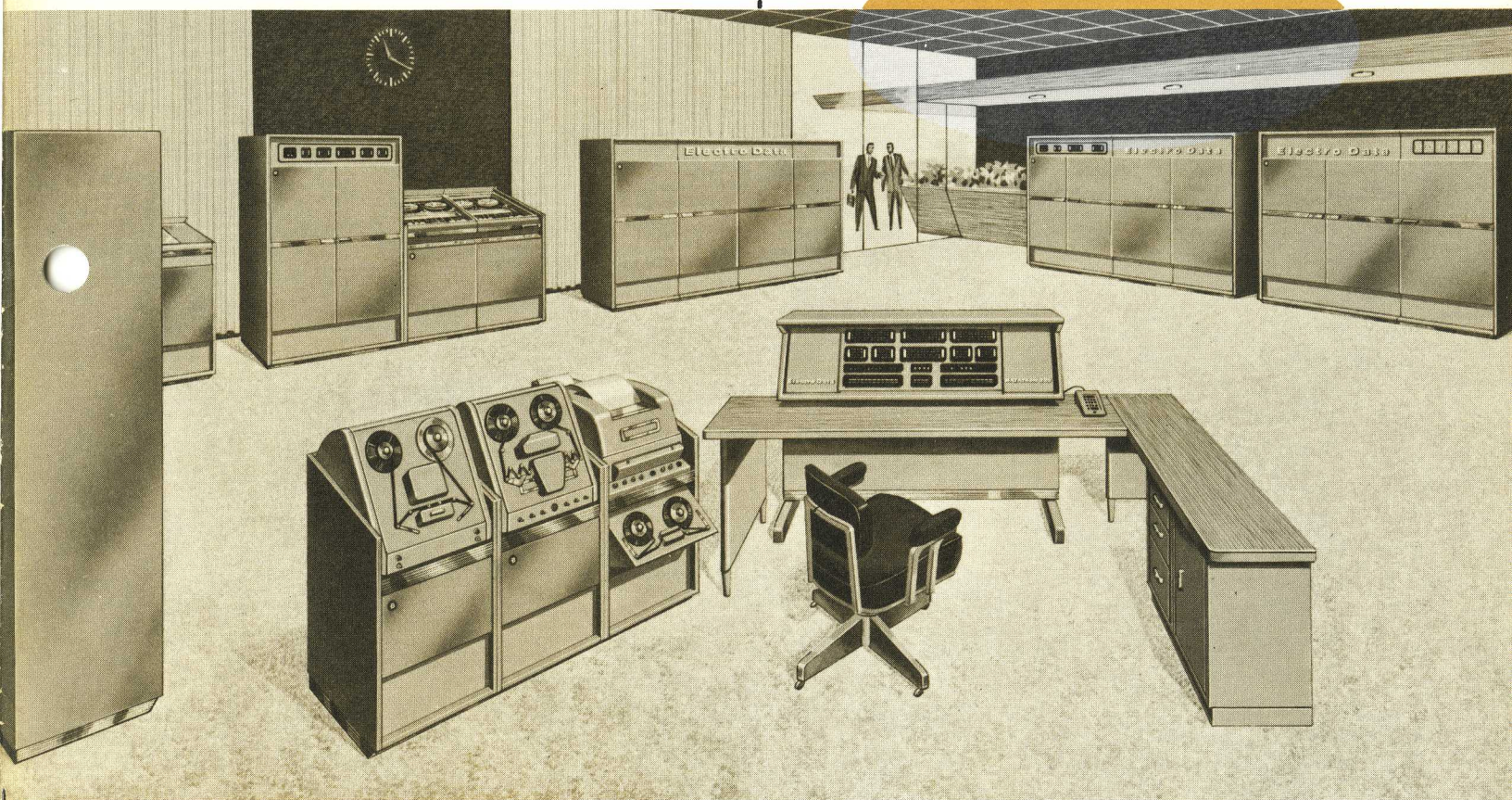


DATATRON 220

INSTRUCTIONS

a brief description



ElectroData

DIVISION

BURROUGHS
CORPORATION

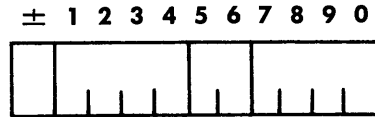
Electronic Data Processing Systems

Copyright © 1957
Burroughs Corporation

TABLE OF CONTENTS

		<i>Page</i>
ARITHMETIC		
Addition	CAD, CAA, ADD, ADA, ADL	1
Subtraction	CSU, CSA, SUB, SUA	1
Multiplication	MUL	1
Division	DIV	2
Miscellaneous	RND	2
Floating Point	FAD, FAA, FSU, FSA, FMU, FDV	2
MANIPULATION, INFORMATION TRANSFER		
Shifting	SRA, SRT, SRS	3
	SLA, SLT, SLS	3
Loading	LDR, LDB, LBC, LSA	3, 4
Storing	STA, STR, STB, STP	4
Transfer in storage	RTF	4
Clearing	CLA, CLR, CLB, CLL	4
Editing	EXT	4
DECISION MAKING		
Comparing	CFA, CFR	5
Branching	BUN, BOF, BRP, BSA	5
	BCH, BCL, BCE, BCU	5, 6
	BFA, BFR, BCS	6
Control	HLT, NOP	6
INSTRUCTION MODIFICATION, TALLYING		
	IBB, DBB	7
	IFL, DFL, DLB	7
INPUT-OUTPUT		
Magnetic tape	MTS, MFS, MTC, MFC	8
	MRD, MRR	8
	MIW, MIR, MOW, MOR	8, 9
	MPF, MPB, MPE, MLS, MRW, MDA	9
	MIB, MIE	9
Paper tape	PRD, PRB, PRI, PWR, PWI	10
Cardatron	CRD, CWR, CRF, CWF, CRI, CWI	10, 11
Control Console	KAD, SPO	11

INSTRUCTION FORMAT:



Digit positions 1, 2, 3 and 4 comprise what are called control digits; these specify different modes of execution, as defined in the summary. The operation code occupies digit positions 5 and 6. Digit positions 7, 8, 9 and 0 usually represent an address in storage; but they are sometimes used for other purposes.

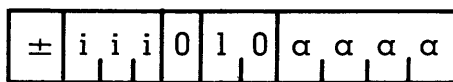
DEFINITIONS OF TERMS AND SYMBOLS:

- ±: sign digit. If the sign digit is an odd integer, automatic B-register address-modification will occur.
