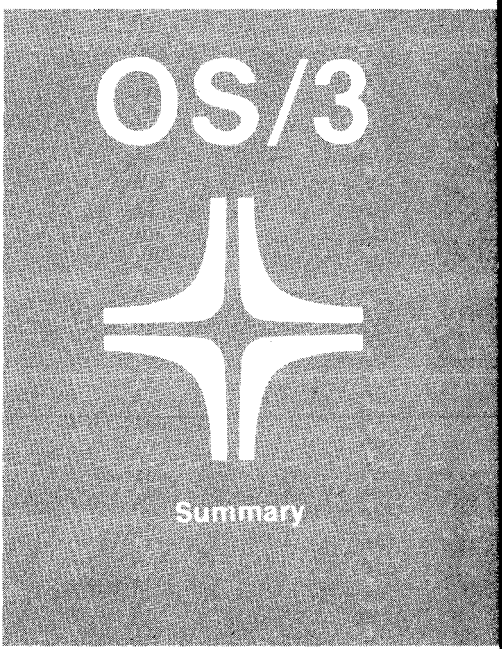
Hardware and Software



Environment: 90/25, 30, 30B, 40 Systems

SPERRY UNIVAC

UP-8203
Rev. 3

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Preface

This hardware and software summary is one in a series designed to be used as a quick-reference document for experienced programmers familiar with the SPERRY UNIVAC Operating System/3 (OS/3). This particular manual consists of figures and tables from the user guides and programmer reference manuals that describe the hardware and software of the SPERRY UNIVAC Series 90 Data Processing Systems operating under the OS/3 operating system.

The information presented here is limited to facts; no introductory information or examples of use are provided. The descriptive information is contained in the 90/30 data processing system processor programmer reference, UP-8052 (current version) and in the following OS/3 manuals: assembler user guide, UP-8061 (current version), job control user guide, UP-8065 (current version), and supervisor user guide, UP-8075 (current version).

The information contained in this manual is placed according to the software component to which it is primarily related and is presented as follows:

- Section 1. GENERAL

  Contains information of a general nature or that which is related to several OS/3 components, and includes the EBCDIC and ASCII character sets, tables for character code conversion, and tables for addressing and hexadecimal-decimal conversion.

- Section 2. ASSEMBLER (BAL)

  Contains information primarily related to the OS/3 assembler, including the BAL instruction formats and the BAL instruction repertoire, arranged by application, mnemonic code, instruction name, and machine code.

- Section 3. JOB CONTROL

  Contains information primarily related to OS/3 job control, including the complete list of job control statements and job control procedure call statements, each arranged in alphabetic sequence, the standard logical unit number assignments, and the canned job control stream call statements.

- Section 4. SUPERVISOR

  Contains information primarily related to the OS/3 supervisor, including the list of supervisor macro instructions arranged in alphabetic sequence within functional groups, a summary of job control statements and input format for the monitor and trace functions, and the layout of low-order main storage, and the condition code settings following a start input/output (SIO) instruction.

- Section 5. PIOCS

  Contains information primarily related to the OS/3 physical input/output control system, including the PSW, IOST, and channel control word formats, peripheral device command codes, and I/O sense data byte definitions for all peripheral devices.

- APPENDIXES

  Contain the powers of 2 and powers of 16 tables, for convenience and quick reference.

Contents

3. JOB CONTROL

4. SUPERVISOR

5. PIOCS

Capital letters, parentheses, and punctuation marks	Must be coded exactly as shown
Lowercase letters and terms	Represent information supplied by the programmer
Braces { }	Necessary entries from which one must be chosen
Brackets [ ]	Optional entries
Ellipsis . . .	Indefinite number of entries
Shading ▒▒	Default option
Underlining ——	Only the underlined portion of the entry need be specified.

1.2. ASCII CHARACTER CODES

(American Standard Code for Information Interchange)

ASCII Character Codes

Bit Positions 4,3,2,1	Bit Positions 7,6,5							
	000	001	010	011	100	101	110	111
0000	NUL	DLE	SP	0	@	P	`	p
0001	SOH	DC1	! (1)	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w

ASCII CHARACTER CODES (cont)

	1000	BS	CAN	(	8	H	X	h	x
	1001	HT	EM	)	9	I	Y	i	y
	1010	LF	SUB	*	:	J	Z	j	z
	1011	VT	ESC	+	;	K	[	k	{
	1100	FF	FS	,	<	L	\	l	¦
	1101	CR	GS	-	=	M	]	m	}
	1110	SO	RS	.	>	N	∧ ①	n	~
	1111	SI	US	/	?	O	—	o	DEL

② ③ ④

NOTES:

ASCII bits are numbered from the left in descending numerical order:

7 6 5 4 3 2 1

Some graphic, card code, and hexadecimal assignments may differ depending upon the device, language, application, or installation policy.

① The following optional graphics can be substituted in the character set:

¬ for ∧

¦ for !

② Sixty-three printable character set

③ Graphics available by use of the type 0768-02 printer, which prints a 94-character set (DEL is not a graphic).

④ Ninety-four printable character set.

1.3. EBCDIC CHARACTER CODES

(Extended Binary Coded Decimal Interchange Code)

EBCDIC Character Codes

Bit Positions 4, 5, 6, 7 \ Bit Positions 0, 1, 2, 3	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	NUL	DLE	DS(1)		SP	&	–						{(4)	}(4)	\(4)	0
0001	SOH	DC1	SOS(1)				/		a(4)	j	~(4)		A	J		1
0010	STX	DC2	FS(1)	SYN					b	k	s		B	K	S	2
0011	ETX	DC3							c	l	t		C	L	T	3
0100									d	m	u		D	M	U	4
0101	HT		LF						e	n	v		E	N	V	5
0110		BS	ETB						f	o	w		F	O	W	6
0111	DEL		ESC	EOT					g	p	x		G	P	X	7
1000		CAN							h	q	y		H	Q	Y	8
1001		EM						`(4)	i	r	z		I	R	Z	9

	1010					[	]	¦③	:							
	1011	VT				.	$	,	#							
	1100	FF	FS		DC4	<	*	%	@							
	1101	CR	GS	ENQ	NAK	(	)	—	'							
	1110	SO	RS	ACK		+	;	>	=							
	1111	SI	US	BEL	SUB	!②	¬②	?	"							

NOTES:

EBCDIC bits are numbered from the left in ascending numerical order:

0 1 2 3 4 5 6 7

Some graphic, card code, and hexadecimal assignments may differ depending upon the device, language, application, or installation policy.

① DS, SOS, FS are the control characters for the EDIT instruction and have been assigned for ASCII mode processing so as not to conflict with the corresponding character positions previously assigned in the EBCDIC chart. As these characters are not outside the range as defined in ANSI X3.4 – 1968, they must not appear in external storage media, such as ANSI standard tapes. This presents no difficulty due to the nature of the EDIT instruction.

② The following optional graphics can be substituted in the character set:

^ for ¬

| for !

③ For 63-character printers, the following substitution is made:

\ for ¦

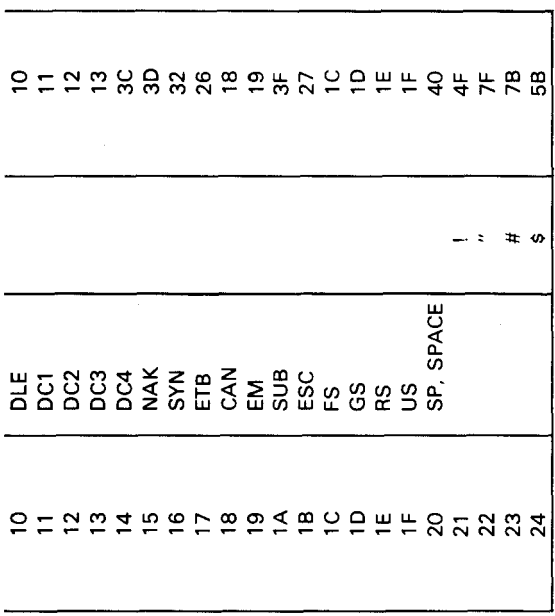
④ The lowercase alphabet and indicated graphics are introduced by use of the type 0768–02 printer, which prints a 94-character set.

1.4. HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS

Hexadecimal Conversion Table

ASCII Hexadecimal	Control Character	Symbol	EBCDIC Hexadecimal
00	NUL		00
01	SOH		01
02	STX		02
03	ETX		03
04	EOT		37
05	ENQ		2D
06	ACK		2E
07	BEL		2F
08	BS		16
09	HT		05
0A	LF		25
0B	VT		0B
0C	FF		0C
0D	CR		0D
0E	SO		0E
0F	SI		0F

HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS (cont)

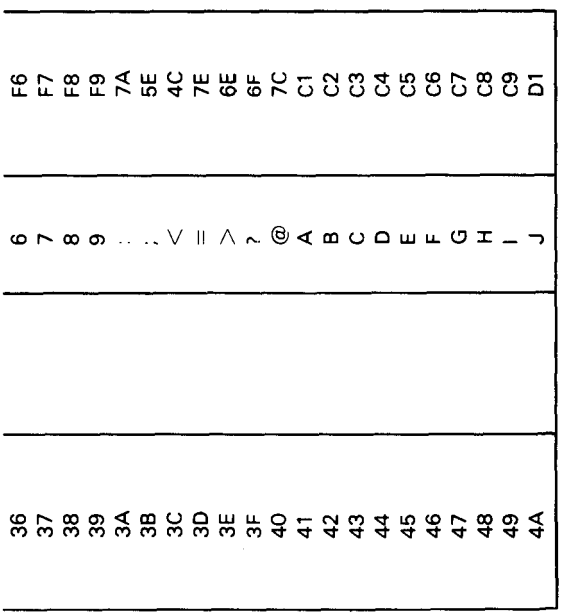


10	DLE		10
11	DC1		11
12	DC2		12
13	DC3		13
14	DC4		3C
15	NAK		3D
16	SYN		32
17	ETB		26
18	CAN		18
19	EM		19
1A	SUB		3F
1B	ESC		27
1C	FS		1C
1D	GS		1D
1E	RS		1E
1F	US		1F
20	SP, SPACE	!	40
21		"	4F
22			7F
23		#	7B
24		$	5B

Hexadecimal Conversion Table (cont)

ASCII Hexadecimal	Control Character	Symbol	EBCDIC Hexadecimal
25		%	6C
26		&	50
27		'	7D
28		(	4D
29		)	5D
2A		*	5C
2B		+	4E
2C		,	6B
2D		-	60
2E		.	4B
2F		/	61
30		0	F0
31		1	F1
32		2	F2
33		3	F3
34		4	F4
35		5	F5

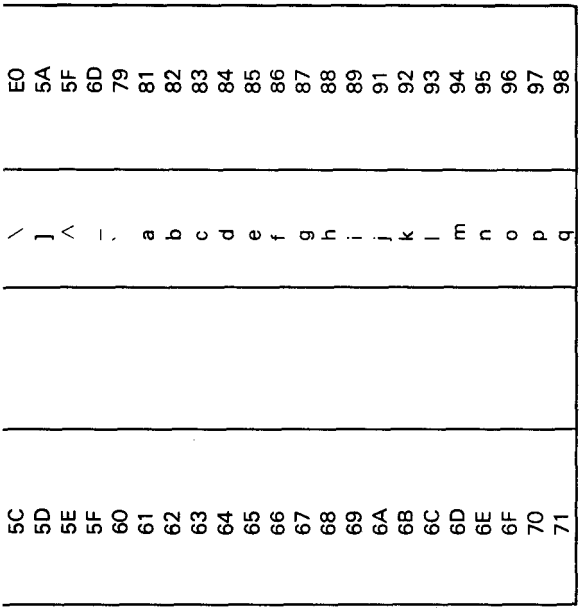
HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS (cont)



Hexadecimal Conversion Table (cont)

ASCII Hexadecimal	Control Character	Symbol	EBCDIC Hexadecimal
4B		K	D2
4C		L	D3
4D		M	D4
4E		N	D5
4F		O	D6
50		P	D7
51		Q	D8
52		R	D9
53		S	E2
54		T	E3
55		U	E4
56		V	E5
57		W	E6
58		X	E7
59		Y	E8
5A		Z	E9
5B		[	4A

HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS (cont)



Hexadecimal Conversion Table (cont)

ASCII Hexadecimal	Control Character	Symbol	EBCDIC Hexadecimal
72		r	99
73		s	A2
74		t	A3
75		u	A4
76		v	A5
77		w	A6
78		x	A7
79		y	A8
7A		z	A9
7B		{	C0
7C		|	6A
7D		}	D0
7E		~	A1
7F	DEL		07*
80	ISR		20*
81	SSB		21*
82	FSB		22*

*For edit mask conversion only.

Character Conversion Table

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
Letters						
A	A	12–1	41	65	C1	193
B	B	12–2	42	66	C2	194
C	C	12–3	43	67	C3	195
D	D	12–4	44	68	C4	196
E	E	12–5	45	69	C5	197
F	F	12–6	46	70	C6	198
G	G	12–7	47	71	C7	199
H	H	12–8	48	72	C8	200

Character Conversion Table (cont)

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
I	I	12–9	49	73	C9	201
J	J	11–1	4A	74	D1	209
K	K	11–2	4B	75	D2	210
L	L	11–3	4C	76	D3	211
M	M	11–4	4D	77	D4	212
N	N	11–5	4E	78	D5	213
O	O	11–6	4F	79	D6	214
P	P	11–7	50	80	D7	215

Q	Q	11–8	51	81	D8	216
R	R	11–9	52	82	D9	217
S	S	0–2	53	83	E2	226
T	T	0–3	54	84	E3	227
U	U	0–4	55	85	E4	228
V	V	0–5	56	86	E5	229
W	W	0–6	57	87	E6	230
X	X	0–7	58	88	E7	231
Y	Y	0–8	59	89	E8	232
Z	Z	0–9	5A	90	E9	233

Character Conversion Table (cont)

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
a	a	12–0–1	61	97	81	129
b	b	12–0–2	62	98	82	130
c	c	12–0–3	63	99	83	131
d	d	12–0–4	64	100	84	132
e	e	12–0–5	65	101	85	133
f	f	12–0–6	66	102	86	134
g	g	12–0–7	67	103	87	135
h	h	12–0–8	68	104	88	136
i	i	12–0–9	69	105	89	137

j	j	12–11–1	6A	106	91	145
k	k	12–11–2	6B	107	92	146
l	l	12–11–3	6C	108	93	147
m	m	12–11–4	6D	109	94	148
n	n	12–11–5	6E	110	95	149
o	o	12–11–6	6F	111	96	150
p	p	12–11–7	70	112	97	151
q	q	12–11–8	71	113	98	152
r	r	12–11–9	72	114	99	153

Character Conversion Table (cont)

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
s	s	11–0–2	73	115	A2	162
t	t	11–0–3	74	116	A3	163
u	u	11–0–4	75	117	A4	164
v	v	11–0–5	76	118	A5	165
w	w	11–0–6	77	119	A6	166
x	x	11–0–7	78	120	A7	167
y	y	11–0–8	79	121	A8	168
z	z	11–0–9	7A	122	A9	169

Numerals						
0	0	0	30	48	F0	240
1	1	1	31	49	F1	241
2	2	2	32	50	F2	242
3	3	3	33	51	F3	243
4	4	4	34	52	F4	244
5	5	5	35	53	F5	245
6	6	6	36	54	F6	246
7	7	7	37	55	F7	247

Character Conversion Table (cont)

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
8	8	8	38	56	F8	248
9	9	9	39	57	F9	249
Symbols						
Exclamation point	!	12–8–7	21	33	4F	79
Quotation mark, dieresis	"	8–7	22	34	7F	127
Number sign, pound sign	#	8–3	23	35	7B	123
Dollar sign	$	11–8–3	24	36	5B	91
Percent sign	%	0–8–4	25	37	6C	108
Ampersand	&	12	26	38	50	80

CHARACTER CONVERSION TABLE (cont)

Apostrophe, acute accent	'	8–5	27	39	7D	125
Opening parenthesis	(	12–8–5	28	40	4D	77
Closing parenthesis	)	11–8–5	29	41	5D	93
Asterisk	*	11–8–4	2A	42	5C	92
Plus sign	+	12–8–6	2B	43	4E	78
Comma, cedilla	,	0–8–3	2C	44	6B	107
Minus sign, hyphen	–	11	2D	45	60	96
Period, decimal point	.	12–8–3	2E	46	4B	75
Slash, virgule, solidus	/	0–1	2F	47	61	97
Colon	:	8–2	3A	58	7A	122

Character Conversion Table (cont)

Character	Printed Symbol	Card Punches	ASCII		EBCDIC	
			Hexadecimal	Decimal	Hexadecimal	Decimal
Semicolon	;	11-8-6	3B	59	5E	94
Less than	<	12-8-4	3C	60	4C	76
Equal sign	=	8-6	3D	61	7E	126
Greater than	>	0-8-6	3E	62	6E	110
Question mark	?	0-8-7	3F	63	6F	111
Commercial at symbol	@	8-4	40	64	7C	124
Opening bracket	[	12-8-2	5B	91	4A	74
Closing bracket	]	11-8-2	5D	93	5A	90
Reverse slash	\	0-8-2	5C	92	E0	224

Circumflex	^	11–8–7	5E	94	5F	95
Underline	—	0–8–5	5F	95	6D	109
Grave accent	`	8–1	60	96	79	121
Opening brace	{	12–0	7B	123	C0	192
Closing brace	}	11–0	7D	125	D0	208
Vertical line	|	12–11	7C	124	6A	106
Overline, tilde	~	11–0–1	7E	126	A1	161

Character Conversion Table (cont)

Character	Card Punches	ASCII		EBCDIC	
		Hexadecimal	Decimal	Hexadecimal	Decimal
Nonprintable Characters					
ACK (acknowledge)	0–9–8–6	06	6	2E	46
BEL (bell)	0–9–8–7	07	7	2F	47
BS (backspace)	11–9–6	08	8	16	22
CAN (cancel)	11–9–8	18	24	18	24
CR (carriage return)	12–9–8–5	0D	13	0D	13
DC1 (device control 1)	11–9–1	11	17	11	17
DC2 (device control 2)	11–9–2	12	18	12	18
DC3 (device control 3)	11–9–3	13	19	13	19

DC4 (device control 4)	9–8–4	14	20	3C	60
DEL (delete)	12–9–7	7F	127	07	7
DLE (data link escape)	12–11–9–8–1	10	16	10	16
DS (digit select)	11–0–9–8–1	80	128	20	32
EM (end of medium)	11–9–8–1	19	25	19	25
ENQ (enquiry)	0–9–8–5	05	5	2D	45
EOT (end of transmission)	9–7	04	4	37	55
ESC (escape)	0–9–7	1B	27	27	39
ETB (end of transmission block)	0–9–6	17	23	26	38

Character Conversion Table (cont)

Character	Card Punches	ASCII		EBCDIC	
		Hexadecimal	Decimal	Hexadecimal	Decimal
ETX (end of text)	12–9–3	03	3	03	3
FF (form feed)	12–9–8–4	0C	12	0C	12
FS (file separator)	11–9–8–4	1C	28	1C	28
FS (field separator)	0–9–2	82	130	22	34
GS (group separator)	11–9–8–5	1D	29	1D	29
HT (horizontal tabulation)	12–9–5	09	9	05	5
LF (line feed)	0–9–5	0A	10	25	37
NAK (negative acknowledge)	9–8–5	15	21	3D	61
NUL (null)	12–0–9–8–1	00	0	00	0

RS (record separator)	11–9–8–6	1E	30	1E	30
SI (shift in)	12–9–8–7	0F	15	0F	15
SO (shift out)	12–9–8–6	0E	14	0E	14
SOH (start of heading)	12–9–1	01	1	01	1
SOS (significance start)	0–9–1	81	129	21	33
SP (space)		20	32	40	64
STX (start of text)	12–9–2	02	2	02	2
SUB (substitute)	9–8–7	1A	26	3F	63
SYN (synchronous idle)	9–2	16	22	32	50
US (unit separator)	11–9–8–7	1F	31	1F	31
VT (vertical tabulation)	12–9–8–3	0B	11	0B	11

1.6. HEXADECIMAL-DECIMAL CONVERSION TABLE

Hexadecimal-Decimal Conversion Table

Hexadecimal to Decimal:

Working from right to left with the hexadecimal digits to be converted, select the decimal number from the digit position column corresponding to each hexadecimal digit. Add the selected decimal numbers to complete the conversion.

Decimal to Hexadecimal:

1. Select the highest decimal number from the table that is less than the decimal number to be converted.
2. Subtract this number from the number to be converted.
3. Note the corresponding hexadecimal digit, its digit position, and the difference.
4. Substitute the difference for the decimal number to be converted and repeat steps 1 and 2 until a zero difference is obtained.
5. Include a 0 for each unused digit position.

The resulting hexadecimal number is the conversion.

Hexadecimal Digit Positions											
6		5		4		3		2		1	
Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec
0	0	0	0	0	0	0	0	0	0	0	0
1	1,048,576	1	65,536	1	4,096	1	256	1	16	1	1
2	2,097,152	2	131,072	2	8,192	2	512	2	32	2	2
3	3,145,728	3	196,608	3	12,288	3	768	3	48	3	3
4	4,194,304	4	262,144	4	16,384	4	1,024	4	64	4	4
5	5,242,880	5	327,680	5	20,480	5	1,280	5	80	5	5
6	6,291,456	6	393,216	6	24,576	6	1,536	6	96	6	6
7	7,340,032	7	458,752	7	28,672	7	1,792	7	112	7	7
8	8,388,608	8	524,288	8	32,768	8	2,048	8	128	8	8
9	9,437,184	9	589,824	9	36,864	9	2,304	9	144	9	9
A	10,485,760	A	655,360	A	40,960	A	2,560	A	160	A	10
B	11,534,336	B	720,896	B	45,056	B	2,816	B	176	B	11
C	12,582,912	C	786,432	C	49,152	C	3,072	C	192	C	12
D	13,631,488	D	851,968	D	53,248	D	3,328	D	208	D	13
E	14,680,064	E	917,504	E	57,344	E	3,584	E	224	E	14
F	15,728,640	F	983,040	F	61,440	F	3,840	F	240	F	15

1.7. HEXADECIMAL ADDITION AND SUBTRACTION TABLE

Hexadecimal Addition and Subtraction Table

+	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

Sign Conventions

Hexadecimal Representation		Binary Representation	Sign	
Generation	Digit		Value	Mode
External	A	1010	Positive	ASCII
	B	1011	Negative	
Processor	C	1100	Positive	EBCDIC
	D	1101	Negative	
External	E	1110	Positive	
	F	1111	Positive	

Linkage Register Conventions

Register	Contents
0	Reserved for system use
1	Parameter/list register
2–12	Free registers
13	Save area register
14	Return address register
15	Entry point register

Instruction Formats

Instruction Type	Source Code Instruction Format: Explicit Form	Source Code Instruction Format: Implicit Form	Object Code Instruction Format
RR	[symbol] opcode r_1,r_2 ①	[symbol] opcode r_1,r_2	First Half Word: Byte 1 = opcode; Byte 2 = reg op 1 (r_1), reg op 2 (r_2)
RX	[symbol] opcode $r_1,d_2(x_2,b_2)$ ②	[symbol] opcode $r_1,s_2(x_2)$	First Half Word: Byte 1 = opcode; Byte 2 = reg op 1 (r_1), x_2; Second Half Word: Bytes 3 and 4 = b_2, address operand 2 (d_2)
RS	[symbol] opcode $r_1,r_3,d_2(b_2)$ ③	[symbol] opcode r_1,r_3,s_2	First Half Word: Byte 1 = opcode; Byte 2 = reg op 1 (r_1), reg op 3 (r_3); Second Half Word: Bytes 3 and 4 = b_2, address operand 2 (d_2)
SI	[symbol] opcode $d_1(b_1),i_2$ ④	[symbol] opcode s_1,i_2	First Half Word: Byte 1 = opcode; Byte 2 = immediate operand (i_2); Second Half Word: Bytes 3 and 4 = b_1, address operand 1 (d_1)
SS	[symbol] opcode $d_1(l,b_1),d_2(b_2)$	[symbol] opcode $s_1(l),s_2$	First Half Word: Byte 1 = opcode; Byte 2 = length op 1 and op 2 ($l-1$); Second Half Word: Bytes 3 and 4 = b_1, address operand 1 (d_1); Third Half Word: Bytes 5 and 6 = b_2, address operand 2 (d_2)
	[symbol] opcode $d_1(l_1,b_1),d_2(l_2,b_2)$	[symbol] opcode $s_1(l_1),s_2(l_2)$	First Half Word: Byte 1 = opcode; Byte 2 = length op 1 (l_1-1), length op 2 (l_2-1); Second Half Word: Bytes 3 and 4 = b_1, address operand 1 (d_1); Third Half Word: Bytes 5 and 6 = b_2, address operand 2 (d_2)

NOTES:

① The RR instruction has three forms:
[symbol] opcode i_1 for the SVC instruction,
[symbol] opcode r_1 for the SPM instruction, and
[symbol] opcode m_1,r_2 for the BCR instruction.

