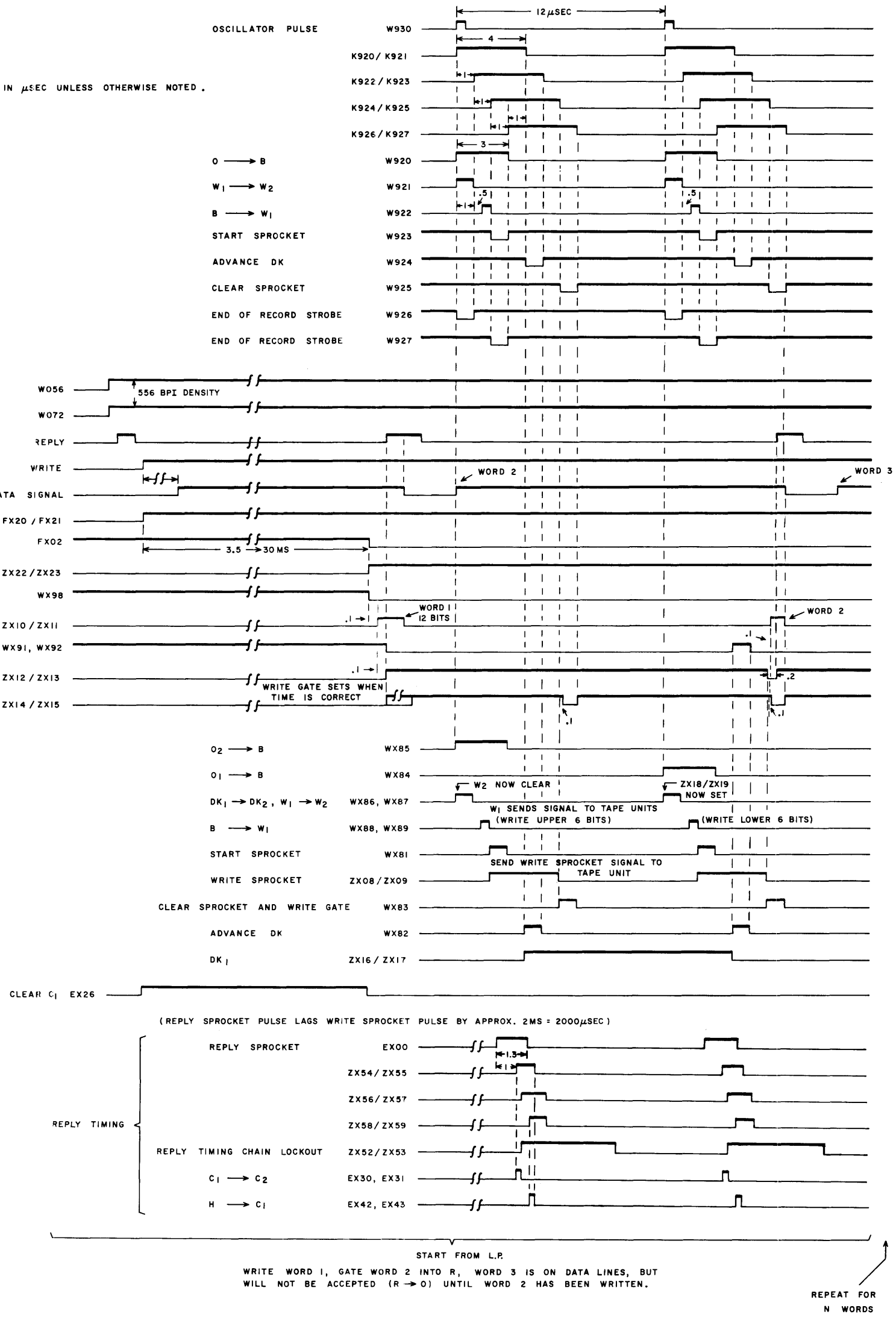
3626 MAGNETIC TAPE CONTROLLER
EQUIPMENT DATA SHEET

Cabinet name	Magnetic Tape Controller
Module or modules contained therein	3626
Height	78 1/2 inches
Depth	27 inches
Width	96 inches
Maximum depth, including all access doors extended	56 inches
Maximum width, including all access doors extended	120 inches
Weight	2200 lbs.
BTU/hour	6700
Power consumption, 400 cycle, 208 volt, three phase	1.5 KW
