

CONTROL DATA 167 CARD READER

**VOLUME 1
DESCRIPTION, OPERATION,
AND PROGRAMMING**

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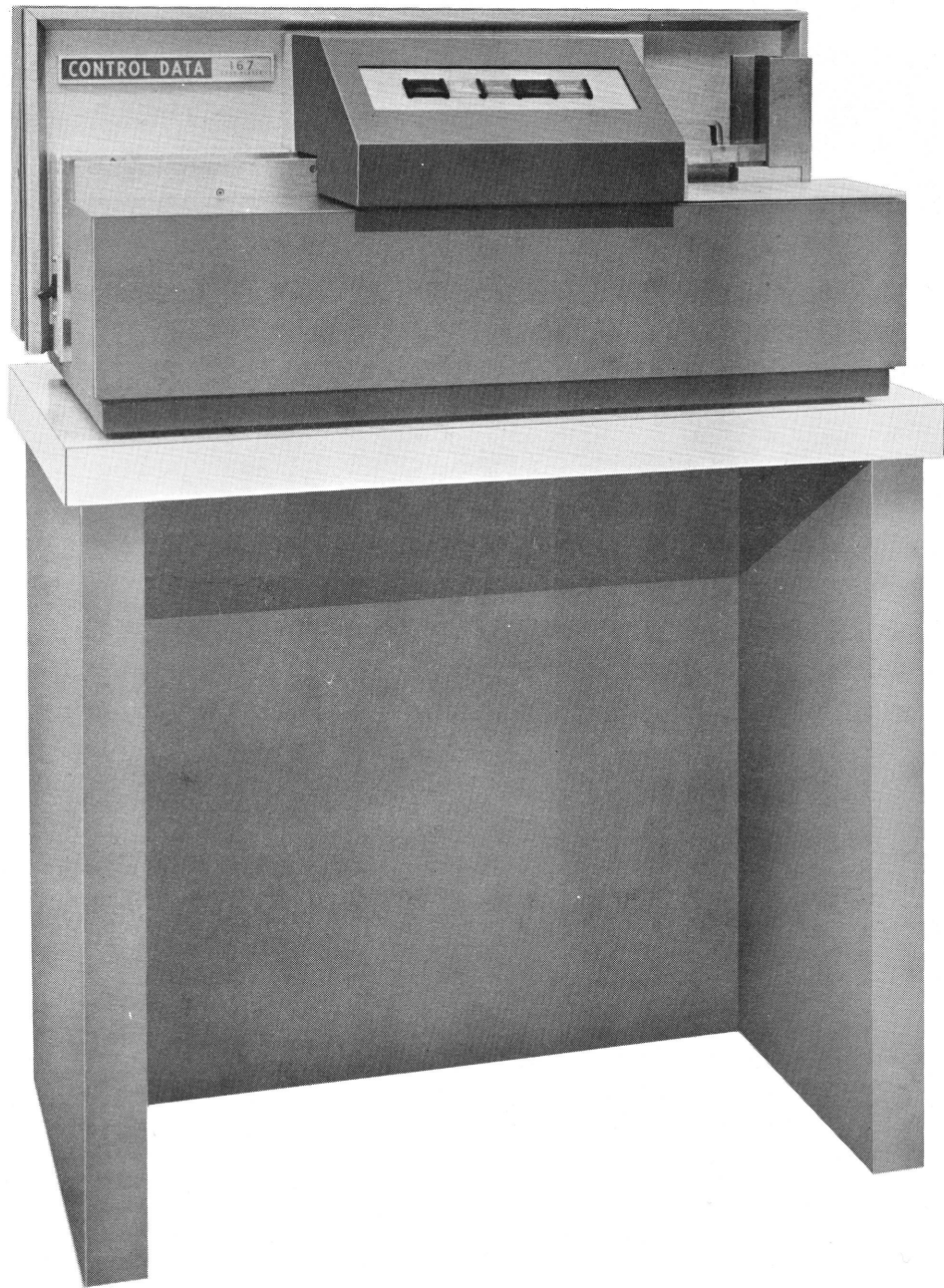
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CHAPTER 1

DESCRIPTION

The Control Data 167 Card Reader reads data from standard punched cards and transfers it to a computer, magnetic tape unit, or line printer. Data is read column by column and sent to associated equipment in a 12-bit per word parallel mode.