② The RX instruction BC is written in the form:
[symbol] opcode $m_1,d_2(x_2,b_2)$

③ The RS shift instructions are written without use of the r_3 operand, in the form:
[symbol] opcode $r_1,d_2(b_2)$

④ Some SI instructions, such as TS, SSM, and SIO, do not use an i_2 field. They are written in the form:
[symbol] opcode $d_1(b_1)$

Legend for Instruction Formats

Symbol	Meaning
opcode	The application instruction operation code
r_1	The number of the general register containing operand 1
r_2	The number of the general register containing operand 2
r_3	The number of the general register containing operand 3
x_2	The number of the general register containing an index number for operand 2 of the RX instruction
i_1	The immediate data used as operand 1 of the SVC instruction
i_2	The immediate data used as operand 2 of an SI instruction
l	The length of the operands as stated in source code*
l_1	The length of operand 1 as stated in source code*
l_2	The length of operand 2 as stated in source code*
b_1	The number of the general register containing the base address for operand 1

b_2	The number of the general register containing the base address for operand 2
d_1	The displacement for the base address of operand 1
d_2	The displacement for the base address of operand 2
m_1	The specified mask used as operand 1 of the BC and BCR instructions
op_1	Operand 1
op_2	Operand 2
op_3	Operand 3
s_1	The symbol used to identify operand 1 in the implicit format
s_2	The symbol used to identify operand 2 in the implicit format

*This is coded as the true source code length of the operand, not the length less 1, as assembled in the object code. The assembler makes a reduction of 1 in the length when converting source code to object code.

2.1.2.1. Instructions by Application

Instruction	Sets Condition Code	Mnemonic Code	Op-code	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Fixed-Point Instructions								
Add	Yes	A	5A	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Add half word	Yes	AH	4A	N,C2	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Add half word	Yes	AH	AA	C1	RX	$r_1,d_2(,b_2)$	r_1,s_2	5.4
Add immediate	Yes	AI	9A	C2*	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
Add immediate	Yes	AI	A6	C1	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
Add	Yes	AR	1A	N,C2	RR	r_1,r_2	r_1,r_2	Native=3.0 (360/20=3.6)
Compare	Yes	C	59	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Compare half word	Yes	CH	49	N,C3	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Compare	Yes	CR	19	N	RR	r_1,r_2	r_1,r_2	3.0
Convert to binary		CVB	4F	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	36.0
Convert to decimal		CVD	4E	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	66.0+6.0s4
Divide		D	5D	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	65.4+1.2s1+0.6rn
Divide		DR	1D	N,F	RR	r_1,r_2	r_1,r_2	64.8+1.2s1
Load		L	58	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.8

Load complement	Yes	LCR	13	N,F	RR	r_1,r_2	r_1,r_2	3.0
Load half word		LH	48	N,C3	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Load multiple		LM	98	N	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	3.0+1.8gr
Load negative	Yes	LNR	11	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load positive	Yes	LPR	10	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load		LR	18	N	RR	r_1,r_2	r_1,r_2	3.0
Load and test	Yes	LTR	12	N	RR	r_1,r_2	r_1,r_2	3.0
Multiply		M	5C	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	39.6+0.6s1+0.6s2+0.6m
Multiply half word		MH	4C	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	24.0+0.6s1+1.8s2+0.6m
Multiply		MR	1C	N,F	RR	r_1,r_2	r_1,r_2	39.0+0.6s1+0.6s2+0.6m
Subtract	Yes	S	5B	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Subtract half word	Yes	SH	4B	N,C2	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Subtract half word	Yes	SH	AB	C1	RX	$r_1,d_2(,b_2)$	r_1,s_2	5.4
Shift left single	Yes	SLA	8B	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	7.2+0.6p+0.6q
Shift left double	Yes	SLDA	8F	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	7.8+1.2p+1.2q

Instructions by Application (cont)

Instruction	Sets Condition Code	Mnemonic Code	Opcode	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Fixed-Point Instructions (cont)								
Supervisor load multiple (pi)		SLM	B8	N	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	4.2+1.8gr
Subtract	Yes	SR	1B	N,C2	RR	r_1,r_2	r_1,r_2	Native=3.0 (360/20=3.6)
Shift right single	Yes	SRA	8A	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	5.4+0.6p+0.6q
Shift right double	Yes	SRDA	8E	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	6.0+1.2p+1.2q
Supervisor store multiple (pi)		SSTM	B0	N	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	4.2+1.2gr
Store		ST	50	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Store half word		STH	40	N,C3	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.8
Store multiple		STM	90	N	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	4.2+1.2gr
Decimal Instructions								
Add decimal	Yes	AP	FA	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	36.6+0.75n1+0.375n2+6.0t1+3.0s5
Compare decimal	Yes	CP	F9	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	31.8+0.375n1+0.375n2+2.4s6
Divide decimal		DP	FD	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	37.8+0.75n1+6.375n2+24.6(n1−n2)
Multiply decimal		MP	FC	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	36.4+0.75n1+14.4(n1−n2)+0.375n2
Move with offset		MVO	F1	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	10.2+1.2n1+1.2n2

Pack		PACK	F2	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	12.0+1.2(n1−1)+1.2(n2−1)
Subtract decimal	Yes	SP	FB	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	36.6+0.75n1+0.375n2+6t1+3.0s6
Unpack		UNPK	F3	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	12.0+1.2(n1−1)+1.2(n2−1)
Zero and add	Yes	ZAP	F8	N,C3	SS	$d_1(l_1,b_1)d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$	16.2+1.8n7+1.2n8+1.8t2(n2−n1)
Logical Instructions								
Add logical	Yes	AL	5E	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Add logical	Yes	ALR	1E	C1,F	RR	r_1,r_2	r_1,r_2	3.0
Compare logical	Yes	CL	55	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Compare logical	Yes	CLC	D5	N,C3	SS	$d_1(l,b_1),d_2(b_2)$**	$s_1(l),s_2$**	9.6+1.2b
Compare logical immediate	Yes	CLI	95	N,C3	SI	$d_1(b_1),i_2$	s_1,i_2	4.8
Compare logical	Yes	CLR	15	N	RR	r_1,r_2	r_1,r_2	3.0
Edit	Yes	ED	DE	N,C3	SS	$d_1,(l,b_1),d_2(b_2)$**	$s_1(l),s_2$	9.0+3.0n+0.6n3+3.0n4+0.6n6
Edit and mark	Yes	EDMK	DF	N,F	SS	$d_1(l,b_1),d_2(b_2)$**	$s_1(l),s_2$	9.0+3.0n+1.2n3+3.0n4+1.2n6
Insert character		IC	43	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.2
Load address		LA	41	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.2
Move		MVC	D2	N,C3	SS	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$	7.6+0.6n+0.6t4(n−1)
Move immediate		MVI	92	N,C3	SI	$d_1(b_1),i_2$	s_1,i_2	4.8
Move numerics		MVN	D1	N,C3	SS	$d_1(l_1,b_1),d_2(b_2)$	$s_1,(l),s_2$	10.2+2.1n***

Instruction	Sets Condition Code	Mnemonic Code	Opcode	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Logical Instructions (cont)								
Move zones		MVZ	D3	N,C2	SS	$d_1(l,b_1),d_2(b_2)$	$s_1,(l),s_2$	10.2+2.1n***
AND	Yes	N	54	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
AND	Yes	NC	D4	N,C1	SS	$d_1(l,b_1),d_2(b_2)$	$s_1,(l),s_2$	10.2+1.5n***
AND	Yes	NI	94	N,C3	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
AND	Yes	NR	14	N	RR	r_1,r_2	r_1,r_2	3.0
OR	Yes	O	56	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
OR	Yes	OC	D6	N,C1	SS	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$	10.2+1.5n***
OR	Yes	OI	96	N,C3	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
OR	Yes	OR	16	N	RR	r_1,r_2	r_1,r_2	3.0
Subtract logical	Yes	SL	5F	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Shift left double logical		SLDL	8D	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	4.8+1.2p+1.2q
Shift left single logical		SLL	89	N	RS	$r_1,d_2(b_2)$	r_1,s_2	5.4+0.6p+0.6q
Subtract logical	Yes	SLR	1F	N,F	RR	r_1,r_2	r_1,r_2	3.0

Shift right double logical		SRDL	8C	N,F	RS	$r_1,d_2(b_2)$	r_1,s_2	4.8+1.2p+1.2q
Shift right single logical		SRL	88	N	RS	$r_1,d_2(b_2)$	r_1,s_2	5.4+0.6p+0.6q
Store character		STC	42	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.8
Test under mask	Yes	TM	91	N,C3	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
Translate		TR	DC	N,C3	SS	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$**	7.2+2.4n
Translate and test	Yes	TRT	DD	N	SS	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$**	8.4+1.8b
Exclusive OR	Yes	X	57	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Exclusive OR	Yes	XC	D7	N	SS	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$**	10.2+1.5n***
Exclusive OR	Yes	XI	97	N	SI	$d_1(b_1),i_2$	s_1,i_2	6.0
Exclusive OR	Yes	XR	17	N	RR	r_1,r_2	r_1,r_2	3.0
Branching Instructions								
Branch and link		BAL	45	N,C1	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	6.0
Branch and link		BALR	05	N	RR	r_1,r_2	r_1,r_2	3.6+0.6s
Branch and store		BAS	4D	C2	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Branch and store		BASR	0D	C2	RR	r_1,r_2	r_1,r_2	3.0+0.6s
Branch on condition (em)		BC	47	N,C3	RX	$m_1,d_2(x_2,b_2)$	$m_1,s_2(x_2)$	3.6
Branch on condition (em)		BCR	07	N,C2	RR	m_1,r_2	m_1,r_2	3.0
Branch on count		BCT	46	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	4.2

Instruction	Sets Condition Code	Mnemonic Code	Opcode	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Branching Instructions (cont)								
Branch on count		BCTR	06	N	RR	r_1,r_2	r_1,r_2	3.6
Branch on index high		BXH	86	N,F	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	7.2-1.2s3
Branch on index low or equal		BXLE	87	N,F	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	7.2-1.2s3
Execute	†††	EX	44	N	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	3.6+0.6r+0.6nrr+e
Floating-Point Instructions								
Add normalized, long	Yes	AD	6A	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	19.2+1.2ce+1.2pr+1.2t1+1.2rp
Add normalized, long	Yes	ADR	2A	N,F	RR	r_1,r_2	r_1,r_2	16.2+1.2ce+1.2pr+1.2t1+1.2rp
Add normalized, short	Yes	AE	7A	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	16.8+1.2ce+1.2pr+1.2t1+1.2rp
Add normalized, short	Yes	AER	3A	N,F	RR	r_1,r_2	r_1,r_2	14.4+1.2ce+1.2pr+1.2t1+1.2rp
Add unnormalized, short	Yes	AU	7E	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	16.8+1.2ce+0.6rp
Add unnormalized, short	Yes	AUR	3E	N,F	RR	r_1,r_2	r_1,r_2	14.4+1.2ce+0.6rp
Add unnormalized, long	Yes	AW	6E	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	19.2+1.2ce+0.6rp
Add unnormalized, long	Yes	AWR	2E	N,F	RR	r_1,r_2	r_1,r_2	16.2+1.2ce+0.6rp

Compare, long	Yes	CD	69	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	21.6+1.2ce
Compare, long	Yes	CDR	29	N,F	RR	r_1,r_2	r_1,r_2	18.0+1.2ce
Compare, short	Yes	CE	79	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	18.0+1.2ce
Compare, short	Yes	CER	39	N,F	RR	r_1,r_2	r_1,r_2	15.6+1.2ce
Divide, long		DD	6D	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	208.2+0.6p1+0.6p2+15.0pn+0.6rn
Divide, long		DDR	2D	N,F	RR	r_1,r_2	r_1,r_2	205.2+0.6p1+0.6p2+15.0pn+0.6rn
Divide, short		DE	7D	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	47.4+0.6p1+0.6p2+15.0pn+0.6rn
Divide, short		DER	3D	N,F	RR	r_1,r_2	r_1,r_2	45.0+0.6p1+0.6p2+6.6pn+0.6rn
Halve, long		HDR	24	N,F	RR	r_1,r_2	r_1,r_2	**7.8+1.2pr+0.6pn+0.6(s2)**
Halve, short		HER	34	N,F	RR	r_1,r_2	r_1,r_2	7.2+1.2pr+0.6pn
Load complement, long	Yes	LCDR	23	N,F	RR	r_1,r_2	r_1,r_2	4.8
Load complement, short	Yes	LCER	33	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load, long		LD	68	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	6.6
Load, long		LDR	28	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load, short		LE	78	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	5.4
Load, short		LER	38	N,F	RR	r_1,r_2	r_1,r_2	3.6
Load negative, long	Yes	LNDR	21	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load negative, short	Yes	LNER	31	N,F	RR	r_1,r_2	r_1,r_2	3.6

Instruction	Sets Condition Code	Mnemonic Code	Op-code	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Floating-Point Instructions (cont)								
Load positive, long	Yes	LPDR	20	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load positive, short	Yes	LPER	30	N,F	RR	r_1,r_2	r_1,r_2	3.6
Load and test, long	Yes	LTDR	22	N,F	RR	r_1,r_2	r_1,r_2	4.8
Load and test, short	Yes	LTER	32	N,F	RR	r_1,r_2	r_1,r_2	4.2
Multiply, long		MD	6C	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	118.2+0.6p1+0.6p2+1.2pn+0.6rn
Multiply, long		MDR	2C	N,F	RR	r_1,r_2	r_1,r_2	115.2+0.6p1+0.6p2+1.2pn+0.6rn
Multiply, short		ME	7C	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	41.4+0.6p1+0.6p2+0.6pn+0.6rn
Multiply, short		MER	3C	N,F	RR	r_1,r_2	r_1,r_2	39.0+0.6p1+0.6p2+0.6pn+0.6rn
Subtract normalized, long	Yes	SD	6B	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	19.2+1.2ce+1.2pr+1.2t1+1.2rp
Subtract normalized, long	Yes	SDR	2B	N,F	RR	r_1,r_2	r_1,r_2	16.2+1.2ce+1.2pr+1.2t1+1.2rp
Subtract normalized, short	Yes	SE	7B	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	16.8+1.2ce+1.2pr+1.2t1+1.2rp
Subtract normalized, short	Yes	SER	3B	N,F	RR	r_1,r_2	r_1,r_2	14.4+1.2ce+1.2pr+1.2t1+1.2rp
Store, long		STD	60	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	7.2
Store, short		STE	70	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	6.0

Subtract unnormalized, short	Yes	SU	7F	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	16.8+1.2ce−0.6a
Subtract unnormalized, short	Yes	SUR	3F	N,F	RR	r_1,r_2	r_1,r_2	14.4+1.2ce−0.6a
Subtract unnormalized, long	Yes	SW	6F	N,F	RX	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$	19.2+1.2ce+0.6rp
Subtract unnormalized, long	Yes	SWR	2F	N,F	RR	r_1,r_2	r_1,r_2	16.2+1.2ce+0.6rp
Status Switching Instructions								
Halt and proceed (pi)		HPR	99	N,C2*	SI	$d_1(b_1),i_2$	s_1,i_2	3.6
Insert storage key (pi)		ISK	09	N,F	RR	r_1,r_2	r_1,r_2	4.2
Load control storage (pi)	Yes	LCS	B1	N	RS	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2	5.4+24.0w+4.8s8
Load program status word (pi)	Yes	LPSW	82	N	SI	$d_1(b_1),i_2$	s_1,i_2	11.4

Instruction	Sets Condition Code	Mnemonic Code	Op-code	Use	Type	Instruction Source Formats		Execution Time in Microseconds
						Explicit	Implicit	
Status Switching Instructions (cont)								
Set program mask	Yes	SPM	04	N	RR	r_1	r_1	3.0
Set storage key (pi)		SSK	08	N,F	RR	r_1,r_2	r_1,r_2	4.2
Set system mask (pi)		SSM	80	N	SI	$d_1(b_1)$	s_1	4.8
Supervisor call	Yes	SVC	0A	N	RR	i_1	i_1	15.0
Test and set	Yes	TS	93	N,F	SI	$d_1(b_1)$	s_1	6.0
Input/Output Instructions								
Start I/O (pi)	Yes	SIO	9C	N	SI	$d_1(b_1)$	s_1	IPC paper peripheral Min Max 15 59 IPC communication 15.6 IDA Min Max 10.2 12.6

								Selector Min Max 25.2 26.4 Multiplexer Min Max 16.8 18.6
Diagnostic Instructions								
Diagnose (pi)†	Yes	DIAG	83	N,C2*	SI	$d_1(b_1),i_2$	s_1,i_2	i_2=00 22.8 i_2=01 42.0 i_2=02 48.0 i_2=0E 12+y [.6+1.8 (z)] i_2=0F secondary function 13.8+3.6d1+6.6d2 +3.6d3+11.4d4−4.2d5 +0.6d6+1.2d7 i_2=0F primary function 13.8+3.6d1+6.6d2+3.6d 3+10.2d4−4.2d5+0.6d8 +3.0d9+3.0d10+3.6d11

SOFTSCOPE forward scan (pi)†	Yes	SSFS	A2	N	RS	(bit pattern)	(bit pattern)	7.2††
SOFTSCOPE reverse scan (pi)†	Yes	SSRS	A3	N	RS	(bit pattern)	(bit pattern)	7.2††
Interval Timer Instruction								
Service timer register (pi)	Yes	STR	03	N	RR	r_1,r_2	r_1,r_2	6.0+0.6t3

LEGEND:

pi	=	privileged instruction	C3	=	instructions used in 9200/9300 or 360/20 compatibility modes
em	=	extended mnemonics	F	=	instructions added as features
C1	=	instructions used only in 9200/9300 compatibility mode	N	=	instructions used in 90/30 native mode
C2	=	instructions used only in 360/20 compatibility mode			

NOTES:

*	Operation exception.
**	1 specification in operand 1 specifies length of both operands.
***	Five cycles per half word: 3.0 microseconds per half word.
†	These instructions are not resident at all times.
††	This execution time is variable.
†††	The condition code may be set by the instruction executed at the operand 2 address.

Legend for Instruction Execution Time

Symbol	Description
a	1 if overflow adjustment is necessary; otherwise 0
b	Number of first operand bytes processed
ce	Number of digit shifts required to equalize the characteristics
d1	Number of zero addresses in switch list
d2	1 if initial r odd general register has nonzero value; otherwise 0
d3	1 if sentinel found; otherwise 0
d4	Number of task control blocks scrutinized
d5	Number of linked task control blocks scrutinized
d6	1 when exclusive search is specified; otherwise 0
d7	1 when match is found; otherwise, 0

Legend for Instruction Execution Time (cont)

Symbol	Description
d8	Number of control blocks with absolute wait bits set
d9	Number of control blocks with wait bits set and ICOR bit clear
d10	1 if ICOR = 1; otherwise 0
d11	1 if ICOR = 0 and no wait bits set; otherwise 0
e	Execution time of subject instruction
gr	Number of general registers loaded or stored
n	Number of bytes in first operand (for instructions with a single field length)
n1	Number of operand 1 bytes
n2	Number of operand 2 bytes
n3	Number of field separator characters in pattern

n4	Number of digit select or significance starter characters in pattern
n6	Number of significant digits detected when significance indicator is not set before digit is examined
n7	Lowest number of bytes specified by L1 or L2
n8	0 if L1 $\leqslant$ L2 (number of bytes in L1 exceeds L2)
nrr	1 if subject instruction of execute instruction is not RR type; otherwise 0
p	Number of 4-place shifts
p1	Number of digit shifts required to prenormalize operand 1
p2	Number of digit shifts required to prenormalize operand 2
pn	1 if the result requires post-normalization; otherwise 0
pr	Number of digit shifts required for post-normalized result
q	Number of 1-place shifts

egend for Instruction Execution Time (cont)

Symbol	Description
r	1 if r1 ≠ 0; otherwise 0
rn	1 if result (product or quotient) is negative; otherwise 0
rp	1 if recomplementing without post-normalization is required; otherwise 0
s	1 if branch is successful; otherwise 0
s1	1 if sign of op1 is negative; otherwise 0
s2	1 if sign of op2 is negative; otherwise 0
s3	1 if sum of first and third operand equal to comparand; otherwise 0
s4	1 if result is greater than one word (8 decimal digits); otherwise 0
s5	1 if signs of op1 and op2 are the same; otherwise 0
s6	1 if signs of op1 and op2 are different; otherwise 0

s8	1 if sentinel detected; otherwise 0
t1	1 if result is recomplemented; otherwise 0
t2	1 if n2 > n1; otherwise 0
t3	1 if timer stored; otherwise 0
t4	1 if one operand address is even and other is odd; otherwise 0
w	Number of control storage words loaded
w1	Number of channel status words
y	0 for byte count = 0
y1	1 for byte count ≠ 0
z	Number of half words in sum

2.1.2.2. Instructions by Mnemonic Code

Mnemonic	Instruction Name	Machine Code	Byte Length	Source Code Format	
				Explicit	Implicit
A	Add	5A	4	$r_1,d_2(x_2,b_2)$ *	$r_1s_2(x_2)$ *
AD	Add Normalized, Long	6A	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
ADR	Add Normalized, Long	2A	2	r_1,r_2	r_1,r_2
AE	Add Normalized, Short	7A	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
AER	Add Normalized, Short	3A	2	r_1,r_2	r_1,r_2
AH	Add Half Word	4A	4	$r_1,d_2(x_2,b_2)$***	$r_1,s_2(x_2)$***
AI	Add Immediate	9A	4	$d_1(b_1),i_2$	s_1,i_2
AL	Add Logical	5E	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
ALR	Add Logical	1E	2	r_1,r	r_1,r_2
AP	Add Decimal	FA	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
AR	Add	1A	2	r_1,r_2	r_1,r_2
AU	Add Unnormalized, Short	7E	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *

AUR	Add Unnormalized, Short	3E	2	r_1,r_2	r_1,r_2
AW	Add Unnormalized, Long	6E	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
AWR	Add Unnormalized, Long	2E	2	r_1,r_2	r_1,r_2
BAL	Branch and Link	45	4	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$
BALR	Branch and Link	05	2	r_1,r_2	r_1,r_2
BAS	Branch and Store	4D	4	compatibility mode only	
BASR	Branch and Store	0D	2		
BC	Branch on Condition	47	4	$i,d_2(x_2,b_2)$	$i,s_2(x_2)$
BCR	Branch on Condition	07	2	i,r_2	i,r_2
BCT	Branch on Count	46	4	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$
BCTR	Branch on Count	06	2	r_1,r_2	r_1,r_2
BXH	Branch on Index High	86	4	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2
BXLE	Branch on Index Low or Equal	87	4	$r_1,r_3,d_2(b_2)$	r_1,r_3,s_2
C	Compare Algebraic	59	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
CD	Compare, Long	69	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
CDR	Compare, Long	29	2	r_1,r_2	r_1,r_2
CE	Compare, Short	79	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *

Mnemonic	Instruction Name	Machine Code	Byte Length	Source Code Format	
				Explicit	Implicit
CER	Compare, Short	39	2	r_1,r_2	r_1,r_2
CH	Compare Half Word	49	4	$r_1,d_2(x_2,b_2)$ ***	$r_1,s_2(x_2)$ ***
CL	Compare Logical	55	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
CLC	Compare Logical	D5	6	$d_1,(l,b_1),d_2(b_2)$	$s_1(l),s_2$
CLI	Compare Logical Immediate	95	4	$d_1(b_1),i_2$	s_1,i_2
CLR	Compare Logical	15	2	r_1,r_2	r_1,r_2
CP	Compare Decimal	F9	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
CR	Compare Algebraic	19	2	r_1,r_2	r_1,r_2
CVB	Convert to Binary	4F	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
CVD	Convert to Decimal	4E	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
D	Divide	5D	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
DD	Divide, Long	6D	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
DDR	Divide, Long	2D	2	r_1,r_2	r_1,r_2
DE	Divide, Short	7D	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *

DER	Divide, Short	3D	2	r_1,r_2	r_1,r_2
DIAG	Diagnose	83	4	(Privileged)	(Privileged)
DP	Divide Decimal	FD	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
DR	Divide	1D	2	r_1,r_2	r_1,r_2
ED	Edit	DE	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
EDMK	Edit and Mark	DF	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
EX	Execute	44	4	$r_1,d_2(x_2,b_2)$***	$r_1,s_2(x_2)$***
HDR	Halve, Long	24	2	r_1,r_2	r_1,r_2
HER	Halve, Short	34	2	r_1,r_2	r_1,r_2
HPR	Halt and Proceed	99	4	(Privileged)	(Privileged)
IC	Insert Character	43	4	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$
ISK	Insert Storage Key	09	2	(Privileged)	(Privileged)
L	Load	58	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
LA	Load Address	41	4	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$
LCDR	Load Complement, Long	23	2	r_1,r_2	r_1,r_2
LCER	Load Complement, Short	33	2	r_1,r_2	r_1,r_2
LCR	Load Complement	13	2	r_1,r_2	r_1,r_2

Mnemonic	Instruction Name	Machine Code	Byte Length	Source Code Format	
				Explicit	Implicit
LCS	Load Control Storage	B1	4	(Privileged)	(Privileged)
LD	Load, Long	68	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
LDR	Load, Long	28	2	r_1,r_2	r_1,r_2
LE	Load, Short	78	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
LER	Load, Short	38	2	r_1,r_2	r_1,r_2
LH	Load Half Word	48	4	$r_1,d_2(x_2,b_2)$ ***	$r_1,s_2(x_2)$ ***
LM	Load Multiple	98	4	$r_1,r_3,d_2(b_2)$ *	r_1,r_3,s_2 *
LNDR	Load Negative, Long	21	2	r_1,r_2	r_1,r_2
LNER	Load Negative, Short	31	2	r_1,r_2	r_1,r_2
LNR	Load Negative	11	2	r_1,r_2	r_1,r_2
LPDR	Load Positive, Long	20	2	r_1,r_2	r_1,r_2
LPER	Load Positive, Short	30	2	r_1,r_2	r_1,r_2
LPR	Load Positive	10	2	r_1,r_2	r_1,r_2

LPSW	Load Program Status Word	82	4	(Privileged)	(Privileged)
LR	Load	18	2	r_1,r_2	r_1,r_2
LTDR	Load and Test, Long	22	2	r_1,r_2	r_1,r_2
LTER	Load and Test, Short	32	2	r_1,r_2	r_1,r_2
LTR	Load and Test	12	2	r_1,r_2	r_1,r_2
M	Multiply	5C	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
MD	Multiply, Long	6C	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
MDR	Multiply, Long	2C	2	r_1,r_2	r_1,r_2
ME	Multiply, Short	7C	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
MER	Multiply, Short	3C	2	r_1,r_2	r_1,r_2
MH	Multiply Half Word	4C	4	$r_1,d_2(x_2,b_2)$ ***	$r_1,s_2(x_2)$ ***
MP	Multiple Decimal	FC	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
MR	Multiply	1C	2	r_1,r_2	r_1,r_2
MVC	Move Characters	D2	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l)$, s_2
MVI	Move Immediate	92	4	$d_1(b_1),i_2$	s_1,i_2
MVN	Move Numerics	D1	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
MVO	Move With Offset	F1	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$

Mnemonic	Instruction Name	Machine Code	Byte Length	Source Code Format	
				Explicit	Implicit
MVZ	Move Zones	D3	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
N	AND Logical	54	4	$r_1,d_2(x_2,b_2)$*	$r_1,s_2(x_2)$*
NC	AND Logical	D4	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
NI	AND Logical Immediate	94	4	$d_1(b_1),i_2$	s_1,i_2
NR	AND Logical	14	2	r_1,r_2	r_1,r_2
O	OR Logical	56	4	$r_1,d_2(x_2,b_2)$*	$r_1,s_2(x_2)$*
OC	OR Logical	D6	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
OI	OR Logical Immediate	96	4	$d_1(b_1),i_2$	s_1,i_2
OR	OR Logical	16	2	r_1,r_2	r_1,r_2
PACK	Pack	F2	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
S	Subtract	5B	4	$r_1,d_2(x_2,b_2)$*	$r_1,s_2(x_2)$*
SD	Subtract Normalized, Long	6B	4	$r_1,d_2(x_2,b_2)$**	$r_1,s_2(x_2)$**
SDR	Subtract Normalized, Long	2B	2	r_1,r_2	r_1,r_2

SE	Subtract Normalized, Short	7B	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
SER	Subtract Normalized, Short	3B	2	r_1,r_2	r_1,r_2
SH	Subtract Half Word	4B	4	$r_1,d_2(x_2,b_2)$ ***	$r_1,s_2(x_2)$ ***
SIO	Start I/O	9C	4	(Privileged)	(Privileged)
SL	Subtract Logical	5F	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
SLA	Shift Left Single Algebraic	8B	4	$r_1,d_2(b_2)$	r_1,s_2
SLDA	Shift Left Double Algebraic	8F	4	$r_1,d_2(b_2)$	r_1,s_2
SLDL	Shift Left Double Logical	8D	4	$r_1,d_2(b_2)$	r_1,s_2
SLL	Shift Left Single Logical	89	4	$r_1,d_2(b_2)$	r_1,s_2
SLM	Supervisor Load Multiple	B8	4	(Privileged)	(Privileged)
SLR	Subtract Logical	1F	2	r_1,r_2	r_1,r_2
SP	Subtract Decimal	FB	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
SPM	Set Program Mask	04	2	r_1	r_1
SR	Subtract	1B	2	r_1,r_2	r_1,r_2
SRA	Shift Right Single Algebraic	8A	4	$r_1,d_2(b_2)$	r_1,s_2
SRDA	Shift Right Double Algebraic	8E	4	$r_1,d_2(b_2)$	r_1,s_2
SRDL	Shift Right Double Logical	8C	4	$r_1,d_2(b_2)$	r_1,s_2

Mnemonic	Instruction Name	Machine Code	Byte Length	Source Code Format	
				Explicit	Implicit
SRL	Shift Right Single Logical	88	4	$r_1,d_2(b_2)$	r_1,s_2
SSFS	SOFTSCOPE Forward Scan	A2	4	(Privileged)	(Privileged)
SSK	Set System Key	08	2	(Privileged)	(Privileged)
SSM	Set System Mask	80	4	(Privileged)	(Privileged)
SSRS	SOFTSCOPE Reverse Scan	A3	4	(Privileged)	(Privileged)
SSTM	Supervisor Store Multiple	B0	4	(Privileged)	(Privileged)
ST	Store	50	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
STC	Store Character	42	4	$r_1,d_2(x_2,b_2)$	$r_1,s_2(x_2)$
STD	Store Long	60	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
STE	Store Short	70	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *
STH	Store Half Word	40	4	$r_1,d_2(x_2,b_2)$ ***	$r_1,s_2(x_2)$ ***
STM	Store Multiple	90	4	$r_1,r_3,d_2(b_2)$ *	r_1,r_3,s_2 *
STR	Service Timer Register	03	2	(Privileged)	(Privileged)
SU	Subtract Unnormalized, Short	7F	4	$r_1,d_2(x_2,b_2)$ *	$r_1,s_2(x_2)$ *

SUR	Subtract Unnormalized, Short	3F	2	r_1,r_2	r_1,r_2
SVC	Supervisor Call	0A	2	i	i
SW	Subtract Unnormalized, Long	6F	4	$r_1,d_2(x_2,b_2)$ **	$r_1,s_2(x_2)$ **
SWR	Subtract Unnormalized, Long	2F	2	r_1,r_2	r_1,r_2
TM	Test Under Mask	91	4	$d_1(b_1),i_2$	s_1,i_2
TR	Translate	DC	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
TRT	Translate and Test	DD	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
TS	Test and Set	93	4	$d_1(b_1)$	s_1
UNPK	Unpack	F3	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$
X	Exclusive OR	57	4	$r_1,d_2(x_2,b_2)$*	$r_1,s_2(x_2)$*
XC	Exclusive OR	D7	6	$d_1(l,b_1),d_2(b_2)$	$s_1(l),s_2$
XI	Exclusive OR, Immediate	97	4	$d_1(b_1),i_2$	s_1,i_2
XR	Exclusive OR	17	2	r_1,r_2	r_1,r_2
ZAP	Zero and Add Decimal	F8	6	$d_1(l_1,b_1),d_2(l_2,b_2)$	$s_1(l_1),s_2(l_2)$

* Operand 2 must be aligned on a full-word boundary.
** Operand 2 must be aligned on a double-word boundary.
*** Operand 2 must be aligned on a half-word boundary.

2.1.2.3. Instructions by Instruction Name

Instruction Name		Machine Code	Mnemonic
Add	(Native and 360/20 modes)	1A	AR ②
Add		5A	A
Add Decimal		FA	AP ②
Add Half Word	(Native and 360/20 modes)	4A	AH ②
Add Half Word	(9200/9300 mode only)	AA ③	AH ②
Add Immediate		9A	AI
Add Immediate	(9200/9300 mode only)	A6 ③	AI ②
Add Logical		1E	ALR ①

Add Logical	5E	AL ①
Add Normalized, Long	2A	ADR ①
Add Normalized, Long	6A	AD ①
Add Normalized, Short	3A	AER ①
Add Normalized, Short	7A	AE ①
Add Unnormalized, Long	2E	AWR ①
Add Unnormalized, Long	6E	AW ①
Add Unnormalized, Short	3E	AUR ①
Add Unnormalized, Short	7E	AU ①
AND	14	NR
AND	54	N

Instruction Name		Machine Code	Mnemonic
AND		94	NI ②
AND	(Native and 9200/9300 modes)	D4	NC ②
Branch and Link		05	BALR
Branch and Link	(Native and 9200/9300 modes)	45	BAL ②
Branch and Store	(360/20 mode only)	4D	BAS ②
Branch and Store	(360/20 mode only)	0D	BASR ②
Branch on Condition	(Native and 360/20 modes)	07	BCR ②
Branch on Condition		47	BC ②

Branch on Count	06	BCTR
Branch on Count	46	BCT
Branch on Index High	86	BXH ①
Branch on Index Low or Equal	87	BXLE ①
Compare	19	CR
Compare	59	C
Compare Decimal	F9	CP ②
Compare Half Word	49	CH ②
Compare Logical	15	CLR
Compare Logical	55	CL
Compare Logical	95	CLI ②

Instruction Name	Machine Code	Mnemonic
Compare Logical	D5	CLC ②
Compare, Long	29	CDR ①
Compare, Long	69	CD ①
Compare, Short	39	CER ①
Compare, Short	79	CE ①
Convert to Binary	4F	CVB
Convert to Decimal	4E	CVD
Diagnose — Privileged	83	DIAG

Divide	1D	DR ①
Divide	5D	D
Divide Decimal	FD	DP ②
Divide, Long	2D	DDR ①
Divide, Long	6D	DD ①
Divide, Short	3D	DER ①
Divide, Short	7D	DE ①
Edit	DE	ED ②
Edit and Mark	DF	EDMK ①
Exclusive OR	17	XR
Exclusive OR	57	X

Instruction Name	Machine Code	Mnemonic
Exclusive OR	97	XI
Exclusive OR	D7	XC
Execute	44	EX
Halt and Proceed — Privileged	99	HPR
Halve, Long	24	HDR ①
Halve, Short	34	HER ①
Insert Character	43	IC
Insert Storage Key — Privileged	09	ISK ①
Load	18	LR

Load	58	L
Load Address	41	LA
Load and Test	12	LTR
Load and Test, Long	22	LTDR ①
Load and Test, Short	32	LTER ①
Load Complement	13	LCR ①
Load Complement, Long	23	LCDR ①
Load Complement, Short	33	LCER ①
Load Control Storage — Privileged	B1	LCS
Load Half Word	48	LH ②
Load, Long	28	LDR ①

Instruction Name	Machine Code	Mnemonic
Load, Long	68	LD ①
Load Multiple	98	LM
Load Negative	11	LNR ①
Load Negative, Long	21	LNDR ①
Load Negative, Short	31	LNER ①
Load Positive	10	LPR ①
Load Positive, Long	20	LPDR ①
Load Positive, Short	30	LPER ①
Load PSW — Privileged	82	LPSW

Load Register		18	LR
Load, Short		38	LER ①
Load, Short		78	LE ①
Move		92	MVI ②
Move		D2	MVC ②
Move Numerics		D1	MVN ②
Move With Offset		F1	MVO ②
Move Zones	(Native and 360/20 modes)	D3	MVZ ②
Multiply		1C	MR ①
Multiply		5C	M
Multiply Decimal		FC	MP ②

Instruction Name	Machine Code	Mnemonic
Multiply Half Word	4C	MH ①
Multiply, Long	2C	MDR ①
Multiply, Long	6C	MD ①
Multiply, Short	3C	MER ①
Multiply, Short	7C	ME ①
OR	16	OR
OR	56	O
OR	96	OI ②

OR (Native and 9200/9300 modes)	D6	OC ②
Pack	F2	PACK ②
Service Timer Register — Privileged	03	STR
Set Program Mask	04	SPM
Set Storage Key — Privileged	08	SSK ①
Set System Mask — Privileged	80	SSM
Shift Left Double	8F	SLDA ①
Shift Left Double Logical	8D	SLDL ①
Shift Left Single	8B	SLA ①
Shift Left Single Logical	89	SLL
Shift Right Double	8E	SRDA ①

Instruction Name	Machine Code	Mnemonic
Shift Right Double Logical	8C	SRDL ①
Shift Right Single	8A	SRA ①
Shift Right Single Logical	88	SRL
Softscope Forward Scan — Privileged	A2	SSFS
Softscope Reverse Scan — Privileged	A3	SSRS
Start I/O — Privileged	9C	SIO
Store	50	ST
Store Character	42	STC
Store Half Word	40	STH ②

Store, Long		60	STD ①
Store Multiple		90	STM
Store, Short		70	STE ①
Subtract	(Native and 360/20 modes)	1B	SR
Subtract		5B	S
Subtract Decimal		FB	SP ②
Subtract Half Word	(Native and 360/20 modes)	4B	SH ②
Subtract Half Word	(9200/9300 mode only)	AB ③	SH ②
Subtract Logical		1F	SLR ①
Subtract Logical		5F	SL ①
Subtract Normalized, Long		2B	SDR ①

Instruction Name	Machine Code	Mnemonic
Subtract Normalized, Long	6B	SD ①
Subtract Normalized, Short	3B	SER ①
Subtract Normalized, Short	7B	SE ①
Subtract Unnormalized, Long	2F	SWR ①
Subtract Unnormalized, Long	6F	SW ①
Subtract Unnormalized, Short	3F	SUR ①
Subtract Unnormalized, Short	7F	SU ①
Supervisor Call	0A	SVC

Supervisor Load Multiple — Privileged	B8	SLM
Supervisor Store Multiple — Privileged	B0	SSTM
Test and Set	93	TS ①
Test Under Mask	91	TM ②
Translate	DC	TR ②
Translate and Test	DD	TRT
Unpack	F3	UNPK ②
Zero and Add	F8	ZAP ②

NOTES:

① Indicates instructions that are added as features.

② Indicates instruction available in native mode and in 9200/9300 and 360/20 compatibility modes, unless indicated otherwise by notes. The absence of ② indicates instruction available in native mode only.

③ Indicates instructions that execute in 9200/9300 compatibility mode only.

Instructions by Instruction Name (cont)

2.1.2.4. Instructions by Machine Code

Machine Code	Mnemonic	Instruction Name	
03	STR	Service Timer Register — Privileged	
04	SPM	Set Program Mask	
05	BALR	Branch and Link	
06	BCTR	Branch on Count	
07	BCR ②	Branch on Condition	(Native and 360/20 modes)
08	SSK ①	Set Storage Key — Privileged	
09	ISK ①	Insert Storage Key — Privileged	
0A	SVC	Supervisor Call	

Machine Code	Mnemonic	Instruction Name	
0D	BASR ②	Branch and Store	(360/20 mode only)
10	LPR ①	Load Positive	
11	LNR ①	Load Negative	
12	LTR	Load and Test	
13	LCR ①	Load Complement	
14	NR	AND	
15	CLR	Compare Logical	
16	OR	OR	

17	XR	Exclusive OR	
18	LR	Load	
19	CR	Compare	
1A	AR ②	Add	(Native and 360/20 modes)
1B	SR ②	Subtract	(Native and 360/20 modes)
1C	MR ①	Multiply	
1D	DR ①	Divide	
1E	ALR ①	Add Logical	
1F	SLR ①	Subtract Logical	
20	LPDR ①	Load Positive, Long	
21	LNDR ①	Load Negative, Long	

Machine Code	Mnemonic	Instruction Name
22	LTDR ①	Load And Test, Long
23	LCDR ①	Load Complement, Long
24	HDR ①	Halve, Long
28	LDR ①	Load, Long
29	CDR ①	Compare, Long
2A	ADR ①	Add Normalized, Long
2B	SDR ①	Subtract Normalized, Long
2C	MDR ①	Multiply, Long

Instructions by Machine Code (cont)

2D	DDR ①	Divide, Long
2E	AWR ①	Add Unnormalized, Long
2F	SWR ①	Subtract Unnormalized, Long
30	LPER ①	Load Positive, Short
31	LNER ①	Load Negative, Short
32	LTER ①	Load And Test, Short
33	LCER ①	Load Complement, Short
34	HER ①	Halve, Short
38	LER ①	Load, Short
39	CER ①	Compare, Short

Machine Code	Mnemonic	Instruction Name
3A	AER ①	Add Normalized, Short
3B	SER ①	Subtract Normalized, Short
3C	MER ①	Multiply, Short
3D	DER ①	Divide, Short
3E	AUR ①	Add Unnormalized, Short
3F	SUR ①	Subtract Unnormalized, Short
40	STH ②	Store Half Word
41	LA	Load Address

42	STC	Store Character	
43	IC	Insert Character	
44	EX	Execute	
45	BAL ②	Branch and Link	(Native and 9200/9300 modes)
46	BCT	Branch on Count	
47	BC ②	Branch on Condition	
48	LH ②	Load Half Word	
49	CH ②	Compare Half Word	
4A	AH ②	Add Half Word	(Native and 360/20 modes)
4B	SH ②	Subtract Half Word	(Native and 360/20 modes)
4C	MH ①	Multiply Half Word	

Machine Code	Mnemonic	Instruction Name	
4D	BAS ②	Branch and Store	(360/20 mode only)
4E	CVD	Convert to Decimal	
4F	CVB	Convert to Binary	
50	ST	Store	
54	N	AND	
55	CL	Compare Logical	
56	O	OR	
57	X	Exclusive OR	

58	L	Load
59	C	Compare
5A	A	Add
5B	S	Subtract
5C	M	Multiply
5D	D	Divide
5E	AL ①	Add Logical
5F	SL ①	Subtract Logical
60	STD ①	Store, Long
68	LD ①	Load, Long
69	CD ①	Compare, Long

Machine Code	Mnemonic	Instruction Name
6A	AD ①	Add Normalized, Long
6B	SD ①	Subtract Normalized, Long
6C	MD ①	Multiply, Long
6D	DD ①	Divide, Long
6E	AW ①	Add Unnormalized, Long
6F	SW ①	Subtract Unnormalized, Long
70	STE ①	Store, Short
78	LE ①	Load, Short

79	CE ①	Compare, Short
7A	AE ①	Add Normalized, Short
7B	SE ①	Subtract Normalized, Short
7C	ME ①	Multiply, Short
7D	DE ①	Divide, Short
7E	AU ①	Add Unnormalized, Short
7F	SU ①	Subtract Unnormalized, Short
80	SSM	Set System Mask — Privileged
82	LPSW	Load PSW — Privileged
83	DIAG	Diagnose — Privileged
86	BXH ①	Branch on Index High

Machine Code	Mnemonic	Instruction Name
87	BXLE ①	Branch on Index Low or Equal
88	SRL	Shift Right Single Logical
89	SLL	Shift Left Single Logical
8A	SRA ①	Shift Right Single
8B	SLA ①	Shift Left Single
8C	SRDL ①	Shift Right Double Logical
8D	SLDL ①	Shift Left Double Logical
8E	SRDA ①	Shift Right Double

8F	SLDA ①	Shift Left Double
90	STM	Store Multiple
91	TM ②	Test Under Mask
92	MVI ②	Move Immediate
93	TS ①	Test and Set
94	NI ②	AND
95	CLI ②	Compare Logical
96	OI ②	OR
97	XI	Exclusive OR
98	LM	Load Multiple
99	HPR	Halt and Proceed — Privileged

Machine Code	Mnemonic	Instruction Name	
9A	AI	Add Immediate	
9C	SIO	Start I/O — Privileged	
A2	SSFS	Softscope Forward Scan — Privileged	
A3	SSRS	Softscope Reverse Scan — Privileged	
A6 ③	AI ②	Add Immediate	(9200/9300 mode only)
AA ③	AH ②	Add Half Word	(9200/9300 mode only)
AB ③	SH ②	Subtract Half Word	(9200/9300 mode only)
B0	SSTM	Supervisor Store Multiple — Privileged	

B1	LCS	Load Control Storage — Privileged	
B8	SLM	Supervisor Load Multiple — Privileged	
D1	MVN ②	Move Numerics	
D2	MVC ②	Move	
D3	MVZ ②	Move Zones	(Native and 360/20 modes)
D4	NC ②	AND	(Native and 9200/9300 modes)
D5	CLC ②	Compare Logical	
D6	OC ②	OR	(Native and 9200/9300 modes)
D7	XC	Exclusive OR	
DC	TR ②	Translate	
DD	TRT	Translate and Test	

Machine Code	Mnemonic	Instruction Name
DE	ED ②	Edit
DF	EDMK ①	Edit and Mark
F1	MVO ②	Move With Offset
F2	PACK ②	Pack
F3	UNPK ②	Unpack
F8	ZAP ②	Zero and Add
F9	CP ②	Compare Decimal
FA	AP ②	Add Decimal

FB	SP ②	Subtract Decimal
FC	MP ②	Multiply Decimal
FD	DP ②	Divide Decimal

NOTES:

① Indicates instructions that are added as features.

② Indicates instruction available in native mode and in 9200/9300 and 360/20 compatibility modes, unless indicated otherwise by notes. The absence of ② indicates instruction available in native mode only.

③ Indicates instructions that execute in 9200/9300 compatibility mode only.

