IBM Customer Engineering

Manual of Instruction

Card Adapter Unit

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Printed in U.S.A.
Form 223-6861

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FOREWORD

This manual explains the logical operation of the IBM Card Adapter Unit. Because this unit may be incorporated in future data processing systems, descriptive material is not related to any particular system. However, the Systems numbers on the illustrations relate to use of the card adapter unit within an IBM 7090 Data Processing System only.

Engineering changes may alter the information included in text and illustrations. Customer engineers should not use this manual alone as a reference manual or servicing aid.

1.0.00 INTRODUCTION

THE IBM Card Adapter Unit (CAU) permits a transistorized computer system to be linked with non-transistorized card machines. To do this, the card adapter unit must act in three major capacities:

1. As a converter of input-output levels--because of the difference in signal levels of transistorized systems and the signal levels of card machines.
2. As a synchronizer between the computer system and the card machines--because of the difference in operating speeds of the system and the card machines.
3. As an assembler of data--because card machine operation is closely related to the punched card while the computer system operates on a basic 36-position word.

The CAU is fully transistorized and designed for packaging in three SMS II (Standard Modular System) panels. Only circuits considered basic for card machine operation are included; power for the CAU must come from the system with which it is used. A single CAU can handle one card reader, one punch, and one printer. If additional card machine operation is desired, more card adapter units must be added to the system.

This section covers operations of the CAU as a package apart from the system. The demands of, and by, the CAU are assumed to accomplish the desired control in external equipment.

The CAU is required to perform five operations: read card reader, write punch, write printer, write printer binary, and read printer. Except for write printer binary and read printer, the card machine operation is the usual operation expected of a reader, punch, and printer.

Write printer binary entails a write printer operation in which only ones are printed. This operation is desirable when binary information is to be represented directly.

Read printer, in addition to performing a standard write printer operation, makes echo pulses available to the system for echo checking. While sending the echo pulses to the system, the CAU actually employs a read operation, so read printer may be thought of as being really write and read printer.

The logical sequences of operation for the five CAU operations are shown in Figures 3.1-1 through 3.5-1. In this manual, only a logical coverage of these operations is stressed.

2.0.00 CARD CONTROL CIRCUITS

CARDS ARE READ in the order: 9-row, 8-row, 7-row...12 row. Each row contains 80 possible holes or bits but, because a system stores full words of 36 bits each, only 72 of the 80 bits may be read into storage. The brushes in the card reader read at the same time all 72 holes wired for calculation; the CAU must separate this row into two separate words.

When the CAU control circuitry receives a circuit breaker (CB) signal from the card machine saying that a row is available for entry to the system, the CAU converts the signal into two demands spaced 400 usec apart. The demands, when received by the system, should cause sampling of the card adapter lines to a data register. The 36 columns wired to calc entry left are sampled first, followed by the 36 columns wired to calc entry right. Because a card is read in the order 9-left, 9-right, 8-left, 8-right ...12-left, 12-right, the control circuitry in the CAU is designated read left and read right.

Twelve rows are to be read from the card reader. The reader, however, emits 13 CB pulses, one for each row to be read and a pulse on the 13-row (one cycle point after the 12-row). A CB counter in the CAU counts the CB pulses: the first 12 are allowed to generate read left and read right gates; the thirteenth causes end-of-record pulses to be generated.

2.1.00 SAMPLE AND DRIVE PULSE GENERATOR

CAU operations are dependent on a circuit labeled sample and drive pulse generator. The heart of this circuit is a 20kc oscillator. This oscillator, through gating, generates the card drive and card sample pulses (Figure 2.1-1).

Card drive pulses are available when the card control trigger is on, following a CB set from a card machine. This is the start of the synchronization of card machines and system. The card machine has indicated to the CAU that it is ready to transmit or receive a row of data. This indication has generated a card drive in the CAU. The card drive then turns on a card synchronization trigger which sets up the gating for the card sample pulse. Because the 20kc oscillator generates both card drive and card sample pulses, the foundation for all CAU control is laid.

2.2.00 CARD RING

The card ring is a binary five-stage trigger ring. It is driven directly from the card drive and generates read and write gating. The first card drive pulse turns on card ring T_1; the second drive pulse turns off T_1. Turning off T_1 turns on T_2. T_2 turns off with the second fall of T_1.

This action continues on through the ring as shown in Figure 2.1-1. When T_5 falls, write left, write right, read left, and read right gates have been generated.