TABLE 1-1. SPECIFICATIONS

MECHANICAL		
	Card Reader	Pedestal
Height	13 1/2 inches	27 inches
Width	29 3/4 inches	30 inches
Depth	18 inches	18 1/2 inches
Weight	120 pounds	90 pounds
Cooling Requirements	630 BTU/hour	
Hopper Capacity	500 cards	
Stacker Capacity	500 cards	
Reading Speed	250 cards/minute maximum	
ELECTRICAL		
Power Requirements	115 vac, 1 phase, 60 cps, 1.6 amp	
Reading Method	Photo-electric: 12 card-row cells 2 card-detect cells	
Timing Source	Magnetic Reluctance Pickup	

TABLE 1-2. EF CODES

Code	Function
4500	EF clear
4501	Free run read
4502	Single cycle read
4540	Check status

Table 1-3 lists possible responses to a status request. Multiple faults are indicated as the sum of individual faults.

TABLE 1-3. STATUS RESPONSES

Code	Meaning
0000	167 ready for operation
0001	Hopper empty
0002	Stacker full
0004	Feed failure
0010	Program error
0020	Amplifier failure
0040	Motor power off

Chapter 2, Operation and Programming, discusses in detail the use of the EF codes and explains the meaning of each status response.

The 167 reads data from cards photo-electrically. As each card-column passes the read station, light passes through each hole present in that column and strikes a solar cell. The 167 amplifies any signals present at the solar cells to standard logic voltage levels and gates them to the computer or other interrogating device. Off-line, the card reader is directed by pseudo select codes.

CHAPTER 2
OPERATION AND PROGRAMMING

MANUAL CONTROLS AND INDICATORS

TABLE 2-1. SWITCHES AND INDICATORS

Name		Function
Main Power (2S01)	S*	Connects 167-2 to power lines
Motor Power (6S04)	S	Applies power to drive motor and excitors
Row 12 "0" Check Disable (6S05)	I**	Motor is running
	S	Disables amplifier "0" check of 12th row when cut-corner cards are used
Load (6S06)	I	Disabled condition
	S	Initiates a Free Run Read (FRR) operation
Stop (6S07)	S	Disables Clutch
	I	Indicates stop
Margin (6S02)	S	Used during routine maintenance reliability tests
H → BCD and Pack (6S08)	S	Selects translate mode off-line
	I	Translate mode

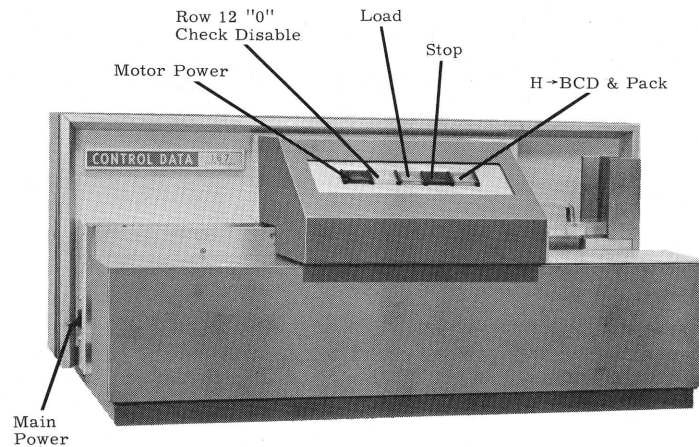


Figure 2-1. Card Reader Controls

- * Switch
- ** Indicator

CARD READER PREPARATION

To prepare the 167 for control by interrogating equipment:

- 1) Place cards in hopper, face down, column one in direction of feed
- 2) Turn on Row 12 "0" Check Disable switch if cut-corner cards are used
- 3) Turn on Main Power switch
- 4) Turn on Motor Power switch
- 5) Issue master clear from associated equipment
- 6) Card reader now ready for external control

EXTERNAL FUNCTION CODES

SELECT CODES

Operation of the 167 card reader is initiated by coded EF instructions from an interrogating device (table 2-2). 12-bit function codes transmitted by the EXC (7500) or EXF (75XX) instruction from the 160/160-A, or pseudo codes from a tape or printer unit, direct operations through controls in the 167. The upper 6 bits (octal 45XX) select the card reader; the lower 6 bits (octal XX00 through XX40) specify the card reader operation. Specially punched cards must be used for card to printer operation. See Control Data 166 Printer manual, volume I.