Power consumption, 60 cycle, 115 volt, single phase	0.35 KW
Line Current, 400 cycle, 208 volt, three phase	4.2 amperes
Line Current, 60 cycle, 115 volt, single phase	4 amperes
Breaker size, 400 cycle, three phase	15A
Breaker size, 60 cycle, single phase	20A
Air required at inlet	700 CFM
Source of cooling air	plenum
Distance from signal cable receptacle to floor	8 1/4 inches

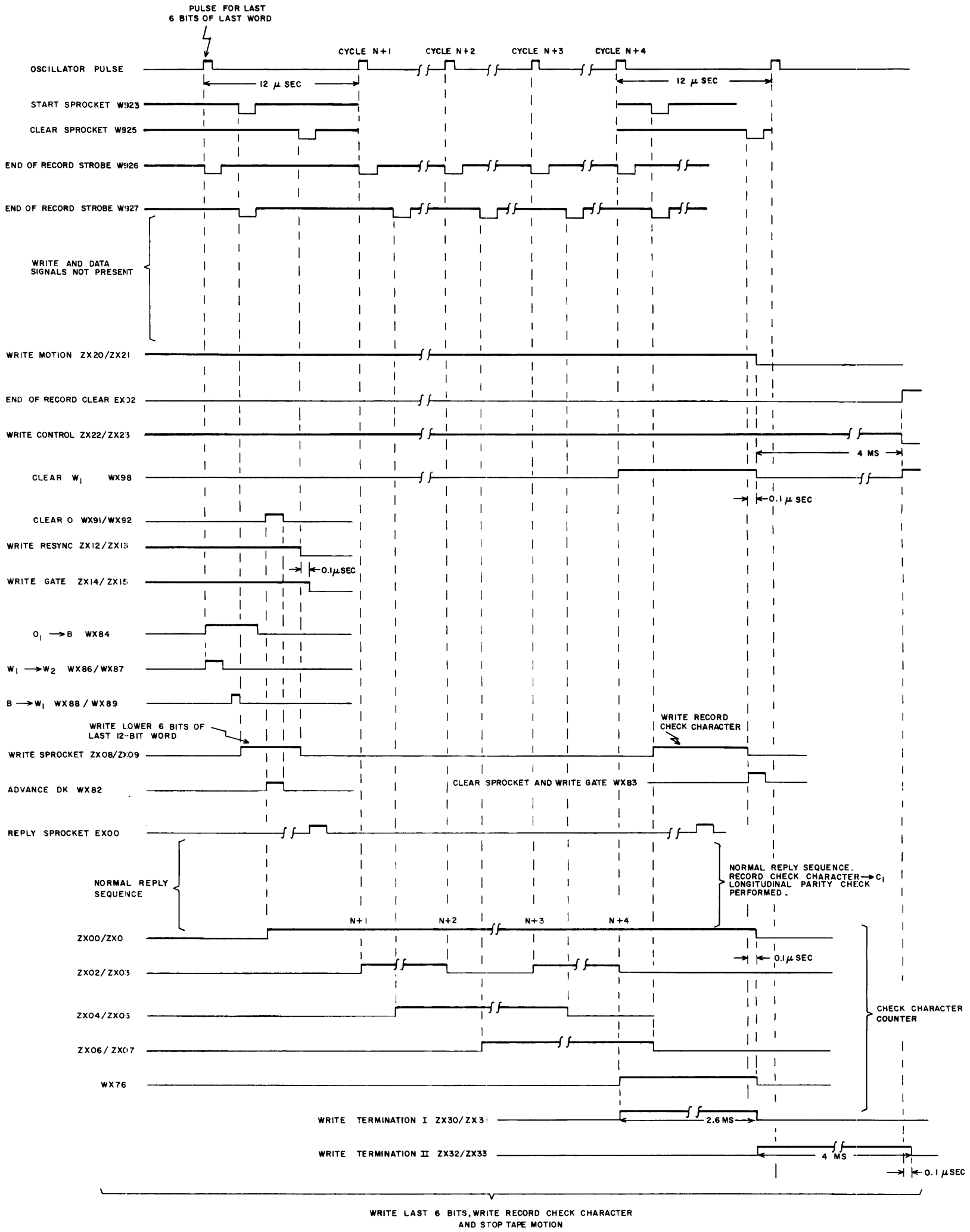
NOTE: Receptacles for cables to tape units range up to 59 inches (maximum)