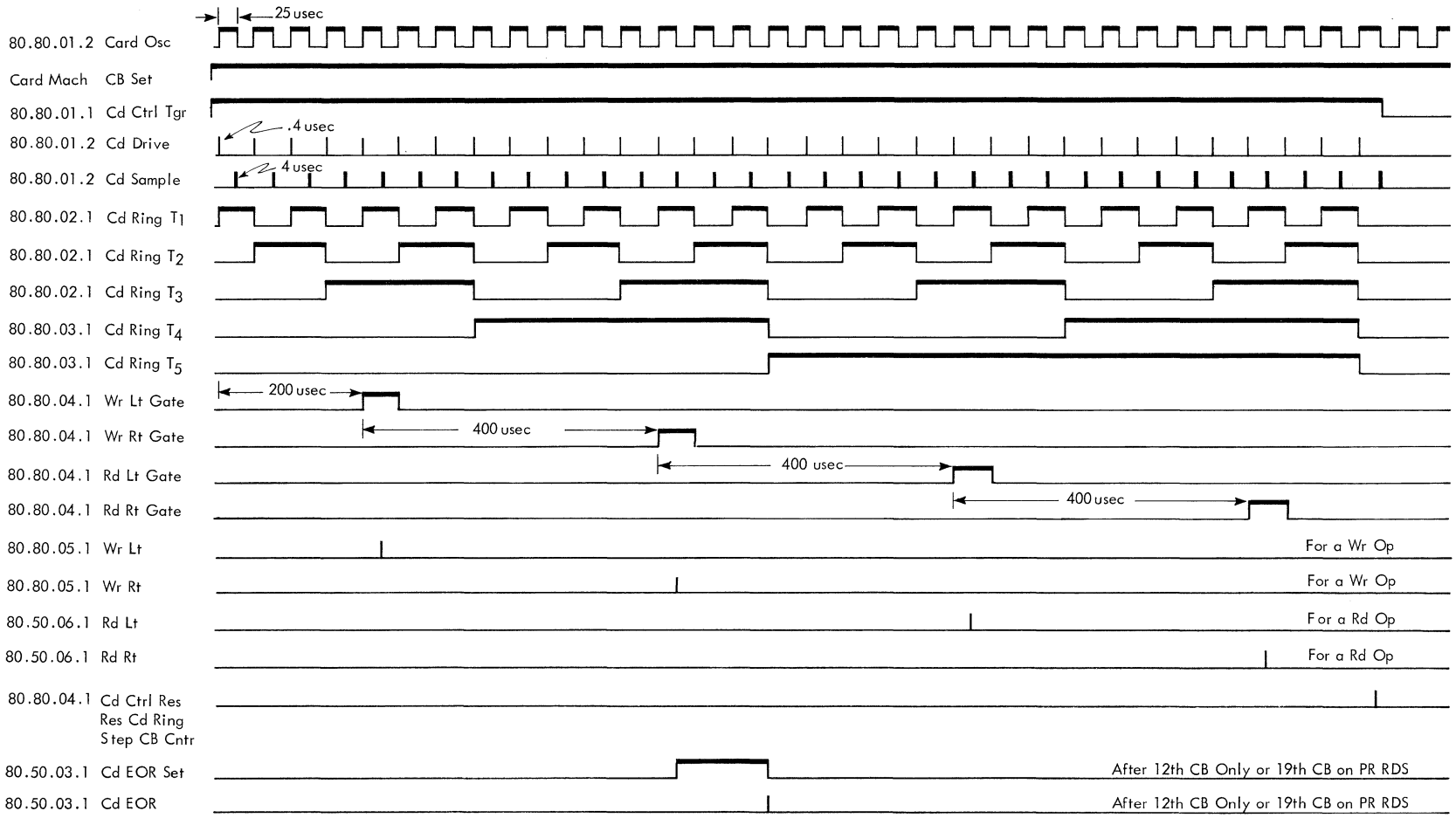

FIGURE 2.1-1. PULSE GENERATION

2.3.00 READ AND WRITE GATES

Figure 2.1-1 indicates the relationship of the read and write gates to the card ring. The T_1 stage of the card ring is used to establish duration of the gates. For compatability with the external system, a 400-usec delay is needed between demands on the system. This delay is evolved in the read and write gating which require the read and write pulses to be 400 usec apart. The pulses then are used to space demands on the system at the required 400-usec intervals.

2.4.00 CB COUNTER

The CB counter has two purposes: to separate transmission time from end-of-record time, and to define writing and reading time when printing with echo checking (read printer).

It is a five-stage, count-up, binary counter. The counter is stepped by the first sample pulse following the fall of the fifth stage of the card ring. At this time, all demands for a row are complete. Except for read printer, all card machine transmission is complete after the CB counter has counted 12, and an after 12 CB control allows generating an end-of-record control.

The CB counter serves as additional control in a read printer operation. During the first eight rows, data are written by the printer. After eight rows of data, read control must be brought up to allow echo information to be sent back to the system. This means the CAU must both read and write during rows 9-12. This operation is controlled by the CB counter.

The CB counter also indicates the end-of-record for a read printer operation. Here, the end-of-record indication after the 12 CB is suppressed to allow completion of echo checking. Instead, an after 19 CB control allows for an end-of-record indication.

3.0.00 SELECTION AND DATA TRANSMISSION

3.1.00 READ CARD READER

A read card reader sequence (Figure 3.1-1) attempts to transmit all punched data from a card at the card reader. The system may request data from many cards or request as little as one-half row of data. The amount of data to be sent is controlled by a data disconnect from the system. Until such a disconnect is received by the CAU, data are sent to the system as long as the reader remains ready. Steps 1-22 following assume no data disconnect from the system:

1. Turn on card reader select trigger.
2. Send read-cards and card-machine-selected controls to the system.
3. Bring up read pulse control.
4. Reset CB counter, card ring, and card control.
5. Select card reader; start cards moving when ready.
6. CB reset from card reader insures restoring card control circuitry.
7. CB set from card reader.
8. Turn on CB trigger.
9. Turn on card control trigger; start card drive.
10. Turn on card sync trigger; start card sample pulse.
11. Card drive starts card ring.
12. Turn on record control.
13. Generate a read-left and a read-right gate.
14. Generate a read-left and a read-right pulse.
15. Send card demand to system for each read pulse.
16. Provide gating of calc entry lines to system with each read pulse.
17. Card ring T_5 turns off record control.
18. Fall of T_5 and next sample pulse step CB counter.
19. CB reset from card reader restores card control circuitry.

After step 19, the information in 9-row left and 9-row right has been transmitted to the system. If an entire card is to be transmitted, steps 7 through 19 are repeated 11 more times. Because the data on a single card constitute a record, it is desirable to send an end-of-record indication to the system after the 12-row.

20. A thirteenth CB set from the card reader causes steps 8-12 to be repeated.
21. Record control on and an after 12 CB control cause an end-of-record set to be sent to the system.
22. Card end-of-record pulse resets card control, card ring, and CB counter to prevent demands when no data are available.

The amount of data transmitted is controlled by the system through a data disconnect control. A data disconnect may be indicated at the end of reading any half-row. This could occur after reading a portion of a card or after reading many cards. If a disconnect does not occur at the end of reading a card, steps 5 through 22 are repeated to read the next card. Card reader select will not have dropped and cards are moved continuously. Read pulse control drops during an after 12 CB control but is restored by the card reader select trigger.