TABLE 2-2. EF SELECT CODES

Code	Name	Description
4500	EF Clear	<p>Clears EF Select FFs and Start Counter FF. Issue an EF clear to terminate:</p> <ol style="list-style-type: none"> 1) a FRR (4501) operation. If card reader is to stop immediately after reading a card, the clear must be received within 1.5 ms after reading of the 80th column. 2) a SCR (4502) operation at any time during the cycle.
4501	Free Run Read (on-line only)	<p>Actuates clutch and starts card movement. Cards move continually without need for reselection between cards. Operation terminates when card reader receives an EF clear (4500) or generates an input disconnect. An input disconnect results from:</p> <ol style="list-style-type: none"> 1) a feed failure, 2) a late input request (program error), or 3) an amplifier failure. <p>Check status immediately after receiving the disconnect. The operator must master clear the card reader before reading can resume.</p>
4502	Single Cycle Read	<p>Actuates clutch and starts card movement. Each 4502 select causes one card to move. The operator may terminate a read operation anytime during a cycle by issuing an EF clear (4500). To read the next card, status must be checked (4540), and another 4502 issued. Full speed operation is possible if 4502 is reselected within 4 ms after the 80th column is read.</p>
4540	Check Status (on-line only)	<p>A 4540 status request directed to the card reader and followed by an input to A (76 instruction) provides the computer with information (a coded response) relative to card reader status. This code is issued anytime previous to a 4501 or 4502 code, or after the last word desired from a card in the 4502 mode. A status request should follow each input disconnect.</p>

STATUS RESPONSES

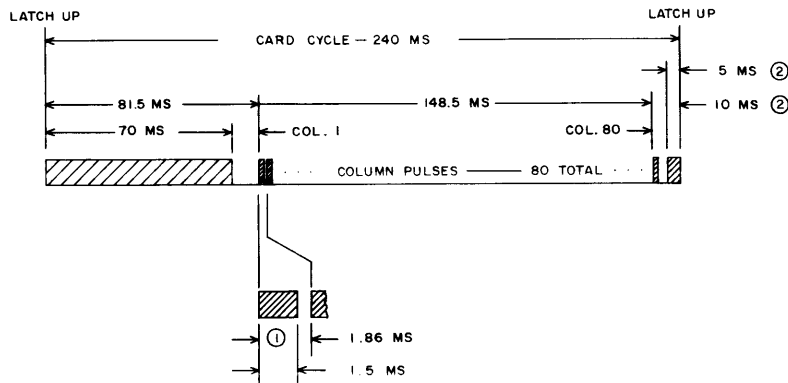
Table 2-3 is a list of status responses the card reader may send to the computer. Multiple faults appear in coded form as the sum of individual faults. For example, 0005 (0001 + 0004) means there was a feed failure and the hopper is empty.

TABLE 2-3. STATUS RESPONSES

Code	Name	Description
0000	167 Ready	
0001	Hopper Empty	All cards have been read
0002	Stacker Full	To prevent a card jam, remove accumulated cards from stacker
0004	Feed Failure	If accompanied by hopper empty, cards are all read; if not, a feed problem exists
0010	Program Error	Input requested too late by interrogating device
0020	Amplifier Failure	At least one of the 12 row amplifiers is not functioning properly
0040	Motor Power Off	3S04 is off

PROGRAM TIMING

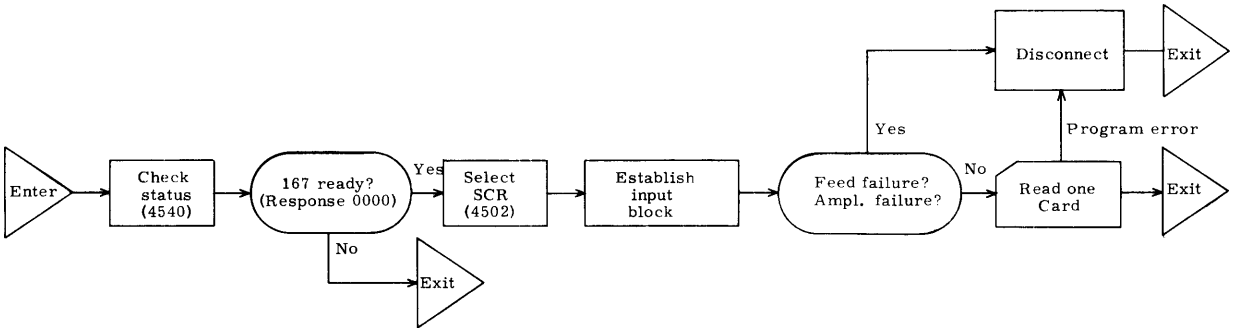
Each card requires 240 ms to pass through the read station. The card reader may send up to 80 12-bit words to the interrogating device from each card. Program timing is the same for single cycle read or free run read. Figure 2-2 shows the program timing for one card cycle. On-line, this chart enables a programmer to make full use of the computer between card columns and to reselect the card reader at a time that assures full speed operation.