Extended Mnemonic Codes for Branch on Condition Instructions

RR-Type Instructions		RX-Type Instructions		BC Equivalent		Function
Mnemonic Code	Hexadecimal Operation Code m_1	Mnemonic Code	Hexadecimal Operation Code m_1	Explicit Form		
BR	07 F	–	–	BCR	$15,r_2$	Branch unconditionally
NOPR	07 0	–	–	BCR	$0,r_2$	No operation
–	–	B	47 F	BC	$15,d_2(x_2,b_2)$	Branch unconditionally
–	–	NOP	47 0	BC	$0,d_2(x_2,b_2)$	No operation
Used After Comparison Instructions						
BHR	07 2	BH	47 2	BC	$2,d_2(x_2,b_2)$	Branch if high
BLR	07 4	BL	47 4	BC	$4,d_2(x_2,b_2)$	Branch if low
BER	07 8	BE	47 8	BC	$8,d_2(x_2,b_2)$	Branch if equal
BNHR	07 D	BNH	47 D	BC	$13,d_2(x_2,b_2)$	Branch if not high
BNLR	07 B	BNL	47 B	BC	$11,d_2(x_2,b_2)$	Branch if not low
BNER	07 7	BNE	47 7	BC	$7,d_2(x_2,b_2)$	Branch if not equal

Extended Mnemonic Codes for Branch on Condition Instructions (cont)

Used After Test-Under-Mask Instructions						
BOR	07 1	BO	47 1	BC	1,$d_2(x_2,b_2)$	Branch if all ones
BZR	07 8	BZ	47 8	BC	8,$d_2(x_2,b_2)$	Branch if all zeros
BMR	07 4	BM	47 4	BC	4,$d_2(x_2,b_2)$	Branch if mixed
BNOR	07 E	BNO	47 E	BC	14,$d_2(x_2,b_2)$	Branch if not all ones
BNZR	07 7	BNZ	47 7	BC	7,$d_2(x_2,b_2)$	Branch if not all zeros
BNMR	07 B	BNM	47 B	BC	11,$d_2(x_2,b_2)$	Branch if not mixed
Used After Arithmetic Instructions						
BOR	07 1	BO	47 1	BC	1,$d_2(x_2,b_2)$	Branch if overflow
BZR	07 8	BZ	47 8	BC	8,$d_2(x_2,b_2)$	Branch if zero
BMR	07 4	BM	47 4	BC	4,$d_2(x_2,b_2)$	Branch if minus
BPR	07 2	BP	47 2	BC	2,$d_2(x_2,b_2)$	Branch if positive
BNOR	07 E	BNO	47 E	BC	14,$d_2(x_2,b_2)$	Branch if not overflow
BNZR	07 7	BNZ	47 7	BC	7,$d_2(x_2,b_2)$	Branch if not zero
BNMR	07 B	BNM	47 B	BC	11,$d_2(x_2,b_2)$	Branch if not minus
BNPR	07 D	BNP	47 D	BC	13,$d_2(x_2,b_2)$	Branch if not positive

Condition Code Settings

Condition Codes	0	1	2	3
Binary Mask	**1000**	**0100**	**0010**	**0001**
Fixed-Point and Decimal Instructions				
Add (A, AH, AI, AR, AP)	=0	<0	>0	Overflow
Compare (C, CH, CR, CP)	op1=op2	<op2	>op2	No cc
Load complement (LCR)	=0	<0	>0	Overflow
Load negative (LNR)	=0	<0	No cc	No cc
Load positive (LPR)	=0	No cc	>0	Overflow
Load and test register (LTR)	=0	<0	>0	No cc
Subtract (S, SH, SR, SP)	=0	<0	>0	Overflow
Shift left (SLA,SLDA)	=0	<0	>0	Overflow
Shift right (SRA,SRDA)	=0	<0	>0	No cc
Zero and add (ZAP)	=0	<0	>0	Overflow

Floating-Point Instructions				
Add norm, long (AD, ADR) and short (AE, AER)	=0	<0	>0	No cc
Add unnorm, long (AW, AWR) and short (AU, AUR)	=0	<0	>0	No cc
Compare, long (CD, CDR) and short (CE, CER)	op1=op2	<op2	>op2	No cc
Load complement, long and short (LCDR, LCER)	=0	<0	>0	No cc
Load negative, long and short (LNDR, LNER)	=0	<0	No cc	No cc
Load positive, long and short (LPDR, LPER)	=0	No cc	>0	No cc
Load and test, long and short (LTDR, LTER)	=0	<0	>0	No cc
Sub norm, long (SD, SDR) and short (SE, SER)	=0	<0	>0	No cc
Sub unnorm, long (SW, SWR) and short (SU, SUR)	=0	<0	>0	No cc
Logical Instructions				
Add logical (AL, ALR)	=0, no carry*	≠0, no carry	=0, carry	≠0, carry
Compare logical (CL, CLC, CLI, CLR)	op1=op2	<op2	>op2	No cc

*Carry is out of the most significant bit position.

Condition Code Settings (cont)

Condition Codes	0	1	2	3
Binary Mask	1000	0100	0010	0001
Logical Instructions (cont)				
Edit (ED) Edit and mark (EDMK)	=0	≠0, and plus sign not detected	>0	No cc
AND (N, NC, NI, NR)	=0	≠0	No cc	No cc
OR (O, OC, OI, OR)	=0	≠0	No cc	No cc
Subtract logical (SL, SLR)	No cc	≠0, no carry	=0, carry	≠0, carry
Test under mask (TM)	=0	=mixed	No cc	=1
Translate and test (TRT)	=0	before last ≠0	Last≠0	No cc

Exclusive OR (X, XC, XI, XR)	=0	≠0	No cc	No cc
Status Switching Instructions				
Load control storage (LCS)	=incomplete data transfer	=complete data transfer	No cc	=complete data transfer hash total error
Load program status word (LPSW)	Set=bit positions 34 and 35 of op1			
Set program mask (SPM)	Set=bit positions 2 and 3 of op1			
Supervisor call (SVC)	Set=bit positions 34 and 35 of SVC new PSW			
Test and set (TS)	=0	=1	No cc	No cc

Condition Codes	0	1	2	3
Binary Mask	**1000**	**0100**	**0010**	**0001**
Diagnostic Instructions				
Diagnose (DIAG)	=0	No cc	No cc	No cc
Soft scope forward scan (SSFS)	SYNC detected	No cc	No cc	SYN not detected
Soft scope reverse scan (SSRS)	0=SYNC detected 1st buffer iteration	1=SYNC not detected 1st buffer iteration	2=SYNC detected subsequent iteration	3=SYNC not detected subsequent iteration

Interval Timer Instruction				
Service timer register (STR)	0=ITR contents (ITR pending)	1=timer interrupt request pending, ITC contains overrun count in twos complement (overrides 0)	2=interrupt point not reached, ITR contains residue count of previously loaded value	3=timer interrupt request reset

Edit Instruction Settings

Mask (Operand 1) Character	EBCDIC/ASCII	S Switch Status	Data (Operand 2) Character	Resulting (Operand 1) Character	Resulting S Switch Status
Fill character	Any	Off	Not examined	Remains same	Off
Digit select byte	20	On	Nonzero	Digit	On*
		On	Zero	Digit	On*
		Off	Nonzero	Digit	On*
		Off	Zero	Fill character	Off
Significance start byte	21	On	Nonzero	Digit	On*
		On	Zero	Digit	On*
		Off	Nonzero	Digit	On*
		Off	Zero	Fill character	On*

Mark (Operand 1) Character	EBCDIC/ASCII	S Switch Status	Data (Operand 2) Character	Resulting (Operand 1) Character	Resulting S Switch Status
Message character	Any except 20, 21 22	On	Not examined	Message character	On*
		Off	Not examined	Fill character	Off*
Field separator byte	22	On	Not examined	Fill character	Off
		Off	Not examined	Fill character	Off

*Sign detection (examined simultaneously with operand 2 digit) affects the S switch as follows:

A plus or minus sign detected as most significant digit causes data exception.
A plus sign detected as a least significant digit causes S switch to be turned off.
A minus sign has no effect on the S switch.

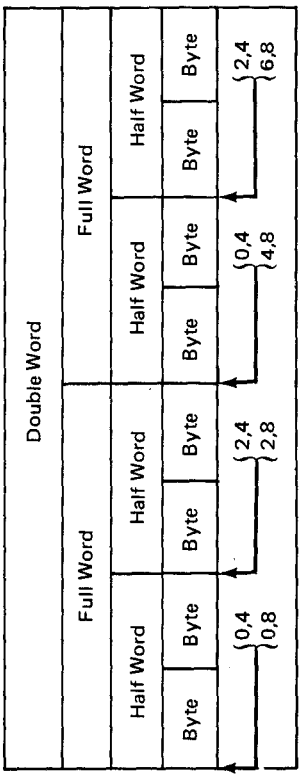
Assembler Operators

Class	Operator	Description	Hierarchy
Arithmetic	*/	A*/B is equivalent to $A*2^B$.	6
	//	Covered quotient; A//B is equivalent to (A + B – 1)/B.	5
	/	A/B means arithmetic quotient of A and B.	5
	*	A*B means arithmetic product of A and B.	5
	–	A–B means arithmetic difference of A and B.	4
	+	A+B means arithmetic sum of A and B.	4
Logical	**	A**B means logical product AND of A and B.	3
	++	A++B means logical sum OR of A and B.	2
	––	A– –B means logical differences XOR of A and B.	2
Relational	=	A=B has value 1 if true; has value 0 if false.	1
	>	A>B has value 1 if true; has value 0 if false.	1
	<	A<B has value 1 if true; has value 0 if false.	1

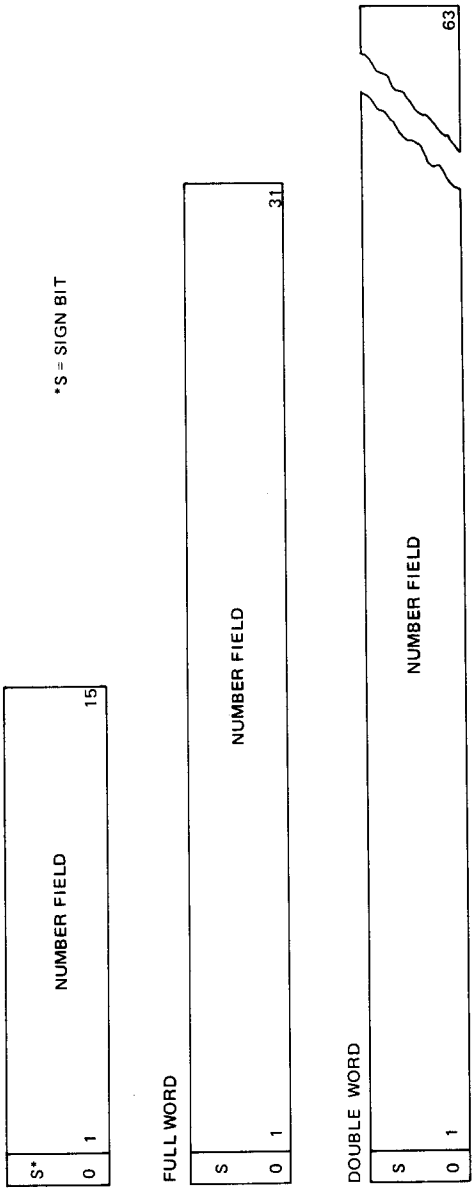
NOTE:

The hierarchy numbers mean that operations with the higher numbers are performed first. Operations are performed from left to right.

2.1.7. Assembler CNOP Alignment



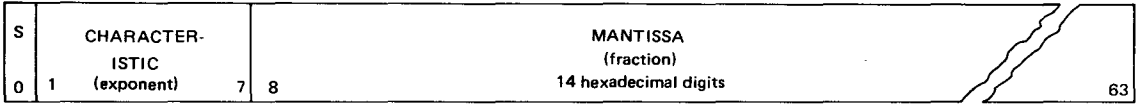
Fixed-Point Numbers



Floating-Point Numbers

FULL WORD (SHORT FORMAT)

DOUBLE WORD (LONG FORMAT)



*S = SIGN BIT

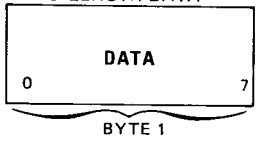
Decimal Numbers

UNPACKED NUMBERS

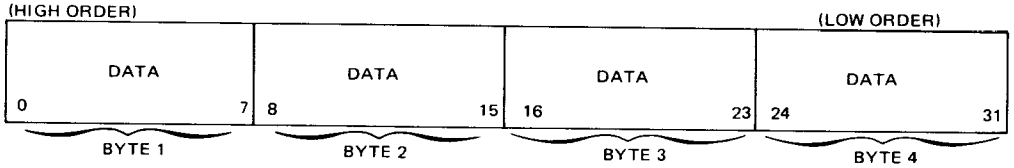
PACKED NUMBERS

Logical Information

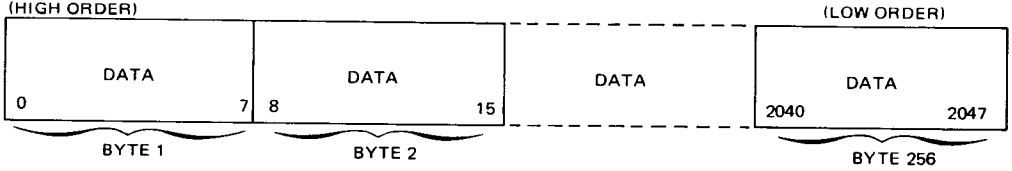
FIXED-LENGTH DATA



FULL WORD



VARIABLE-LENGTH DATA



Data Boundary Alignments

To align data on double-word, full-word, and half-word main storage boundaries, use the following source code statement formats:

LABEL	OPERATION	OPERAND	COMMENTS
	DS	ØD	DOUBLE WORD
	DS	ØF	FULL WORD
	DS	ØH	HALF WORD

To align data or instructions on double-word, full-word, or half-word main storage boundaries, use the following directive formats:

LABEL	OPERATION	OPERAND	COMMENTS
	CNOP	Ø,4	Ø BYTE OFFSET FROM FULL-WORD BOUNDARY
	CNOP	2,4	2 BYTE OFFSET FROM FULL-WORD BOUNDARY
	CNOP	Ø,8	Ø BYTE OFFSET FROM DOUBLE-WORD BOUNDARY
	CNOP	2,8	2 BYTE OFFSET FROM DOUBLE-WORD BOUNDARY
	CNOP	4,8	4 BYTE OFFSET FROM DOUBLE-WORD BOUNDARY
	CNOP	6,8	6 BYTE OFFSET FROM DOUBLE-WORD BOUNDARY

Data and Storage Definition Statement Conventions

Operation	Operand	Comments
Fixed Point		
DC	[d] t[L_n] {'c' / (c)}	d = duplication factor in decimal t = definition type constant* L_n = explicit length factor in decimal 'c' = the constant specification for data (c) = the constant specification for an address
DS	[d] t[L_n] ['c' / (c)]	
Floating Point		
DC	[d] t[L_n] [S+n] 'c[E±n]'	S+n = scale modifier 'c[E±n]' = the constant specification with optional exponent

*See assembler DEFINE CONSTANT (DC) and DEFINE STORAGE (DS) types.

Data and Storage Definition Statement Conventions (cont)

Type Code	Constant or Storage Type	Alignment	Source Code Specification		Storage Format	Truncation or Padding	Length in Bytes		
							Implied	Minimum Explicit	Maximum Explicit *
C	Character	None	Characters	C' '	Character	Right	Variable	1	256 (DC) 65,535 (DS)
X	Hexadecimal	None	Hexadecimal digits	X' '	Hexadecimal	Left	Variable	1	256 (DC) 65,535 (DS)
B	Binary	None	Binary digits	B' '	Binary	Left	Variable	1	256
P	Packed decimal	None	Decimal digits	P' '	Packed decimal	Left	Variable	1	16
Z	Zoned decimal	None	Decimal digits	Z' '	Character	Left	Variable	1	16
H	Half word, fixed point	Half word	Decimal digits	H' '	Fixed-point binary	Left	2	1	8

F	Full word, fixed point	Full word	Decimal digits	F' '	Fixed-point binary	Left	4	1	8
Y	Half-word address	Half word	Expression	Y( )	Binary	Left	2	1	2
A	Full-word address	Full word	Expression	A( )	Binary	Left	4	1	4
S	Base and displacement	Half word	One or two expressions	S( )	Base and displacement	None	2	2	2
V	External address	Full word	Relocatable symbol	V( )	Binary	Left	4	3	4
E	Full word, floating point	Full word	Decimal digits	E' '	Floating-point binary normalized	Right	4	1	8
D	Double word, floating point	Double word	Decimal digits	D' '	Floating-point binary normalized	Right	8	1	8

*Maximum explicit lengths consider duplication factors.

Label	Operation	Operand	Description
[symbol]	CCW	op_1,op_2,op_3,op_4	Initiates I/O operations
unused	CNOP	a_1,a_2	Adjusts the location counter to a half-word, full-word, or double-word main storage boundary
[symbol]	COM	unused	Defines a control section that is a main storage area common to two or more separately assembled routines
unused	COPY	symbol	Source module, identified by the operand field symbol, is taken from a library and included in the source program being assembled.
[symbol]	CSECT	unused	Indicates to the assembler the initiation or continuation of a control section

unused	DROP	r_1 [,...,r_n]	Informs the assembler that the specified registers are not available for base register assignment
[symbol]	DSECT	unused	Defines a data storage area permitting one or more programs to use indirect symbolic addressing for the same record
unused	EJECT	unused	Advances the printer form to the next page for continued listing
[symbol]	END	[e]	Indicates the end of a source module or a macro definition being assembled
unused	ENTRY	symbol [,symbol,...,symbol]	Declares the symbols defined within the module to which reference is made by other modules

Basic Assembler Directives (cont)

Label	Operation	Operand	Description
symbol	EQU	e[,a]	Defines symbols (primarily length and value of a symbol)
unused	EXTRN	symbol [,symbol,..., symbol]	Specifies symbols referred to in the module being assembled but defined in some other module
unused	ICTL	[beginning column] [,ending column] [,continuation column]	Specifies new values for the beginning, ending, and continuation coding columns
unused	ISEQ	[leftmost column ,rightmost column]	Specifies the columns of the source statement that contain the field used for checking the sequence of statements

[symbol]	LTORG	unused	Generates all literals previously defined into a data pool within the source program
mnemonic operation code	OPSYM	unused	Tells assembler not to accept the mnemonic operation code specified in the label field
[symbol]	ORG	[e]	Sets or resets the location counter to a specified value

Label	Operation	Operand	Description
unused	PRINT	[{**ON** / OFF}] [,{**GEN** / NOGEN}] [,{DATA / **NODATA**}] [,{**SINGLE** / DOUBLE}]	Enables the programmer to control the contents of the assembly listing

Basic Assembler Directives (cont)

unused	PUNCH	'c_1,...,c_{80}'	Produces a record at assembly time and is used to produce job control card images to precede or follow the object module
unused	REPRO	unused	Reproduces a record in its entirety (columns 1 through 80) at assembly time; the record precedes or follows the object module.
unused	SPACE	[i]	Advances the paper in the printer a specified number of lines
[symbol]	START	[a]	Defines the name of the first control section, the program name, and the initial value of the location counter

Basic Assembler Directives (cont)

Label	Operation	Operand	Description
unused	TITLE	'c'	Provides data for the heading which appears at the top of each page of the assembler listing and advances the printer form to a new page
unused	USING	$v,r_1[,...,r_n]$	Informs the assembler that a specified register is available for base register assignment and that it will contain a specific value at execution time

Legend:

a = an absolute or relocatable expression
e = a relocatable expression
c = a character string
i = an unsigned decimal integer
r = a register
v = a relocatable or absolute value

Label	Operation	Operand	Description
unused	ACTR	SETA expression	Used to limit the number of AGO, AIF, GOTO, AGOB, AIFB, and GO statements that may be processed by the assembler within a macro definition or source program
[.s_1]	{AGO / AGOB / GOTO}	.s_2	Unconditionally alters the sequence of source statement processing
[.s_1]	{AIF / AIFB}	(b).s_2	Conditionally alters the sequence of source statement processing
.s	{ANOP / LABEL}	unused	Facilitates branching to a point in a program when a statement is unavailable to define the branch destination
[&varisymb]	DO	aa	Defines the start of a range of code to be generated repetitively and specifies the number of times it is to be generated
unused	ENDO	unused	Signals the end of range of a DO statement

Conditional Assembler Statements (cont)

Label	Operation	Operand	Description
unused	{GBL / GBLA / GBLB / GBLC}	$s_1[,s_2,\ldots,s_n]$	Declares general-purpose, arithmetic, Boolean, or character global set symbols, respectively
unused	{LCL / LCLA / LCLB / LCLC}	$s_1[,s_2,\ldots,s_n]$	Declares general-purpose, arithmetic, Boolean, or character local set symbols, respectively
unused	MEXIT	unused	Indicates to the assembler that the processing of a macro definition should be terminated before ending normally with a MEND statement
unused	MNOTE	{'m' / Δ,'m' / S,'m' / *,'m'}	Generates error message or comments on assembly listing
unused	PNOTE	{* / 'e'},'m'	Generates error message or comments on assembly listing

&s	SET	{ae / ce}	Assigns arithmetic or character-string value to variable symbol declared by LCL or GBL statement
&s	SETA	a	Assigns arithmetic value to variable symbol declared by LCLA or GBLA statement
&s	SETB	b	Assigns binary value of 0 or 1 to variable symbol declared by LCLB or GBLB statement
&s	SETC	c	Assigns character value to variable symbol declared by LCLC or GBLC statement

LEGEND:

a = a valid SETA term or arithmetic combination of valid SETA terms
b = a valid logical expression, a 0, or a 1, which must be enclosed in parentheses
(b) = a SETB logical expression enclosed in parentheses
c = a valid SETC operand
'e' = a character expression
aa = a valid SETA expression or a valid SET expression written in a macro definition
ae = a valid arithmetic expression
ce = a valid character expression
'm' = a message

.s = a sequence symbol
$.s_1$ = a sequence symbol
$.s_2$ = a sequence symbol defined in a following source code statement
S = a severity code
$s_1, s_2, \ldots, s_n$ = set symbol names
&s = set symbol declared by the appropriate local or global set symbol (i.e., LCL, GBL, LCLA, GBLA, etc)
&varisymb = an optional variable symbol
* = indicates that the message that follows is informational and not an error
Δ = blank

Macro Definition Statements (Proc Format)

Proc Construction

	Label	ΔOperationΔ	Operand	Description
HEADING	[&symbol]	PROC	[&pos,n] [,&key$_1$=,...,&key$_m$=]	Signals start of procedure definition
	call-name	NAME	[pos-0]	Names the procedure called
BODY	[{symbol / &symbol / .symbol}]	mnemonic-code . . . mnemonic-code	operands . . . operands	
TRAILER	unused	END	unused	Indicates end of procedure definition

Macro Definition Statements (Macro Format)

Macro Construction

	Label	△Operation△	Operand	Description
HEADING	unused	MACRO	unused	Signals start of procedure definition
	[&symbol]	call-name	[&pos$_1$,...,&pos$_n$] [,&key$_1$=,...,&key$_m$=]	Names the procedure called
BODY	[{ symbol / &symbol / .symbol }]	mnemonic-code . . . mnemonic-code	operands . . . operands	
TRAILER	unused	MEND	unused	Indicates end of procedure definition

2.3.5. Macro Call Instruction Format

Macro Call Instruction Format

Label	△Operation△	Operand
[symbol]	call-name	$[p_1,p_2,\ldots p_{252}]$

Label △ Operation △ Operand	Description
//[symbol] ALTER [phase-name] [,address] [,change] [,{RESET / ORG}]	Introduces load module alterations at execution time
//[symbol] ALTJCS [file-label-id] [,{vol-ser-no / RES / RUN}] [,rpw] [,{FREE / ONLY / OFF / ON}] [,LUN=nnn]	Specifies an alternate library file (one other than YJCS) to be searched for jprocs
//[symbol] CAT lfdname[,catpw] [,SCR] [,{GEN=nn / MEM}]	Causes a file to be cataloged
//[symbol] CC {command / 'command and parameters'}	Allows OS/3 system console and workstation commands to be issued from control stream

Label △ Operation △ Operand	Description
//[symbol] CR	Allows input from card reader to be inserted in control stream
// DATA FILEID=file-identifier[,RETAIN] [,IGNORE]	Loads card data to a spool file
// DATA STEP=nnn	Allows you to replace embedded data sets for one run of a job
//[symbol] DD [{ RCFM / RCFMn } = { FIXBLK / FIXUNB / UNDEF / VARBLK / VARUNB }] } [, { BKSZ / BKSZn } =n] [[, { RCSZ / RCSZn } =n]	Allows changes to certain DTF keywords at run time

$$\left[,\left\{\begin{matrix}\text{LACE}\\\text{LACEn}\end{matrix}\right\}=n\right]\left[,\left\{\begin{matrix}\text{SIZE}\\\text{SIZEn}\end{matrix}\right\}=\left\{\begin{matrix}n\\\text{AUTO}\end{matrix}\right\}\right]$$

$$\left[,\left\{\begin{matrix}\text{UOS}\\\text{UOSn}\end{matrix}\right\}=n\right]$$

$$\left[,\left\{\begin{matrix}\text{KLEN}\\\text{KLENn}\end{matrix}\right\}=n\right]\left[,\left\{\begin{matrix}\text{KLOC}\\\text{KLOCn}\end{matrix}\right\}=n\right]$$