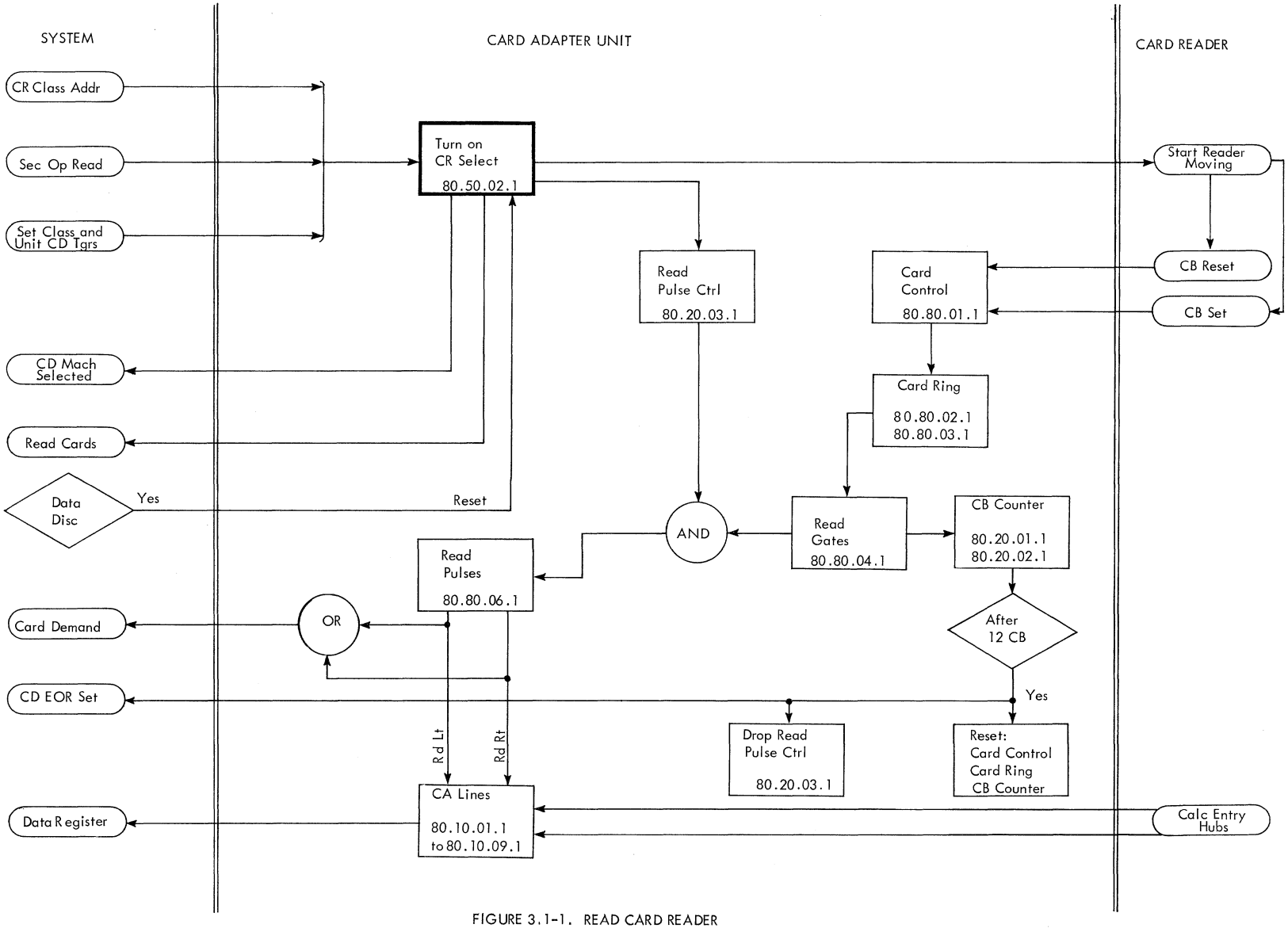

FIGURE 3.1-1. READ CARD READER

When the CAU receives a data disconnect, the following occur:

1. Immediate reset of card reader select trigger.
2. Disconnect pulse sent to card reader to suspend reading of data.
3. Card reader select trigger off drops read pulse control.

No further transmission of data is possible during this card reader select operation, and the card reader latches up after completing the present card feed cycle.

3.2.00 WRITE PUNCH

A write punch operation (Figure 3.2-1) enables a system to prepare, on line, a punched card output. Card punching must take place a row at a time and start with the 9-row first. Because the system employs a 36-bit word, it is possible to punch two words in a single row of the card. The CAU synchronizes the transmission of two such words during the setup time of the punches in the card punch. The number of words transmitted is controlled by a data disconnect from the system; 24 words may be punched in a single card. After punching a complete card, the CAU provides the system with an end-of-record indication. If a data disconnect has not been indicated after punching a complete card, the CAU causes the continuous feed of another card to the punching station. The following sequence shows how the CAU synchronizes data transmission to the card punch. It is assumed, until otherwise indicated, that no data disconnect has occurred.

1. Turn on card punch select trigger.
2. Send write cards, channel write cards, and card machine selected controls to the system.
3. Bring up write pulse control.
4. Reset CB counter, card ring, and card control.
5. Select card punch; start cards moving when ready.
6. CB reset from card punch to insure restoring card control circuitry.
7. CB set from card punch.
8. Turn on CB trigger.
9. Turn on card control trigger; start card drive.
10. Turn on card sync trigger; start card sample pulse.
11. Card drive starts card ring.
12. Turn on record control.
13. Generate a write-left and a write-right gate.
14. Generate a write-left and a write-right pulse.
15. Send a card demand to system for each write pulse.
16. Provide gating of data register lines to calc exits with each write pulse.
17. Card ring T_5 turns off record control.
18. Fall of T_5 and next sample pulse step CB counter.
19. CB reset from card punch to restore card control circuitry.