- sL: define the boundaries of a partial-word field: s designates the digit position of the low-order digit; L designates the number of digits in the partial-word field.
- f: partial-word designator. If f=0, the entire word is specified; if f=1, the partial-word field defined by sL is specified.
- aaaa: address of storage location.
- i: not relevant to the execution of the instruction.
- v: variation designator.

ARITHMETIC

CAD 10

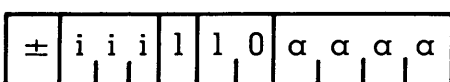
CLEAR, ADD



Replace the contents of the A register by the contents of aaaa.

CAA 10

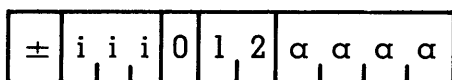
CLEAR, ADD ABSOLUTE



Replace the contents of the A register by the absolute value of the contents of aaaa.

ADD 12

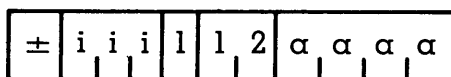
ADD



Add the contents of aaaa to the contents of the A register. The sum appears in the A register.

ADA 12

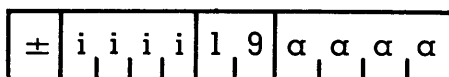
ADD ABSOLUTE



Add the absolute value of the contents of aaaa to the contents of the A register. The sum appears in the A register.

ADL 19

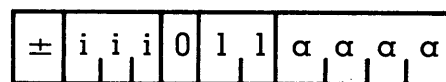
ADD TO LOCATION



Add the contents of the A register to the contents of aaaa. The sum appears in aaaa.

CSU 11

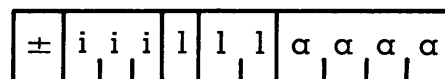
CLEAR, SUBTRACT



Replace the contents of the A register by the negative of the contents of aaaa.

CSA 11

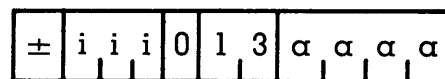
CLEAR, SUBTRACT ABSOLUTE



Replace the contents of the A register by the negative of the absolute value of the contents of aaaa.

SUB 13

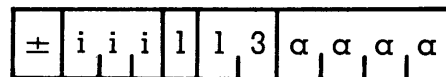
SUBTRACT



Subtract the contents of aaaa from the contents of the A register. The difference appears in the A register.