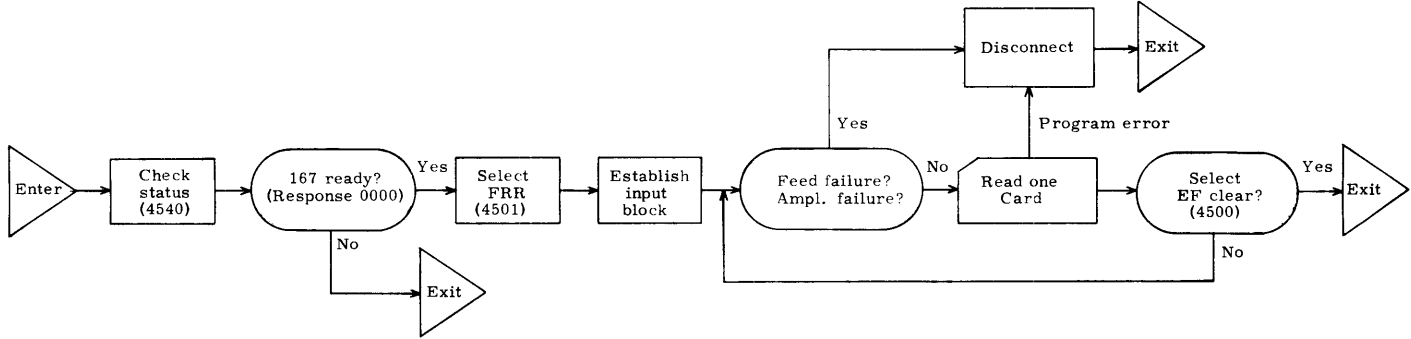
- Notes:
- 1 Shaded areas indicate computer program time available between column input requests.
 - 2 Redesign of the clutch is in progress; the indicated times will change when new clutch is installed.

Figure 2-2. Program Timing

Figure 2-3. Flow Charts of Sample Programs



SINGLE CYCLE READ



FREE RUN READ

CHAPTER 3

PRINCIPLES OF OPERATION

This chapter discusses the principles of operation for each section of the card reader logic. The accompanying diagrams are simplified. For more details, refer to the unabridged logic diagrams in volume II, appendix F.

EF CODE TRANSLATOR

Many peripheral equipments may be connected to the computer. The EF code translator (figure 3-1) recognizes selection of the 167 and determines the function it is to perform. EF select codes from the computer, or pseudo codes from other interrogating equipment, are received on the output lines. The accompanying function ready signal enables the 167 to translate the codes and set the function select FF's. EF bits 6-11 (octal 45XX) select the 167; bits 00, 01, or 05 select the function. Previous to an EF selection, a 1.5 μ sec pulse from A209 clears the function select FF's. An output resume, which is directed back to the interrogator after 5 μ sec, turns off the function ready and clears the output lines. The interrogating equipment may request status (4540), free run read (4501), or single cycle read (4502).

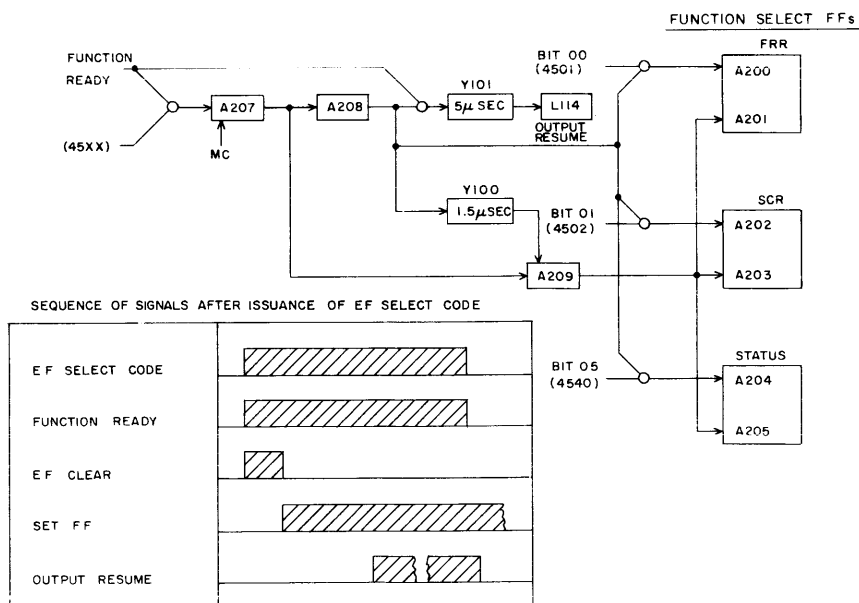


Figure 3-1. EF Code Translator

CHECK STATUS

Before selecting or reselecting a 167 read operation, the computer must sense card reader conditions by executing a status request (4540) followed by an input to A (76) instruction. Coded status information* is transferred to the computer on its input lines. Execution of a status request (4540), accompanied by a function ready signal, sets the Status FF. An input request, which may appear any time thereafter, generates an input ready signal and simultaneously gates status information to the computer. The input ready causes the input request to drop; a 1.5 μ sec pulse clears the Status FF. Figure 3-2 shows the circuits and timing associated with a status operation.