After step 19, a word of data has been punched in 9-row left and in 9-row right. If an entire card is to be transmitted, steps 7-19 above are repeated 11 more times. After punching the 12-row of the card, the CAU sends an end-of-record indication to the system.

20. A thirteenth CB set from the card punch causes steps 8-12 above to be repeated.
21. Record control on and an after 12 CB control causes an end-of-record set to be sent to the system.

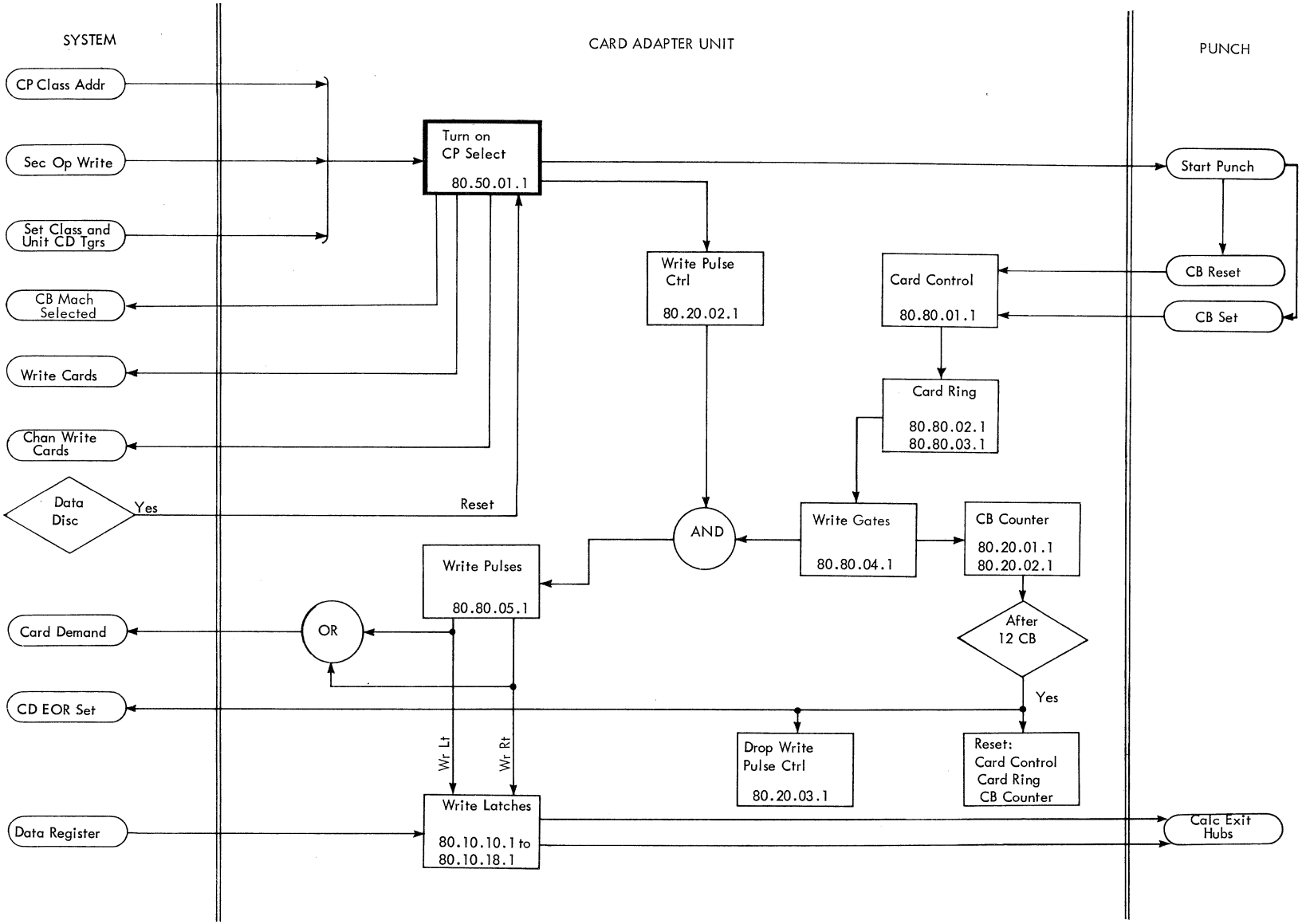

FIGURE 3.2-1. WRITE PUNCH

22. Card end-of-record pulse resets card control, card ring, and CB counter to prevent transmission of data when no punching position is at the punch station.

If no data disconnect occurs after punching a complete card, steps 5 through 22 above are repeated to punch the following card. Card punch select will not have dropped and cards are moved continuously through the card punch. Write pulse control drops during after 12 CB control but is restored by the card punch select trigger.

A data disconnect may be received by the CAU following any word transmission. This may occur after punching a half-row, a full row, or an entire card. In all cases, the data disconnect causes the same CAU sequence to stop transmission of data.

When the CAU receives the data disconnect the following occur:
1. Immediate reset of card punch select trigger.
2. Disconnect pulse sent to card punch.
3. Card punch select trigger off drops write pulse control.

No further transmission of data is possible and the card punch latches up at the end of the present card feed cycle.

3.3.00 WRITE PRINTER

A write printer operation (Figure 3.3-1) allows a system to prepare, on line, a printed output. Such an output may be desirable for spot-checking system operation or for an immediate display of system output.

There are 120 possible printing positions available for each line of printing. Only 72 of these positions are under direct control of the card adapter unit. These 72 printer positions are pulsed from 36 calc exit left and 36 calc exit right outputs. Additional positions may be printed through split wiring at the printer.

The order for impulsing the printer is 9, 8, 7...12. Because the CAU controls 72 printing positions, two words are transmitted during each impulsing time of the printer. To set up a complete print image requires 24 words from the system.