SUA 13

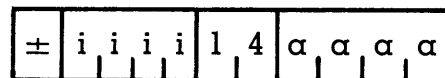
SUBTRACT ABSOLUTE



Subtract the absolute value of the contents of aaaa from the contents of the A register. The difference appears in the A register.

MUL 14

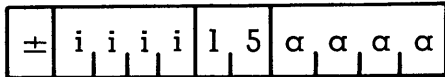
MULTIPLY



Multiply the contents of aaaa by the contents of the A register. The ten low-order digits of the product appear in the R register; the high-order digits are in the A register.

DIV 15

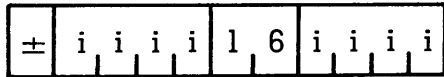
DIVIDE



The contents of the R register are the ten low-order digits of the dividend; the contents of the A register are the high-order digits of the dividend. Divide the dividend by the contents of aaaa. The quotient appears in the A register, the remainder in the R register.

RND 16

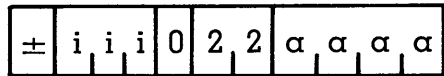
ROUND



If the high-order digit in the R register is greater than or equal to 5, add 1 to the contents of the A register.

FAD 22

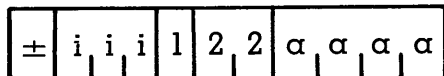
FLOATING ADD



Add the floating-point number in aaaa to the floating-point number in the A register. The floating-point sum appears in the A register.

FAA 22

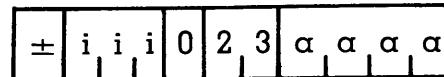
FLOATING ADD ABSOLUTE



Add the absolute value of the floating-point number in aaaa to the floating-point number in the A register. The floating-point sum appears in the A register.

FSU 23

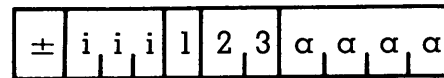
FLOATING SUBTRACT



Subtract the floating-point number in aaaa from the floating-point number in the A register. The floating-point difference appears in the A register.

FSA 23

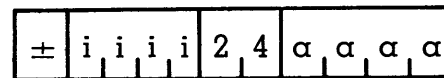
FLOATING SUBTRACT ABSOLUTE



Subtract the absolute value of the floating-point number in aaaa from the floating-point number in the A register. The floating-point difference appears in the A register.

FMU 24

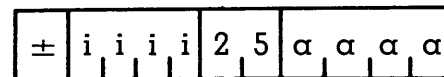
FLOATING MULTIPLY



Multiply the floating-point number in aaaa by the floating-point number in the A register. The low-order digits of the floating-point product appear in the R register; the high-order digits are in the A register.

FDV 25

FLOATING DIVIDE

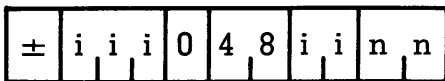


The contents of the R register are the low-order digits of the floating-point dividend; the high-order digits are in the A register. Divide the floating-point dividend by the floating-point number in aaaa. The floating-point quotient appears in the A register.

MANIPULATION, INFORMATION TRANSFER

SRA 48

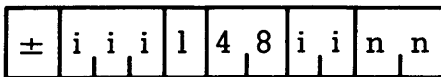
SHIFT RIGHT A



Shift the contents of the A register, excluding the sign digit, nn positions to the right. Digits shifted out of the A register are lost; as each digit is shifted out, a high-order zero is entered in the A register.

SRT 48

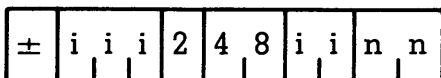
SHIFT RIGHT A AND R



Shift the contents of the A and R registers, together, but excluding the sign digits, nn positions to the right. Digits shifted out of the low-order position of the R register are lost; as each digit is shifted out, a high-order zero is entered in the A register. The sign of the R register is changed to the sign of the A register.

SRS 48

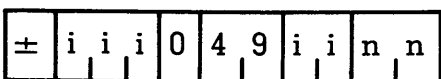
SHIFT RIGHT A WITH SIGN



Shift the contents of the A register, including the sign digit, nn positions to the right. Digits shifted out of the low-order position of the A register are lost; as each digit is shifted out, a zero is entered in the sign-digit position.

SLA 49

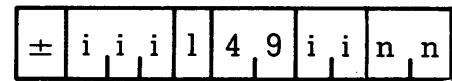
SHIFT LEFT A



Shift the contents of the A register, excluding the sign digit, nn positions to the left. This is a circulating shift: as each digit is shifted out of the high-order position, it enters the low-order position of the A register.