Distance from power junction box to floor	2 inches

NOTE: ALL TIMES ARE IN μSEC UNLESS OTHERWISE NOTED.



WRITE TIMING FOR ONE 12 BIT WORD (ASSUMING 556 BPI DENSITY AND A START FROM LOAD POINT).



NOTE:

WHEN DOING A WRITE NONSTOP, THE WRITE SIGNAL DROPS FOR ABOUT 1 μ SEC AFTER RECEIVING THE REPLY, THE NORMAL RECORD CHECK CHARACTER IS WRITTEN, AND TAPE MOTION CONTINUES WITHOUT STOPPING.

WRITE RECORD CHECK CHARACTER TIMING (ASSUMING 556 BPI DENSITY)

362 X

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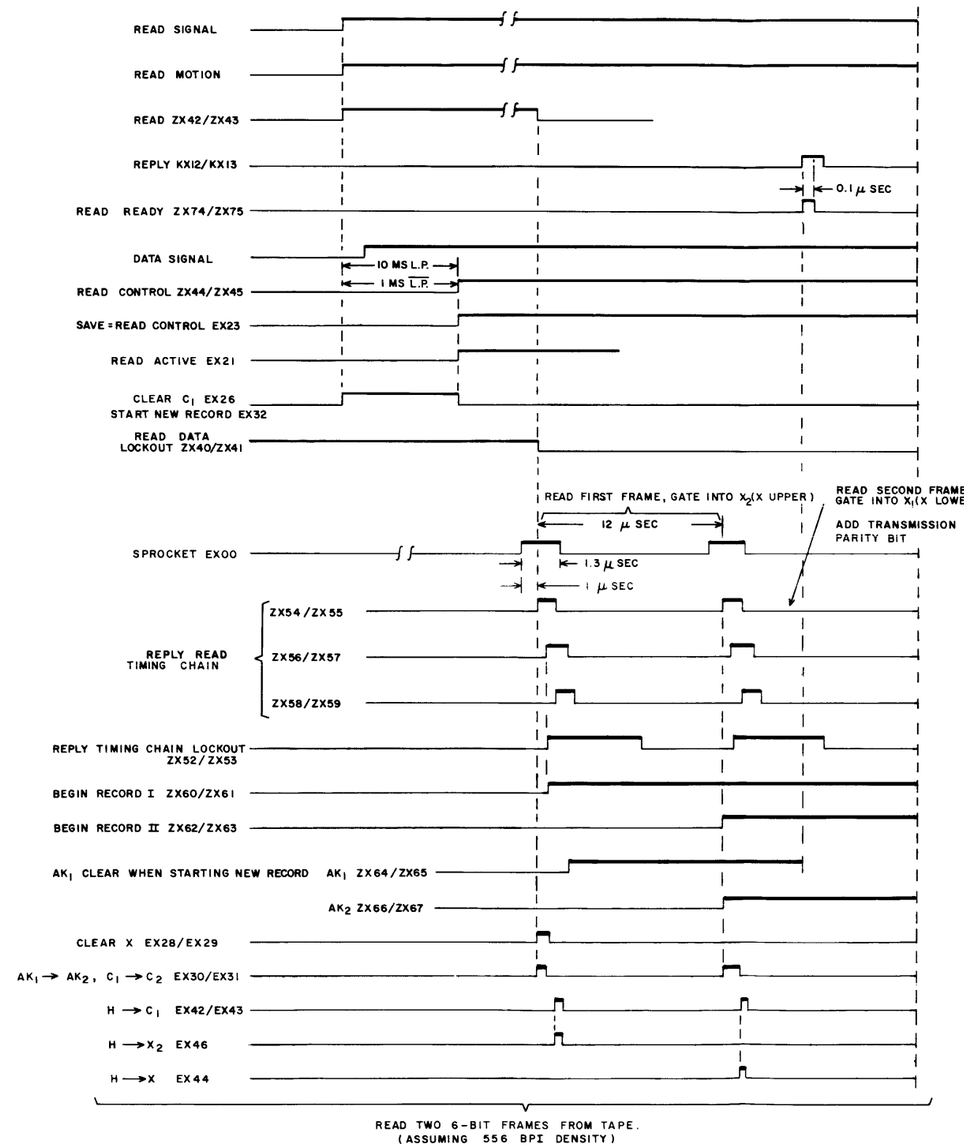