The number of words transmitted by the CAU is under control of a data disconnect from the system. Until such a disconnect is received, the CAU causes the printer to remain selected. As long as the printer is ready and selected, two words are transmitted during each printer impulse time. The following sequence shows how the CAU synchronizes data transmission to the printer. It is assumed, until otherwise indicated, that no data disconnect has occurred.

1. Turn on printer write select trigger.
2. Send write cards, channel write cards, and card machine selected controls to the system.
3. Bring up write pulse control.
4. Reset CB counter, card ring, and card control.
5. Select printer; start printer moving when ready.
6. CB reset from printer to insure restoring card control circuitry.
7. CB set from printer.
8. Turn on CB trigger.
9. Turn on card control trigger; start card drive.

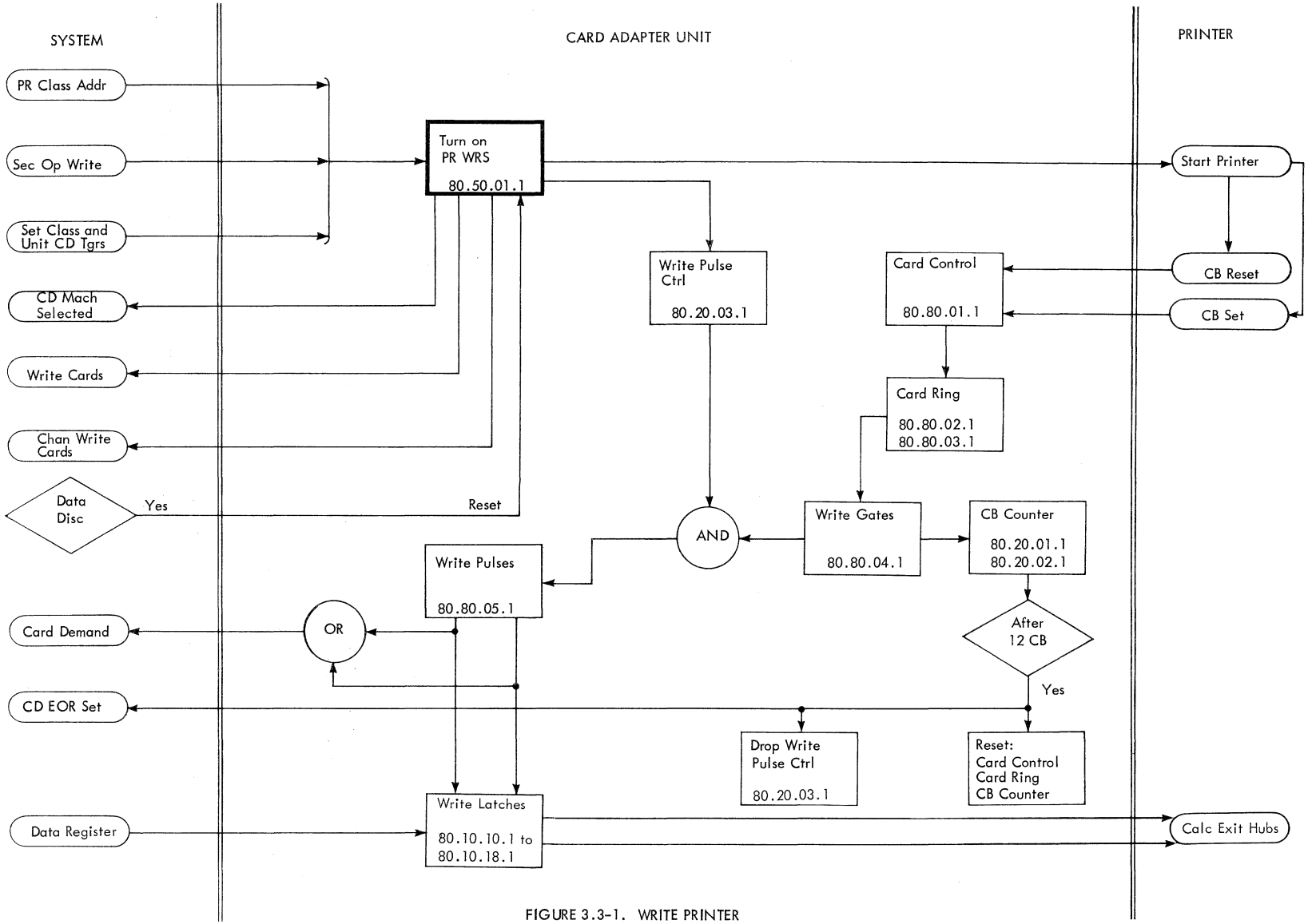

FIGURE 3.3-1. WRITE PRINTER

10. Turn on card sync trigger; start card sample pulse.
11. Card drive starts card ring.
12. Turn on record control.
13. Generate a write left and a write right gate.
14. Generate a write left and a write right pulse.
15. Send a card demand to system for each write pulse.
16. Provide gating of data register lines to calc exits with each write pulse.
17. Card ring T_5 turns off record control.
18. Fall of T_5 and next sample pulse step CB counter.
19. CB reset from printer to restore card control circuitry.

After step 19, a word of data will have impulsed the print magnets, at 9-time, from calc exit left and from calc exit right. Assuming an entire card image is to be set up at the printer, steps 7-19 are repeated 11 more times. After setting up the print magnets for 12-time, the CAU sends an end-of-record indication to the system.

20. A thirteenth CB set from the printer causes steps 8-12 above to be repeated.
21. Record control on and an after 12 CB control cause an end-of-record set to be sent to the system.
22. Card end-of-record pulse resets card control, card ring, and CB counter, to prevent transmission of data while no setup time is possible at the printer.

If a data disconnect has not occurred after printing, steps 5 through 22 above are repeated to print the following card image. Printer write select has not dropped and the printer continues to move into the next print cycle. Write pulse control drops during after 12 CB control but is restored by the printer write select trigger.

A data disconnect may be received by the CAU following any word transmission. This may occur after setup of a complete card image or any portion of an image. In either case, the data disconnect causes the same CAU sequence to stop transmission of data.

