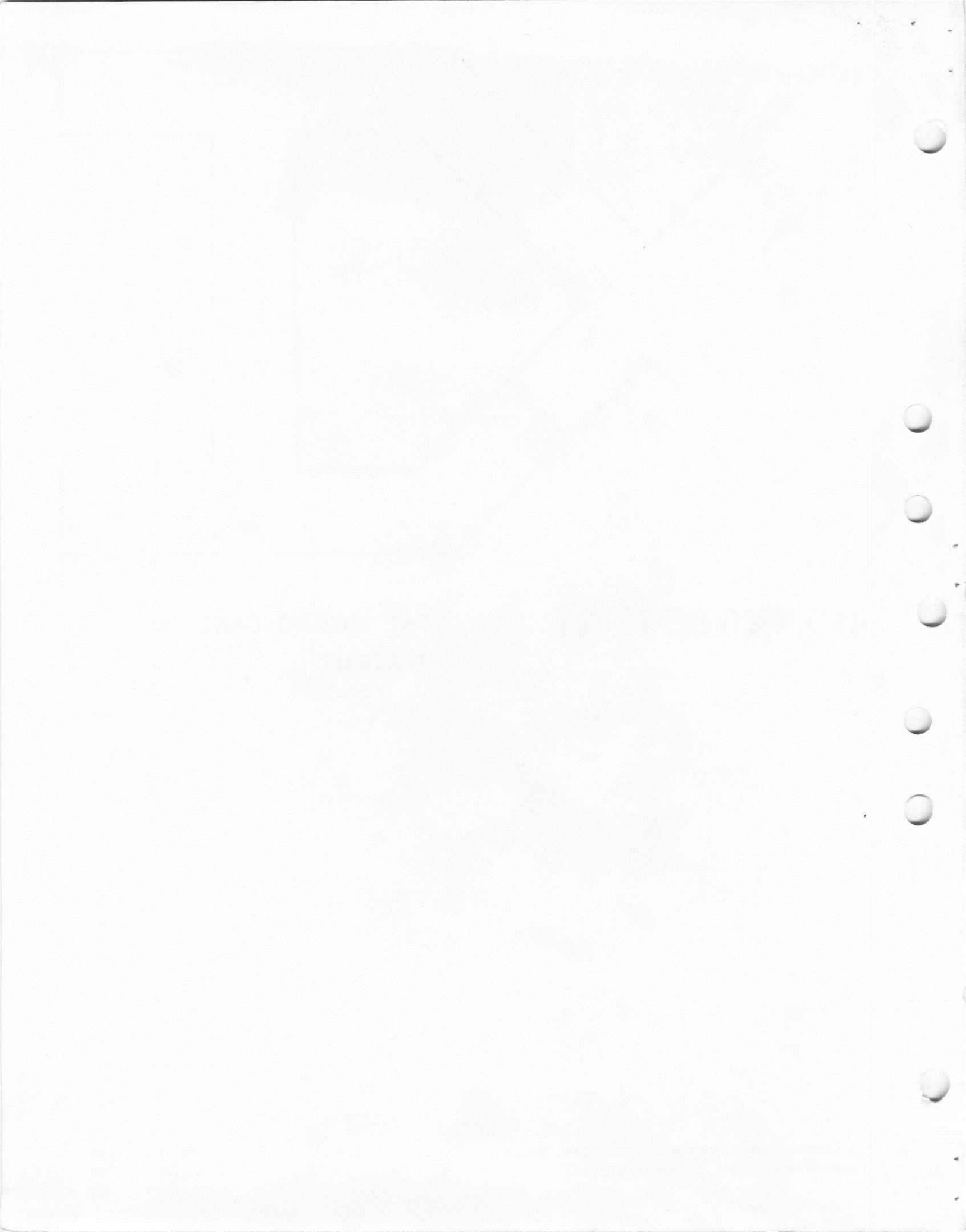


MONROBOT XI

THE MONRO-CARD
SYSTEM

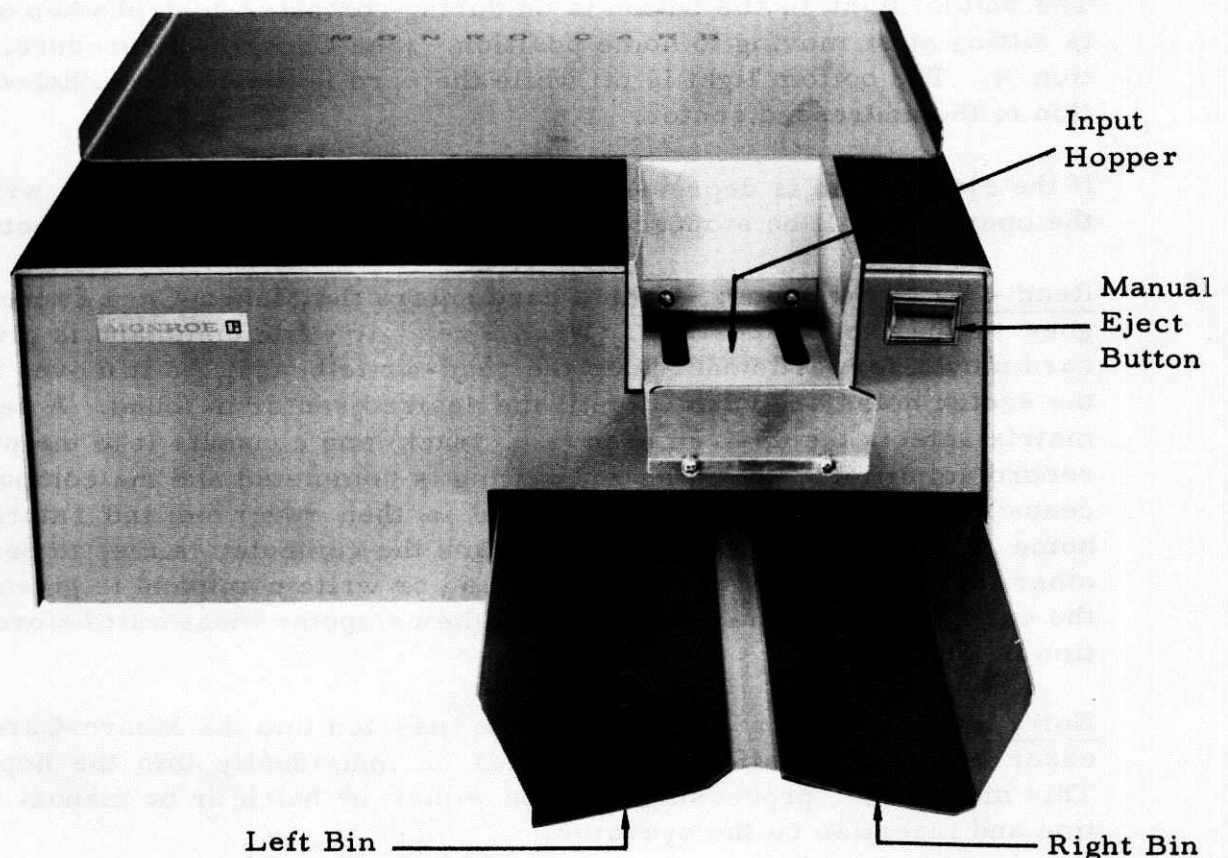


THE MONRO-CARD SYSTEM

The Monro-Card System consists of a Monrobot XI computer, a Monro-Card Processor, and Monroe Magnetic Cards. The Monro-Card Processor is a special purpose device connected to the Monrobot XI. It can, under control of the computer program, transfer a computer word from the computer to a selected register on a magnetic card, transfer a word from a selected card register to the computer, or eject the card from the unit to a selected bin and enter a new card into the card unit.

MONRO-CARD UNIT

The Monro-Card Processor consists of a magnetic card handling mechanism, read-write heads and electronic circuits, an input hopper and two output bins.



Input Hopper: Cards are placed in the input hopper with the magnetic oxide coating (the brown side) up and with the cut corner away from the card unit. A small weight is supplied which should be placed on top of stack of cards to assure that the cards are fed properly. The bottom card (the first one

to enter) should be projected slightly to start proper feeding. The input hopper has a capacity of approximately 250 cards.

Output Bins: When an eject command is given the card in the reader will fall into one of two output bins as indicated by the program instruction. When the ejected card emerges from the unit the next card is brought in and moved to home position. Each output bin has a capacity of approximately 130 cards.

Manual Eject Button: The push button at the right of the input hopper can be used by the operator to take control of the card unit from the computer and eject a card. This button is a split light. The top light indicates computer control of the card unit when lit. When the button is depressed, the light goes out and the card within the unit is ejected into the bin indicated by the last computer eject command. While the light is out the computer can not operate the card unit. When the button is depressed the bottom card in the hopper enters and is moved to home position.

The bottom light in the button is on during computer control when a card is sitting at or moving to home position. (See Checking Procedure, Section 3). The bottom light is off while the card is moving from home position to the addressed sector.

If the eject button is depressed while the computer is reading or writing, the operation will be stopped immediately and the card will be ejected.

Read - Write Sequence: When a card enters the Monro-Card Processor it goes to the "home" position. When a read or write command is given the card moves forward underneath the read-write heads. As it moves forward the sector holes are counted until the desired sector is found. A selection matrix selects the desired head (i. e. track) and connects it to the playback-record amplifiers. Reading or writing is completed and the computer proceeds to the next command. The card is then reversed and returned to home position. During this return time the computer is free to perform other instructions. If another card read or write command is given before the card arrives at the home position the computer must wait before execution is possible.

Entry of Cards: Monro-Cards may be inserted into the Monro-Card processor either automatically in batches or individually into the hopper. This means that processing may be either by batch or by manual selection and insertion by the operator.