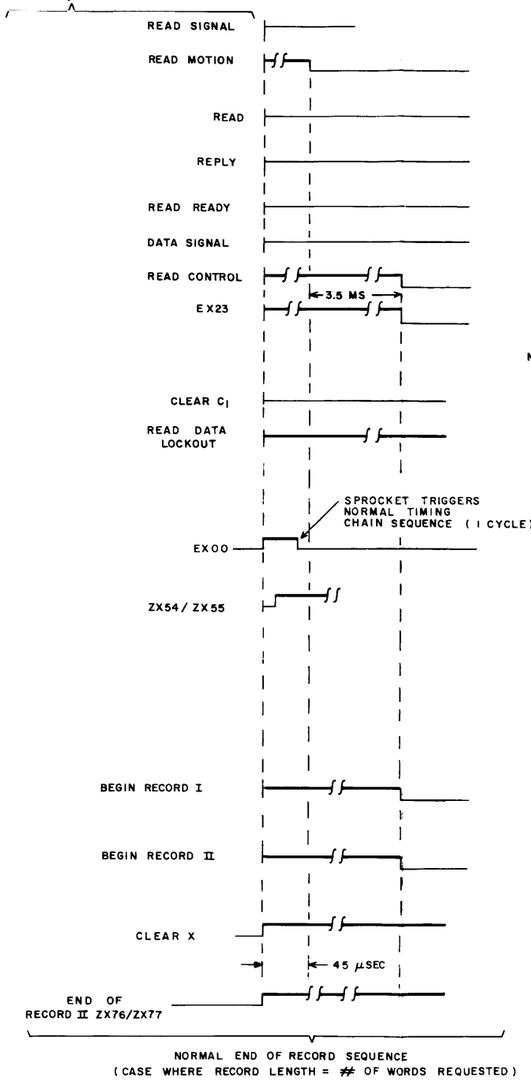


READ TWO 6-BIT FRAMES FROM TAPE.
(ASSUMING 556 BPI DENSITY)

READ AND DATA SIGNALS HAVE DROPPED, NO SPROCKET PULSE FOR APPROXIMATELY 28 μ SEC

(THE END OF RECORD SEQUENCE IS NOT ENTERED UNTIL AT LEAST 2 FRAMES OF INFORMATION HAVE BEEN READ)



NORMAL END OF RECORD SEQUENCE
(CASE WHERE RECORD LENGTH = ## OF WORDS REQUESTED)

RECORD CC IS READ AFTER GOING INTO ER SEQUENCE, BUT 500 μ SEC DELAY ALLOWS SPROCKET PULSE TO CYCLE TIMING CHAIN ONCE. EX28/EX29 HOLD A CONSTANT CLEAR ON THE X RESISTER SO THE RECORD CC IS NOT AVAILABLE FOR OUTPUT.