When the CAU receives a data disconnect, the following occur:
1. Immediate reset of printer write select trigger.
2. Disconnect pulse sent to printer.
3. Printer write select trigger off drops write pulse control.

No further transmission of data is possible and the printer coasts to a stop at the completion of the present print cycle.

3.4.00 WRITE PRINTER BINARY

Write printer binary (Figure 3.4-1) causes writing of 1's only. This allows a system to represent stored information in binary format. Two words of information may be represented during one print cycle. These two words are transmitted during setup time for the 1-row. The transmission is under control of a write left and a write right pulse.

With the exception of write pulse control and the write controls sent to the system, write printer binary operation corresponds to operation for write printer. Three additional triggers in CAU provide write cards control and channel write cards control during the 1-row.

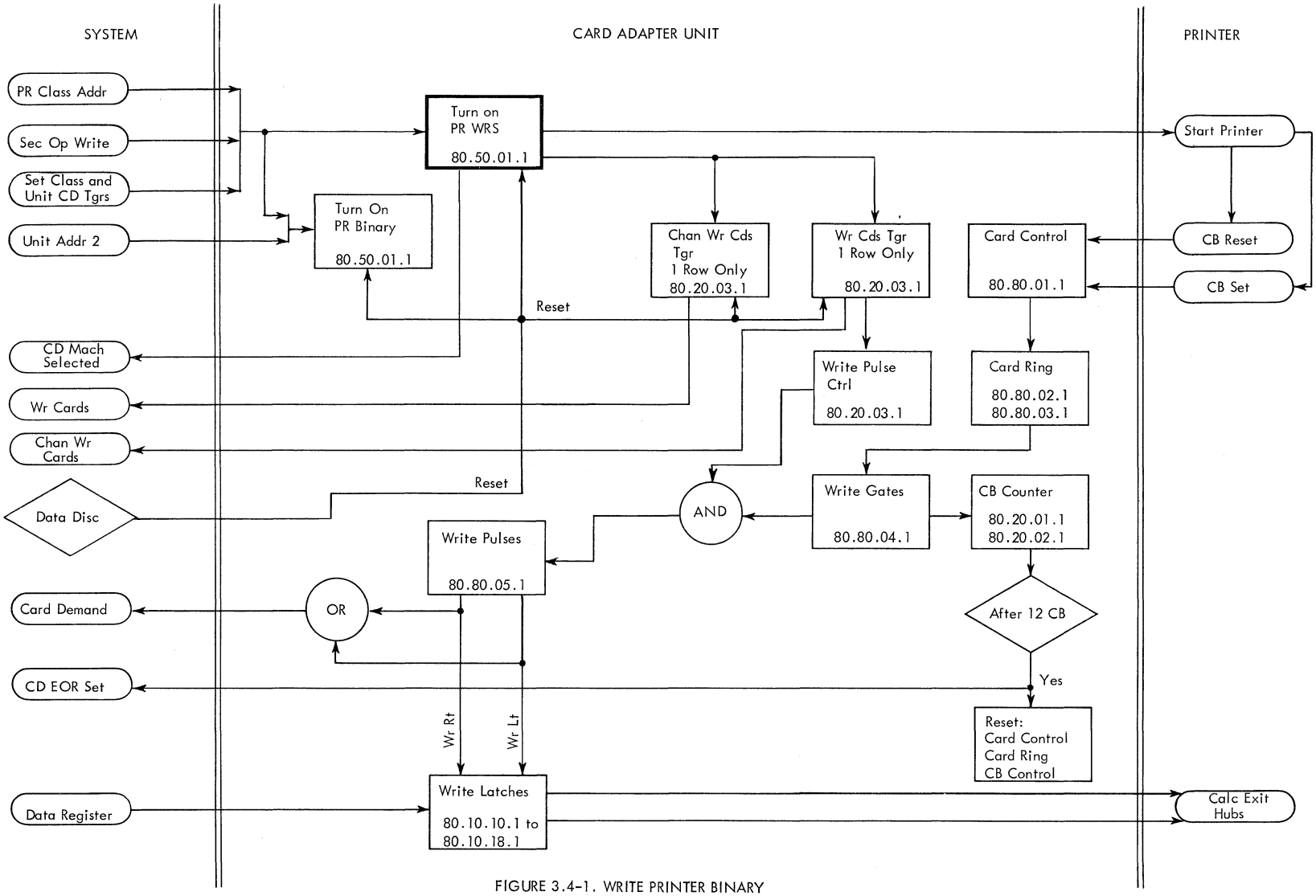

FIGURE 3.4-1. WRITE PRINTER BINARY

Write printer, with a unit address of two, turns on a print binary trigger in addition to the printer write select trigger. The print binary trigger suppresses the normal write pulse control circuitry and turns on a write cards trigger and a channel write cards trigger during transmission time for the 1-row. The write cards trigger generates write pulse control; the channel write cards trigger provides writing control to the channel.

A data disconnect is normally initiated after setting up either the left half of the 1-row or both halves of the 1-row. If a data disconnect does not occur after printing, the print binary select circuitry causes the printer to proceed for another print cycle.

3.5.00 READ PRINTER

The read printer instruction (Figure 3.5-1) enables a system to check the accuracy of numerical printing. Under control of the CAU, echo impulses from the printer are returned to the system. The system, through programming, may store the echo data and then compare it with the information originally sent to the printer. The order in which the CAU may route information to the printer and return echo impulses is fixed by the printer.

During the early part of a read printer instruction, the CAU causes writing at the printer. During the 1-row through 12-row, however, the CAU causes both writing and reading at the printer. That is, the print magnets must be energized at the same time the type wheel contacts are reading echoes of earlier digits. During the latter portion of the cycle, after the 12-row, echo checking (reading) alone occurs.