[,INDS=n]

$$\left[,\text{ACCESS}=\left\{\begin{matrix}\text{EXC}\\\text{EXCR}\\\text{SRDO}\\\text{SRD}\\\text{SADD}\end{matrix}\right\}\right]$$

$$\left[,\text{REWIND}=\left\{\begin{matrix}\text{NORWD}\\\text{UNLOAD}\end{matrix}\right\}\right]$$

Label△Operation△Operand	Description
[,OPRW=NORWD] [,CLRW={NORWD / RWD}] [,FILABL={NO / NSTD / STD}] [,TPMARK=NO] [,RECV={YES / FCE}] [,VSEC={YES / n}][,VMNT={ONE / NO}][,RCB={NO / YES}] [,OFFSET=1]	
//[symbol] DECAT lfdname[,catpw] [,SCR] [,{GEN / ROL}]	Causes a file to be removed from the catalog
//[symbol] DST dest-1[,dest-2,...,dest-16]	Supplies the destination identification of a remote device for spool output

//[symbol] DVC { nnn[(n)] / RES / RUN } [, { addr / ALT / IGNORE / OPT / I / O / REQ[(n)] / REAL }]	Requests assignment of peripheral devices to a job
//[symbol] DVC PROG [,program-name] [,label] [,HOST=host-id]	Used in place of // DVC when the device assignment set is for a program-to-program type file
//[symbol] EQU lun-1,type-1[,lun-2,type-2,...,lun-n,type-n]	Equates logical unit numbers to specific code for device type
//[symbol] EXEC program-name [, { library-name / YRUN / YLOD }] [,[±] switch-priority] [,ABNORM=label]	Provides the name of the load module to be executed

Label △ Operation △ Operand	Description
//[symbol] EXT { DA / IS / IR / MI / NI / SQ / ST } [,{ C / CF / F }] [,{ inc / 0 / 1 }] [{ addr / Tccc:hh / BLK / TBLK / CYL / ,TRK / OLD }] [,{ mi / (bi[,ai]) }] [,{ mj / (bj[,aj]) }] ,...] [,OLD]	Obtains disk space; provides information needed to create new files or extend existing files stored on disk
//[symbol] EXT SQ,C,0,BLK,(bi,ai)	Obtains diskette space; provides information needed to create new files

//[symbol] FIN	Terminates card reader operation
//[symbol] FREE lfdname-1[(DEV)],...,lfdname-n[(DEV)]	Releases peripheral devices assigned to job and not required in later job steps
//[symbol] GBL set-id-1[=init-1][,set-id-2[=init-2],...,set-id-n[=init-n]]	Assigns global status to a set symbol
//[symbol] GO destination	Causes an unconditional branch, in a foward direction, to another job control statement
//[symbol] IF (a op b) destination	Causes a conditional branch, in a forward direction, to another job control statement
//[symbol] JNOTE comment-line [,destination-1,...,destination-n] ③	Used to communicate with the system console operator, specific workstations identified by user-id, or the originating workstation

Job Control Statements (cont)

Label △Operation △Operand	Description
//[symbol] JOB jobname [, {P / H / **N**}] [,min] [,max] [, {tasks / **1**}] [, {max-time / SUP}] [,print-option-list] [,acct-no] [,nXm] [, {ACT / LOG / NOACT / NOLOG / NONE / BOTH}] [, {NOHDR / **HDR**}]	Indicates the beginning of control information for a job
//symbol JSET value	Assigns local status to a set symbol
//[symbol] LBL {file-identifier / 'file-identifier'} [, {file-serial-number / VCHECK}]	Supplies label information for files on disk and tape volumes for use by data management

[,expiration-date] [,creation-date] [,{file-sequence-number / 1}] [,{generation-number / 1}] [,{version-number / 1}]	
//[symbol] LBL { [qualifier/] level-id-1 [,level-id-2...[,level-id-n]] [{+n / -n / nn}] [(rpw/wpw)] / '[qualifier/] level-id-1 [,level-id-2...[,level-id-n]] [{+n / -n / nn}] [(rpw/wpw)]' } [,{file-serial-number / VCHECK}] [,expiration-date] [,creation-date] [,{file-sequence-number / 1}] [,{generation-number / 1}] [,{version-number / 1}]	Supplies file catalog information for files on disk and tape volumes

Label △Operation △Operand	Description
//[symbol] LCB [{C'char-string-1' / X'hex-string-1'}] [,{C'char-string-2' / X'hex-string-2'},...,{C'char-string-n' / X'hex-string-n'}] [,CARTNAME=symbol] [,NAME={48-BUS / 48-SCI / 63-STD / OWNLC1 / OWNLC2}] [,CARTID={C'c' / X'aa'}] [,NUMBCHAR=n] [,TYPE={**0773** / 0768 / 0770 / 0776 / 0778}] [,SPACE={C'c' / X'aa' / **X'40'**}] [,MISM={**IGNORE** / REPORT}]	Allows overriding of SYSGEN load code buffer parameters. Note that only underlined letters on these operands are required; however, the entire word may be specified.

[,DUAL= { C'abababab' / C'bbbb' / X'yyyyyyyy' / X'xxyyxxyyxxyyxxyy' }] [,MISMCHAR= { C'c' / X'aa' / X'40' }]	
//[symbol] LFD { filename / *filename } [,{ n / 8 }] [,{ ACCEPT / EXTEND / INIT / RELOD / PREP }]	Links file information in control stream with data management file definition
//[symbol] MTC lfdname, { BB,nn / BM,nn / FB,nn / FM,nn / WM,nn / RL / RU }	Positions tape volumes before or after the execution of a job step
//[symbol] NOP [QUERY]	Inserts labels to be used as targets of branch or SKIP statements

Job Control Statements (cont)

Label △Operation △Operand	Description
//[symbol] OPR comment-line ① [,destination-1,...,destination-n] ③	Displays messages at the system console, the master workstation, or individual workstations identified by user-id
//[symbol] OPTION p_1,...,p_n ② ③ ABRDUMP,ACN=account-number,BOF,BUF=nXm,DOF, DUMP,EOD=xx,GABRDUMP,GDUMP,GJODUMP,GO,GSYSDUMP, HDR={NOHDR / HDR},HOLD,JOBDUMP,LINK, LOG={logical-unit-number / ORIGINATOR / CENTRAL},MASTER=destination, MASTER=destination(EXEC),MAX=maximum-main-storage-size, MERGE=NO,MIN=minimum-main-storage-size,MXT=maximum-time, NOSCHED,NOSCHED:(alt-filename[,{RES / RUN / vsn}] [,write-password]), NSCAN,NSRCH,NSUB,NULL,OFT=+n,OPL=option-list,	Allows user to specify certain optional software features and operating environment

[ORIGINATOR=destination,OUT={ORIGINATOR / CENTRAL / [host-id:] user-id}, PRI=switch-priority,PRT={ACT / LOG / NOACT / NOLOG / NONE / BOTH},QUERY,REPEAT,SAVE, SAVE:(alt-filename[,{RES / RUN / vsn}] [,write-password]),SCAN, SEVERE,SIG,SUB,SYSDUMP,TEST,TRACE,TSK=number-of-tasks, UNDEFINED,UNEQUAL,XUF]	
//[symbol PARAM operand-1[,...,operand-n]	Used to submit information to a program during its execution
//[symbol] PAUSE comment-line ① [,destination-1,...,destination-n] ③	Displays messages at the system console, the master workstation, or other workstations identified by user-id, and halts the job until the appropriate response is made

Job Control Statements (cont)

Label △Operation △Operand	Description
//[symbol] QGBL set-id-1[=init-1] [,set-id-2[=init-2],...,set-id-n[=init-n]]	Allows you to change the value of global set symbols at run time from the workstation
//[symbol] QUAL [qualifier]	Appends a qualifier to subsequent file identifiers in the job
//[symbol] REN lfdname, {new-label / 'new-label'} [,NTERM]	Permanently changes (renames) the label of a disk file
//[symbol] ROUTE destination-1[,...,destination-8]	Routes spooled output (print or punch) to DDP sites and auxiliary workstation printers
//[symbol] RST filename,checkpoint-id,number [,jobname[(rename)] [,pri] [,key-1=val-1,...,key-n=val-n]]	Restarts a program from a checkpoint

//[symbol] RUN [{jobname[(new-name)]} / {(new-name)}] [{:alt-filename / :(alt-filename, {RES / RUN / vsn}) / :(alt-filename, {RES / RUN / vsn}, read-password)}] [, {PRE / HIGH / NOR}] [,key-1=val-1,...,key-n=val-n]	Initiates the reading of a job control stream that requires the use of an input device (i.e., card reader, diskette, or spool file)
//[symbol] RV jobname[(new-name)] [{:alt-filename / :(alt-filename, {RES / RUN / vsn}) / :(alt-filename, {RES / RUN / vsn}, read-password)}] [, {PRE / HIGH / NOR}] [,key-1=val-1,...,key-n=val-n]	Initiates the reading of a job control stream that does not reside in a card reader, diskette, or spool file and that does not contain a // CR statement

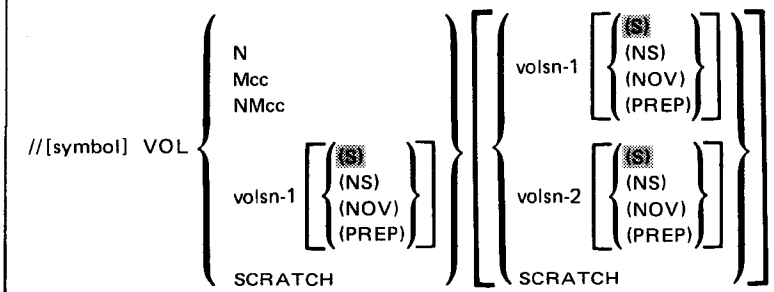
//[symbol] SCR lfdname [, { DATE [,yyddd] / PRE [,aaaa] }]	Scratches unwanted files
//[symbol] SET DATE,yy/mm/dd[,yyddd] [,yyddd] //[symbol] SET UPSI,switch-setting //[symbol] SET COMREG,char-string	Sets or modifies date field, user program switch indicator, or communications region in the job preamble
//[symbol] SFT { module-1 [,...,module-n] [,DLOAD=[([calls], {expansion-limit / MAX})]] / DLOAD=[([calls], {expansion-limit / MAX})] }	Identifies shared-code data management modules required by user job, overrides SYSGEN limits for dynamic expansion of the user job region, and allows dynamic expansion of the user job region for externally referenced program modules
//[symbol] SKIP target-label[,mask]	Identifies the target control statement of a branch control statement

Job Control Statements (cont)

Label △Operation △Operand	Description
//[symbol] SPL { HOLD / RETAIN / DUMP / DISK / TAPE } [,nXm] [, { no-cop / **1** }] [, { no-skpcode / **7** }] [, { max-rec / **5120** }] [,forms] [, { NOHDR / **HDR** }] [,NOTSTL] [,brk-pge] [,NOUPD] [,NOCMP] [,RETAIN] [,HOLD] [,SECURE]	Controls the spooling environment
//[symbol] UID { user-id-1 / (addr-1) / user-id-1 (addr-1) } [,..., { user-id-255 / (addr-255) / user-id-255 (addr-255) }]	Allows you to specify a workstation by user-id, or the system master workstation by specifying YMAS
//[symbol] USE DP, dialog-name[printer-lfd] [,new-audit-lfd] [,old-audit-lfd]	Used as part of a workstation device assignment set; calls the dialog processor

//[symbol] USE LIB,module-name	Used in the device assignment set for a source library; allows a user program (under consolidated data management) to either sequentially read or write (create) a source module
//[symbol] USE MENU [, { format-file-LFD/ YFMT / YFMT/format-file-LFD / format-file-LFD / YFMT }] [,initial-menu] [, { nnn / 1 }] [,menu-format-1=alias-1 [,...,menu-format-12=alias-12]]	Used as part of a workstation device assignment set; calls menu services

//[symbol] USE SFS [, {[format-file-LFD-1]/[,format-file-LFD-2] / format-file-LFD / **SYSFMT**}] [,initial-screen] [, {nnn / **1**}] [,screen-format-1=alias-1 [,...,screen-format-12=alias-12]]	Used as part of a workstation device assignment set; calls screen format services
//[symbol] VFB [,FORMNAME=symbol] [,USE= {STAND1 / OWNVF1}] [LENGTH=LINES] [,DENSITY={**6** / **8**}] [,TYPE={9300 / 0768 / 0770 / **0773** / 0776 / 0778}] [,OVF=(line-1,...,line-n)] [,OVF2=(line-1,...,line-n)] [,CD1=(line1,...,line-n),...[,CD15=(line-1,...,line-n)]]	Overrides system vertical format buffer

Label △Operation △Operand	Description
	Supplies volume serial numbers of data and program volumes to be accessed by the job

[, { volsn-2 [{ (S) / (NS) / (NOV) / (PREP) }] / volsn-3 [{ (S) / (NS) / (NOV) / (PREP) }] / SCRATCH } ,...]	
/$	Start of data
/*	End of data
/&	End of control stream

NOTES:

1. If comment includes embedded blanks, it must be enclosed by apostrophes.
2. Parameters specified in p_1 through p_n may be specified in any order, except the REPEAT parameter should not be used when LINK is used with GO.
3. Where destination = [host=id:] user-id

Characters Used to Specify Mode Setting on VOL Statement

Used with UNISERVO 12/16 and 10/14 Magnetic Tape Volumes					
Tape	**cc**	**Bytes per Inch**	**Parity**	**Translate Feature**	**Convert Feature**
7-track	10	200	Odd	Off	On
	20	200	Even	Off	Off
	28	200	Even	On	Off
	30	200	Odd	Off	Off
	38	200	Odd	On	Off
	50	556	Odd	Off	On
	60	556	Even	Off	Off
	68	556	Even	On	Off
	70	556	Odd	Off	Off
	78	556	Odd	On	Off
	90	800	Odd	Off	On
	A0	800	Even	Off	Off
	A8	800	Even	On	Off
	B0	800	Odd	Off	Off
	B8	800	Odd	On	Off
9-track	C8	800	Odd	Off	Off
	C0*	1600	Odd	Off	Off

Used with UNISERVO VI-C Magnetic Tape Volumes					
7-track	10	200	Odd		On
	20	200	Even		Off
	30	200	Odd		Off
	50	556	Odd		On
	60	556	Even		Off
	70	556	Odd		Off
	90	800	Odd		On
	A0	800	Even		Off
	B0	800	Odd		Off
9-track	80	800	Odd		Off

*Also applies to the UNISERVO 20 Magnetic Tape Subsystem

NOTE:

Only VI-C mode setting may be used on the 90/25.

Standard Logical Unit Number Assignments

Device Type Code	Logical Unit No.	Device Type and Features
08020000	1, 2	Reader of 0920/0930 paper tape subsystem
02020000	3, 4	Punch of 0920/0930 paper tape subsystem
08010000	5, 6	2703 optical document reader
04080000	7	9200/9300 printer
08080000	8	9200/9300 card reader
02080000	9	9200/9300 card punch
FFFFFFFF	10–17	Spare
	18, 19	Reserved
04F80000	20, 21	Any printer, no features specified
04400000	22, 23	0773/0778** printer, no optional features
04100000	24, 25	0776 printer, no optional features
04200000	26, 27	0768 printer, no optional features
04800000*	28, 29	0770 printer, no optional features

08F80000	30, 31	Any card reader subsystem, no features specified
08200000	32, 33	0717/0719** card reader, no features specified
08800000	34, 35	0716 card reader, no features specified
08400000	36, 37	Reserved
	38, 39	Reserved
02F80000	40, 41	Any card punch subystem, no features specified
02200000	42, 43	0605 card punch, no features specified
02400000	44, 45	0604 card punch, no features specified
	46, 47	Reserved
FFFFFFFF	48, 49	Spare
20FF0000	50–59	Any disk
20100000	60–63	8416 disk subsystem
20020000	64–66	8418 MODI disk subsystem (low density)
20020004	67–69	8418 MODII disk subsystem (high density)

*Device type code changed to 04100000 during supervisor initialization if 0776 printer used in place of 0770.
**Configured with the 90/25 System

Standard Logical Unit Number Assignments (cont)

Device Type Code	Logical Unit No.	Device Type and Features
20200000	70–74	8430 disk subsystem
20200004	75–79	8433 disk subsystem
20400000	80–85	8414 disk subsystem
20800000	86–89	8411 disk subsystem
10FF0000	90–99	Any tape, no features specified
10FF000A	100–102	Any tape, 9-track phase encoded
10FF00006	103–105	Any tape, 9-track NRZI
10FF00005	106–109	Any tape, 7-track NRZI
10C8000A	110–112	Slow tape, 9-track phase encoded

10C80006	113–115	Slow tape, 9-track NRZI
10C80005	116–119	Slow tape, 7-track NRZI
1034000A	120–122	Fast tape, 9-track phase encoded
10340006	123–125	Fast tape, 9-track NRZI
10340005	126, 127	Fast tape, 7-track NRZI
	128, 129	Reserved
40FF0000	130–133	Any diskette
40800000	134, 135	8413 diskette
400F0001	138, 139	Any diskette, 128 byte
400F0002	140, 141	Any diskette, 256 byte

*Device type code changed to 04100000 during supervisor initialization if 0776 printer used in place of 0770.
**Configured with the 90/25 System

Standard Logical Unit Number Assignments (cont)

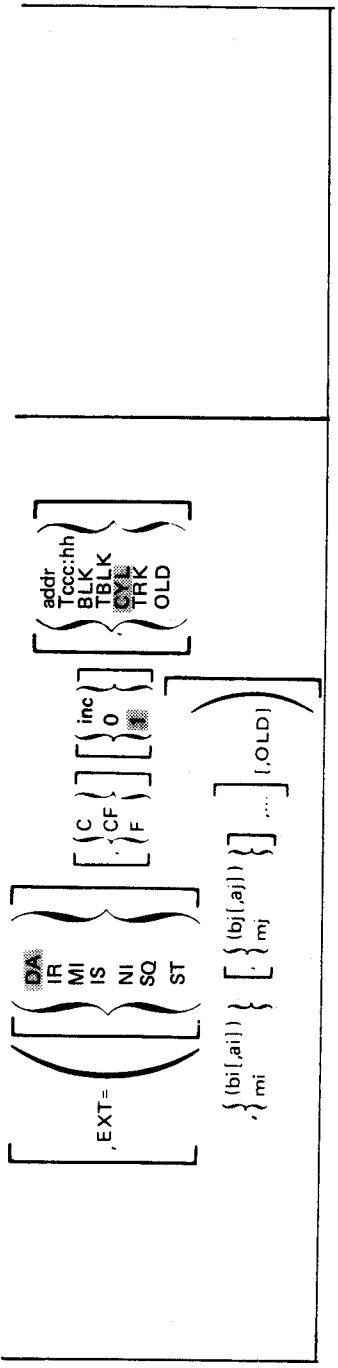
Device Type Code	Logical Unit No.	Device Type and Features
400F0004	142, 143	Any diskette, 512 byte
400F0008	144, 145	Any diskette, 1024 byte
FFFFFFFF	146, 147	Spare
40FF0020	148, 149	Double-density diskette
40FF0100	150, 151	Any diskette, autoload
40FF0040	152, 153	Any diskette, double-sided
	154–159	Reserved
2008C004	160	8415 disk subsystem–fixed
20088000	161	8415 disk subsystem–removable
2008C004	162	8415 disk subsystem–fixed
	163-179	Reserved
20400004	180–185	8424/8425 disk subsystem
	186–199	Reserved

01FF0000	200–215	Any workstation
01FF0004	216–219	Any workstation with 24 by 80 screen
FFFFFFFF	220–254	Spare
	255, 256	Reserved

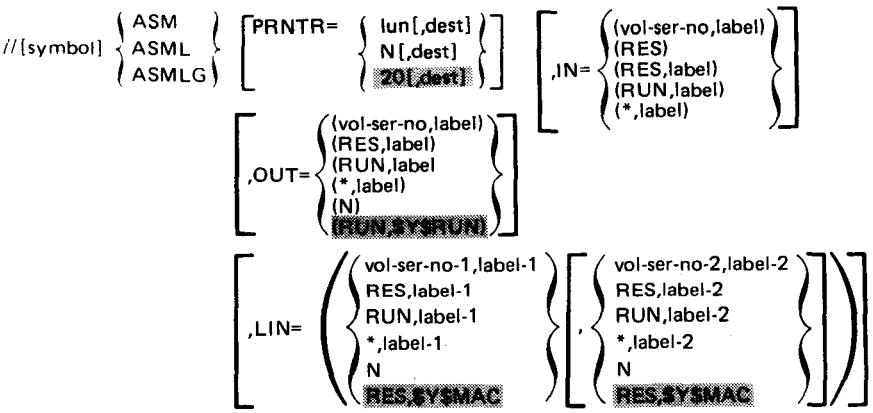
*Device type code changed to 04100000 during supervisor initialization if 0776 printer used in place of 0770.
**Configured with the 90/25 System

Job Control Procedure Call Statements

Label △ Operation △ Operand	Description
//[symbol] procname [p_1,p_2,...,p_n,k_i=v_i,k_j=v_j,...,k_m=v_m]	Format of all user job control procedure call statements
//lfdname ACCESS { { lblname [, { n / 8 }] [, { ACCEPT / EXTEND / INIT / RELOD / PREP }] } [, { DVC=nn,VOL= { volsn / **RUN** / * } / VOL= { volsn / **RUN** / * } }] }	Generates the job control statements required to assign a device to a job step so that the file on that device can be accessed at job execution time
//lfdname ALLOC { { lblname [, { n / 8 }] [, { ACCEPT / EXTEND / INIT / RELOD }] } [, { DVC=nn,VOL= { volsn / **RUN** / * } / VOL= { volsn / **RUN** / * } }] }	Generates job control statements required to assign a disk to a job step and allocates space on that disk for the file


[,EXT=
DA
IR
MI
IS
NI
SQ
ST
[,C
,CF
F]
[,inc
0
1]
[,addr
Tccc:hh
BLK
TBLK
CYL
TRK
OLD]
,(bi[,ai])
mi
[,(bj[,aj])
mj
[,OLD]

Job Control Procedure Call Statements (cont)

Label △Operation △Operand	Description
	Generates the job control statements needed to run the assembler language translator

```
[,COPY=((vol-ser-no-1,label-1 | RES,label-1 | RUN,label-1 | *,label-1 | N | RES,SYSSRC)[,(vol-ser-no-2,label-2 | RES,label-2 | RUN,label-2 | *,label-2 | N | RES,SYSSRC)])]

[,LST={option | (opt-1,...,opt-n)}]

[,SCR1={vol-ser-no | RES}]

[,SCR2={vol-ser-no | RUN}]
```

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
(cont) [,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RES,YLOD)** ① / **(RUN,YRUN)** ② }]	
//[symbol] { AUTO / AUTRPG / AUTRPGL / AUTRPGLG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OUT= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / N / **(RUN,YRUN)** }]	Generates the job control statements needed to execute RPG II auto report

Job Control Procedure Call Statements (cont)

Label △Operation △Operand	Description
[,OUTSRC= {(vol-ser-no,label,lfd-name) / (RES,label,lfd-name)}] [,LST= {K / M / N / S}] [,SCR1= {vol-ser-no / RES}] [,SCR2= {vol-ser-no / RUN}] [,ALTLOD= {(vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RES,YLOD)}] [,EMB= {NO / YES}] [,MOD= {3 / 4 / 5 / IRAM}] [,SKIP=C]	

[,COPYn= { (vol-ser-no,label,lfd-name) / (RES,label,lfd-name) / (RUN,label,lfd-name) }] [,ERRFIL= (vol-ser-no,label,module-name)]	
//[symbol] { COBL74 / COBL74L / COBL74LG } [PRNTR= { lun[,dest] / N[,dest] / 20[,dest] }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,LIN= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RES,YSRC) }]	Generates the job control statements needed to execute the 1974 ANSI COBOL language translator

[,OBJ= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RUN,YRUN) }] [,SCR1= { vol-ser-no / RES }]
[,SCR2= { vol-ser-no / RES }] [,SCR3= { vol-ser-no / RUN }]
[,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RES,YLOD) ① / (RUN,YRUN) ② } [,option=specification]]

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
//[symbol] { COBOLB / COBOLBL / COBOLBLG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OBJ= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RUN,YRUN)** }] [,LIN= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RES,YSRC)** }] [,OUT=(p_1,...,p_n)] [,LST=p_1,...,p_n)] [,SCR1= { vol-ser-no / **RES** }] [,SCR2= { vol-ser-no / **RES** }] [,SCR3= { vol-ser-no / **RUN** }]	Generates the job control statements needed to execute Basic COBOL language translator