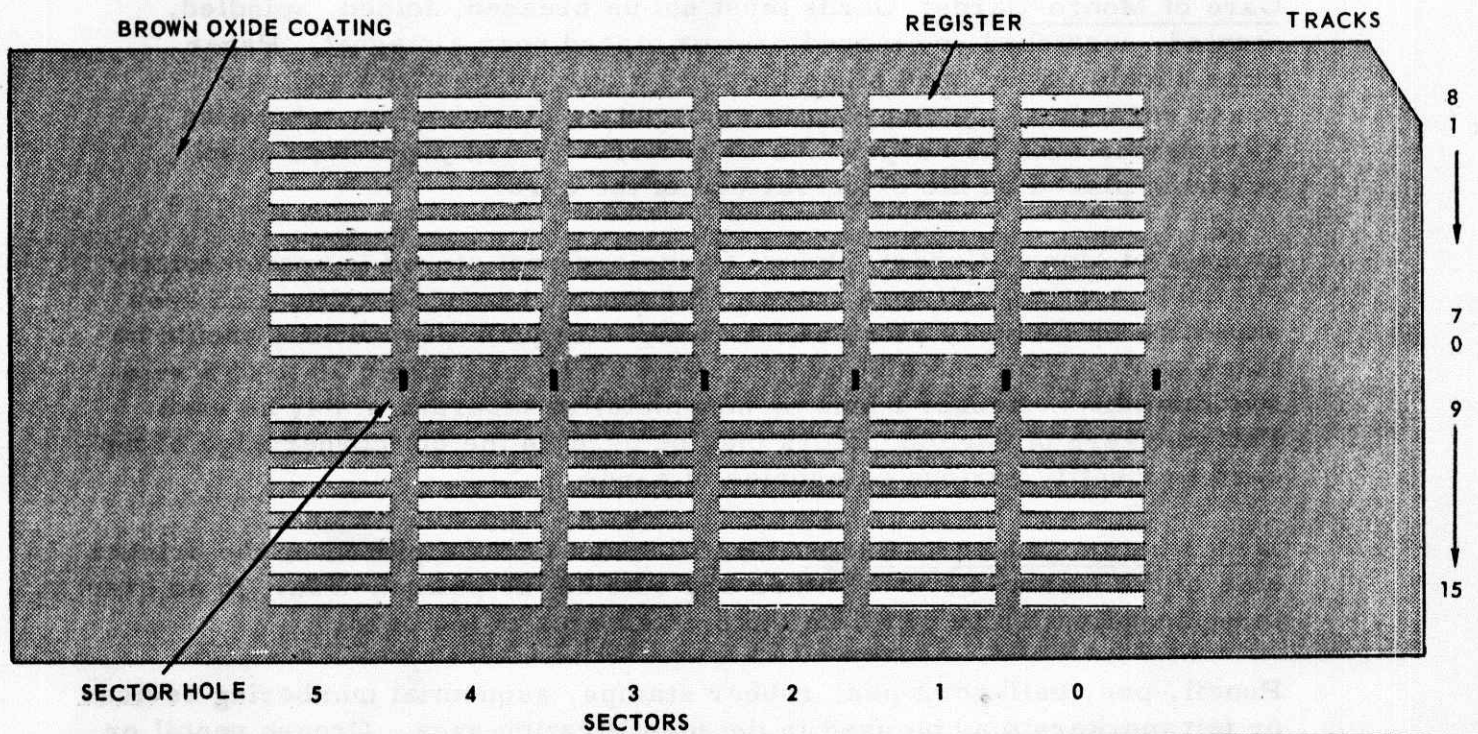
Input-Output Indicator Light: The indicator light immediately to the left of the "Parity" light at the top of the control panel is for the Monro-Card Unit. This light will be on during the time the Monro-Card is advancing from "home" position until it reaches the addressed sector location. The light is not on during return of the card to the home position.

THE MONRO-CARD

Size: 3.250 in. by 7.375 in., the same size as standard tabulating cards.

Other Visible Characteristics: One side of the card is coated with brown magnetic oxide, the other is printed. Six holes are punched in positions corresponding to tabulating card columns 14, 23, 32, 41, 50, 59, row 4. These holes denote the beginning of a sector when sensed by the card processor.


Storage Capacity: The Monro-Card contains 96 registers arranged in 16 tracks running the length of the card subdivided into 6 sectors as shown below.



← No.

← name

DO NOT TYPE ON SHADED AREA

MONROE  A DIVISION OF LITTON INDUSTRIES

HIGH CAPACITY - MAGNETICALLY RECORDED - REUSABLE DATA STORAGE **MONRO-CARD®**

Register Contents: Each register of the Monro-Card contains one 32 bit computer word and 34 check bits. The check bits are placed in the register automatically during writing and are checked automatically during reading. Each register has an address which is specifically selected during reading or writing.

Information recorded in a Monro-Card register may be in the form of up to nine decimal digits with sign, five alphanumeric characters, or two program instructions. Card register contents are equivalent to register contents of drum memory.

Care of Monro-Cards: Cards must not be creased, folded, spindled, stapled, scratched, or moved past or placed near a magnet. Paper clips should not be used since they are easily magnetized and can cause scratches. Monro-Cards must not be placed in any tabulating card device such as keypunches or sorters. Oiled paper tape should never be placed on the oxide surface of the card.

Storage of Monro-Cards: Monro-Cards are best stored in commercially available vertical tab card trays. The cut corner or identification area should be up for easy retrieval or filing. Adequate precautions should be taken against dust and dirt or heat over 90° F, and within 30 to 65% relative humidity. Rubber bands or non-metallic separators may be used. Felt markers of various colors may be used on the cut corner edge of the card to identify various categories of cards.

Identification of Monro-Cards: Identification is to be placed on the printed side of the Monro-Card on either end outside the printed area. In no case may identification be typed on the printed area of the card.

Pencil, pen, ball-point pen, rubber stamps, sequential numbering devices or felt markers may be used in the identification area. Grease pencil or thick, removable waxy substances are not suitable. Typewriter identification in the plain areas is suitable if care is taken to avoid embossing through the card, especially the hyphen and decimal point characters.

TIMING

Reading or writing: The card travels forward from home position to the read/write head at 56 ms (75 word times) per sector and returns to home position at 37 ms (50 word times) per sector. If a card is not ready or available, the computer will wait until execution is possible. No other computer operation will proceed until the command has been executed. Card return time may be utilized with other computer operations.

When writing, the information written should be read back and compared to the original word in the computer. Consequently, writing time takes twice as long as read time since both write and read commands are required.

TIMING CHART

Sector Number	0	1	2	3	4	5	
Forward	110	165	220	275	330	385	ms
Return	82	119	158	190	230	270	ms

Timing variation for sector 0 is $\pm 10\%$, for all other sectors $\pm 5\%$.

Eject: The Monro-Card eject command requires 3 ms (4 word times) of computer processing time for execution. Computer operations may then proceed as usual.

Eject/feed cycle: The eject command may be given even though the card is returning home from reading or writing, it is not necessary that the card be at the home position. Ejection of a card and feeding of the next card to the home position will require 1.5 seconds to execute the full cycle. If a read or write command is given during this time the device will appear "busy" until the new card is at the home position. No other computer operation can occur.

Over-all timing: It is evident that the format chosen for the lay-out of data on the Monro-Card will bear a definite relationship to the operating speed of the object program. In order to achieve maximum speed it is necessary to make a careful study of the frequency of use of each item of data. The 16 registers of the zero sector of the card should be utilized to provide minimum access to data used most often. If possible this sector should also contain alphanumeric packed words. Sectors 1 through 5 should be used for data less frequently required. A Monro-Card layout form is available. (MO-256).

The forward time measurement is from the beginning of a Monro-Card read or write instruction until the computer is released to process any instruction other than a Monro-Card read or write instruction. The return time is measured from the end of the forward time measurement until the processor is not busy and will accept another Monro-Card read or write instruction. Any combination of successive Monro-Card read or write instructions will take the combined times of forward and return, plus the combined tolerance, for the sector of interest.

CHECKING PROCEDURES

Advanced circuit design is built into the Monroe-Card Processor which checks and indicates all errors to assure accurate results. Three types of errors may occur, all of which are checked and indicated by a non-zero accumulator at the completion of reading. The programmer is responsible for testing of this condition and setting up correction procedures in the program. These error conditions are described below.

1. Faulty Cards:

Drop out: Drop out is a loss in signal amplitude which occurs when the card moves away from the reading head due to a bend in the card or a dirt particle on the card. If this is sensed while reading the operation is terminated and the card is returned to home position.

Parity: A parity error occurs when one of the 34 check bits does not compare properly with the information word bit during reading.

2. Program Error:

Sector Number Greater than Five: The reading or writing transport cycle will occur physically in the Monro-Card Processor, however, no information will be read or written. The card will not return to home position in most instances, requiring use of the eject button to release the card to the card bin.

Track Number Greater than 15: The reading or writing cycle will occur physically in the Monro-Card Processor, however, no information will be written or erroneous information will be read. The card will return to the home position.

3. Operator Error:

Cards inserted wrong: If a card is inserted backwards (cut corner first) or upside down (brown side down) drop out will occur.

Manual Eject During Read or Write: If a card is manually ejected by the operator while the computer is reading or writing on the card the operation is stopped immediately and the card is ejected. An error signal is sent to the computer (non-zero accumulator) if the manual eject took place during reading. Partial or no information will be written if eject took place during writing.

Programming Checks:

1. Every card should have an identification number in the zero sector and track. This register should be read as soon as a new card enters the reader to assure correct card orientation.
2. After every read command the accumulator should be compared to zero. If not zero, reading a second time, since most errors are random, will more than likely be successful. If not successful the writing was bad or the card has been damaged and should then be discarded.
3. There are no error indications when writing on the card, therefore, after every write, the register just written should be read back and after testing for a zero accumulator compared to the original word. Here again, two attempts should be sufficient to overcome all errors of a random nature.

MONRO-CARD COMMAND DESCRIPTION

<u>Command</u>	Monro-Card Read
<u>Code</u>	40--
<u>Instruction</u>	40AR AR = 00 → 0X 20 → 2X 40 → 4X 60 → 6X 80 → 8X S0 → SX

Fast Access Registers

004, 005, 006

Description

The read command transfers the contents of the addressed Monro-Card register into FA 5. The previous contents of FA 4 are destroyed. Parity is automatically checked and a zero accumulator at the completion of the operation indicates no parity error. If FA 6 is not zero an error has occurred. The addressed Monro-Card register is not affected by the read command.

<u>Command</u>	Monro-Card Write
<u>Code</u>	48--
<u>Instruction</u>	48AR AR = 00 → 0X 20 → 2X 40 → 4X 60 → 6X 80 → 8X S0 → SX

Fast Access Registers

004, 005

Description

The write command transfers the contents of FA 5 to the addressed Monro-Card register. The previous contents of FA 4 are destroyed. No errors are indicated for a write, therefore, the information written must be read back and checked against the original word. The contents of FA 5 are not affected by the command.