NOTES:

1. IF AN END OF RECORD CC IS READ WHEN READ AND DATA LINES ARE UP, AN ER SIGNAL IS GENERATED BY SETTING THE ER DISCONNECT FF (ZX72/ZX73). THIS SIGNAL DROPS WHEN THE DATA SIGNAL DROPS. TAPE MOTION HALTS.
2. IF READ AND DATA SIGNALS DROP BEFORE AN ER IS READ, READING CONTINUES TO ER AND STOPS. DATA IS NOT ENTERED INTO THE X REGISTER AFTER THE READ DATA LOCKOUT FF SETS.
3. IF, AT THE TIME WHEN READ AND DATA SIGNALS DROP AND THE MACHINE ENTERS AN ER SEQUENCE, READ AND DATA SIGNALS REAPPEAR WITHIN 45 μ SEC, TAPE MOTION DOES NOT STOP. THE NORMAL RECORD CC IS READ, AND THE TAPE UNIT STARTS READING THE NEXT RECORD.
4. ALL TIMES ARE IN μ SEC UNLESS OTHERWISE NOTED.

362X

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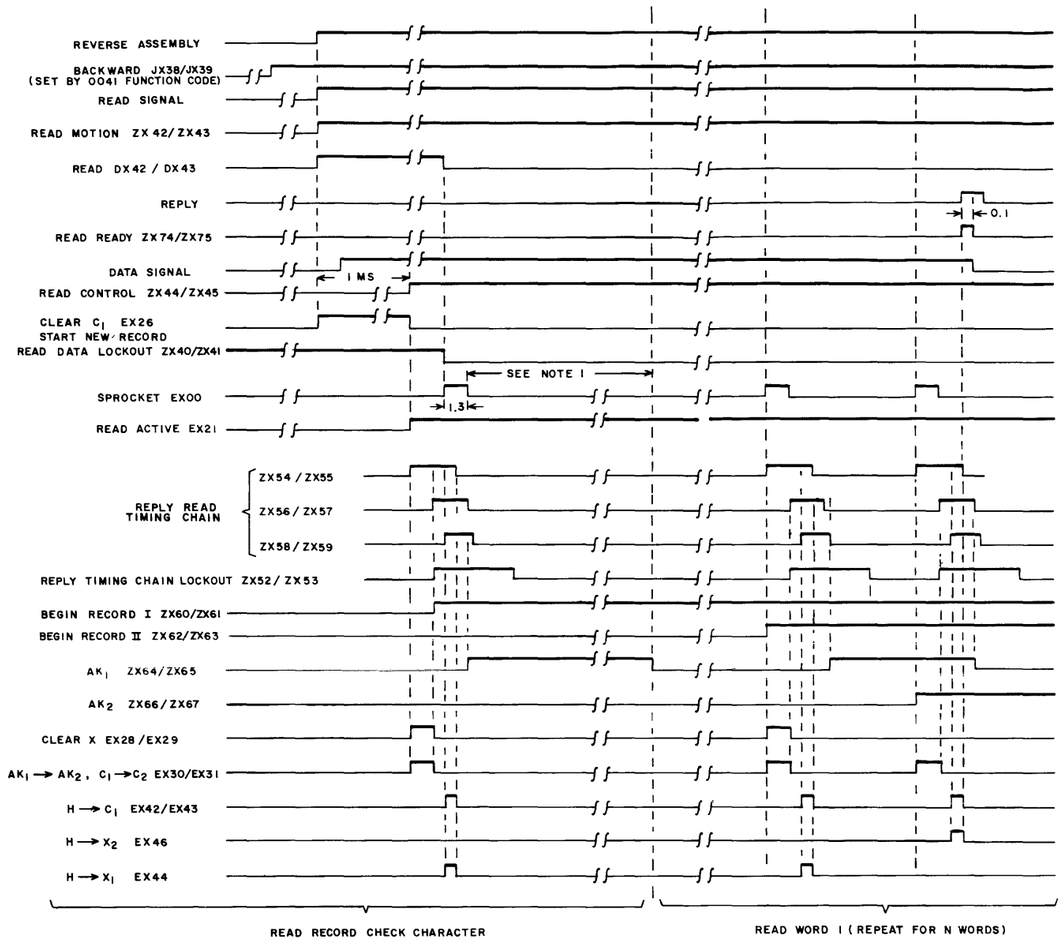
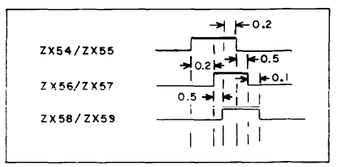
NORMAL READ TIMING