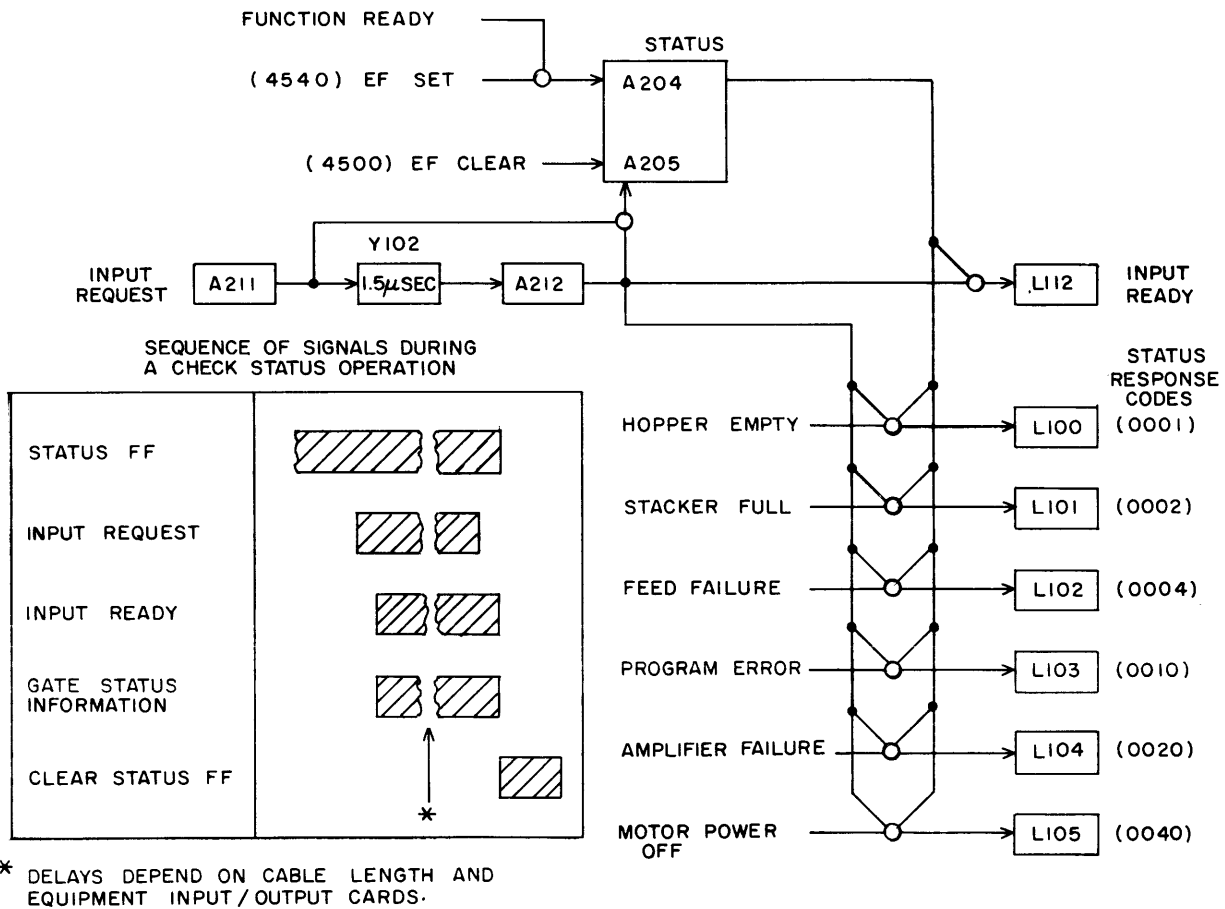
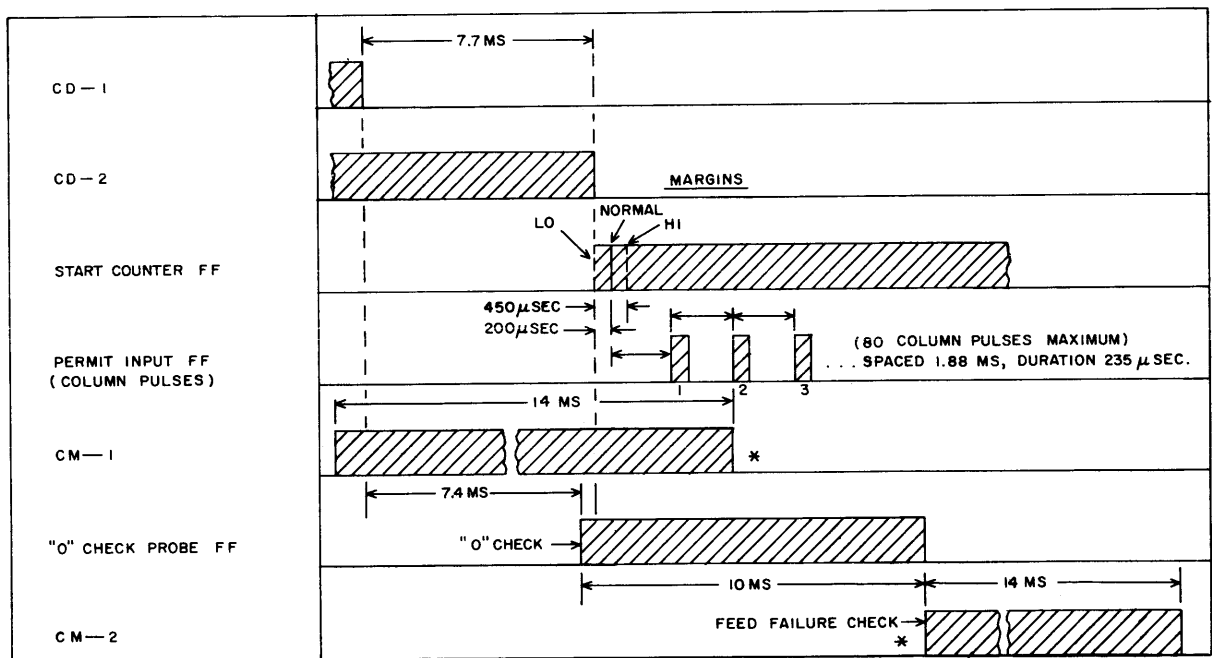