PROGRAMMING THE MONRO-CARD

Register Addresses: Each register on the card is addressed specifically when reading or writing. The address is determined by the sector and the track. This is a two digit sexadecimal address, 8 binary bits. The high order 4 bits indicate the sector and the remaining 4 bits indicate the track.

T - 1	T - 0
X X X X	X X X X
Sector (0-S)	Track (0-X)

SEXADECIMAL ADDRESS CODING

		SECTOR					
		0	1	2	3	4	5
T r a c k	0	00	20	40	60	80	S0
	1	01	21	41	61	81	S1
	↓	↓	↓	↓	↓	↓	↓
X		0X	2X	4X	6X	8X	SX

MONRO-CARD COMMANDS

TETRAD	T 3				T 2				T 1				T 0				SEXADECIMAL TETRAD			
BINARY	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1				
2 ⁿ	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		3	2	1
Read	0	1	0	0	0	0	0	0	← Address →				→				4	0	A	R
Write	0	1	0	0	1	0	0	0	← Address →				→				4	8	A	R
Eject	0	0	0	0	1	0	0	0	0	0	0	0	← Bin →				0	8	0	B

Increment of Monro-Card Addresses:

Because Monro-Card addresses are discontinuous (registers 10 - 1X, 30 - 3X, 50 - 5X, and 70 - 7X do not exist) it is not possible to increment an address by adding a one unless further testing is done to check for non-existent sectors.

The card addresses may be incremented as illustrated below without additional testing for illegal sectors:

	Example 1	Example 2	Example 3	Example 4
Instruction	40AR	4000	400X	4 0 0 X 3 4 5 0
Add	0011	0011	0011	0 0 1 1 0 0 0 0
Extract	XXWX	XXWX	XXWX	X X W X X X X X
Result	40AR+1	4001	4020	4 0 2 0 3 4 5 0

Initialization of Monro-Cards

A valid recording of a 32 bit computer word with the required 34 check bits must be written in a Monro-Card register prior to reading. Reading of an un-recorded register will result in a parity error condition.

If selected registers of the Monro-Card are to be used for data accumulation purposes and are required to be initialized to zero prior to use, this must be done using the Monro-Card write command.

Utility Programs for Monro-Cards

A group of useful Monro-Card service routines is contained in "Utility Programs for Monro-Cards" (MO-283).

MONRO-CARD READ/WRITE SUBROUTINES

The following pages contain flowcharts and machine and symbolic coding for sample Monro-Card Read and Write subroutines.

Read from Monro-Card

This routine must be entered with a compound instruction as follows:

A link 3450 (Jump mark to the routine)
B link 6UAR (AR = Monro-Card register address)

On exit the contents of the addressed Monro-Card register will be found in FA 3, 5 and 6.

If a parity error occurs the computer will halt in reset condition with 0124 displayed in the control panel lights. The operator should remove any cards in the hopper and press the eject button to check the card for the cause of error. The card is placed back in the hopper followed by any cards which were removed. The eject button is pressed to return control to the computer and feed in the card which was removed. Then press the START button to re-read the card register contents.

Write on Monro-Card

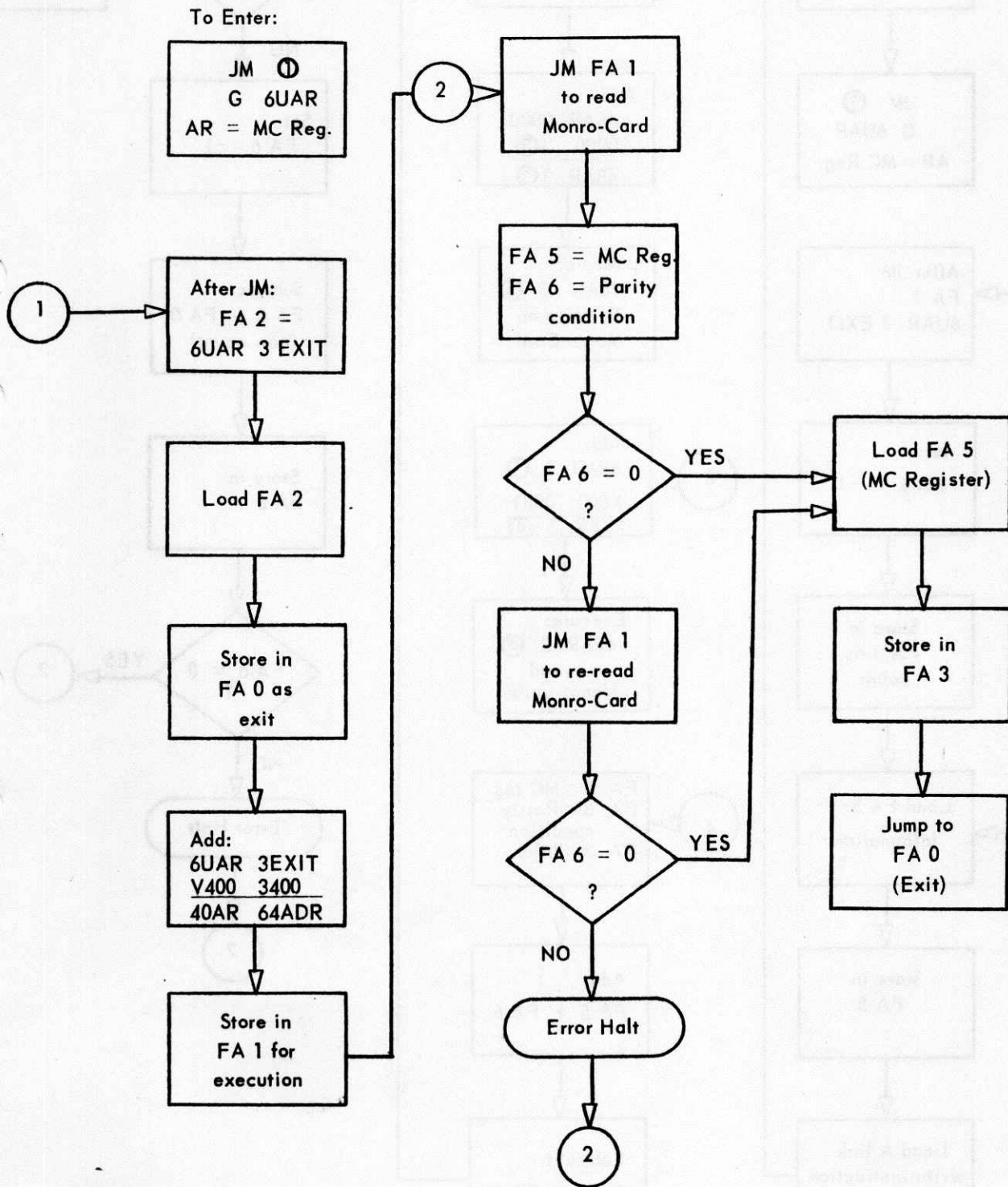
This routine must be entered with a compound instruction as follows:

A link 3455 (Jump mark to the routine)
B link 6UAR (AR = Monro-Card register address)

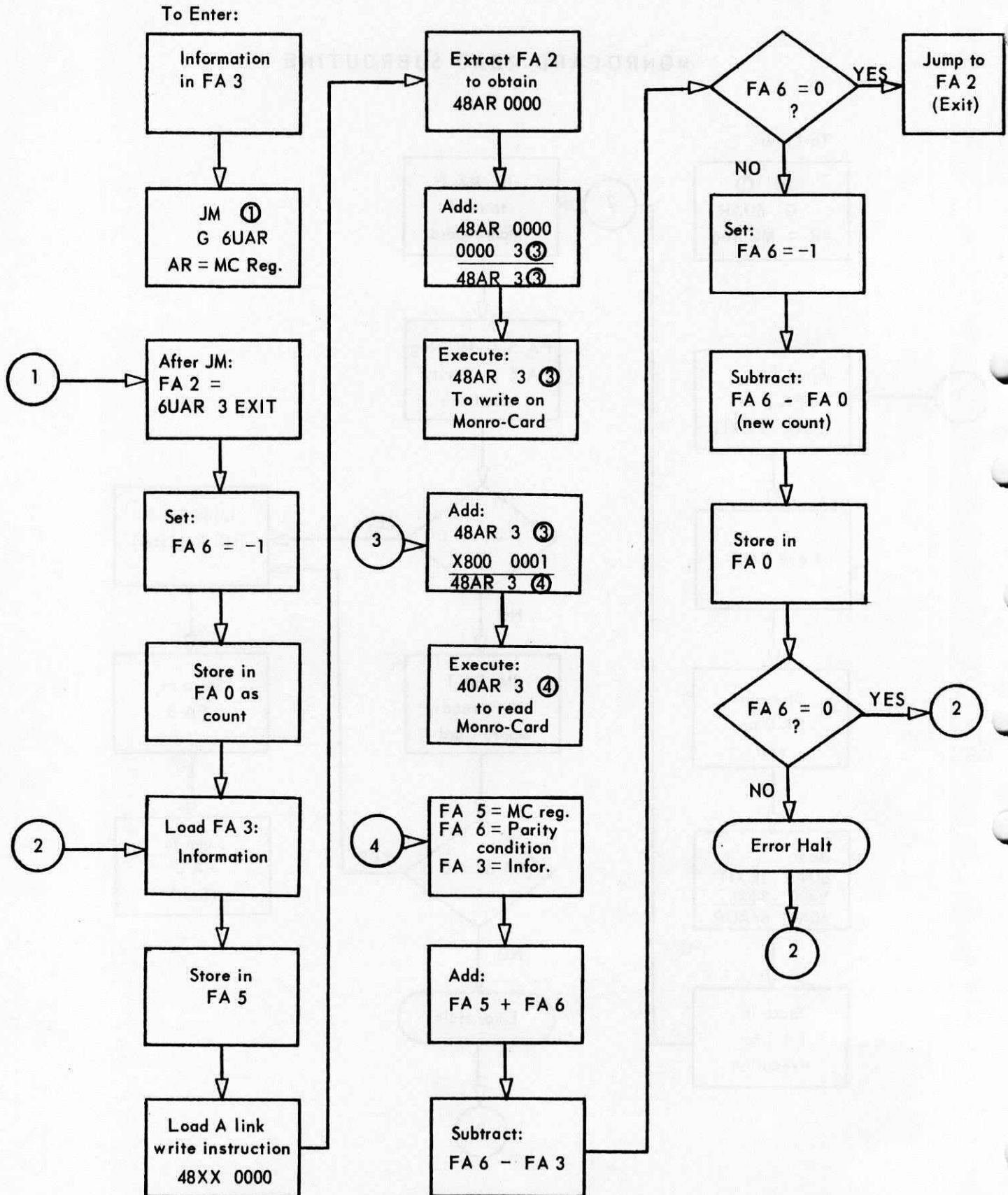
The information to be written must be in FA 3 on entry to the subroutine and will be in FA 3 and 5 on exit.