SLT 49

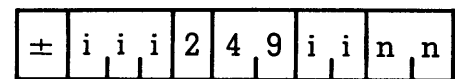
SHIFT LEFT A AND R



Shift the contents of the A and R registers, together, but excluding the sign digits, nn positions to the left. This is a circulating shift: as each digit is shifted out of the high-order position of the A register, it enters the low-order position of the R register. The sign of the A register is changed to the sign of the R register.

SLS 49

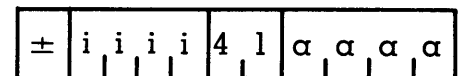
SHIFT LEFT A WITH SIGN



Shift the contents of the A register, including the sign digit, nn positions to the left. This is a circulating shift: as each digit is shifted out of the sign-digit position, it enters the low-order position of the A register.

LDR 41

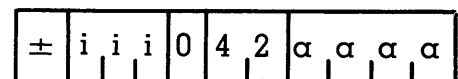
LOAD R



Replace the contents of the R register by the contents of aaaa.

LDB 42

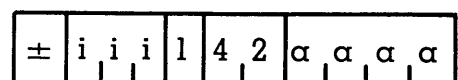
LOAD B



Replace the contents of the B register by the four low-order digits of aaaa.

LBC 42

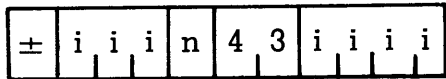
LOAD B COMPLEMENT



Replace the contents of the B register by the 10's complement of the number which is the content of the four low-order digit positions of aaaa.

LSA 43

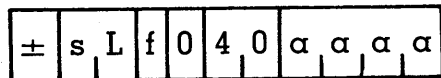
LOAD SIGN A



Replace the sign digit of the A register by n.

STA 40

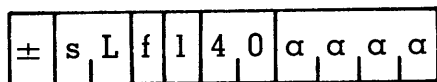
STORE A



Replace the contents of the specified partial-word field in aaaa, or the contents of the entire word, by the contents of the corresponding field in the A register.

STR 40

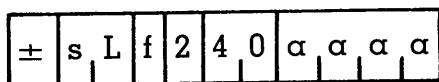
STORE R



Replace the contents of the specified partial-word field in aaaa, or the contents of the entire word, by the contents of the corresponding field in the R register.

STB 40

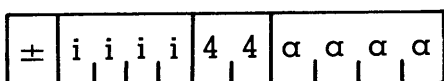
STORE B



Replace the contents of the specified partial-word field in aaaa by the contents of the corresponding field in the B register.

STP 44

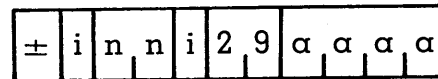
STORE P



Replace the address portion of aaaa by the contents of the P register, increased by 1.

RTF 29

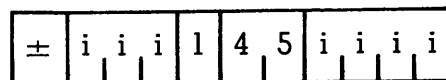
RECORD TRANSFER



Transfer the contents of nn consecutively-addressed locations, beginning with the one whose address is aaaa, to the nn consecutively-addressed locations beginning with the one whose address is in the B register.

CLA 45

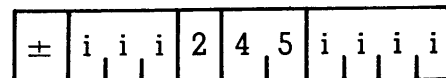
CLEAR A



Replace every digit in the A register by 0.

CLR 45

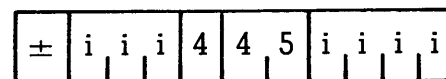
CLEAR R



Replace every digit in the R register by 0.

CLB 45

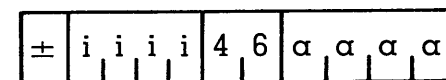
CLEAR B



Replace every digit in the B register by 0.

CLL 46

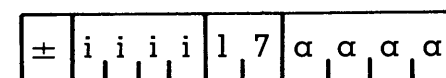
CLEAR LOCATION



Replace every digit in aaaa by 0.

EXT 17

EXTRACT



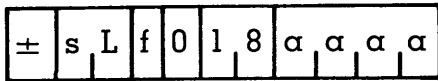
For each digit in aaaa that is an even integer, the corresponding digit in the A register is replaced by zero.

DECISION MAKING

CFA

18

COMPARE FIELD A

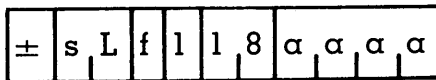


Compare the contents of the specified partial-word field in aaaa, or the contents of the entire word, with the corresponding field in the A register. According as the contents of the field in the A register are greater than, equal to, or less than the contents of the corresponding field in aaaa, set the COMPARISON Indicator to HIGH, EQUAL, or LOW.