Figure 3-2. Status

* See Operation and Programming, chapter 2.

READING CARDS

The 167 reads a card one column at a time and sends data to the interrogator in a 12-bit per word parallel mode, 80 columns maximum per card. Fourteen exciter lamp/solar cell pairs are located in the read station. Twelve of these are for reading data from the 12 card rows; one (CD-2) starts the counter and one (CD-1) stops the counter. A magnetic reluctance pickup emits pulses continuously at the rate of eight per card column. Two cams generate signals during each card cycle. The timing relationship between signals is shown in figure 3-3.



* SET CAM AT THIS EDGE.

Figure 3-3. Timing Chart - 167

CUMULATIVE-8 COUNTER

Selecting the free run or single cycle read mode pulls the clutch and advances a card through the read station (figure 3-4). When no card is in the read station, a "1" from CD-1 holds a forced clear on the Start Counter FF (figure 3-5). As a card enters, the clear drops. Selecting a free run or single cycle read operation removes a lockout "1" from B112 so that CD-2 can set the Start Counter FF. Setting this FF reapplies a lockout to B112 via R119 and removes a forced clear from the cumulative-8 counter. This allows pulses from the magnetic reluctance pickup to advance the counter.

The counter emits one signal for every eight it receives from the pickup. A pulse generator (K115 and Y106) shapes these output signals into 1.5μsec pulses. Delays Y103 and Y104 prevent short extraneous pulses from advancing the counter. During maintenance tests, an adjustable delay (Y105 + Y111 + no delay) allows the operator to vary the position of the column pulses with respect to the card columns. Signal CM-1 drops to "0" after the first column of a card has been read. This prevents the Start Counter FF from being reset until the next card enters the read station. Delay Y112 ensures that B112 remains locked out until CM-1 drops in case an EF clear (4500) immediately follows the reading of the first column.