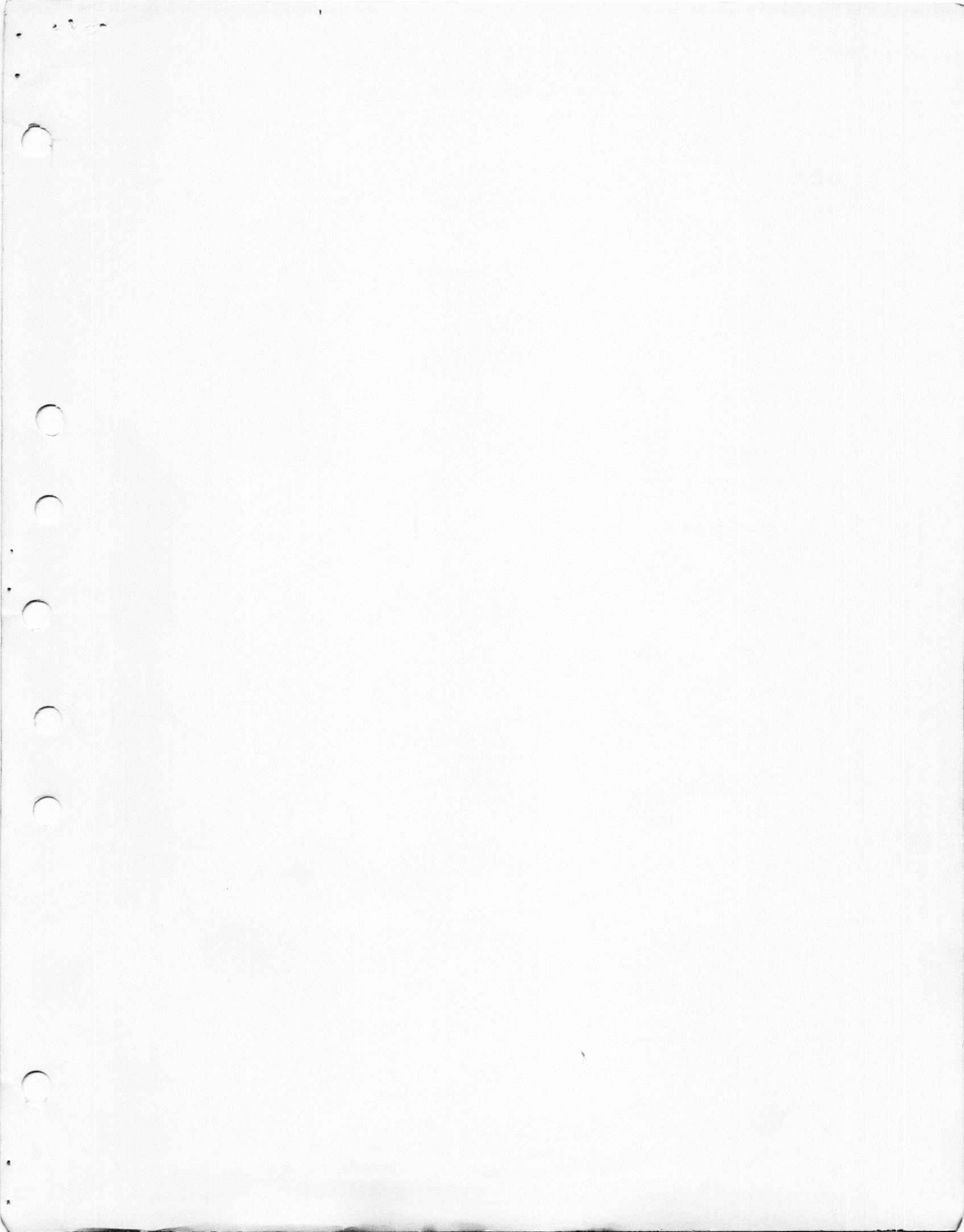
Parity error procedure is as described for the Read from Monro-Card subroutine.