CFR

18

COMPARE FIELD R

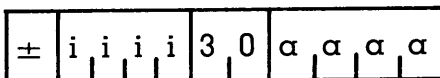


Compare the contents of the specified partial-word field in aaaa, or the contents of the entire word, with the corresponding field in the R register. According as the contents of the field in the R register are greater than, equal to, or less than the contents of the corresponding field in aaaa, set the COMPARISON Indicator to HIGH, EQUAL, or LOW.

BUN

30

BRANCH, UNCONDITIONALLY

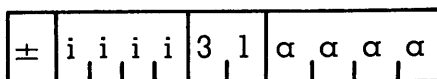


Transfer control to the instruction in aaaa.

BOF

31

BRANCH, OVERFLOW

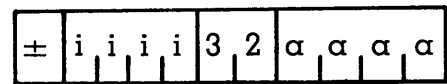


If the OVERFLOW Indicator is on, transfer control to the instruction in aaaa; if not, control continues in sequence.

BRP

32

BRANCH, REPEAT

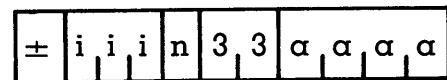


If the REPEAT Indicator is on, transfer control to the instruction in aaaa; if not, control continues in sequence.

BSA

33

BRANCH, SIGN A

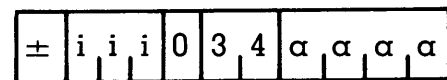


If the sign digit in the A register equals n, transfer control to the instruction in aaaa; if not, control continues in sequence.

BCH

34

BRANCH, COMPARISON HIGH

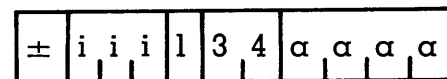


If the COMPARISON Indicator is HIGH, transfer control to the instruction in aaaa; if not, control continues in sequence.

BCL

34

BRANCH, COMPARISON LOW

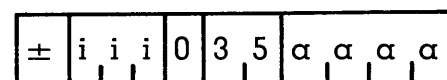


If the COMPARISON Indicator is LOW, transfer control to the instruction in aaaa; if not, control continues in sequence.

BCE

35

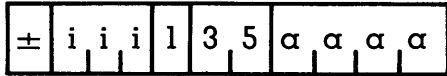
BRANCH, COMPARISON EQUAL



If the COMPARISON Indicator is EQUAL, transfer control to the instruction in aaaa; if not, control continues in sequence.

BCU 35

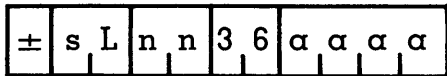
BRANCH, COMPARISON UNEQUAL



If the COMPARISON Indicator is HIGH or LOW, transfer control to the instruction in aaaa; if not, control continues in sequence.

BFA 36

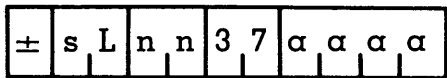
BRANCH, FIELD A



Beginning with the low-order digit of the specified partial-word field in the A register, successively higher-order digits are compared alternately with the low-order and high-order digit of nn. If equality is found, transfer control to the instruction in aaaa; if not, control continues in sequence.

BFR 37

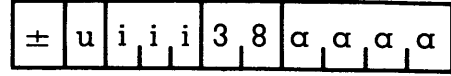
BRANCH, FIELD R



Beginning with the low-order digit of the specified partial-word field in the R register, successively higher-order digits are compared alternately with the low-order and high-order digit of nn. If equality is found, transfer control to the instruction in aaaa; if not, control continues in sequence.

BCS 38

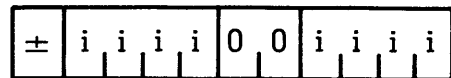
BRANCH, CONTROL SWITCH



If PROGRAM CONTROL SWITCH u is on, transfer control to the instruction in aaaa; if not, control continues in sequence.

HLT 00

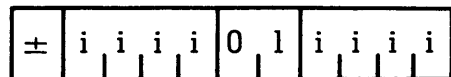
HALT



Stop all operation.

NOP 01

NO OPERATION



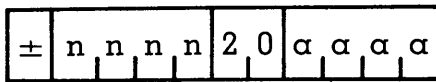
Do nothing: proceed immediately to the next instruction in sequence.