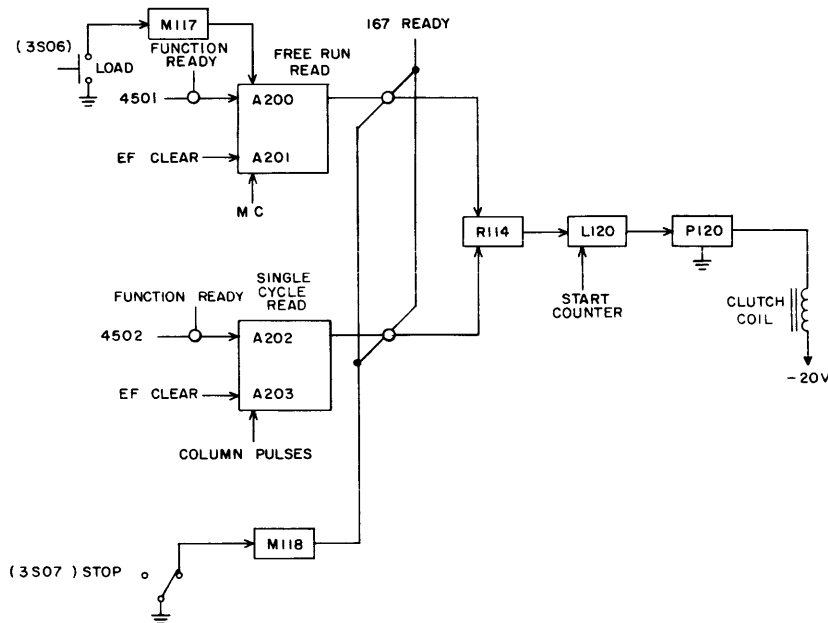


Figure 3-4. Free Run and Single Cycle Read

PERMIT INPUT

The column pulses emitted by the counter coincide with each card column (figure 3-5). They set the Permit Input FF if an input request is present, and gate data to the interrogator. If the input request is not present, an input disconnect occurs. An input ready is sent to the interrogator 5 μ sec after an input request is received. This turns off the input request and clears the input lines.

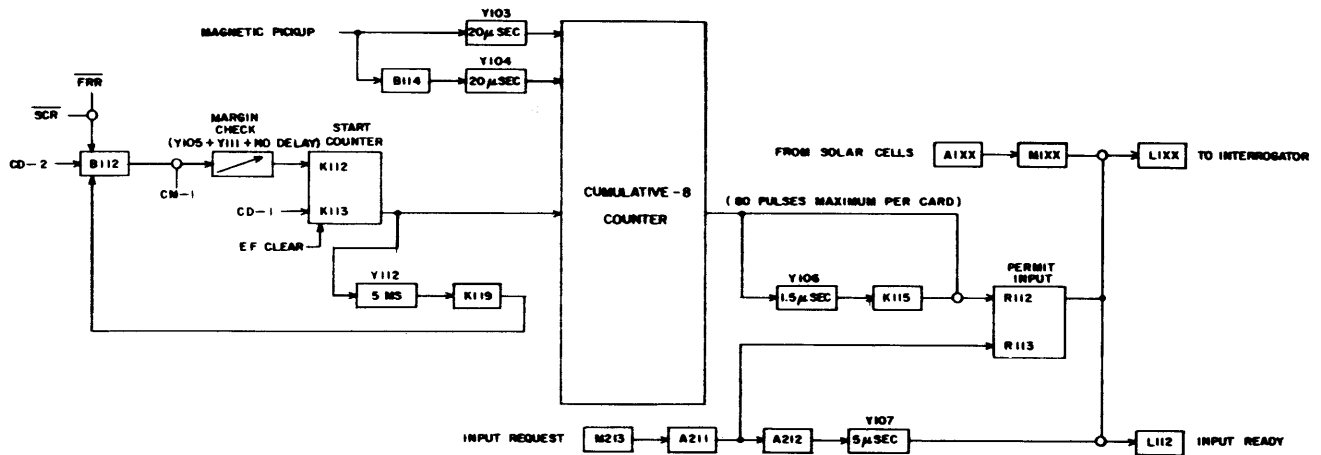


Figure 3-5. Start Counter and Permit Input

FREE RUN READ

The Free Run Read FF (figure 3-4) is set by either an EF code 4501 from the computer or by a signal from Load switch S06 on the card reader control panel. On-line it can be cleared only by an EF clear (4500) or MC. The FRR FF output gates the input to clutch puller P120. The Load switch permits local starting of the card reader. Stop switch S07, used for local stopping of a FRR operation, must be returned to the normal (light off) position before operation may resume. An input to L120 from the Start Counter FF locks out the clutch puller during the time that the counter is running.

SINGLE CYCLE READ

The Single Cycle Read FF (figure 3-4) is set by EF code 4502 and is cleared by the first column pulse during a read cycle or by an EF clear (4500). Its main functions are to gate the input to R114 and to pull the clutch for one read cycle.