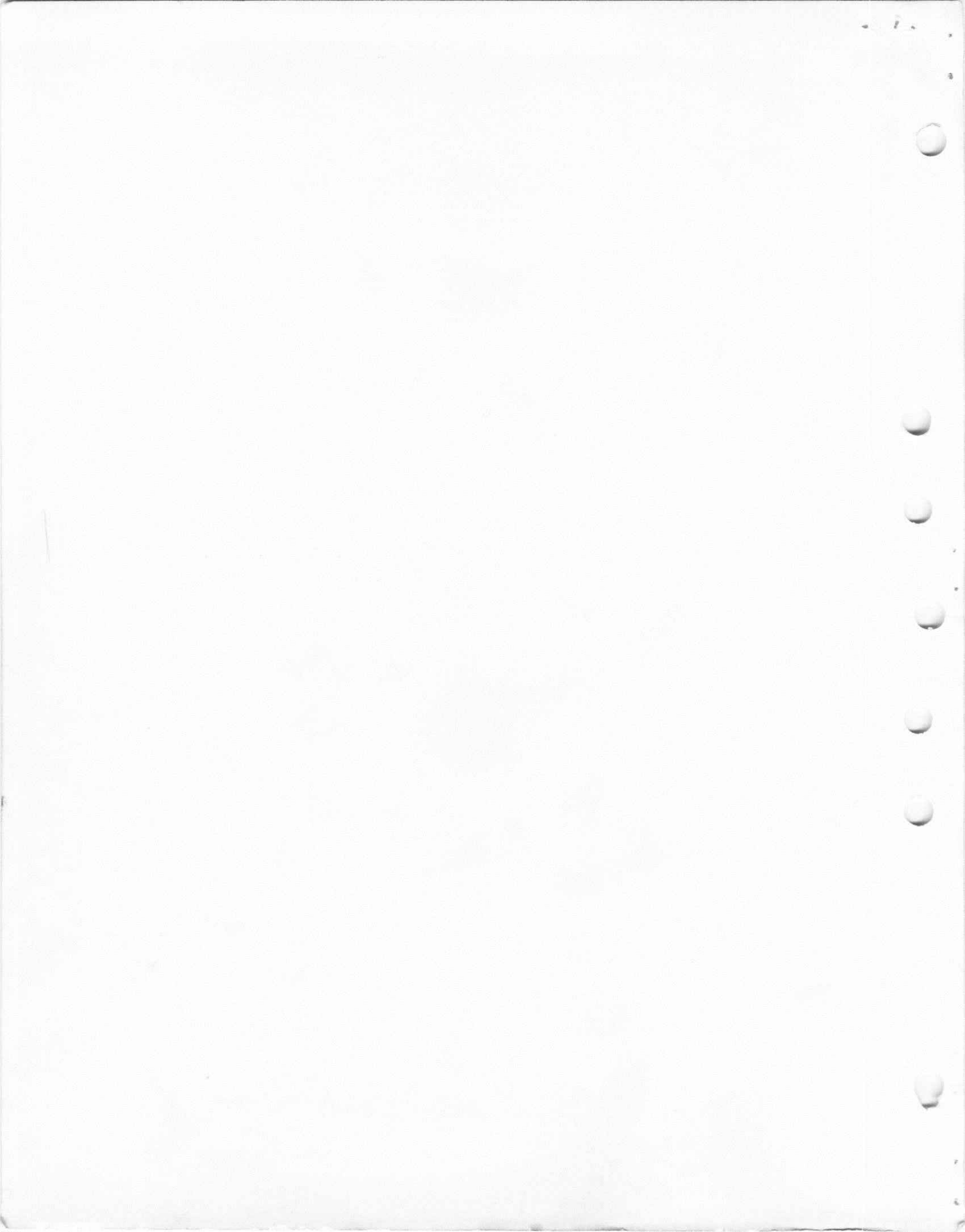
MONRO-CARD READ SUBROUTINE

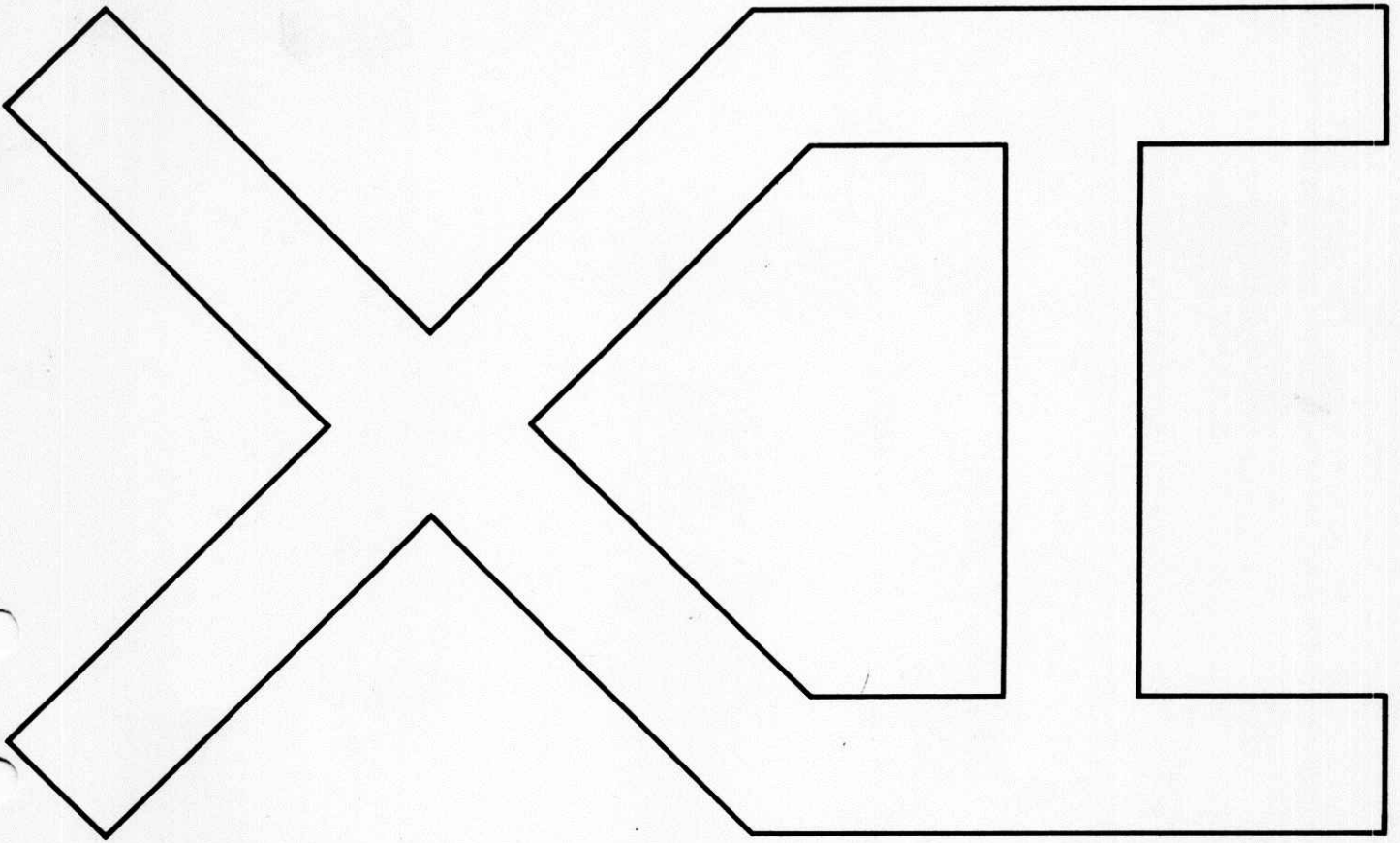


MONRO-CARD WRITE SUBROUTINE



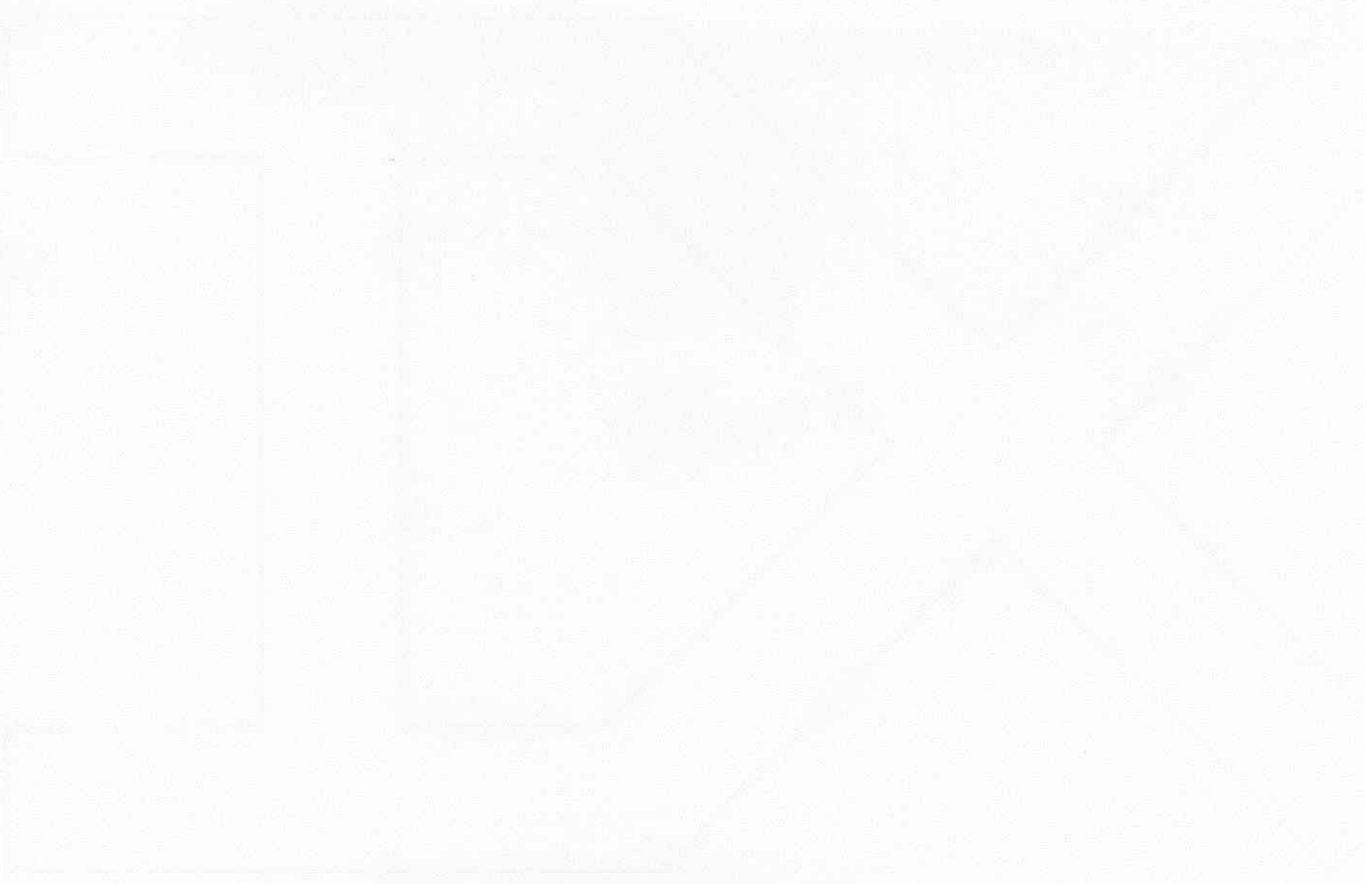






MONROBOT XI

UTILITY PROGRAMS
FOR MONRO-CARD



BRANDS WITH
FOR MORE

BRANDS WITH

The UTILITY PROGRAMS which follow are intended for use with a Monrobot XI computer installed with a Monro-Card Processor. They provide an optional method of program input/output as well as a means of duplicating or setting to zero all or portions of a Monro-Card.

An explanation of the Monro-Card commands and suggested read and write subroutines is given in "The Monro-Card System." (MO-218)

The Monro-Card Utility Programs are available in Symbo C source tape format.

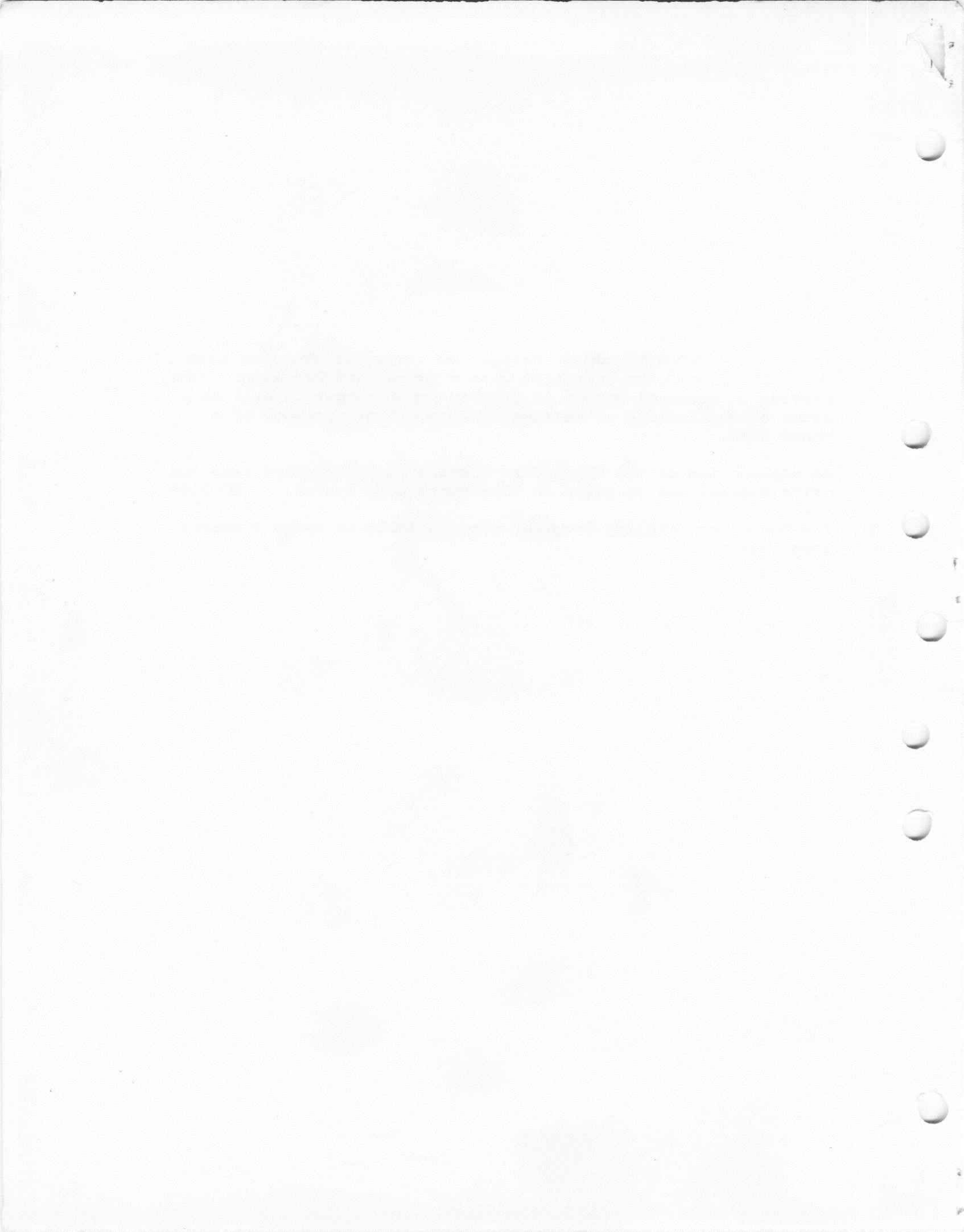


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UTILITY PROGRAM UT-20

Procedure to be Used for Program Input From Monro-Cards

1. Press the RESET button.
2. Place the UT-20 program tape on the program input tape reader.
3. Type 37X00000. Press the LOAD and START buttons. On completion of reading the computer will halt in RESET condition.
4. After the Utility Routine has been recorded on the drum, the following rules for use must be observed:

The routine must always be entered with a jump mark instruction to ensure that FA 2 will be properly loaded with an exit instruction. This may be in one of two forms:

34103ADR where ADR represents the starting address of the program being read in.