The CAU controls to accomplish a read printer operation may be seen in Figure 3.5-2. Note that all requirements of CAU have been satisfied. In accomplishing these requirements, much activity is in the form of read cards, write cards, and channel write cards. As shown in the expanded ninth through twelfth CB section, these controls are employed by the system and are covered in the manual describing the system with which the CAU is employed.

Disconnect on a read printer operation may be initiated at any time by the system. Such a disconnect causes resetting of the printer read select trigger and write and read pulse control, if they are up. Normally the system would request a disconnect only after a complete read printer cycle. If no disconnect occurs after printing and echo checking a complete line of print, the read printer select trigger initiates the control for printing and echo checking another line of print.

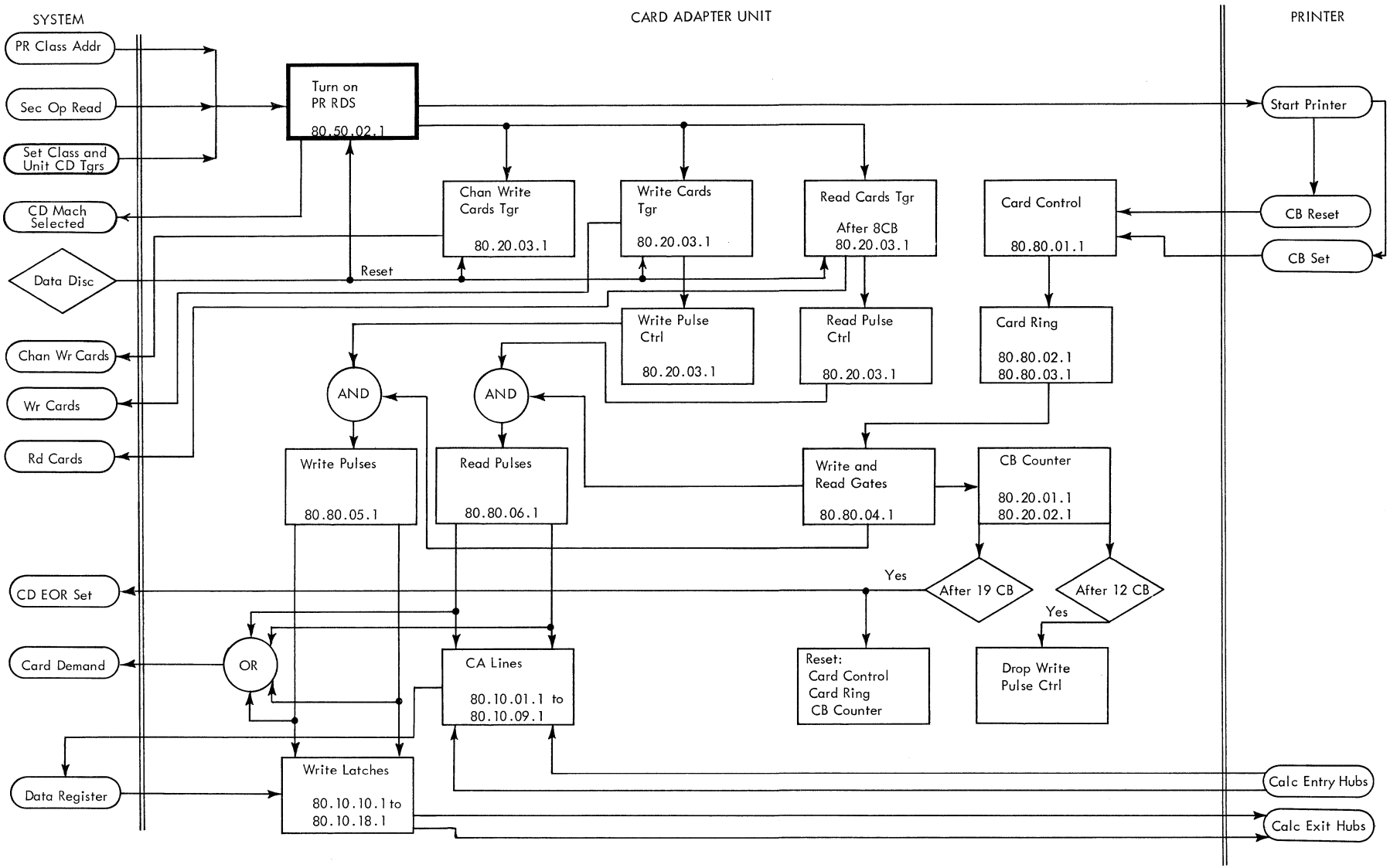

FIGURE 3.5-1. READ PRINTER

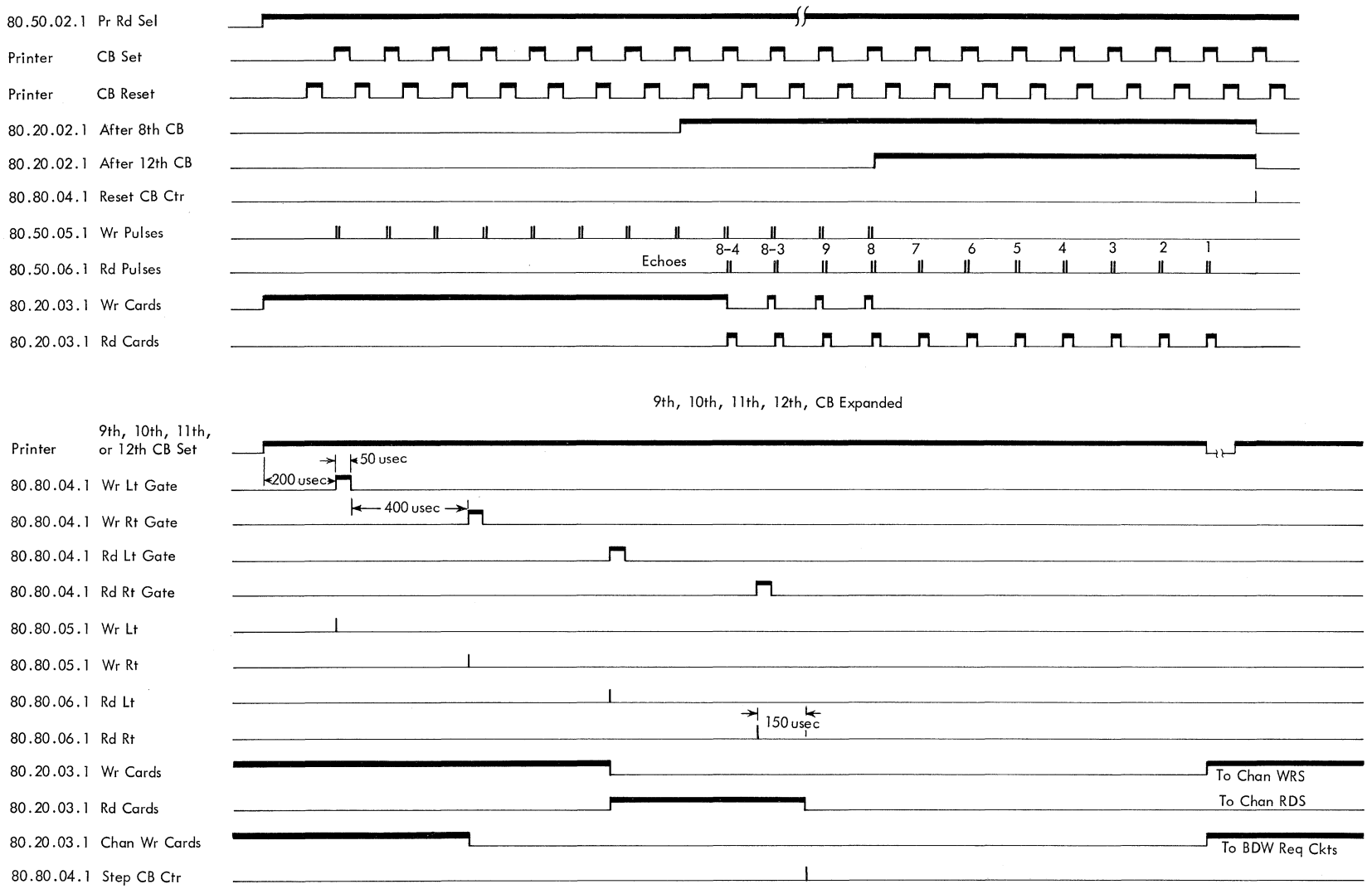

FIGURE 3.5-2. PRINTER READ SELECT

4.0.00 READ-WRITE MANUAL CONTROL

ALL CAU OPERATIONS except read printer may be placed under manual control at the external system. A read cards switch control from the system, coupled with a manual control from the system, turns on the card reader select trigger. The resulting CAU operation is identical to a read card reader sequence. The completion of the sequence is again under control of a data disconnect.

Manual operation is controlled similarly for punch and printer operation by substituting write punch switch and write printer switch controls. An additional control, print binary switch, when coupled with write printer switch and manual controls activates a print binary routine.

5.0.00 CONTROL AND TEST CIRCUITRY

SEVERAL CONTROL lines in the card adapter unit require little more than level setting. The logical significance of the lines is not apparent within CAU, but they are required in linking a system to the card machines. The purpose of these lines is not stressed in this section but rather in sections relating to the system or the card machines.

5.1.00 SENSE OUTPUTS

The CAU can transmit 12 sense output controls from a system to the appropriate card machines. Two sense outputs are used with the card punch to enable a system to alter card punching. Ten sense outputs are used with the printer to allow a system to alter carriage or printing controls.

The CAU provides gating for the sense outputs. This gating, in the form of CB pulses, originates at the respective card machines. A card end-of-record control, originating in the CAU, is used for repetitive impulsing of the sense outputs for the duration of the card machine select.