[,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RES,YLOD)** ① / **(RUN,YRUN)** ② }]	
//[symbol] { COBOL / COBOLL / COBOLLG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OBJ= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RUN,YRUN)** }] [,LIN= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RES,YSRC)** }] [,OUT=(p_1,...,p_n)] [,LST=p_1,...,p_n)]	Generates the job control statements needed to run the Extended COBOL language translator

Label △Operation△ Operand	Description
(cont) [,SCR1={vol-ser-no / **RES**}] [,SCR2={vol-ser-no / **RES**}] [,SCR3={vol-ser-no / **RUN**}] [,ALTLOD={(vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RES,YLOD)** ① / **(RUN,YRUN)** ②}]	
//[symbol] DVCDKT vol-ser-no [,lun] [,NOVOL={Y / **N**}]	Assigns the same logical unit number to a diskette volume having different files used in a job
//[symbol] DVCVOL {vol-ser-no / RES / RUN} [,lun] [,NOVOL={Y / **N**}]	Assigns the same logical unit number to a disk volume having different files used in a job

//[symbol] DVCVTP vol-ser-no[,lun] [,PREP= { Y / **N** }] [,NOVOL= { Y / **N** }]	Assigns the same logical unit number to a tape volume having different files used in a job
//[symbol] { FORT / FORTL / FORTLG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OUT= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / NO / **(RUN,YRUN)** }] [,OPT= (D,N,X)] [,MDE= 1] [,STX= options] [,CNL= k] [,LIN= { filename / lib1 }] [,LST= { k / option }] [,MAP= (S,A,L)] [,SIZE= { L / S }]	Generates the job control statements needed to run the Basic FORTRAN language translator

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
(cont) `[,SCR1={vol-ser-no / RES}] [,ALTLOD={(vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RUN,$Y$RUN)}]`	
`//[symbol] {FOR / FORL / FORLG} [PRNTR={lun[,dest] / N[,dest] / 20[,dest]}] [,IN={(vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label)}]` `[,OUT={(vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / NO / (RUN,$Y$RUN)}]`	Generates the job control statements needed to run the Extended FORTRAN language translator

[,SCR1= { vol-ser-no / RES }]
[,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (RUN,YRUN) }]
[,OPT=(D,N,X)][,MDE=I]
[,STX=option][,CNL=k]
[,LIN= { filename / LIB1 }] [,LST=option]

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
//[symbol] { FOR4 / FOR4L / FOR4LG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OUT= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / NO / **(RUN,YRUN)** }] [,SCR1= { vol-ser-no / **RES** }] [,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RUN,YRUN)** }]	Generates the job control statements needed to run the FORTRAN IV language translator

[,OPT=(S,N,X)] [LIN=filename] [,LST=option] [,MAP=(S,A,L)] [,SIZE={L | S}]	
//[symbol] {LINK | LINKG} [input-module-name-1,...,input-module-name-10] [PRNTR={lun[,dest] | N[,dest] | **20[,dest]**}] [,IN={(vol-ser-no,label) | (RES) | (RES,label) | (RUN,label) | (*,label) | **(RUN,YRUN)**}] [,OUT={(vol-ser-no,label) | (RES,label) | (RUN,label) | (*,label) | (N) | **(RUN,YRUN)**}]	Generates the job control statements needed to execute the linkage editor

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
(cont)	

```
[,RLIB={(vol-ser-no,label)}][,ALIB={(vol-ser-no,label)}]
       {(RES,label)       }       {(RES,label)       }
       {(RUN,label)       }       {(RUN,label)       }
       {(*,label)         }       {(*,label)         }

[,SCR1={vol-ser-no}] [,STD={YES}]
       {RES       }       {NO }

[,ALTLOD={(vol-ser-no,label)}] [,OPT='options']
         {(RES,label)       }
         {(RUN,label)       }
         {(*,label)         }
         {(RUN,$YSRUN)      }
```

[,CLIB= { (vol-ser-no,label,mod-name) / (RES,label,mod-name) / (RUN,label,mod-name) / (*,label,mod-name) }] [,CMT='comments'] [,ENTER=expression]	
//[symbol] { RPG / RPGL / RPGLG } [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,IN= { (vol-ser-no,label) / (RES) / (RES,label) / (RUN,label) / (*,label) }] [,OUT= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / (N) / **(RUN,YRUN)** }] [,LST= { K / M / N / S }]	Generates the job control statements needed to run the RPG language translator

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
(cont) [,SCR1= { vol-ser-no / **RES** }] [,SCR2= { vol-ser-no / **RES** }] [,ALTLOD= { (vol-ser-no,label) / (RES,label) / (RUN,label) / (*,label) / **(RUN,YRUN)** }] [,EMB= { NO / **YES** }] [,MOD= { 3 / 4 / 5 / IRAM }] [,COL=7]	Generates the job control statements needed to run the RPG language translator
//[symbol] SPOOL [REDIRECT= { DISK / TAPE / DISKETTE }] [,BUF=nXm] [,COPIES= { N / **1** }] [,SKIPCODE= { n / **7** }] [,RECORDS= { n / **5120** }] [,FORMNAME= forms]	Redefines the handling of spooled output files (print, punch, and data-set-label diskettes) established during SYSGEN

[,HDR= { NO / **YES** }] [,TESTPAGE= { NO / **YES** }] [,PAGEBRK= n] [,UPDATE= { NO / **YES** }] [,COMPRESS= { NO / **YES** }] [,RETAIN= { YES / **NO** }] [,HOLD= { YES / **NO** }] [,SECURE= { YES / **NO** }]	
// ignored UDD IN= ({ vol-ser-no / RES / RUN } ,label [, { noext / **8** }] [,ACCEPT]) ,OUT= ({ vol-ser-no / RES / RUN } ,label [, { noext / **8** }] [, { ACCEPT / EXTEND / INIT / RELOD }]) [PRNTR= { lun[,dest] / N[,dest] / **20[,dest]** }] [,PUNCH= { YES / **NO** }] [,COMPARE= { YES / **NO** }]	Generates the job control statements for the device assignment sets needed by the data utility routine to copy or compare one disk file to another disk file

Job Control Procedure Call Statements (cont)

Label △ Operation △ Operand	Description
[,EXT=(([(DA / MI / IR / IS / **SQ** / NI)]) [,(C / CF / F)] [,(inc / 0 / **1**)] [,(addr / Tccc:hh / **BLK** / TBLK / CYL / TRK / OLD)] [,(mi / (bi ,ai))] [,(mj / (bj,aj))] ,... [,OLD])]	Generates the job control statements for the device assignment sets needed by the data utility routine to copy or compare one disk file to another disk file

```
//ignored UDT IN=( { vol-ser-no } ,label [ , { noext } ] [,ACCEPT] )
                 { RES        }            { 8     }
                 { RUN        }

      ,OUT=(vol-ser-no,label)

      [,PRNTR= { lun[,dest] } ]
               { N[,dest]   }
               { 20[,dest]  }

      [,PUNCH= { YES } ] [,COMPARE = { YES } ]
               { NO  }               { NO  }
```

Generates the job control statements for the device assignment set needed by the data utility routine to copy or compare a disk file to a tape file

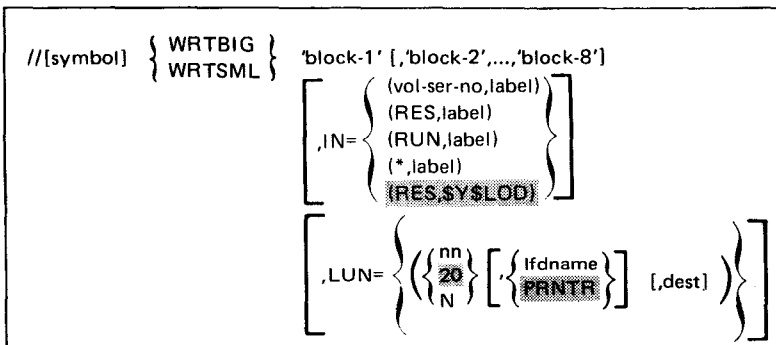
Job Control Procedure Call Statements (cont)

Label △ Operation △ Operand	Description
//ignored {UPLCNV / LNKUPL} [PRNTR= {n / ■}] ,FILn= {vsn,label,filename / RES,label,filename / RUN,label,filename}	Generates the job control statements for the device assignment set needed by the UTS 400 upline conversion routine or upline linker routine
//ignored UTD IN=(vol-ser-no,label) ,OUT=({vol-ser-no / RES / RUN} ,label [,{noext / ■}] [,{ACCEPT / EXTEND / INIT / RELOD}])	Generates the job control statements for the device assignment set needed by the data utility routine to copy or compare a tape file to a disk file

```
[,PRNTR= { lun[,dest] }] [,PUNCH= {YES}]
         { N[,dest]   }          {NO }
         {20[,dest]   }

[,COMPARE= {YES}]
           {NO }

[,EXT=( [ { DA }  ] [,{C }] [,{inc}] [,{addr    }]
        [ { MI }  ]    {CF}    { 0}    {Tccc:hh }
        [ { NI }  ]    {F }    {1 }    {BLK     }
        [ { IR }  ]                    {TBLK    }
        [ { IS }  ]                    {CYL     }
        [ {SQ }  ]                     {TRK     }
                                       {OLD     }

  [,{mi   }] [,{mj   }] ,... ] [,OLD] ) ]
    {(bi,ai)}  {(bj,aj)}
```

Job Control Procedure Call Statements (cont)

Label △Operation△ Operand	Description
//[lfdname] { WORKn / TEMPn } [{ DVC=nn,VOL= { RES / RUN / vol-ser-no } / VOL= { RES / RUN / vol-ser-no } }] [, { BLK=4000 / BLK=nnnn / CYL=nn }] [,EXTSP= { nn / 16 }] [,SECALL= { n / 1 }] [,TYPE= { file-type / ST }]	Generates any device assignment sets needed for temporary work files for either one job step (WORK) or for the duration of the job (TEMP)



Prints block letters on your printed output; from up to 12 characters per line and 4 lines per page (WRTBIG), to a maximum of 20 characters per line and 6 lines per page (WRTSML)

NOTES:

(1) Default for language translators run alone or with the LINK (L) option.

(2) Default for language translators run with the LINK (L) and GO (G) options.

Job Control Procedure Directives

Label △Operation △ Operand	Description
[symbol] END unused	Ends a job control procedure definition
symbol NAME parameter	Names a job control procedure definition
[symbol] PROC [pos,n] [,k,...,k]	Starts a job control procedure definition

Canned Job Control Stream Call Statements

Job Name	Function
ADD1KCOS	Adds 1K COS to YSRC on SYSRES.
ADD2KCOS	Adds 2K of COS to YSRC on SYSRES.
ADD3KCOS	Adds 2K of fast COS to YSRC on SYSRES.
CGV/CHGVSN	Changes a volume serial number on a previous prepped disk pack. CGV is used at the console; CHGVSN is used for card streams.
COPYREL	Copies RELEASE/SYSRES files from an existing SYSRES to a new SYSRES volume.
COPY$10	Creates a backup copy of an 8410 disk.
COPY$11	Creates a backup copy of an IBM 2311 disk onto a Series 90 supported disk. Note that the 8411 and 8414 disks may not be used as output devices.
DCOP	Copies SYSRES from one disk file to another.
DRDP	Prints directory partition of a librarian disk file.
DUMPLOG	Dumps job or console log records to disk.
DUMPLOGT	Dumps job or console log records to tape.
DUMP20	Dumps the image of an IBM 360/20 disk pack.

Canned Job Control Stream Call Statements (cont)

Job Name	Function
ECDC	Feeds in cards with names for an emulation carriage tape loops display program.
ECDK	Keys in names for an emulation carriage tape loops display program.
JBLOG	Produces a job accounting report with SYSLOG residing on disk.
JBLOGT	Produces a job accounting report with SYSLOG residing on tape.
LISTRES	Prints directory for SYSRES modules.
MODLST	Lists the contents of the system libraries.
ONUERL	Prints error log report.
PACKRES	Compresses all modules on SYSRES and prints directory of compressed modules.
PIMAGE	Creates a copy of an 8410 disk image onto a Series 90 supported disk. (Note that an input tape must be mounted when PIMAGE creates a pack file but not when it creates a workfile. The logical unit number for the disk must be provided.)
PNCH9300	Punches card deck to use 9300 as peripheral device.
PRNT9300	Prints source module needed to use 9300 as a peripheral device.
PRP1KCOS	Repositions 1K COS from YSRC on SYSRES for COS-IPL.
PRP2KCOS	Repositions 2K COS from YSRC on SYSRES for COS-IPL.
PRP3KCOS	Repositions 2K of fast COS from YSRC on SYSRES for COS-IPL.

Canned Job Control Stream Call Statements (cont)

Job Name	Function
SAMRPT	Prints system activity monitor report.
SCLIST	Lists all shared code modules in SYSRES.
SETREL	Preps and allocates RELEASE/SYSRES files.
SMC	Installs a software maintenance change (SMC).
SMCLIST	Prints SMC log.
SMP	Installs a software maintenance package (SMP).

SYSDUMP	Prints a complete system dump from SYSRES or another system disk.
SYSDUMPO	Prints a complete system dump or a portion of a system dump from SYSRES or another system disk.
UPLDELT	Deletes the specified UTS 400 upline dump file.
UPLDMPN	Prints the specified UTS 400 upline dump file.
UPLDUMP	Prints and deletes the specified UTS 400 upline dump file.
VTOC20	Prints a volume table of contents listing of an IBM 360/20 disk pack image.
WRT	Creates files on a diskette.

- Add COS to YSRC on SYSRES.

  System Console: RU { ADD1KCOS / ADD2KCOS / ADD3KCOS }

  Card Reader: COS deck followed by // FIN job control statement

Canned Job Control Stream Call Statements (cont)

- Change a volume serial number on a previously prepped disk pack. Parameters may be entered at the console using the CGV command or the CHGVSN command with input cards.

System Console Keyin: RV CGV,,O=old-vsn,N=new-vsn,T=disk-type

System Console with Cards: RU CHGVSN

Card Reader:

1 LABEL	△OPERATION△ 10	16 OPERAND	△ COMMENTS
//OLDVSN	JSET	\old-vsn/	
//NEWVSN	JSET	\new-vsn/	
//TYPE	JSET	\disk-type/	
//FIN			

- Copy RELEASE/SYSRES files from an existing SYSRES to a second disk pack of any type.

  System Console Keyin: RV COPYREL,[,V=vsn][,T=disk-type][,S=first-file][,E=last-file]

  Disk type values are:

Value	Disk Type	Value	Disk Type
11	8411	18B	8418 high density
14	8414	24	8424
15F	8415 fixed	25	8425
15R	8415 removable	30	8430
16	8416	33	8433
18A	8418 low density		

NOTE:

If your SYSRES is on more than one volume of an 8415 removable disk, COPYREL must be run once for each volume.

Canned Job Control Stream Call Statements (cont)

where:

S=first-file

Indicates the first file to be copied, according to the code letter specified. If omitted, copying begins with S.

E=last-file

Indicates the last file to be copied, according to the code letter specified. If omitted, copying ends with A.

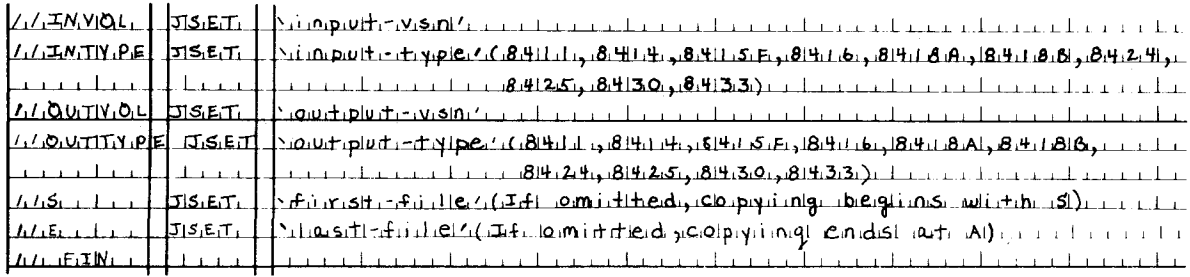
The first file and last file code letters are:

Copy Order	Code	File Name
1	S	YSRC
2	O	YOBJ
3	L	YLOD
4	M	YMAC
5	J	YJCS
6	G	SG$JCS
7	SGMAC	SG$MAC
8	SGOBJ	SG$OBJ
9	SGLOD	SG$LOD
10	SCLOD	YSCLOD

Copy Order	Code	File Name
11	MIC	YMIC
12	IVP	IVPLIB
13	SMCFILE	SMCFILE
14	FMT	YFMT
15	SAVE	YSAVE
16	DIALOG	YDIALOG
17	SDF	YSDF
18	HELP	YHELP
19	T	YTRAN
20	A	YTRANA

System Console Keyin with Cards: RU COPYREL

Card Reader for All Disk Types Except 8415 Removable:



NOTE:

When using cards, only the following code letters can be used to specify first and last files: S, O, L, M, J, G, T, or A.

Card Reader for 8415 Removable Disk (must be run once for each volume)

Run 1 (primary disk):

```
//.INVOL   JSET   'input-vsn'
//.INTYPE  JSET   'input-type'(8411,8414,841F,8416,841A,841B,8424,
                  8425,8430,8433)
//.VSNI    JSET   'primary-output-vsn'
//.OUTTYPE JSET   '8411SIR'
//.S       JSET   'first-file'(If omitted, copying begins with S1)
//.E       JSET   'last-file'(If omitted, copying ends with A1)
//.FIN
```

Run 2 (secondary disk):

```
// IDENTIFY  JSET  // input-vsn/,
// IDENTITY.PE  JSET  // input-type/(8411,8411,8411,8411,8411,8411,8411,8411,8411,8411),
                      8412,8413,8413)
// VSN2  JSET  // secondary-output-vsn/,
// DUTITY.PE  JSET  // output-vsn/,
// LS  JSET  // first-file/(IF omitted,copying begins with 5),
// LE  JSET  // last-file/(IF omitted,copying ends with A)
// FIN
```

Canned Job Control Stream Call Statements (cont)

- Create a backup copy of an 8410 disk.

System Console Keyin: RV COPY$10,,

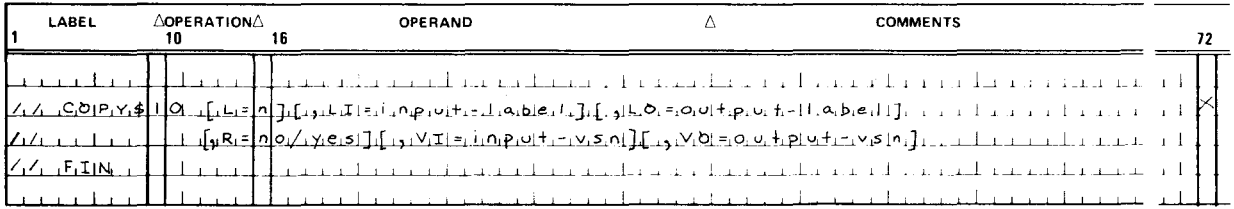
[,L={**0**/1—9}][,LI={**X**/input-label}]

[,LO={**X**/output-label}][,R={**N**/Y}]

[,VI={**X**/input-vsn}][,VO={**X**/output-vsn}]

System Console Keyin with Cards: RU COPY$10

Card Reader:



- Create a backup copy of an IBM 2311 disk onto a Series 90 supported disk.

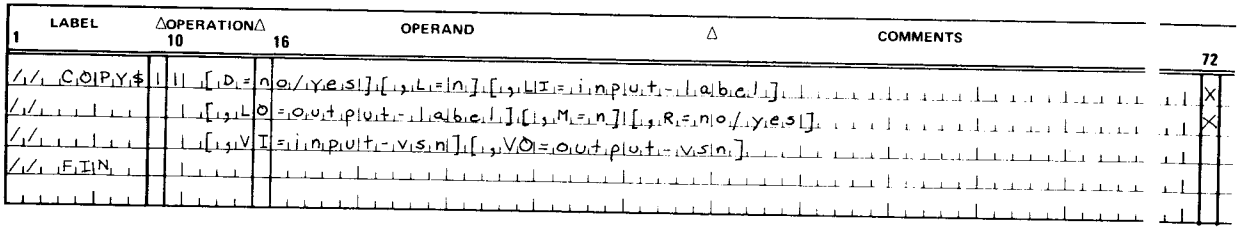
System Console Keyin: RV COPY$11,, [,D={N|Y}] [,L={3|0-9}] [,LI={X|input-label}]

[,LO={X|output-label}] [,M={1|2}] [,R={N|Y}]

[,VI={X|input-vsn}] [,VO={X|output-vsn}]

System Console Keyin with Cards: RU COPY$11

Card Reader:



- Copy SYSRES from one disk pack to another disk of the same type.

  System Console Keyin: RV DCOP, [,T={disk-type / 16}] [,N={number / 1}] [,V={YES / NO}]

Canned Job Control Stream Call Statements (cont)

- Print directory partition of librarian disk file.

  File-identifier names of up to 11 characters:

  System Console Keyin: RV DRDP,,V=vsn,L=file-identifier

  Card Reader: No input required

File identifier names of 12 or more characters:

System Console: No entry required

Card Reader:

```
1 LABEL      OPERATION 10 16 OPERAND                    COMMENTS
// JOB  DRDP
// DVC  20                // LFD  PRNTR
// DVC  50                // VOL  vsn          // LBL  file-identifier
// LFD  LU $IDTFI
// OPTION JOBDUMP
// EXEC  SULBD
// PARAM file-identifier
/&
// FIN
```

Canned Job Control Stream Call Statements (cont)

- Dump job or console log records to disk.

System Console Keyin: RV DUMPLOG

$$\left[,\left[\left[,D=\left\{\begin{matrix}\textbf{ACT}\\\textbf{LOG}\\\text{CON}\end{matrix}\right\}\right]\left[,F=\left\{\begin{matrix}\text{INIT}\\\text{ALLOC}\end{matrix}\right\}\right]\right]\right]$$

- Dump job or console log records to tape.

System Console Keyin: RV DUMPLOGT

$$\left[,\left[\left[,D=\left\{\begin{matrix}\textbf{ACT}\\\textbf{LOG}\\\text{CON}\end{matrix}\right\}\right]\left[,V=\left\{\begin{matrix}\text{vsn}\\\textbf{SYSLOG}\end{matrix}\right\}\right]\left[,C=\left\{\begin{matrix}\textbf{Y}\\\text{N}\end{matrix}\right\}\right]\right]\right]$$

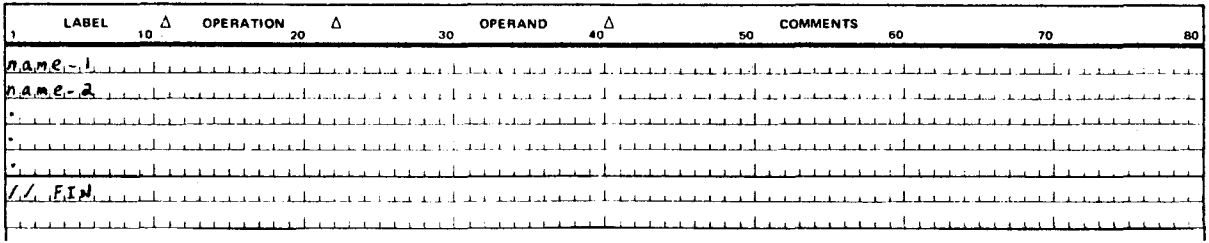
- Dump the image of an IBM 360/20 disk pack.

  System Console Keyin: RV DUMP20,,V=nnnnnn,L=dump-pack-filename

- Feed in cards with record names for an emulation carriage tape loops display program.

  System Console Keyin: RU ECDC

  Card Reader:



Canned Job Control Stream Call Statements (cont)

For alternate file search: RU ECDC,,F=(vsn,lbl-name)

For RUN command keyins when alternate file id entry is more than 28 characters:

System Console Keyin: RU ECDC,,F=(CR)

Card Reader:

1 LABEL	△OPERATION△ 10 16	OPERAND	△	COMMENTS
/./ VOL vsn				
/./ LBL lbl-name				
/./ FIN				
name-11				
name-12				
.				
.				
.				
/./ FIN				

For alternate file search: RV ECDC,,F=(vsn,lbl-name)

- Key in record names for an emulation carriage tape loops display program.