INSTRUCTION MODIFICATION, TALLYING

IBB

20

INCREASE B, BRANCH

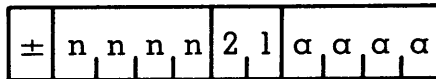


Increase the contents of the B register by nnnn. If overflow occurs, control continues in sequence; if not, transfer control to the instruction in aaaa.

DBB

21

DECREASE B, BRANCH

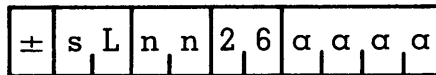


Decrease the contents of the B register by nnnn. If underflow occurs, control continues in sequence; if not, transfer control to the instruction in aaaa.

IFL

26

INCREASE FIELD LOCATION

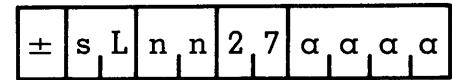


Increase the contents of the specified partial-word field in aaaa by nn. If overflow occurs, set the OVERFLOW Indicator on.

DFL

27

DECREASE FIELD LOCATION

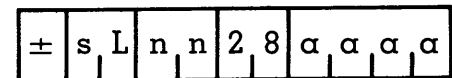


Decrease the contents of the specified partial-word field in aaaa by nn. If underflow occurs, set the REPEAT Indicator off; if not, set the REPEAT Indicator on.

DLB

28

DECREASE FIELD LOCATION, LOAD B



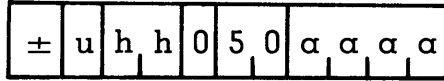
Decrease the contents of the specified partial-word field in aaaa by nn. If underflow occurs, set the REPEAT Indicator off; if not, set the REPEAT Indicator on. In either case, load the B register with the modified partial-word field.

INPUT-OUTPUT

MAGNETIC TAPE

MTS 50

MAGNETIC-TAPE SEARCH



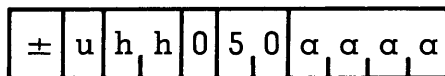
± = 0 or 1:

Search on unit u, lane hh, for the block whose first word is identical with the word in aaaa.

Searching is done independently of Computer control.

MFS 50

MAGNETIC-TAPE FIELD SEARCH



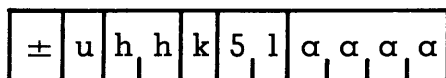
± = 4 or 5:

The boundaries of a partial-word field are specified in the B register. Search on unit u, lane hh, for the block the specified part of whose first word is identical with the corresponding part of the word in aaaa.

Searching is done independently of Computer control.

MTC 51

MAGNETIC-TAPE SCAN



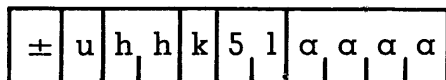
± = 0 or 1:

Select unit u, lane hh. Scan in the forward direction for the block whose kth word is identical with the word in aaaa.

Scanning is done independently of Computer control.

MFC 51

MAGNETIC-TAPE FIELD SCAN



± = 4 or 5:

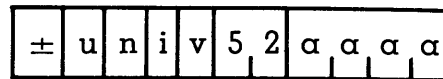
The boundaries of a partial-word field are specified in the B register. Select unit u, lane hh. Scan in the forward direction for the block the specified part of whose kth word is identical with the corresponding part of the word in aaaa.

Scanning is done independently of Computer control.

MRD

52

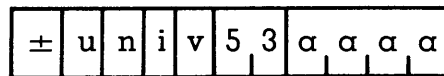
MAGNETIC-TAPE READ



Read n blocks from unit u into consecutively-addressed locations beginning with aaaa. B-register address-modification of designated input can be programmed. Automatic transfer of control occurs when an end-of-file control block is sensed. Parity is checked with automatic re-trial if an error is detected.

MRR 53

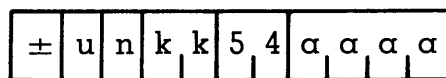
MAGNETIC-TAPE READ, RECORD



Read n blocks—including prefaces—from unit u into consecutively-addressed locations beginning with aaaa. B-register address-modification of designated input can be programmed. Automatic transfer of control occurs when an end-of-file control block is sensed. Parity is checked with automatic re-trial if an error is detected.

MIW 54

MAGNETIC-TAPE INITIAL WRITE

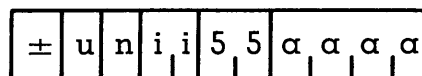


Write on "clean" (i.e., just edited) tape on unit u. Write n blocks, each kk words long, from consecutively-addressed locations beginning with the word in aaaa. The preface word, which contains the number kk, is written just before the first data word of the block.