34100000 if a stop is desired after program input.

5. Press the RESET button.
6. Place the program cards in any sequence in the hopper followed by a card containing zero in register SO. When the zero is read the program will exit.
7. Type the selected form of the 3410 instruction. Press the LOAD and START buttons. The program will read into the computer.
8. If a parity error occurs on reading in the program, the computer will halt with the RESET light on and 0110 displayed in the control panel lights. Press the START button to re-read.

Typewriter at Device No. 1, Tape Reader at Device No. 2 and Monro-Card Processing Unit.

MONROBOT XI PROGRAM SHEET

PROGRAM

PROGRAM INPUT FROM MONRO-CARDS

PAGE

000

DATE

PROGRAMMER

	REGISTER	CONTENTS	NOTES
	A B	X	
	A B		
	A B		FAST ACCESS ADDRESSES
	A B		
	A B		
	A B		
	A B		
	A B		
007	A B	()	(012) Stored exit [010]
008	A B	V002 X01W	(011)(015)(017) Load exit 40306EXIT Add Constant 00003000 HALT
009	A B	T001 3401	Store in FA 1 Jump mark to read card; 0 = exit
00S	A B	0010 3001	Halt, parity error Jump to read again
00T	A B	W000 601U	(01T) Subtract ending constant 0 = end of card
00U	A B	V017 X01X	Load card read instruction Add Constant 00000011
00V	A B	X40X T017	Extract Constant XXXXXWX Store incremented read instruction
00W	A B	3017 300X	Jump to continue Fill ← 85
00X	A B	XXXX XXWX	Constant: extractor

MONROBOT XI PROGRAM SHEET

PROGRAM

PROGRAM INPUT FROM MONRO-CARDS

PAGE

010

DATE

PROGRAMMER

REGISTER		CONTENTS	NOTES
010	A B	V002 T007	Load exit Save exit
011	A B	3408 40S0	(01U) Jump mark to read starting address
012	A B	V005 6007	Load starting address instruction 0 = exit
013	A B	T019 V01V	Store 6400TADR in program Load card read instruction
014	A B	T017 3015	Store in program No-op
015	A B	3408 40S1	Jump mark to read ending address
016	A B	V005 T000	Load ending address instruction Store in FA 0
→ 017	A B	(3408 4000)	(37W8 40AR) (00W) Jump mark to read card [014,00V]
018	A B	9401 U005	Generate a 1 1 to FA 5/card contents to FA 6
019	A B	()	(6400) No-op [013,01T] TADR Store card contents
01S	A B	V019 X005	Load drum store instruction Add Constant 00000001
01T	A B	T019 300T	Store incremented drum store instruction Jump to test for end of card
01U	A B	0800 3011	(00T) Eject card Jump to read next card
01V	A B	3408 4000	Constant: virgin read instruction
01W	A B	0000 3000	Constant: command increment
01X	A B	0000 0011	Constant: address increment

UTILITY PROGRAM UT-21

Procedure to be Used for Program Output to Monro-Cards

1. Press the RESET button.
2. Place the UT-21 program tape on the program input tape reader.
3. Type 37X00000. Press the LOAD and START buttons. Upon completion of program input, the computer will halt in RESET condition.
4. Press the RESET button.
5. Place the Monro-Cards in the hopper.
6. Type 33S00000. Press the LOAD and START buttons. A carriage return will occur.
7. Enter the starting address of the program to be output to Monro-Cards. Press the START button. A carriage return will occur.
8. Enter the ending address of the program to be output to Monro-Cards. Press the START button. A carriage return will occur.
9. If a parity error occurs, the computer will halt with the RESET light on and 0111 displayed in the control panel lights. Press the START button to re-read.
10. If an information compare error occurs, the computer will halt with the Reset light on and 0112 displayed in the control panel.
11. On completion of the program an E will print. Program will repeat from Step 7.

Typewriter at Device No. 1, Tape Reader at Device No. 2 and Monro-Card Processing Unit.

MONROBOT XI PROGRAM SHEET

PROGRAM

PROGRAM OUTPUT TO MONRO-CARDS

PAGE

350

DATE

PROGRAMMER

REGISTER	CONTENTS	NOTES
3S0	A B S380 U500	(3T8) Carriage Return Clear FA 6 to 0
3S1	A B 0000 S380	Halt, enter starting address Carriage Return ← BS
3S2	A B X3U8 T3SS	Add constant 6400V000 Store in program
3S3	A B W3U9 T000	Subtract constant 00002000 Store 6400TADR
3S4	A B U500 0000	Clear FA 6 to 0 Halt, enter ending address
3S5	A B S380 X3US	Carriage Return Add constant 00000001
3S6	A B X3U8 T3T9	Add constant 6400V000 Store ending address + 1 instruction
3S7	A B V000 33S8	Load starting address instruction Fill
3S8	A B 37TT 48S0 <small>60</small>	Jump mark to write starting address instruction
3S9	A B V3TS T3ST	(3T8) Load card write instruction Store in program
3SS	A B ()	(6400) (3T1) No-op (3S2,3SV) VADR Load drum register
3ST	A B ()	(37TT) Jump mark to write register (3S9,3Sw) 48AR
3SU	A B 9401 X3SS	Generate a 1 Add drum load instruction
3SV	A B T3SS W3T9	Store incremented drum load instruction Subtract ending instruction
3SW	A B 63T2 V3ST	0 = end of program output Load card write instruction
3SX	A B X3UT X7UU	Add constant 00000011 Extract constant XXXXXXWX

MONROBOT XI PROGRAM SHEET

PROGRAM
PROGRAM OUTPUT TO MONRO-CARDS

PAGE 3T0	DATE	PROGRAMMER
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REGISTER	CONTENTS	NOTES
3T0	A T3ST B W3S8	Store incremented card write instruction Subtract 37TT48S0
3T1	A 63T2 B 33SS	0 = end of card Jump to continue
3T2	A V3SS B W3UV	(3SW)(3T1) Load drum load instruction Subtract constant 00002001
3T3	A 37TT B 4881	Jump mark to write ending address of card
3T4	A 0800 B V3T9	Eject card Load ending address + 1 instruction
3T5	A W3SS B 63T8	Subtract drum load instruction 0 = end of program output
3T6	A V000 B X3US	Load ending instruction Add 1
3T7	A 33S8 B 33T8	Jump to write new starting address Fill
3T8	A S375 B 33S0	(3T5) Print E Jump to repeat program
3T9	A () B ()	(6400) Ending address + 1 instruction (3S6) (VADR)
3TS	A 37TT B 4800	Constant: virgin write instruction
3TT	A T005 B T000	Store register contents for output Store in FA 0
3TU	A V002 B X3UW	Load exit (48AR3ADR) Add constant 00003400
3TV	A T001 B 3401	Store in FA 1 (48AR6ADR) Jump mark to write and test
3TW	A V001 B W3UX	Load card write instruction Subtract constant 08000000
3TX	A T001 B W3VO	Store card read instruction Subtract constant VU003400

MONROBOT XI PROGRAM SHEET

PROGRAM

PROGRAM OUTPUT TO MONRO-CARDS

PAGE

3U0

DATE

PROGRAMMER

REGISTER		CONTENTS	NOTES
3U0	A B	T003 3401	Store 64003ADR as exit Jump mark to read card
3U1	A B	63U5 0011	0=no parity error Halt, parity error
3U2	A B	V000 T005	Load register contents to write Store for output
3U3	A B	V001 X3UX	Load card read instruction Add constant 08000000
3U4	A B	33TV 33U5	Jump to write again Fill
3U5	A B	V005 W000	(3U1) Load register contents read Subtract contents to write
3U6	A B	6003 33U7	0=contents compare, exit Fill
3U7	A B	0012 33U7	Halt, error in information compare
3U8	A B	6400 V000	Constant: virgin drum load instruction
3U9	A B	0000 2000	Constant: drum load and drum store
3US	A B	0000 0001	Constant: address increment
3UT	A B	0000 0011	Constant: card write increment
3UU	A B	XXXX XXWX	Constant: extractor
3UV	A B	0000 2001	Constant: drum load, ending address
3UW	A B	0000 3400	Constant: jump zero
3UX	A B	0800 0000	Constant: card read and card write

MONROBOT XI PROGRAM SHEET

PROGRAM

PROGRAM OUTPUT TO MONRO-CARDS

PAGE

3V0

DATE

PROGRAMMER

REGISTER	CONTENTS	NOTES
3V0	A VU00 B 3400	Constant: exit for FA 3
	A B	
	A B	
	A B	
	A B	
	A B	
	A B	
	A B	
	A 4000 B 6	
	A 3 B	
	A V005 B T3W8	
	A U500 B 9401	
	A X 2 B T 2	
	A Y B X	
	A X B T	
	A 3 B	
	A B	

UTILITY PROGRAM UT-22

Procedure to be Used to
Clear 96 Register Monro-Card

1. Press the RESET button.
2. Place the UT-22 program tape on the program input tape reader.
3. Type 37X00000. Press the LOAD and START buttons. Upon completion of program input, the computer will halt in Reset condition.
4. Press the RESET button.
5. Place the Monro-Cards to be cleared to zero in the hopper.
6. Type 33S00000. Press the LOAD and START buttons. A carriage return will occur.
7. Enter the maximum card register address which is to be set to zero. Press the START button.
8. The zeroed cards will be ejected to the right bin; defective cards will be ejected to the left bin. The program will continue until all cards are zeroed.

Typewriter at Device No. 1, Tape Reader at Device No. 2 and Monro-Card Processing Unit.