5.2.00 SENSE ENTRY

In addition to the 12 sense outputs transmitted through the CAU, there is also a printer sense input. This sense input is available in the CAU for test by the system. If a test request is received, and the sense entry is active, a printer sense entry control is sent to the system.

5.3.00 END OF FILE

The end-of-file indication is generated by the card reader and transmitted to the system by a circuit in the card adapter unit. The nature and reason for such an indication may be seen in the section covering the card reader.

An end-of-file indication from the card reader causes a trigger to be set in the CAU. The output of this trigger is available to the system for sampling. The end-of-file trigger may be reset from either the card reader or the system.

5.4.00 PULSE GENERATION TEST

The CAU pulse generation circuitry may be tested by using controls in the system. These controls when seen in the CAU are designated: hand key normally open, hand key normally closed, and card cycle operation.

The hand key controls allow CB set and CB reset operations to be manually duplicated at the system. Pulse generation may be initiated by turning on the CB trigger with hand key normally open control. The CB trigger initiates the pulse sequencing seen in Figure 2.1-1. Under the card cycle control from the system, the pulse generation is allowed to proceed only to the completion of the write left gate where a reset of the card control trigger is forced.

The hand key normally closed causes resetting of the CB trigger and the next hand key normally open sets the CB trigger again. The pulse generation proceeds through the write-right gate. Read gates result from further setting and resetting of the CB trigger. Having run through the entire ring, the CB counter is stepped. Continued setting and resetting of the CB trigger causes the operation to cycle repeatedly.

The write and read pulse circuitry and the end-of-record control may be tested if card machine select triggers are manually forced on during testing operation.

The card cycle operation control has been designed for use during test operation. If the card cycle control is not used, hand key normally open may be used to cause one complete cycle of the card ring. No further test is possible until the card cycle control is activated.

5.5.00 LOAD CARDS

A card reader sequence may be initiated under load cards control at the system. A set card reader select on load and a not manual cause the setting of the card reader select trigger in the CAU. The card reader select trigger initiates a normal reader sequence (Section 3.1.00).

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