If magnetic end-of-tape is sensed, turn on END-OF-TAPE Indicator.

MIR 55

MAGNETIC-TAPE INITIAL WRITE, RECORD



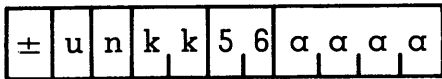
Write on "clean" tape on unit u; write n blocks—with preface words—beginning with the preface word in location aaaa; take words from consecutively-addressed locations thereafter.

If magnetic end-of-tape is sensed, turn on END-OF-TAPE Indicator.

MOW

56

MAGNETIC-TAPE OVERWRITE

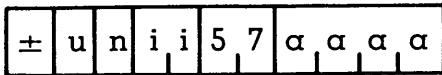


Overwrite n blocks on unit u, each block kk words long; take words from consecutively-addressed locations beginning with the word in aaaa.

MOR

57

MAGNETIC-TAPE OVERWRITE, RECORD

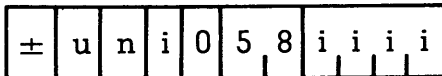


Overwrite n blocks on unit u beginning with the preface word in location aaaa; take words from consecutively-addressed locations thereafter.

MPF

58

MAGNETIC-TAPE POSITION, FORWARD



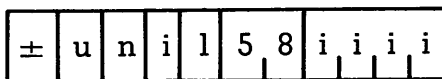
Move tape on unit u, in the forward direction, past n blocks.

This operation is executed independently of Computer control.

MPB

58

MAGNETIC-TAPE POSITION, BACKWARD



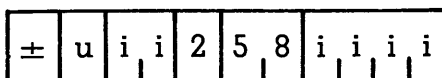
Move tape on unit u, in the backward direction, past n blocks.

This operation is executed independently of Computer control.

MPE

58

MAGNETIC-TAPE POSITION AT END OF INFORMATION



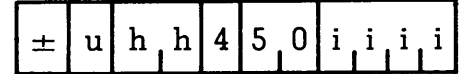
Move tape on unit u to the "end of information." Stop prepared to (initial) write the next block.

This operation is executed independently of Computer control.

MLS

50

MAGNETIC-TAPE LANE SELECT



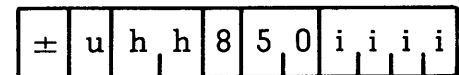
On unit u, select the read-write head specified by hh. There is no tape movement.

This operation is executed independently of Computer control.

MRW

50

MAGNETIC-TAPE REWIND



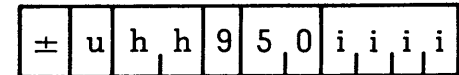
Rewind unit u. Select lane hh at completion of rewind.

Rewinding occurs independently of Computer and Magnetic-Tape Control Unit control.

MDA

50

MAGNETIC-TAPE REWIND, DE-ACTIVATE



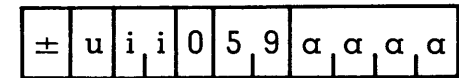
Rewind unit u. Select lane hh at completion of rewind and set interlocks which cause alarm if unit is referred to before interlocks are reset manually.

Rewinding occurs independently of Computer and Magnetic-Tape Control Unit control.

MIB

59

MAGNETIC-TAPE INTERROGATE, BRANCH

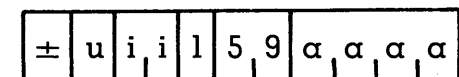


If unit u is ready, transfer control to the instruction in aaaa; otherwise, control continues in sequence.

MIE

59

MAGNETIC-TAPE INTERROGATE END-OF-TAPE, BRANCH

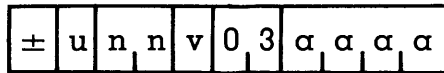


If the END-OF-TAPE Indicator on unit u is on, transfer control to the instruction in aaaa; otherwise, control continues in sequence.

PAPER TAPE

PRD 03

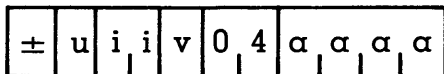
PAPER-TAPE READ



Read nn words, from unit u, into consecutively-addressed locations beginning with aaaa. Automatic alphanumeric translation is provided. B-register address-modification of designated input can be programmed. A control word in paper tape permits overriding of nn.

PRB 04

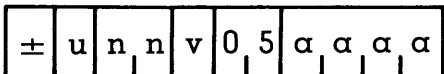
PAPER-TAPE READ, BRANCH



Read from unit u, the words from paper tape going into consecutively-addressed locations beginning with aaaa. Continue reading until a control word in paper tape is encountered: execute the instruction which is the control word. Automatic alphanumeric translation is provided. B-register address-modification of designated input can be programmed.

