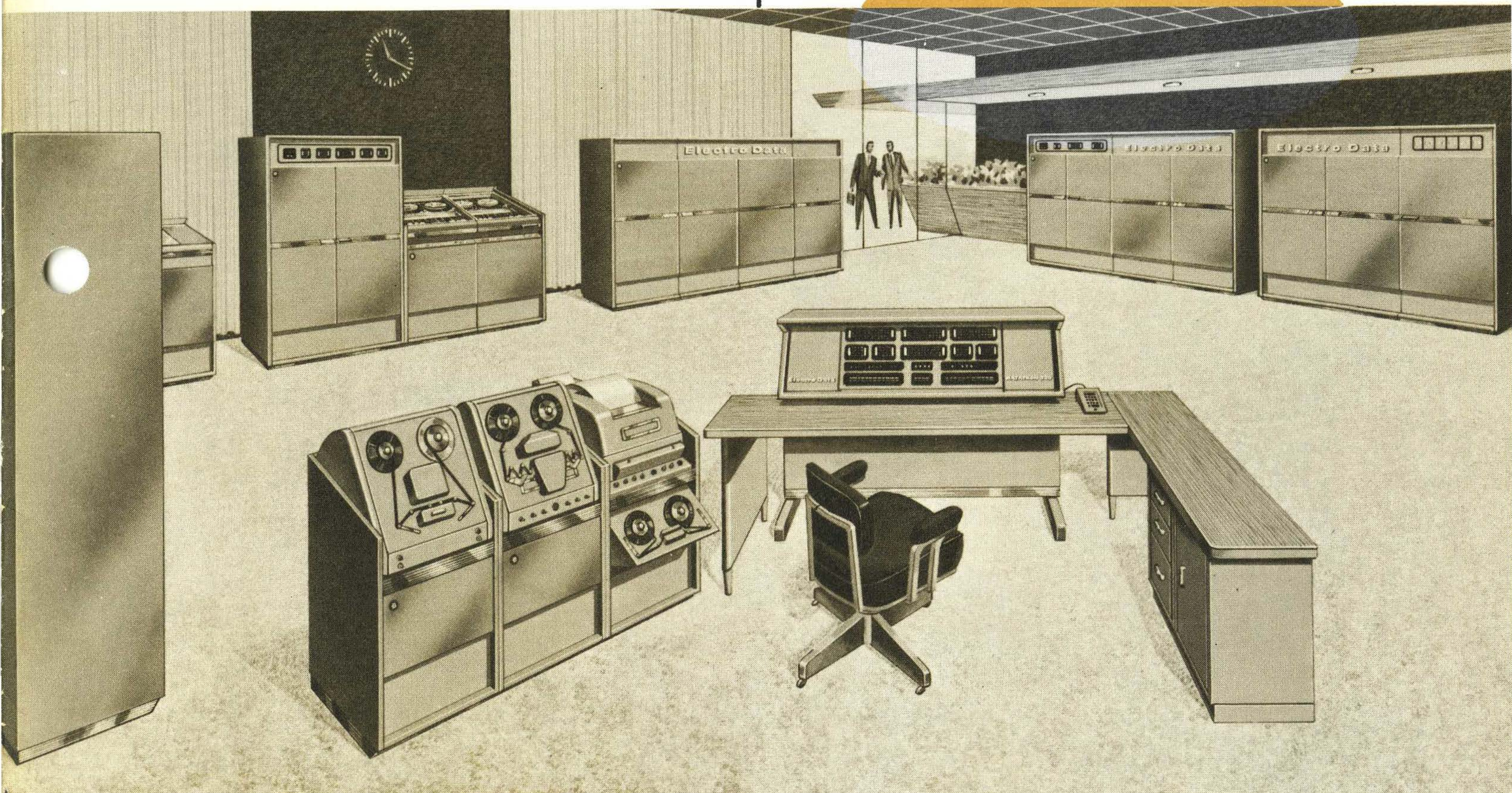
DATATRON 220

INSTRUCTIONS

a brief description

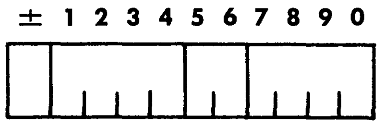


ElectroData
DIVISION
BURROUGHS CORPORATION

Electronic Data Processing Systems

TABLE OF CONTENTS

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

±	i i i	0	1 0	α α α α

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

CAA 10

CLEAR, ADD ABSOLUTE

±	i i i	1	1 0	α α α α

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

ADD 12

ADD

±	i i i	0	1 2	α α α α

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

ADA 12

ADD ABSOLUTE

±	i i i	1	1 2	α α α α

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

±	i i i i	1 9	α α α α

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

CSU 11

CLEAR, SUBTRACT

±	i i i	0	1 1	α α α α

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

CSA 11

CLEAR, SUBTRACT ABSOLUTE

±	i i i	1	1 1	α α α α

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

SUB 13

SUBTRACT

±	i i i	0	1 3	α α α α

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

SUA 13

SUBTRACT ABSOLUTE

±	i i i	1	1 3	α α α α

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

±	i i i i	1 4	α α α α

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

±	i i i i	1 5	α α α α

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

±	i i i i	1 6	i i i i

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

±	i i i	0	2 2	α α α α

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

±	i i i	1	2 2	α α α α

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

±	i i i	0	2 3	α α α α

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

±	i i i	1	2 3	α α α α

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

±	i i i i	2 4	α α α α

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

±	i i i i	2 5	α α α α

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

±	i i i	0	4 8	i i	n n

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

±	i i i	1	4 8	i i	n n

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

±	i i i	2	4 8	i i	n n

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

±	i i i	0	4 9	i i	n n

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

±	i i i	1	4 9	i i	n n

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

±	i i i	2	4 9	i i	n n

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

±	i i i i	4 1	α α α α

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

LDB 42

LOAD B

±	i i i	0	4 2	α α α α

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

LBC 42

LOAD B COMPLEMENT

±	i i i	1	4 2	α α α α

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

±	i	i	i	n	4	3	i	i	i	i

Replace the sign digit of the A register by n.