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3S0

REGISTER	L	A	CONTENTS	NOTES
T3S0 S380	L	A	S380 V3T8	Carriage Return Load Constant 0011 0011
3S1 S380	L	A	T000 V3T9	Store address increment Load Constant XXWX XXWX
3S2	A	B	T003 U500	Store extractor in FA 3 Clear FA 6 to 0
3S3	A	B	0000 T005	Halt, enter card ending address Store address
3S4	A	B	9080 9080	Binary shift left 8 bits Binary shift left 8 bits
3S5	A	B	X005 X3T6	Add address = 00AR 00AR Add Constant 4800 4000
3S6	A	B	X000 X403	Add Constant 0011 0011 Extract Constant XXWX XXWX
3S7	A	B	T3T7 33S8	Store maximum write and read instruction No-op
3S8	A	B	V3T6 T001	(3SW)(3T5) Load write and read instruction Store in FA 1
3S9	A	B	S07X 3401	(3T4) Clear FA 5 to 0 Jump mark to zero register and read back
3SS	A	B	63ST 33SU	0 = no parity error Jump to write again
3ST	A	B	V005 63T1	(3SS) Load contents read 0 = read back correct
3SU	A	B	S07X 3401	(3SS) Clear FA 5 to 0 Jump mark to zero and read back
3SV	A	B	63SX 33SW	0 = no parity error No-op
3SW	A	B	0801 33S8	(3T0) Eject error card Jump to zero next card
3SX	A	B	V005 63T1	(3SV) Load contents read 0 = read back correct

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3T0

REGISTER	CONTENTS	NOTES
3T0	A B 33SW 33T1	Jump to eject error card Fill
3T1	A B V001 X000	(3ST)(3SX) Load write and read instruction Add address increment
3T2	A B X403 T001	Extract Constant XXWX XXWX Store incremented write and read instruction
3T3	A B W3T7 63T5	Subtract maximum write and read instruction 0 = end of card
3T4	A B 33S9 33T5	Jump to zero next register Fill
3T5	A B 0800 33S8	(3T3) Eject zeroed card Jump to zero next card
3T6	A B 4800 4000	Constant: virgin write and read instruction
3T7	A B ()	Maximum write and read instruction [3S7]
3T8	A B 0011 0011	Constant: address increment
3T9	A B XXWX XXWX	Constant: extractor
	A B	
	A B	
	A B	
	A B	
	A B	
	A B	

UTILITY PROGRAM UT-23

Procedure to be Used to Copy or Duplicate 96 Register Monro-Card

1. Press the RESET button.
2. Place the UT-23 program tape on the program input tape reader.
3. Type 37X00000. Press the LOAD and START buttons. Upon completion of program input the computer will halt in Reset condition.
4. Press the RESET button.
5. Type 33400000. Press the LOAD and START buttons. A carriage return will occur.
6. To copy Monro-Cards, Switch No. 1 must be OFF. Stack the master card followed by a blank card, etc. To duplicate a Monro-Card, press Switch No. 1 ON and stack the master card followed by blank cards.
7. Enter the address of the last card register to be copied or duplicated. Press the START button.
8. The master cards will be ejected to the left bin and copied cards to the right bin.
9. If a parity error occurs on reading or writing the Monro-Card, the computer will halt with the Reset light on and 0113 displayed in the control panel lights. Press the START button to re-read.
10. If an information compare error occurs, the computer will halt with the Reset light on and 0114 displayed in the control panel lights.
11. The program will continue until all cards are processed. To repeat program proceed from Step 4.

Typewriter at Device No. 1, Tape Reader at Device No. 2 and Monro-Card Processing Unit.

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REGISTER	CONTENTS	NOTES
340	A S380 B U500	Carriage Return Clear FA 6 to 0
341	A 0000 B X374	Halt, enter card ending address Add Constant 00000011
342	A X775 B T005	Extract Constant 0000XXWX Store ending address +1
343	A X361 B T370	Add virgin read instruction Store maximum read instruction
344	A V005 B X36X	Load ending address + 1 Add virgin write instruction
345	A T371 B 3346	Store maximum write instruction No-op
346	A V361 B T348	(35U) Load virgin read instruction Store in program
347	A V372 B T34S	Load drum store instruction Store in program
348	A () B ()	(375V) (34X) Jump mark to read card [34U,346] 40AR
349	A 9401 B U005	Generate a 1 1 to FA 5/card contents to FA 6
34S	A () B ()	(6400) No-op [347,34X] TADR Store card contents
34T	A V348 B X374	Load card read instruction Add Constant 00000011
34U	A X776 B T348	Extract Constant XXXXXXWX Store incremented read instruction
34V	A W370 B 6350	Subtract maximum read instruction 0 = jump to copy or duplicate card
34W	A V34S B X005	Load drum store instruction Add Constant 00000001
34X	A T34S B 3348	Store incremented drum store instruction Jump to read card

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REGISTER	CONTENTS	NOTES
350	A B 0801 3351	(34V) Eject card to left bin No-op
351	A B V373 T353	(35U) Load drum load instruction Store in program
352	A B V36X T354	Load card write instruction Store in program
353	A B ()	(6400) (35S) Load drum register [351] VADR
354	A B ()	(3762) Jump mark to write card [352] 48AR
355	A B 9401 T005	Generate a 1 Store 1 in FA 5
356	A B V354 X374	Load card write instruction Add Constant 00000011
357	A B X776 T354	Extract Constant XXXXXXWX Store incremented card write instruction
358	A B W371 635T	Subtract maximum write instruction 0 = end of card
359	A B V353 X005	Load drum load instruction Add 1
35S	A B T353 3353	Store incremented drum load instruction Jump to write next register
35T	A B 0800 U401	(358) Eject card to right bin Test Switch 1
35U	A B 7351 3346	Jump if ON to duplicate card Jump to read next card
35V	A B V002 X377	Load exit Add Constant 00003000
35W	A B T001 335X	Store card read instruction No-op
35X	A B 3401 0013	Jump mark to read and test Halt, parity error

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REGISTER	CONTENTS	NOTES
360	A B 3001 3361	Jump to re-read Fill
361	A B 375V 4000	Constant: virgin read instruction
362	A B T005 T000	Store register contents to write Store in FA 0
363	A B V002 X378	Load exit Add Constant 00003400
364	A B T001 3401	(36T) Store card write instruction Jump mark to write card
365	A B V001 W379	Load card write instruction Subtract Constant 08000000
366	A B T001 W37S	Store card read instruction Subtract Constant VU003400
367	A B T003 3401	Store exit in FA 3 Jump mark to read back card
368	A B 636U 0013	0 = read back OK Halt, parity error
369	A B V000 T005	Load register contents to write Store for output
36S	A B V001 X379	Load card read instruction Add Constant 08000000
36T	A B 3364 336U	Jump to write again Fill
36U	A B V005 W000	(368) Load register contents read Subtract contents to write
36V	A B 6003 336W	0 = items compare, exit No-op
36W	A B 0014 336W	Halt, information compare error
36X	A B 3762 4800	Constant: virgin write instruction

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REGISTER	CONTENTS	NOTES
370	()	Maximum read instruction [343]
371	()	Maximum write instruction [345]
372	6400 T37T	Constant: drum store instruction
373	6400 V37T	Constant: Drum load instruction
374	0000 0011	Constant: address increment
375	0000 XXWX	Constant: address extractor
376	XXXX XXWX	Constant: extractor
377	0000 3000	Constant: parity test
378	0000 3400	Constant: jump zero
379	0800 0000	Constant: card read and card write
37S	VU00 3400	Constant: exit for FA 3
37T		This register and up to 95 registers are required to store card contents for copying or duplication
	A B	
	A B	
	A B	
	A B	

UTILITY PROGRAM UT-24

Procedure to be Used to Transfer Monro-Card Contents to Tape, Verify, and Restore

This utility program is used to punch a tape of the contents of a Monro-Card and verify it; restore the contents of a card from a punched tape.

1. Press the RESET button.
2. Place the UT-24 program tape on the program input tape reader.
3. Set the tab stops 10 and 23 spaces from the left margin.
4. Type 37X00000. Press the LOAD and START buttons. On completion of program input, the computer will halt in RESET condition.
5. Press the RESET button.
6. Place the Monro-Cards in the hopper.
7. To PUNCH TAPE from Monro-Cards:
 - a. Type 335U0000. Press the LOAD and START buttons. A carriage return will occur. The letters ADR will be typed out and a carriage return will occur. Type the last register number (in hexadecimal) of the Monro-Card to be punched on tape. Press the START button. The entire Monro-Card is read up to the register specified and then the program is output to the tape punch with tape lead at the beginning and end of the tape.
 - b. At the end of tape punching, a carriage return will occur. Input light #2 (tape reader) will come on. Remove the punched tape and place it on the tape reader. Verification of the tape will take place.
 - c. If it is desired to punch the same registers from the next Monro-Card, press switch 1 before the preceding card is ejected from the Monro-Card unit. The contents of that card will be output to tape and can be verified by using step b.

- d. If the tape register does not match the Monro-Card contents in the verification process, the following will print on the typewriter:

(Register Address)	(Contents of Tape)	(Contents of Monro-Card)
XXX	XXXXXXXX	XXXXXXXX

Example:

250	22007290	22007390
-----	----------	----------

- e. If the tape has been mispunched, a new tape must be produced.

8. To restore Monro-Cards from tape

- Place the tape containing the Monro-Card information on the tape reader. Place Monro-Cards in the hopper.
- Type 335X0000. Press the LOAD and START buttons. The tape is read into the computer and then transferred to the Monro-Cards.

9. Error indications displayed in the control register lights:

<u>Indicator</u>	<u>Cause and Correction</u>
0113	Parity error in reading or writing of Monro-Card. Press Start.
0114	Contents of register read and contents to write on Monro-Card do not compare. Program will not continue.
2200	Parity error in reading tape. Reset tape back two codes and press the space bar to continue reading.