INPUT DISCONNECT

The input instruction may establish a storage field block of greater capacity than the anticipated input block. The input disconnect indicates to the computer that the 167 has no more data to deliver; the computer may return to its main program with no further delay. Off-line, the disconnect halts operations. Three sets of conditions will cause a disconnect: feed failure, program error, or amplifier failure (figure 3-6).

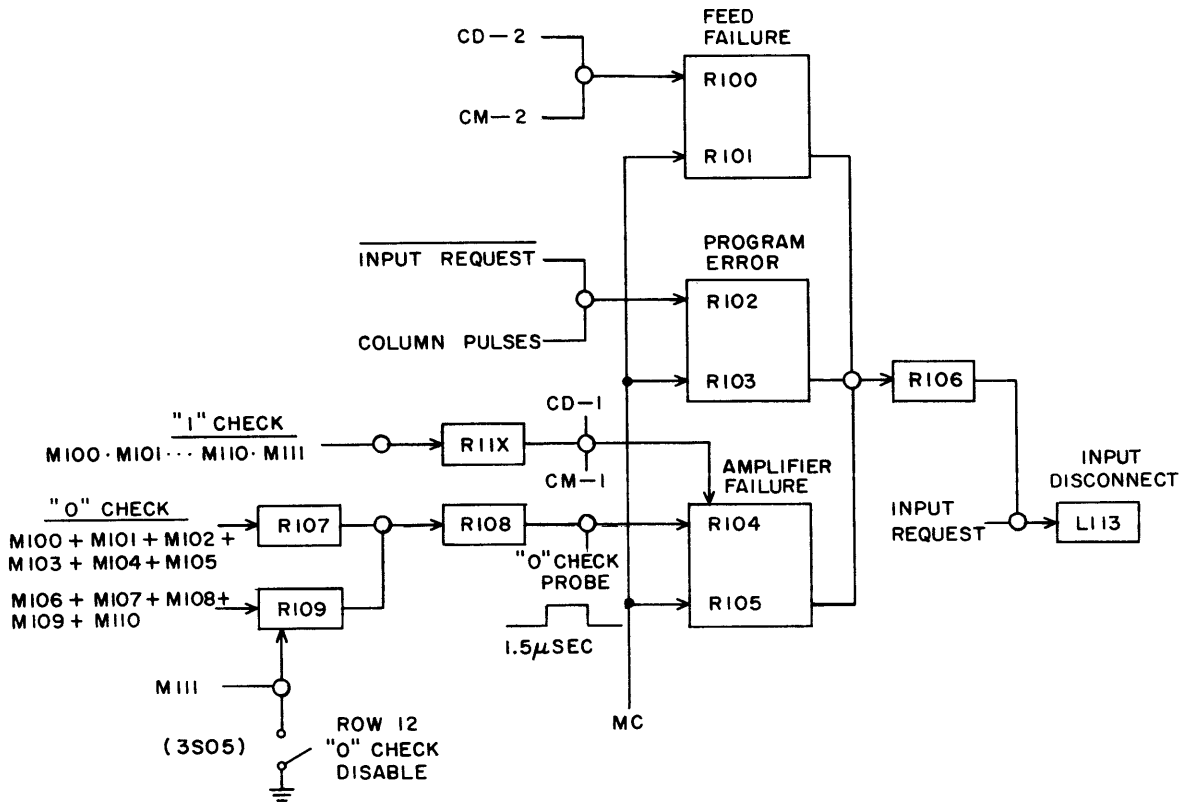


Figure 3-6. Input Disconnect

FEED FAILURE

The Feed Failure FF is set if the Start Counter FF has not been set by a card before the signal from CM-2 appears.

PROGRAM ERROR

The Program Error FF is set if an input request is not present as each column pulse rises.

AMPLIFIER FAILURE

The light amplifiers are checked automatically as each card enters the read station.

"1" Check

As soon as a card covers CD-1, but before it covers the row-lamps, the light amplifiers are checked for output. If any amplifier is not supplying a "1", the Amplifier Failure FF is set. Failure of an amplifier to supply a "1" may be caused by insufficient exciter lamp brilliancy, dirt in the solar cell aperture, or a defective amplifier.

"0" Check

After the "1" check, a "0" check is made to ensure that none of the amplifiers emit a "1" when the solar cell apertures are all covered by the leading edge of a card. The presence of a "1" usually indicates that the brilliance of an exciter lamp is set too high, causing light to penetrate the card and switch the light amplifier. An input disconnect may occur any time that corner-cut cards are used unless the Row 12 "0" Check Disable switch (S05) is on.

When an input disconnect is received by the computer, the operator must correct the trouble and execute a master clear before card reader operation can resume.

CONTROL DATA

CORPORATION

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