STA 40

STORE A

±	s	L	f	0	4	0	a	a	a	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

±	s	L	f	1	4	0	a	a	a	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 R register.

STB 40

STORE B

±	s	L	f	2	4	0	a	a	a	a

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

±	i	i	i	i	4	4	a	a	a	a

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

RTF 29

RECORD TRANSFER

±	i	n	n	i	2	9	a	a	a	a

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

±	i	i	i	1	4	5	i	i	i	i

Replace every digit in the A register by 0.

CLR 45

CLEAR R

±	i	i	i	2	4	5	i	i	i	i

Replace every digit in the R register by 0.

CLB 45

CLEAR B

±	i	i	i	4	4	5	i	i	i	i

Replace every digit in the B register by 0.

CLL 46

CLEAR LOCATION

±	i	i	i	i	4	6	a	a	a	a

Replace every digit in aaaa by 0.

EXT 17

EXTRACT

±	i	i	i	i	1	7	a	a	a	a

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

±	s L	f	0	1 8	a a a 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

±	s L	f	1	1 8	a a a 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 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

±	i i i i	3 0	a a a a

Transfer control to the instruction in aaaa.

BOF 31

BRANCH, OVERFLOW

±	i i i i	3 1	a a a a

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

BRP 32

BRANCH, REPEAT

±	i i i i	3 2	a a a a

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

BSA 33

BRANCH, SIGN A

±	i i i	n	3 3	a a a 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

±	i i i	0	3 4	a a a a

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

BCL 34

BRANCH, COMPARISON LOW

±	i i i	1	3 4	a a a a

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

BCE 35

BRANCH, COMPARISON EQUAL

±	i i i	0	3 5	a a a a

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

BCU 35

BRANCH, COMPARISON UNEQUAL

±	i i i	1	3 5	a a a a

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

±	s L	n n	3 6	a a a 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

±	s L	n n	3 7	a a a a

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

±	u	i i i	3 8	a a a a

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

HLT 00

HALT

±	i i i i	0 0	i i i i

Stop all operation.

NOP 01

NO OPERATION

±	i i i i	0 1	i i i i

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

INSTRUCTION MODIFICATION, TALLYING

IBB 20

INCREASE B, BRANCH

±	n n n n	2 0	a a a a

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

±	n n n n	2 1	a a a a

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

±	s L	n n	2 6	a a a a

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

±	s L	n n	2 7	a a a a

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

±	s L	n n	2 8	a a a a

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

±	u	h	h	0	5	0	α	α	α	α

$\pm = 0$ 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

±	u	h	h	0	5	0	α	α	α	α

$\pm = 4$ 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

±	u	h	h	k	5	1	α	α	α	α

$\pm = 0$ or 1:

Select unit u, lane hh. Scan in the forward direction for the block whose k^{th} word is identical with the word in aaaa.

Scanning is done independently of Computer control.

MFC 51

MAGNETIC-TAPE FIELD SCAN

±	u	h	h	k	5	1	α	α	α	α

$\pm = 4$ 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 k^{th} word is identical with the corresponding part of the word in aaaa.

Scanning is done independently of Computer control.

MRD 52

MAGNETIC-TAPE READ

±	u	n	i	v	5	2	α	α	α	α

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

±	u	n	i	v	5	3	α	α	α	α

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

±	u	n	k	k	5	4	α	α	α	α

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

±	u	n	i	i	5	5	α	α	α	α

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

±	u	n	k k	5 6	a a a a

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

±	u	n	i i	5 7	a a a a

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

±	u	n	i	0	5 8	i i i i

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

±	u	n	i	1	5 8	i i i i

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

±	u	i i	2	5 8	i i i i

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

±	u	h h	4	5 0	i i i i

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

±	u	h h	8	5 0	i i i i

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

±	u	h h	9	5 0	i i i i

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

±	u	i i	0	5 9	a a a a

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

±	u	i i	1	5 9	a a a a

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

±	u	n n	v	0 3	a a a a

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

±	u	i i	v	0 4	a a a a

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

±	u	n n	v	0 5	a a a a

(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

±	u	n n	i	0 6	a a a a

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

±	u	i i i	0 7	a a a a

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

±	u	i i	r	6 0	a a a a

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, reloading of the buffer is accomplished automatically under Cardatron control.

CWR 61

CARD WRITE

±	u	i	c	f	6 1	a a a a

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

±	u	i i	f	6 2	a a a a

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

±	u	i i	f	6 3	a a a a

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

±	u	i i i	6 4	a a a a

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

CWI 65

CARD WRITE INTERROGATE, BRANCH

±	u	i i i	6 5	a a a a

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

CONTROL CONSOLE

KAD 08

KEYBOARD ADD

±	i i i i	0 8	i i i i

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

±	i	n n	i	0 9	a a a a

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

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