System Console Keyin: RV ECDK
(message requests record name)
record name keyin
.
.
.
EOJ

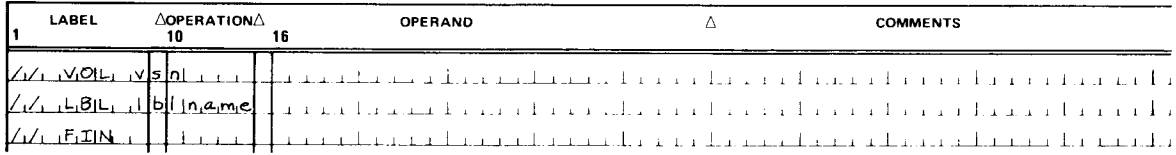
For alternate file search:

System Console Keyin: RV ECDK,,F=(vsn,lbl-name)

For RUN command keyins when alternate file id entry is more than 28 characters:

System Console Keyin: RV ECDK,,F=(CR)

Card Reader:



- Produce a job accounting report with SYSLOG residing on disk.

  System Console Keyin: RUN JBLOG [,,V={vsn / **RES**},L={vsn / **SYSLOG**},S={A / **B** / C}]

  Card Reader: No input required.

- Produce a job accounting report with SYSLOG residing on tape.

  System Console Keyin: RUN JBLOGT [,,V={vsn / **SYSLOG**},S={A / **B** / C}]

  Card Reader: No input required.

- Print directory for SYSRES modules.

  System Console Keyin: RV LISTRES,[,F=file-name][,V=vsn]

Canned Job Control Stream Call Statements (cont)

- List contents of the system libraries.

  System Console Keyin: RV MODLST [,,VSN=vsn]

- Print error log report.

  System Console Keyin: RV ONUERL

  With this keyin, all options are set to their default values.

System Console Keyin with Cards: RU ONUERL,,CARD=YES

Card Reader:

LABEL	OPERATION	OPERAND	COMMENTS
	(ONUERL control cards; see parameters)		
// FIN			

Where parameters may include:

```
[// PARAM ESUMFIL=(INIT)]
                 (YES )
                 (NO  )

[// PARAM OPEN=(BEGIN   )]
              (CURRENT )
              (PRIOR   )
```

```
[// PARAM ELOGDMP={YES}]
                 {NO }

[// PARAM ELOG={ON }]
              {OFF}

[// PARAM LOG-ID={SYSGEN-specified-installation-name-and-number}]
                {installation-name-and-number                 }
                {NONE                                         }

[// PARAM TRACE=YES]
```

- Compress all modules on SYSRES and print directory of compressed modules.

  System Console Keyin: RV PACKRES,[,F=file-name][,V=vsn]

- Create a copy of an 8410 disk image onto a Series 90 supported disk.

  System Console Keyin: RV PIMAGE

  Card Reader:

LABEL	OPERATION	OPERAND	COMMENTS	
1 10	△ 20	△ 30 40	△ 50 60	72
// PIMAGE (see parameters)				X
(Additional PIMAGE control cards if necessary)				
// FIN				
(9200/9300 RESTORE or VTOC control cards)				
// FIN				

Canned Job Control Stream Call Statements (cont)

Where parameters are:

VOL9030=vvvvv

[,DISCDRV={ddd / 050}]

[,DSKTYPE={8411 / 8414 / 8415 / 8416 / 8418 / 8424 / 8425 / 8430 / 8433}]

$$\left[,\left\{\begin{array}{l}\text{INPUT=CARD}\\ \text{TAPEDRV=}\left\{\begin{array}{l}\text{ttt}\\ \text{090}\end{array}\right\}\end{array}\right\}\right]$$

[,CNTRL=NOINPT]

$$\left[,\text{PACKNAME=}\left\{\begin{array}{l}\text{aaaaaaaa}\\ \text{DISC8410}\end{array}\right\}\right]$$

$$\left[,\text{RERUN=}\left\{\begin{array}{l}\text{NO}\\ \text{YES}\end{array}\right\}\right]$$

[,INIT=ONLY]

For running the PIMAGE program with spooling:

System Console Keyin: IN
RV PIMAGE

Card Reader:

```
LABEL      OPERATION      OPERAND      COMMENTS
1    10    20    30    40    50    60    72
// DATA FILEID=PIMAGEREAD17!
// PIMAGE (see parameters)                                    X
(Additional PIMAGE control cards if necessary)
// FIN
(9200/9300 RESTORE or VTOC control cards)
// FIN
```

- Punch card deck to use 9300 as peripheral device.

  System Console Keyin: RV PNCH9300

  Card Reader: No input required.

- Print source module needed to use 9300 as a peripheral device.

  System Console Keyin: RV PRNT9300

  Card Reader: No input required.

- Reposition COS from YSRC for COS-IPL.

  System Console Keyin: RV { PRP1KCOS / PRP2KCOS / PRP3KCOS } ,,V=vsn, T=disk-type

Where disk-type values are:

Value	Disk Type
11	8411
14	8414
15F	8415 fixed
15R	8415 removable
16	8416
18A	8418 low density
18B	8418 high density
24	8424
25	8425
30	8430
33	8433

System Console Keyin with Cards: RU $\begin{Bmatrix} \text{PRP1KCOS} \\ \text{PRP2KCOS} \\ \text{PRP3KCOS} \end{Bmatrix}$

Card Reader:

```
// VSNI   SET  current vsn (existing VSNI)
// TYPE   SET  disk type (8411,8412,8413,8414,8415,8416,8418,8419,
                8424,8425,8430,8433)
// FIN
```

- Print system activity monitor report.

System Console Keyin: RV SAMRPT,,V=vol-ser-no

$$\left[,\text{F}=\begin{Bmatrix} \text{filename} \\ \text{SAMFILE} \end{Bmatrix}\right]\left[,\text{SFL}=\begin{Bmatrix} \text{ALL} \\ \text{LST} \end{Bmatrix}\right]$$

Card Reader: No input required.

- List all shared code modules in SYSRES.

  System Console Keyin: RV SCLIST

- Prep and allocate RELEASE/SYSRES files.

  System Console Keyin: RV SETREL,,V=vsn,T=disk-type, P=prep-type

  Where disk-type values are:

Value	Disk Type	Value	Disk Type
11	8411	18	8418 high and low density
14	8414	24	8424
15F	8415 fixed	25	8425
15R	8415 removable	30	8430
16	8416	33	8433

NOTE:

If you are prepping a 8415 removable disk with both a primary and secondary volume, SETREL must be performed on both volumes. See the following description of using SETREL with cards for further details.

Where prep-type values are:

Code	Meaning
N	No prep performed, assign files only
F	Full prep, with surface analysis
P	Partial prep, without surface analysis (If omitted, P is assumed)

NOTE:

SETREL will prep the disk pack with 1K COS. If 2K COS or 2K fast COS is required, run the appropriate PRP2KCOS or PRP3KCOS immediately after running SETREL.

System Console Keyin with Cards: RU SETREL

Card Reader for all Disk Types (except 8415 Removable) Specifying Partial Prep:

LABEL	OPERATION	OPERAND	COMMENTS
//PREP	JSET	'P'	PARTIAL PREP WITH NO SURFACE ANALYSIS
//VSNO	JSET	'vsn'	VOLUME SERIAL NUMBER OF DISK PACK
//TYPE	JSET	'disk-type'	(8411,8414,8415F,8416,8418,8424,8425,8430,8433)
//FIN			

Card Reader for all Disk Types (except 8415 Removable) Specifying Full Prep:

LABEL	OPERATION	OPERAND	COMMENTS
//PREP	JSET	'1'	FULL PREP WITH SURFACE ANALYSIS
//VSNO	JSET	'vsn'	VOLUME SERIAL NUMBER OF DISK PACK
//TYPE	JSET	'disk-type'	(8411,8414,8415F,8416,8418,8424,8425,8430,8433)
//FIN			
INSERT	NONE		INDICATES NO DEFECTIVE CYLINDERS OR TRACKS ON DISK
	(OR)		
INSERT	ccchh		SPECIFIES HEXADECIMAL ADDRESS OF DEFECTIVE CYLINDER AND TRACK
//FIN			

NOTE:

To prep a selector channel device disk pack with no defective tracks, omit the INSERT△△△NONE statement but include the second // FIN statement.

Card Reader for 8415 Removable (must run once for each volume):

Run 1 (primary disk):

LABEL	OPERATION	OPERAND	COMMENTS
//PREP	JSET	'Ø'	PARTIAL PREP WITH NO SURFACE ANALYSIS
//VSN1	JSET	'Vsn'	VOLUME SERIAL NUMBER OF PRIMARY DISK PACK
//TYPE	JSET	'8415R'	
//FIN			

Run 2 (secondary disk):

```
LABEL      OPERATION      OPERAND      COMMENTS
1    10    20    30    40    50    60    70    80
//PREP   JSET   'Ø'          PARTIAL PREP WITH NO SURFACE ANALYSIS
//VSN2   JSET   'vsn'        VOLUME SERIAL NUMBER OF SECONDARY DISK PACK
//TYPE   JSET   '8415R'
//FIN
```

NOTE:

This example shows SETREL performing a partial prep of an 8415R disk pack. A full prep can be accomplished by changing the statements in the manner previously described for the other disk types.

- Install a software maintenance change (SMC).

System Console Keyin: RV SMC,,INPUT=$\left\{\begin{matrix}C\\CR\\(CR,vsn)\\(DKD,vsn)\\(T,vsn)\\(D,RES)\\(D,vsn)\end{matrix}\right\}$ $\left[,BACKOUT=\left\{\begin{matrix}(D,RES)\\(D,RUN)\end{matrix}\right\}\right]$

- Run SMC installation program to perform additional tasks.

System Console Keyin: RV SMC,,INPUT=$\left\{\begin{matrix}C\\CR\\(CR,vsn)\\(DKD,vsn)\\(T,vsn)\end{matrix}\right\}$,CHG=Y $\left[,BACKOUT=\left\{\begin{matrix}(D,RES)\\(D,RUN)\end{matrix}\right\}\right]$

Canned Job Control Stream Call Statements (cont)

- Print SMC log.

  System Console Keyin: RV SMCLIST,[,FMT={F / C}][,SEQ1={COMP / SMC# / PP-TYPE / DATE}]

  [,SEQ2={COMP / SMC# / PP-TYPE / DATE}]

- Install a software maintenance package (SMP).

  System Console Keyin: RV SMP,,INPUT={(D,vsn) / (D,RES) / (DK,vsn) / (T,vsn)} [,BACKOUT={(D,RUN) / (D,vsn)}]

- Run SMP installation program for additional tasks.

System Console Keyin: RV SMP,,INPUT= { (D,vsn) / (D,RES) / (DK,vsn) / (T,vsn) } ,CHG=Y [,BACKOUT= { (D,RUN) / (D,vsn) }]

- Print a complete system dump from SYSRES or another system disk.

  System Console Keyin: RV SYSDUMP,,[,V=vsn]

- Print a system dump from SYSRES or another system disk after an HPR.

  System Console Keyin: RV SYSDUMPO,, [DO= { ALL [NOSHARE] | DUMP [{ NOSHARE | SELECT }] | TRANSLATED [NOSHARE] | JOBS [{ NOSHARE | SELECT }] | SAVE | RESTORE | NONE }] [,V=vsn] [,P=did]

NOTES:

1. *After an HPR has occurred, the system must be brought back up and the IPL performed before the RV SYSDUMPO command can be entered.*

2. *The options and suboptions of the DO= parameter allow for a more specific dump. The use of these options is described in the dump analysis user guide/programmer reference, UP-8837 (current version).*

3. *If the command is entered without a DO= parameter entry, the following message is displayed:*

   SD01 DUMP OPTION (ALL,NONE,DUMP,TRANSLATED,JOBS,RESTORE,SAVE)

   An option can be entered at this time, or, by leaving it blank, a default of ALL is assumed and a complete system dump is produced.

- Delete specified UTS 400 upline dump file.

  System Console Keyin: RV UPLDELT,, {ALL / ID=file-id}

- Print specified UTS 400 upline dump file.

  System Console Keyin: RV UPLDMPN,,ID=file-id

- Print and delete specified UTS 400 upline.

  System Console Keyin: RV UPLDUMP,,ID=file-id

- Print a volume table of contents listing of an IBM 360/20 disk pack image.

  System Console Keyin: RV VTOC20,,V=nnnnnn,L=disk-pack-filename

Canned Job Control Stream Call Statements (cont)

- Create files on a diskette.

System Console Keyin: RV WRT,[,D={did / 130}],V=vsn[,F={filename / IMAGE}][,B={sectors / 52}]

[,O={Y / N}][,S={Y / N}][,E={Y / N}][,R={Y / N}][,A={Y / N}]

Where the functions that may be performed on a file are:

O	Opens an existing file
S	Scratches all or part of a file
E	Extends (adds to) an existing file
R	Recreates (overwrites) an existing file
A	Sorts the file in numeric order

Diskette utility commands and their meanings:

A	Inserts a record into a file
C	Identifies a line to be changed
R	Changes an identified line
I	Ignores an issued C command
L	Lists the contents of a file
F	Closes a file
E	Terminates utility processing
D	Displays the available commands

Physical Input/Output Control System

Label	Operation	Operand	Description
Physical Input/Output Control			
symbol	BCW	device-cmd-code [,data-addr] [,data-flag] [,data-byte-count] [,repl-addr] [,repl-flag] [,repl-byte-count] [,control-flag]	Generates buffer control word
symbol	CCB	PIOCB-name, {BCW-name / CCW-name} [, {PUB-entry / 0}] [, {error-option / X'00'}]	Generates command control block
symbol	CCW	[device-cmd-code] [,data-addr] [,flag] [,data-byte-count]	Generates channel command word
[symbol]	EXCP	{CCB-name / (1)} [,C]	Executes channel program

Label	Operation	Operand	Description
Physical Input/Output Control (cont)			
symbol	PIOCB	[{FCB-length / MAX / 16}]	Generates input/output control block
[symbol]	RDFCB	{PIOCB-name / (1)} [, {error-addr / (r)}]	Reads file control block

Input/Output Synchronization			
[symbol]	WAIT	{ ALL / CCB-name / (1) } [, { branch-addr / (15) }]	Waits for one or all input/output requests to complete
[symbol]	WAITM	{ CCB-name-1, CCB-name-2[,...,CCB-name-n] / list-name / (1) }	Waits for one of several input/output requests to complete

Label	Operation	Operand	Description
		Disk	
[symbol]	ALLOC	{FCB-name / filename-addr / (1)} [, {error-addr / (r)}] [, {vol-seq-no,OLD,NOFCB / (0)}]	Assigns space to a new disk file or to an existing disk file
[symbol]	EXTEND	{FCB-name / filename-addr / (1)} [, {error-addr / (r)}] [, {{01 / 80}, {vol-seq-no / (0)} [,FCBCORE]}]	Assigns additional space to an existing disk file

[symbol]	OBTAIN	{ param-list / (1) } [, { error-addr / (r) }] [, { vol-seq-no / 1 }] [,FCBCORE]	Accesses VTOC user block
[symbol]	RENAME	{ param-list / (1) } [, { error-addr / (r) }] [{ vol-seq-no / 1 }] [,FCBCORE]	Renames a disk file
[symbol]	SCRTCH	{ FCB-name / (1) } [, { PREFIX / ALL / (0) }] [, { error-addr / (r) }]	Deallocates one or more disk files

Label	Operation	Operand	Description
		Diskette	
[symbol]	ALLOC	{FCB-name / filename-addr / (1)} [, {error-addr / (r)}] [, {vol-seq-no,,NOFCB / (0)}]	Assigns space to a new diskette file
[symbol]	OBTAIN	{param-list / (1)} [, {error-addr / (r)}] [, {vol-seq-no / 1}] [,FCBCORE]	Obtains diskette label information


[symbol]
SCRTCH
{FCB-name / (1)} [,] [, {error-addr / (r)}]
Deallocates diskette file

Label	Operation	Operand	Description
		Disk SAT	
[symbol]	CLOSE	{ filename-1 [,...,filename-n] / (1) / *ALL }	Closes disk file
filename	DTFPF	PCA1=partition-name-1 [,...,PCA7=partition-name-7] [,ACCESS= { EXC / EXCR / SRDO / SRD }] [,ALINE=YES] [,ERROR=symbol] [,EXTENTS=n] [,FCB=YES] [,LIBUP=YES] [,WAIT=YES]	Defines partitioned file
[symbol]	GET	{ filename / (1) } , { PCA-name / (0) }	Gets next logical block

[symbol]	OPEN	{ filename-1 [,...,filename-n] } { (1) }	Opens disk file
partition-name	PCA	BLKSIZE=n IOAREA1=symbol [,EODADDR=symbol] [,FORMAT=NO] [,KEYLEN=n] [,LACE=n] [,LBLK=n] [,SEQ=YES] [,SIZE=n] [,UOS=n] [,VERIFY=YES]	Defines partition control appendage
[symbol]	PUT	{ filename } { (1) } , { PCA-name } { (0) }	Outputs logical block
[symbol]	{ READE } { READH }	{ filename } { (1) } , { PCA-name } { (0) }	Searches track by key, equal Searches track by key, equal or higher
[symbol]	SEEK	{ filename } { (1) } , { PCA-name } { (0) }	Accesses physical block
[symbol]	WAITF	{ filename } { (1) }	Waits for block transfer

Label	Operation	Operand	Description
		Tape SAT	
[symbol]	CLOSE	{ filename-1 [,...,filename-n] (1) }	Closes tape file
[symbol]	CNTRL	{ filename (1) } ,code	Initiates nondata operations on a tape unit
[symbol]	GET	{ filename (1) } , { TCA-name (0) }	Gets next logical block
[symbol]	OPEN	{ filename-1 [,...,filename-n] (1) }	Opens tape file

[symbol]	PUT	$\left\{\begin{matrix}\text{filename}\\(1)\end{matrix}\right\}$,$\left\{\begin{matrix}\text{TCA-name}\\(0)\end{matrix}\right\}$	Outputs next logical block
filename	SAT	TCA=TCA-name [,ERROR=error-addr] [,FCB=YES] [,WAIT=YES]	Defines a magnetic tape file to be processed by TSAT

Label	Operation	Operand	Description
		Tape SAT (cont)	
TCA-name	TCA	IOAREA1=area-name ,BLKSIZE=n [,BKNO=YES] [,CKPTREC=YES] [,CLRW={NORWD / RWD}] [,EOFADDR=end-of-data-addr] [,FILABL={STD / NSTD / NO}] [,LBLK=n] [,OPRW=NORWD] [,READ={FORWARD / BACK}] [,REWIND={UNLOAD / NORWD}]	Defines the logical attributes of a magnetic tape file to be processed by TSAT

		[,TPMARK=NO] [,TYPEFLE=OUTPUT]	
[symbol]	WAITF	{filename / (1)}	Waits for block transfer

Label	Operation	Operand	Description
		Task Management	
[symbol]	ATTACH	{ECB-name / (1)}, {entry-point-name / (0)} [, {error-addr / (r)}] [,n]	Creates and activates additional tasks
[symbol]	AWAKE	[{ECB-name / (1)}]	Reactivates existing, nonactive task
[symbol]	CHAP	{n / (1)}	Changes priority of task
[symbol]	DETACH	[{ECB-name / (1)}] [, {error-addr / (r)}]	Terminates task normally
[symbol]	ECB		Generates event control block

[symbol]	TYIELD		Deactivates a task
Task Synchronization			
[symbol]	POST		Activates waiting task
[symbol]	TGO	{ECB-name / ALL / (1)} [, {error-addr / (r)}] [,TYIELD]	Reactivates a task or tasks deactivated by previous TPAUSE macro instruction
[symbol]	TPAUSE	{ECB-name / ALL / (1)} [, {error-addr / (r)}]	Deactivates task or tasks until a subsequent TGO macro instruction is issued to reactivate the task or tasks
[symbol]	WAIT	{ECB-name / (1)}	Waits for task request to complete
[symbol]	WAITM	{ECB-name-1,ECB-name-2 [,...,ECB-name-n] / list-name / (1)}	Waits for one of several task requests to complete

Label	Operation	Operand	Description
		Program Loader	
[symbol]	FETCH	{ phase-name / (1) } [, { entry-point-name / (0) }] [,R] [,DA]	Loads program phase and branches
[symbol]	LOAD	{ phase-name / (1) } [, { load-addr / (0) }] [, { error-addr / (r) }] [,R] [,DA]	Loads program phase and returns control
[symbol]	LOADI	{ phase-name / (1) } , { work-area-addr / (0) }	Locates program phase and stores its phase header in work area

		[, {work-area-length / **13**}] [, {error-addr / (r)}] [,R]	
[symbol]	LOADR	{phase-name / (1)} [, {load-addr / (0)}] [, {error-addr / (r)}] [,R] [,DA]	Loads program phase, relocates address constants, and returns control
Job and Task Termination			
[symbol]	CANCEL	[{error-code / (0) / **0**}] [,NODUMP]	Terminates job abnormally
[symbol]	EOJ		Terminates job step normally

Label	Operation	Operand	Description
Timer Services			
[symbol]	GETIME	[{M / S}]	Obtains current time and date
[symbol]	SETIME	[{time-interval / (1)}] [,WAIT] [, {M / S}]	Sets elapsed time counter for the requesting task
Program Linkage			
symbol	ARGLST	param-1,...,param-n	Generates an argument list as required by the CALL/VCALL macro. This is a declarative macro and must not appear in executable code.

[symbol]	{ CALL / VCALL }	{ entry-point / (15) } [, { (param-1,...,param-n) / list-address / (1) }]	Pass control from a program to a specified entry point in another program
[symbol]	RETURN	[(r1,r2)] [,T] [,SA= { savearea-name / * }]	Marks the exit point of the called program
[symbol]	SAVE	[(r1,r2)] [,T] [,COVER= { r / (r1,r2,...rn) / 15 }] [,COVADR= { base-addr / * }] [,SA=savearea-name]	Marks the entry point of the called program

Label	Operation	Operand	Description
		Island Code Linkage	
[symbol]	EXIT	{ OC / PC }	Exits from unsolicited operator communications, or program check island code routine
[symbol]	EXIT	IT [, { timer-interval / (1) }] [, { M / S }]	Exits from interval timer island code routine
[symbol]	STXIT	{ AB / IT / OC / PC }	Terminates linkage with abnormal termination, interval timer, unsolicited operator communications, or program check island code routine
[symbol]	STXIT	{ AB / IT / PC } [, { entry-point / (1) }, { save-area / (0) }]	Links island code routine when used for abnormal termination, interval timer island code linkage, or program check.

[symbol]	STXIT	OC [,{entry-point,save-area,msg-area,length / (1)}]	Links island code routine when used for unsolicited operator communications linkage
System Information Control			
[symbol]	GETCOM	{to-addr / (1)}	Retrieves data from job communication area
[symbol]	GETINF	{PRE / PUB / SIB / TCB}, {work-area / (1)},bytes, displacement	Retrieves data from system control tables
[symbol]	PUTCOM	{from-addr / (1)}	Places data in job communication area

Label	Operation	Operand	Description
		Control Stream Reader	
[symbol]	GETCS	{ input-area / (1) } [, { number-of-records / 0 / **1** }] [, { error-addr / (r) }] [, { n / **80** }]	Retrieves embedded data file submitted in job control stream
[symbol]	SETCS	{ NEXT / data-set-no / pointer / (1) } [, { R / **S** }] [, { error-addr / (r) }]	Resets pointer to embedded data file

Storage Displays			
[symbol]	DUMP	[{identification code / (0) / 0}]	Prints out job in main storage and terminates job step
[symbol]	{SNAP / SNAPF}*	{start-addr-1,end-addr-1 / [...,start-addr-n,end-addr-n] / (1)}	Prints out portions of main storage and returns control

*SNAP or SNAPF macro is also a debugging aid. See 4.6.