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PROGRAMMER

2W0

REGISTER	CONTENTS	NOTES
2W0	A B S380 U401	Carriage Return Switch 1 for address repeat
2W1	A B 7316 S331	Print A
2W2	A B S334 S329	Print D Print R
2W3	A B S380 U500	Carriage Return Clear FA 6 to 0
2W4	A B 0000 T37U	Halt, enter ending address Store ending address
2W5	A B X369 X76S	Add constant 0000 0011 Extract constant 0000 XXWX
2W6	A B T005 X303	Store ending address plus 1 Add 36XX 4000 - monro card read routine
2W7	A B T312 V005	Store maximum read instruction Load ending address plus 1
2W8	A B X311 T313	Add 3704 4800 - monro card write routine Store maximum record instruction
2W9	A B V303 T2WT	Load 36XX 4000 Store in program
2WS	A B V314 T2WV	Load 6400 T37V Store in program
2WT	A B ()	Card read instruction
2WU	A B 9401 U005	Generate a 1 1 to FA 5/ Card contents to FA 6
2WV	A B ()	Drum store instruction
2WW	A B V2WT X369	Load card read instruction Add constant 0000 0011
2WX	A B X76T T2WT	Extract XXXXXXWX Store incremented card read instruction

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PROGRAMMER

REGISTER		CONTENTS	NOTES
2X0	A B	W312 62X3	Subtract maximum card read instruction At end of card
2X1	A B	V2WV X005	Load drum store instruction Add constant 0000 0001
2X2	A B	T2WV 32WT	Store incremented drum store instruction Jump to read card
2X3	A B	0801 335V	Eject master to left bin Jump to output to tape
2X4	A B	V315 T2X6	Load 6400 V37V Store in program
2X5	A B	V311 T2X7	Load 3704 4800 Store in program
2X6	A B	()	Drum load instruction
2X7	A B	()	Card write instruction
2X8	A B	9401 T005	Generate a 1 Store in FA 5
2X9	A B	V2X7 X369	Load card write instruction Add constant 0000 0011
2XS	A B	X76T T2X7	Extract XXXX XXWX Store incremented card write instruction
2XT	A B	W313 62XW	Subtract maximum card write instruction At end of card
2XU	A B	V2X6 X005	Load drum load instruction Add constant 1
2XV	A B	T2X6 32X6	Store incremented drum load instruction Jump to load next register
2XW	A B	0800 3360	Eject card
2XX	A B	V002 X36U	Load exit Add constant 0000 3000

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REGISTER		CONTENTS	NOTES
300	A B	T001 3301	Store card read instruction Fill
301	A B	3401 0013	Jump to read and test Parity error halt
302	A B	3001 3303	Jump to read again Fill
303	A B	36XX 4000	Card read instruction
304	A B	T005 T000	Store register contents in FA 5 Store in FA 0
305	A B	V002 X36V	Load exit Add constant 0000 3400
306	A B	T001 3401	Store card write instruction Jump mark to write
307	A B	V001 W36W	Load card write instruction Subtract constant 0800 0000
308	A B	T001 W36X	Store card read instruction Subtract constant VU00 3400
309	A B	T003 3401	Store in FA 3 Jump mark to read back
30S	A B	630W 0013	If correct, jump Halt, parity error
30T	A B	V000 T005	Load register contents Store for output
30U	A B	V001 X36W	Load card read instruction Add constant 0800 0000
30V	A B	3306 330W	Jump to write again Fill
30W	A B	V005 W000	Load register contents read Subtract contents to write
30X	A B	6003 3310	If zero, contents compare Fill

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REGISTER		CONTENTS	NOTES
310	A B	0014 3310	Halt, error Halt
311	A B	3704 4800	Card write instruction
312	A B	()	Maximum card read instruction
313	A B	()	Maximum card write instruction
314	A B	6400 T37V	Drum store instruction
315	A B	6400 V37V	Drum load instruction
316	A B	V37U 32W5	Load ending address
317	A B	V002 T340	Load exit Store exit
318	A B	V31S T000	Load T005 2401 Store in FA 0
319	A B	V341 T001	Load 733U X005 Store in FA 1
31S	A B	T005 2401	Store in FA 5 Input from tape
31T	A B	W370 731S	Subtract start code Read tape lead
31U	A B	3400 9020	Read address Binary shift left 6 bits
31V	A B	3400 5371	Read address Multiply by 1 0000 / OADR 0000 to FA 5
31W	A B	V005 X342	Load OADR 0000 Add V000 3329
31X	A B	S380 3321	Carriage return Jump to read tape registers

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REGISTER	CONTENTS	NOTES
320	A B V003 X371	Increment address Add 1 0000
321	A B T003 U500	Store incremented address Set FA 6 to 0
322	A B 3400 9020	Jump mark to read tape register Binary shift left 6 bits
323	A B 3400 9008	Jump mark to read Binary shift left 4 bits
324	A B 3400 9020	Jump mark to read Binary shift left 6 bits
325	A B 3400 9020	Jump mark to read Binary shift left 6 bits
326	A B 3400 9008	Jump mark to read Binary shift left 4 bits
327	A B 3400 T005	Jump mark to read Store tape register
328	A B 3003 3329	To load drum register Fill
329	A B W005 6320	Subtract tape register Tape and drum the same
32S	A B V005 T004	Load tape register Store tape register
32T	A B V003 X772	Load address Extract XXXX 0000
32U	A B 9008 3732	Binary shift left 4 bits Jump mark to print address
32V	A B V004 S35W	Load tape register Tab
32W	A B 3734 V003	Jump mark to print tape register Load VADR 3329
32X	A B X373 3006	Add 0000 0007 Jump to execute modified instruction

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REGISTER		CONTENTS	NOTES
330	A B	S35W 3734	Tab Jump mark to print drum register
331	A B	S380 3320	Carriage return Jump to increment address
332	A B	X371 S07X	Add 1 0000 Clear FA 5
333	A B	8U08 3335	Binary left end around cycle 4 bits Jump to print register
334	A B	S07X 8W08	Clear FA 5 Left end around, generate an 8's bit
335	A B	6002 U005	FA 6 = 0, exit Char to FA 6/ remainder to FA 5
336	A B	633S W374	IBM zero Subtract 0000 000S
337	A B	733T X375	Number 1-9 Add 0000 0012 alpha character
338	A B	U005 S27X	Remainder to FA 6/ Character to FA 5 Print character
339	A B	8U08 3335	Binary left end around cycle 4 bits Jump to print register
33S	A B	9410 3338	Generate 0000 0010 Jump to print
33T	A B	X374 3338	Add 0000 000S Jump to print
33U	A B	W376 633X	Subtract 8000 000S1 End code FA 6 = 0, print end
33V	A B	2200 S35V	Parity error Backspace
33W	A B	V005 3000	
33X	A B	S380 3340	Carriage Return Jump to exit

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REGISTER		CONTENTS	NOTES
340	A B	()	Exit
341	A B	733U X005	Instructions for FA 1
342	A B	V000 3329	Modification instruction
343	A B	V314 X777	Load 6400 T37V Extract 0000 03XX
344	A B	X354 T000	Add 735S VADR Store in FA 0
345	A B	V2WV X777	Load drum store instruction Extract 0000 03XX
346	A B	X354 T003	Add 735S VADR Store in FA 3
347	A B	V355 T001	Load 8U20 S47X Store in FA 1
348	A B	3756 S5TX	Jump mark to punch tape lead Punch starting code
349	A B	V000 9080	Load 735S VADR Binary shift left 8 bits
34S	A B	9080 9008	Binary shift left 8 bits Binary shift left 4 bits
34T	A B	S07X 3401	Clear FA 5 for output Punch address
34U	A B	3401 334V	Fill
34V	A B	3400 U000	Load register contents
34W	A B	X004 U000	Increment 733U VADR
34X	A B	3401 9802	Jump mark to punch register contents Binary shift right 2 bits

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REGISTER	CONTENTS	NOTES
350	A 3401 B 3401	Jump mark to punch register contents
351	A 3401 B 9802	Binary shift right 2 bits
352	A 3401 B V003	Load 733U V Ending ADR
353	A W000 B 334V	Subtract 733U VADR Jump to repeat
354	A 735S B V000	To punch end code and tape lead
355	A 8U20 B S47X	Binary left end around cycle 6 bits Output to tape
356	A V378 B T004	Load 0000 0001 Store constant in FA 4
357	A V379 B 3358	Load decimal 200 Fill
358	A S540 B W004	Punch tape lead Subtract 0000 0001
359	A 6002 B 3358	FA 6= 0, enough tape lead Repeat punching tape lead
35S	A S5W0 B 3756	Punch end code Punch tape lead
35T	A 335W B 335U	To verify after punching Fill
35U	A 32W0 B 6400	To input card contents No-op
35V	A 3343 B 335W	To output to tape Fill
35W	A 3717 B 335U	To verify after punching To input card contents
35X	A S380 B 3360	Carriage Return Fill

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REGISTER		CONTENTS	NOTES
360	A B	37X0 V315	Jump mark to load card contents Load 6400 V DRUM
361	A B	X77S T004	Extract 0000 OTXX ADR Store in FA 4
362	A B	V003 9880	Binary shift right 8 bits
363	A B	9880 X77S	Binary shift right 8 bits Extract 0000 OTXX
364	A B	W004 S07X	Subtract drum table Clear FA 5
365	A B	137T U005	Divide by 0000 0010
366	A B	9010 X005	Binary shift left 5 bits Add the remainder
367	A B	X311 T313	Add card write instruction Store as maximum write instruction
368	A B	32X4 3369	Fill
369	A B	0000 0011	Constant: card write increment
36S	A B	0000 XXWX	Constant: extractor
36T	A B	XXXX XXWX	Constant: extractor
36U	A B	0000 3000	Constant: instruction modifier
36V	A B	0000 3400	Constant: jump mark instruction
36W	A B	0800 0000	Constant: card read and card write
36X	A B	VU00 3400	Constant: exit for FA 3

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REGISTER	CONTENTS	NOTES
370	A B 0000 00TX	Constant: start code
371	A B 0001 0000	Constant: address increment
372	A B XXXX 0000	Constant: extractor
373	A B 0000 0007	Constant:
374	A B 0000 000S	Constant: digit input
375	A B 0000 0012	Constant: alpha input
376	A B 8000 00S1	Constant: monro card ending address
377	A B 0000 03XX	Constant: address extractor
378	A B 0000 0001	Constant: address increment
379	A B 0000 00U8	Constant: decimal 200
37S	A B 0000 0TXX	Constant: address extractor
37T	A B 0000 0010	Constant: detractor
37U	A B ()	Storage for ending address
37V	A B ()	Drum storage
	A B	
	A B	