PRI 05

PAPER-TAPE READ, INVERSE FORMAT

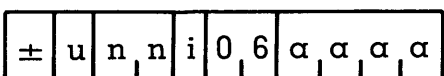


(Certain business machines punch sign digit last: this is "inverse format.")

Read from unit u; read nn words into consecutively-addressed locations beginning with aaaa. B-register address-modification of designated input can be programmed. A control word in paper tape permits overriding of nn.

PWR 06

PAPER-TAPE WRITE

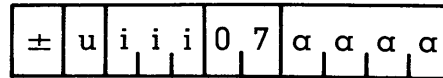


Punch, or print, nn words from consecutively-addressed locations, beginning with the contents of aaaa, using punch or printer u, respectively.

PWI

07

PAPER-TAPE WRITE INTERROGATE, BRANCH

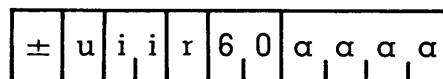


If punch or printer unit u is ready, transfer control to the instruction in aaaa; otherwise, control continues in sequence.

CARDATRON

CRD 60

CARD READ

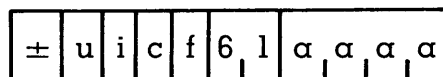


Transfer the contents of the buffer of input unit u into consecutively-addressed locations, beginning with aaaa. The information is edited automatically by the format band selected by a punch in the card whose contents are in the buffer. B-register address-modification of designated input can be programmed. If r is odd, the next card is not read into the buffer.

Transfer of information from the next card to the buffer is independent of Computer control. That is, re-loading of the buffer is accomplished automatically under Cardatron control.

CWR 61

CARD WRITE



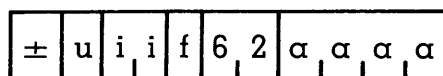
Transfer to the buffer of output unit u, words from consecutively-addressed locations beginning with aaaa. Edit the information using format band f.

Print one line, or punch one card, with the contents of the buffer, controlling the punch or printer as specified by c.

Printing or punching is independent of Computer control.

CRF 62

CARD READ, FORMAT LOAD

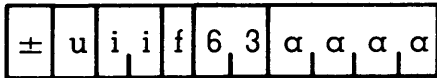


Load format band f, input unit u, with the editing control-stream occupying the 29 consecutively-addressed locations beginning with aaaa.

CWF

63

CARD WRITE, FORMAT LOAD

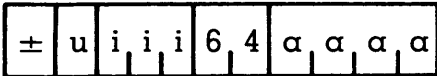


Load format band f, output unit u, with the editing control-stream occupying the 29 consecutively-addressed locations beginning with aaaa.

CRI

64

CARD READ INTERROGATE, BRANCH

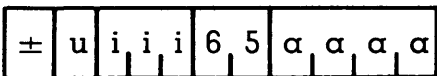


If input unit u is ready, transfer control to the instruction in aaaa; otherwise, control continues in sequence.

CWI

65

CARD WRITE INTERROGATE, BRANCH



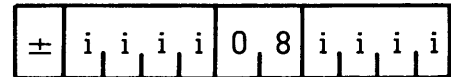
If output unit u is ready, transfer control to the instruction in aaaa; otherwise, control continues in sequence.

CONTROL CONSOLE

KAD

08

KEYBOARD ADD

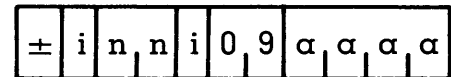


Activate the Console keyboard. The number entered on the keyboard is added to the contents of the A register. The sum appears in the A register.

SPO

09

SUPERVISORY PRINT-OUT



Print, on the Supervisory Printer, nn words from consecutively-addressed locations beginning with the contents of aaaa. Alphanumeric translation is automatic.

DATATRON 220

Manufacturers of . . .

DATATRON 205

ElectroData 101

ElectroData Division
BURROUGHS CORPORATION

460 SIERRA MADRE VILLA, PASADENA, CALIFORNIA

**district
offices**

BOSTON

KANSAS CITY

NEW YORK

ST. PAUL

PHILADELPHIA

DENVER

PITTSBURGH

LOS ANGELES

ROCHESTER

SAN FRANCISCO

WASHINGTON, D. C.

SEATTLE

CHICAGO

OTTAWA

CLEVELAND

MONTREAL

DALLAS

TORONTO

DETROIT