NOTES:

1. IF NO SPROCKET PULSE IS RECEIVED FOR 28 μSEC AFTER THE FIRST SPROCKET PULSE, THE CHARACTER READ IS A RECORD CHECK CHARACTER. AK1 IS CLEARED AT THE END OF THE 28 μSEC DELAY. THIS ENABLES CLEARING X WHEN THE NEXT SPROCKET PULSE IS RECEIVED SO THE RECORD CHECK CHARACTER WILL NOT BE AVAILABLE TO THE DATA LINES. THE VERTICAL PARITY ERROR FF IS ALSO CLEARED WHEN AK1 IS CLEARED SINCE THE RECORD CHECK CHARACTER MAY OR MAY NOT HAVE VERTICAL PARITY.
2. IF THE FIRST CHARACTER IS NOT A RECORD CHECK CHARACTER, THE SEQUENCE OF EVENTS IS SIMILAR TO A NORMAL READ OPERATION; ONE EXCEPTION BEING THAT THE H → X1, AND H → X2 TRANSFERS ARE REVERSED.
3. IF THE LAST FRAME IS READ AND READ AND DATA SIGNALS REQUEST MORE INFORMATION, (THE READ LINE HAS NOT DROPPED) AN END OF RECORD IS GENERATED BY SETTING THE ER DISCONNECT FF (ZX72/ZX73). THIS SIGNAL DROPS WHEN THE DATA SIGNAL DROPS, TAPE MOTION HALTS.
4. IF READ AND DATA SIGNALS DROP BEFORE THE LAST FRAME IS READ, READING CONTINUES TO THE LAST FRAME AND STOPS. DATA IS NOT ENTERED INTO THE X REGISTER AFTER THE READ DATA LOCKOUT FF SETS.
5. IF AT THE TIME WHEN READ AND DATA SIGNALS DROP AND THE MACHINE REACHES A RECORD GAP, READ AND DATA SIGNALS REAPPEAR WITHIN 500 μSEC, TAPE MOTION DOES NOT STOP. THE RECORD GAP IS SKIPPED AND THE TAPE UNIT STARTS READING THE NEXT RECORD.
6. IF A REVERSE READ IS ATTEMPTED WHEN TAPE IS AT LOAD POINT, A CONSTANT CLEAR IS HELD ON THE READ MOTION FF. THE READ OPERATION HALTS INDEFINITELY.

THIS TIMING CHART SHOWS THE SEQUENCE OF EVENTS IN A REVERSE READ OPERATION WHEN THE FIRST FRAME READ IS A RECORD CHECK CHARACTER.

ALL TIMES ARE IN μSEC UNLESS OTHERWISE NOTED.

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REVERSE READ TIMING