Label	Operation	Operand	Description
		Checkpoint Facility	
[symbol]	CHKPT	filename [,restart-addr] [,list-name] [,error-addr]	Writes a series of checkpoint records to a specified checkpoint file
list-name	DCFLT	{ (disk-PIOCB-1) / (tape-PIOCB-1,tmc-1,bc-1) } [{ ,(...),(disk-PIOCB-n) / (...,...,...),(tape-PIOCB-n,tmc-n,bc-n) }]	Generates a table of PIOCS files
[symbol]	DCPCLS	{ filename / (1) }	Closes a SAT checkpoint file defined by a DDCPF macro instruction

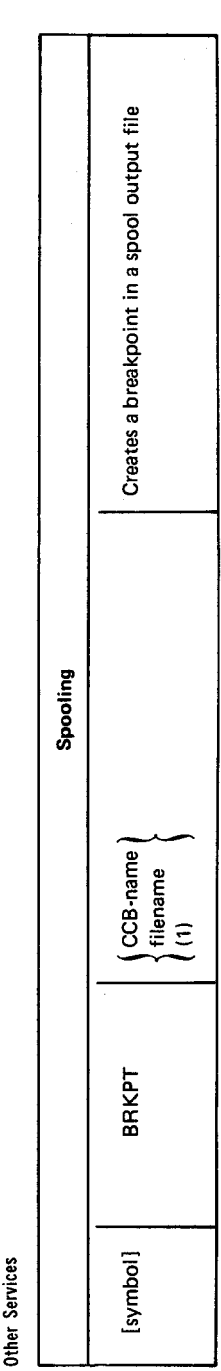
[symbol]	DCPOPN	{ filename (1) }	Opens a SAT checkpoint file defined by a DDCPF macro instruction
filename	DDCPF		Defines a SAT file to which checkpoint records are to be written

Label	Operation	Operand	Description
[symbol]	GETMSG	{buff-addr-1 / (1)} [, {msg-length / (0) / 60}] [, {error-addr / (r)3}] [,] [, {buff-addr-2 / (r)4}] [, {buff-length-2 / (r)5}]	Retrieves message from canned message file
[symbol]	WTL	{buff-addr / (1)} [, {msg-length / (0) / 60}] [, {error-addr / (r)3}]	Writes message to the system log file

[symbol]	WTLD	{buff-addr-1 / (1)} [,{msg-length / (0) / 60}] [,{error-addr / (r)3}] [,REPLY] [,{buff-addr-2 / (r)4}] ,{buff-length-2 / (r)5}	Writes message to system log file after displaying on system console or workstation

Message Display, Logging, and Operator Communication (cont)

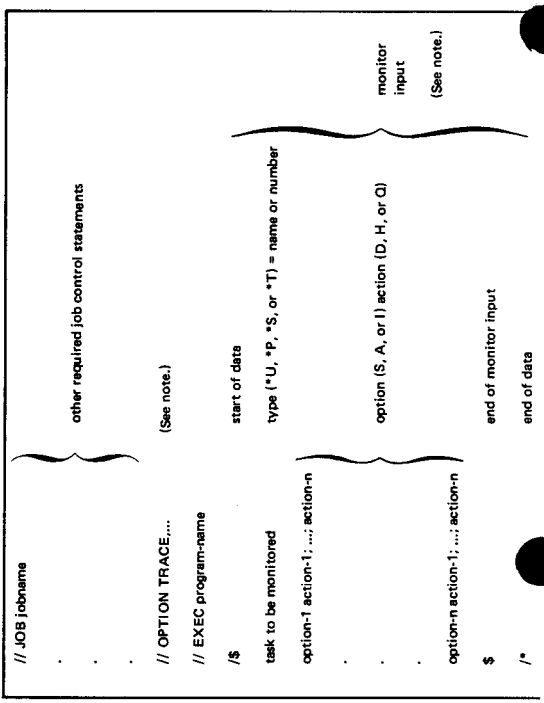
Label	Operation	Operand	Description
[symbol]	OPR	{ buff-addr-1 / (1) } [, { msg-length / (0) / 60 }] [, { error-addr / (r)3 }] [,REPLY] [, { buff-addr-2 / (r)4 }] [, { buff-length-2 / (r)5 / 60 }]	Displays message on system console or workstation for reply or information


Other Services
Spooling
[symbol]
BRKPT
CCB-name
filename
(1)
Creates a breakpoint in a spool output file

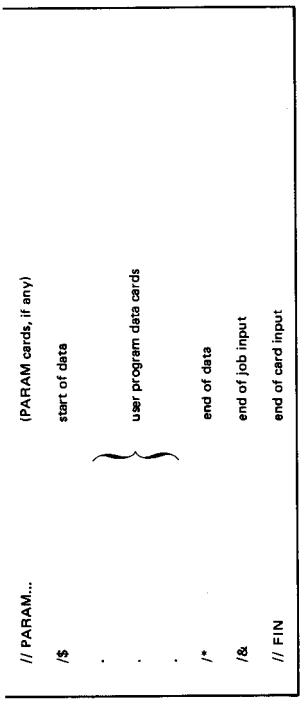
4.2. MONITOR AND TRACE

4.2.1. Control Stream Format for a Job to be Monitored From the Start of the Program

Control Stream Format for a Job to be Monitored From the Start of the Program



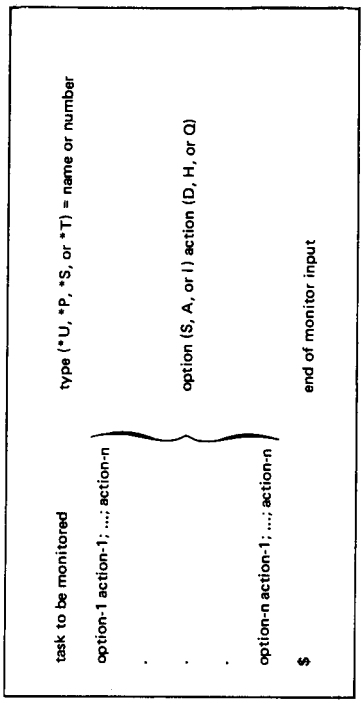
Control Stream Format for a Job to be Monitored From the Start of the Program (cont)



NOTE :

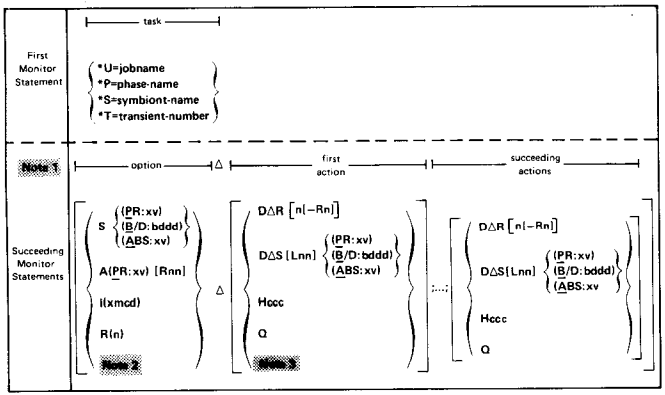
The TRACE entry is required if monitor input is entered via the job control stream.

4.2.2. Monitor Input Format for Input by the Operator After Program Execution has Begun



Monitor Input Format for Input by the Operator After Program Execution has Begun

Statement Formats for Monitor Input



NOTES:

1. The first action is separated from the option by a blank space, and any succeeding actions are separated from the previous action by a semicolon.
2. If no option is specified, the monitor routine assumes a default option (each instruction is interrupted) and default display. (See 4.2.4.)
3. If no action is specified, the monitor routine produces a default display.

Summary of Actions and Program Information Printed

Program Information Printed	Action				
	Display Register (D R)	Display Storage (D S)	Default Display	Halt (H)	Quit (Q)
Job name*	x	x	x	x	x
TCB address*	x	x	x	x	x
Program base address*	x	x	x	x	x
PSW contents	x	x	x	x	x
Next instruction to execute	x	x	x	x	x
Option causing this printout	x	x	x	x	x
Contents of specified registers	x				
Contents of specified storage		x			
Contents of changed registers			x		
Contents of referenced storage			x		
HALT message				x	

*These items are included only for the first option that causes a printout.

Low-Order Main Storage Layout

Byte Address (Hexadecimal)	0 1 2 3	4 5 6 7	8 9 A B	C D E F
00X				
01X	IOSTCW0	IOSTCW1	IOSTCW2	(Reserved)
02X	IOST	Old PSW	IOST	New PSW
03X	Machine Check	Old PSW	Machine Check	New PSW
04X	Program Exception	Old PSW	Program Exception	New PSW
05X	Supervisor Call	Old PSW	Supervisor Call	New PSW
06X	Interval Timer	Old PSW	Interval Timer	New PSW
07X	(Reserved)		(Reserved)	
08X	Monitor	Old PSW	Monitor	New PSW

Low-Order Main Storage Layout (cont)

Byte Address (Hexadecimal)	0 1 2 3	4 5 6 7	8 9 A B	C D E F
09X	(Reserved)		(Reserved)	
0AX	CAW	MM ① / LL ② / RR ③ / 00 ④	(Reserved)	
0BX	Rel. Reg. 0	Rel. Reg. 1	Rel. Reg. 2	Rel. Reg. 3
0CX	Rel. Reg. 4	Rel. Reg. 5	Rel. Reg. 6	Rel. Reg. 7
0DX	(Reserved)		(Reserved)	
0EX	IOST BCSW		IOST BCSW	
0FX	Int. Disk BCW0	Int. Disk BCW1	Int. Disk BCW2	Int. Disk BCW3
10X	Console BCW0	Console BCW1	Console BCW2	Console BCW3

11X	Reader BCW0	Reader BCW1	Reader BCW2	Reader BCW3
12X	Printer BCW0	Printer BCW1	Printer BCW2	Printer BCW3
13X	Punch BCW0	Punch BCW1	Punch BCW2	Punch BCW3
14X	LA0 BCW0*	LA0 BCW1*	LA0 BCW2*	LA0 BCW3*
15X	LA6 BCW0*	LA6 BCW1*	LA6 BCW2*	LA6 BCW3*
16X	LA1 BCW0*	LA1 BCW1*	LA1 BCW2*	LA1 BCW3*
17X	LA7 BCW0*	LA7 BCW1*	LA7 BCW2*	LA7 BCW3*
18X	LA2 BCW0*	LA2 BCW1*	LA2 BCW2*	LA2 BCW3*
19X	LA8 BXW0*	LA8 BCW1*	LA8 BCW2*	LA8 BCW3*
1AX	LA3 BCW0*	LA3 BCW1*	LA3 BCW2*	LA3 BCW3*

Low-Order Main Storage Layout (cont)

Byte Address (Hexadecimal)	0 1 2 3	4 5 6 7	8 9 A B	C D E F
1BX	LA9 BCW0*	LA9 BCW1*	LA9 BCW2*	LA9 BCW3*
1CX	LA4 BCW0*	LA4 BCW1*	LA4 BCW2*	LA4 BCW3*
1DX	LA10 BCW0*	LA10 BCW1*	LA10 BCW2*	LA10 BCW3*
1EX	LA5 BCW0*	LA5 BCW1*	LA5 BCW2*	LA5 BCW3*
1FX	LA11 BCW0*	LA11 BCW1*	LA11 BCW2*	LA11 BCW3*
20X	Mux. Subch. 0 BCW0	Mux. Subch. 0 BCW1	Mux. Subch. 0 BCW2	Mux. Subch. 0 BCW3
21X	Mux. Subch. 1 BCW0	Mux. Subch. 1 BCW1	Mux. Subch. 1 BCW2	Mux. Subch. 1 BCW3
22X	Mux. Subch. 2 BCW0	Mux. Subch. 2 BCW1	Mux. Subch. 2 BCW2	Mux. Subch. 2 BCW3
23X	Mux. Subch. 3 BCW0	Mux. Subch. 3 BCW1	Mux. Subch. 3 BCW2	Mux. Subch. 3 BCW3

24X	Mux. Subch. 4 BCW0	Mux. Subch. 4 BCW1	Mux. Subch. 4 BCW2	Mux. Subch. 4 BCW3
25X	Mux. Subch. 5 BCW0	Mux. Subch. 5 BCW1	Mux. Subch. 5 BCW2	Mux. Subch. 5 BCW3
26X	Mux. Subch. 6 BCW0	Mux. Subch. 6 BCW1	Mux. Subch. 6 BCW2	Mux. Subch. 6 BCW3
27X	Mux. Subch. 7 BCW0	Mux. Subch. 7 BCW1	Mux. Subch. 7 BCW2	Mux. Subch. 7 BCW3
28X	(Unused)			
29X				
2AX				
2BX				
2CX				
2DX				

Low-Order Main Storage Layout (cont)

Byte Address (Hexadecimal)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2EX	(Unused)															
2FX																
30X	DISKETTE 0			BCW0	DISKETTE 0			BCW1	DISKETTE 0			BCW2	DISKETTE 0			BCW3
31X	DISKETTE 1			BCW0	DISKETTE 1			BCW1	DISKETTE 1			BCW2	DISKETTE 1			BCW3
32X	DISKETTE 2			BCW0	DISKETTE 2			BCW1	DISKETTE 2			BCW2	DISKETTE 2			BCW3
33X	DISKETTE 3			BCW0	DISKETTE 3			BCW1	DISKETTE 3			BCW2	DISKETTE 3			BCW3
34X	LA0**/WS9			BCW0	LA0**/WS9			BCW1	LA0**/WS9			BCW2	LA0**/WS9			BCW3
35X	LA6**/WS10			BCW0	LA6**/WS10			BCW1	LA6**/WS10			BCW2	LA6**/WS10			BCW3
36X	LA1**/WS11			BCW0	LA1**/WS11			BCW1	LA1**/WS11			BCW2	LA1**/WS11			BCW3
37X	LA7**/WS12			BCW0	LA7**/WS12			BCW1	LA7**/WS12			BCW2	LA7**/WS12			BCW3
38X	LA2**/WS1			BCW0	LA2**/WS1			BCW1	LA2**/WS1			BCW2	LA2**/WS1			BCW3
39X	LA8**/WS2			BCW0	LA8**/WS2			BCW1	LA8**/WS2			BCW2	LA8**/WS2			BCW3
3AX	LA3**/WS3			BCW0	LA3**/WS3			BCW1	LA3**/WS3			BCW2	LA3**/WS3			BCW3

Low-Order Main Storage Layout (cont)

3BX	LA9**/WS4	BCW0	LA9**/WS4	BCW1	LA9**/WS4	BCW2	LA9**/WS4	BCW3
3CX	LA4**/WS5	BCW0	LA4**/WS5	BCW1	LA4**/WS5	BCW2	LA4**/WS5	BCW3
3DX	LA10**/WS6	BCW0	LA10**/WS6	BCW1	LA10**/WS6	BCW2	LA10**/WS6	BCW3
3EX	LA5**/WS7	BCW0	LA5**/WS7	BCW1	LA5**/WS7	BCW2	LA5**/WS7	BCW3
3FX	LA11**/WS8	BCW0	LA11**/WS8	BCW1	LA11**/WS8	BCW2	LA11**/WS8	BCW3

*Communication adapter-1

**Communications adapter-2 (mutually exclusive with workstations)

NOTES:

① MM = machine microcode ID field

② LL = load microcode ID field

③ RR = revision level microcode ID field

④ 00 = zero filler

Command Control Block (CCB) Format

Byte	0	1	2	3
0	control byte 1	I/O error count	transmission byte	control byte 2
4	TCB address① or next CCW address			
8	CCB link	address② or residual CCW byte count		
12	CCW address			
16	PIOCB pointer (PUB address)			
20	sense byte 0	sense byte 1	sense byte 2	sense byte 3
24	sense byte 4	sense byte 5	device status	channel status

Notes:

① During the I/O command execution, bytes 4–7 contain the address of the TCB associated with this CCB. At I/O command termination, PIOCS inserts the address of the next CCW in the chain.

② During I/O command execution, bytes 8–11 contain the address of the next CCB in the chain at this job level. At I/O command termination, PIOCS inserts the number of bytes remaining in the CCW byte count (when the I/O command terminated) into bytes 10 and 11.

COMMAND CONTROL BLOCK (CCB) FORMAT (cont)

Byte	Length	Content
0	1	Control byte 1 Bits 0–2 Reserved 3 1 = Ignore block numbers 4 Reserved 5 1 = CCB in wait condition 6–7 Reserved
1	1	Binary count of errors encountered processing the CCB
2	1	Transmission byte Bit 0 0 = CCB in process 1 = CCB processed 1 1 = Unrecoverable error 2 1 = Unique error 3 1 = No record found 4 1 = Unit exception 5 1 = Block numbers not equal 6 1 = Track end 7 1 = Cylinder end
3	1	Control byte 2 Bit 0 1 = User error recovery 1 1 = Accept unrecoverable errors 2 1 = Accept unique errors 3 1 = Diagnostic CCB 4 1 = System access CCB 5 Reserved 6 Reserved 7 1 = Block number area reserved
4–7	4	During I/O command execution, full-word address of TCB associated with this CCB or At I/O command termination, full-word address of next CCW if not at end of command chain

Command Control Block (CCB) Format (cont)

Byte	Length	Content
8–11	4	During I/O command execution, full-word address of next CCB or
10–11	2	At I/O command termination, bytes remaining in CCW byte count when I/O command was terminated
12–15	4	Full-word address of first CCW
16–19	4	Address of PIOCB entry which contains the half-word address of PUB associated with this CCB
20–23	4	Sense bytes 0 through 3
24,25	2	Sense bytes 4 and 5
26	1	Device status Bit 0 1 = Attention 1 1 = Status modifier 2 1 = Control unit end 3 1 = Busy 4 1 = Channel end 5 1 = Device end 6 1 = Unit check 7 1 = Unit exception
27	1	Channel status Bit 0 0 1 1 = Incorrect length 2 1 = Program check 3 1 = Invalid address 4 1 = Channel data check 5 1 = Interface control check 6 1 = Channel control check 7 1 = Buffer terminate

IPC SIO Condition Codes

Condition Code	Peripheral Control State	Peripheral Subsystem State	Command Disposition	Interrupt Disposition	Destination of Status Byte in IOSTIW
00	Available	Run	Accepted	Stored (1)	Integrated Peripheral (2)
01	Available	Stop	Rejected (3)	Stored (1)	Integrated Peripheral
10 (4)	Busy	—	Rejected	Not Stored	—
11	Not operational	—	Rejected	Not Stored	—

NOTES:

(1) Interrupt word is stored in the BCSW by a status sequence subsequent to the exit from the SIO sequence.

(2) The interrupt word normally contains device status and is stored at the completion of the operation.

(3) Sense command is not to be rejected by the integrated peripheral control when the associated peripheral subsystem is in stop state.

(4) The addressed integrated peripheral control is also considered busy if there is a pending status condition in the subchannel or control.

Significance of the 01_2 Condition Code

$(01)_2$ Error Condition Code	Detected by	Location of IOSTIW Status Byte
Invalid Command	Peripheral control	Peripheral subsystem
Protection exception on command reference	IPC	Channel
Address check on command reference	IPC	Channel
Storage parity check on command reference	IPC	Channel
Addressing exception on command reference	IPC	Channel

IDA SIO Condition Codes

Condition Code	IDA State	Device State	Command Action	Interrupt Word Stored	Applicable Status Field in IOSTIW
00	Available	Run	Accepted	Yes (1)	Device (2)
01	Available	Busy	Rejected (3)	Yes	Device
01	Available	Stop	Rejected (3)	Yes	Device
10 (4)	Busy	--	Rejected	No	--

NOTES:

(1) IOSTIW is stored in the BCSW at completion of command.

(2) Device status is stored if no other errors occur (such as channel status).

(3) Sense, ECC sense, diagnostic, or ECC diagnostic commands are not rejected. Condition code = 00.

(4) Integrated disk adapter (IDA) is considered busy if pending status condition prevails.

Multiplexer Channel SIO Condition Codes

Condition Code	State ④			Command Action	IOSTIW Stored	Applicable Status Field in IOSTIW	Initial Selection Sequence
	Channel	Subchannel	Subsystem				
00	A	A	A	Accepted	Yes ①	Device	Yes
01	A	A	P	Rejected	Yes ②	Device	Yes
10	P	X	X	Rejected	Yes ③	–	No
	A	A	W	Rejected	No	–	Attempted (immediate busy)
11	N	X	X	Rejected	No	–	No
	X	X	N	Rejected	No	–	Attempted

NOTES:

① Refer to the AAA state.

② The COMMAND OUT response to a STATUS IN is given when the busy bit is set in the control unit status. A subsequent control unit request to present status is accepted by the channel, if possible, and a STATUS SERVICE REQUEST is generated.

③ A STATUS SERVICE REQUEST has been previously generated.

④ A = Available
W = Working
P = Status pending
N = Nonoperational
X = Any state

Selector Channel SIO Condition Codes

Condition Code	State ④	Command Action	IOSTIW Stored	Applicable Status Field in IOSTIW	Initial Selection Sequence
00	A A A	Accepted	Yes ①	Device	Yes
01	A A P	Rejected	Yes ②	Device	Yes
	P P X	Rejected	Yes ③	Device and/or channel	No
10	W W X	Rejected	No	–	No
	A A W	Rejected	No	–	Attempted (immediate busy)
11	N X X	Rejected	No	–	No
	A A N	Rejected	No	–	Attempted

NOTES:

① Refer to AAA state.

② The COMMAND OUT signal response to a STATUS IN signal is given when the control unit status has the busy bit set. A subsequent control unit request to present status is accepted by the channel, if possible, and a STATUS SERVICE REQUEST signal is generated.

③ A STATUS SERVICE REQUEST signal has been generated as a result of a previous operation. An IOSTIW containing status pertaining to the previous operation is stored. The IOSTIW contains both CHANNEL STATUS and DEVICE STATUS signals if both were stored in the channel and the device address pertains to both. No new status results from the SIO instruction.

④ A = available
W = working
X = any state
P = status pending
N = nonoperational

Summary of System Debugging Aids

Function	Use	Console Command	Results
Pseudo monitor*	To identify the routine changing a particular byte	SET HA,PM,address [,job-name]	HPR code 99130202 (Press RUN to continue.)
Resident monitor*	To identify the instruction changing a particular byte	SET HA,RM,address [,job-name]	HPR code 99130404 (Press RUN to continue.)
Mini monitor	To identify the instruction changing a particular byte	MM value,address, RTUE	HPR code 991200 (Press RUN to continue.)
Verify bytes 0—B*	To identify the routine destroying low-order storage	Included in supervisor debug option	HPR code 99130303 (Press RUN to continue.)
History tables*	To provide some recent history in SYSDUMPs	Included in supervisor debug option	Continuous updating of resident tables
Halt on transient load	To halt if and when a particular transient is loaded	SET HA,TL,hex-id	HPR code 990C0C (Press RUN to continue.)

Halt on transient call*	To halt if and when a particular transient is called	SET HA,TC,hex-id	HPR code 990C0D (Press RUN to continue.)
Halt on transient exit*	To halt if and when a particular transient is exited	SET HA,TE,hex-id	HPR code 990C0E (Press RUN to continue.)
Halt on shared code call*	To halt if and when certain (or all) shared code modules are called	SE HA, SC [{, module-name / prefix.}]	HPR code 991D01 (Press RUN to continue.)
Halt on shared code return*	To halt if and when certain (or all) shared code modules return	SE HA, SR [{, module-name / prefix.}]	HPR code 991D02 (Press RUN to continue.)
Halt on shared code return with error*	To halt if and when certain (or all) shared code modules return with error	SE HA, SE [{, module-name / prefix.}]	HPR code 991D03 (Press RUN to continue.)
Pause on shared code call*	To pause a task if and when certain (or all) share code modules are called	SE PA, SC [{, module-name / prefix.}]	SE25 console message (Enter 'C' to continue.)

Summary of System Debugging Aids (cont)

Function	Use	Console Command	Results
Pause on shared code return*	To pause a task if and when certain (or all) shared code modules return	SE PA, SR [{, module-name / prefix.}]	SE25 console message (Enter 'C' to continue.)
Pause on shared code return with error*	To pause a task if and when certain (or all) shared code modules return with error	SE PA, SE [{, module-name / prefix.}]	SE25 console message (Enter 'C' to continue.)
Halt on symbiont load	To halt if and when a particular symbiont (or symbiont phase) is loaded	SET HA,SY,idnn	HPR code 997C (Press RUN to continue.)
PIOCS debug option	To identify checksum errors or internal PIOCS problems	SET DE,IO	HPR code 990F
Transient debug option	To halt on transient errors (100—1FF)	SET DE,TR	HPR code 99080800

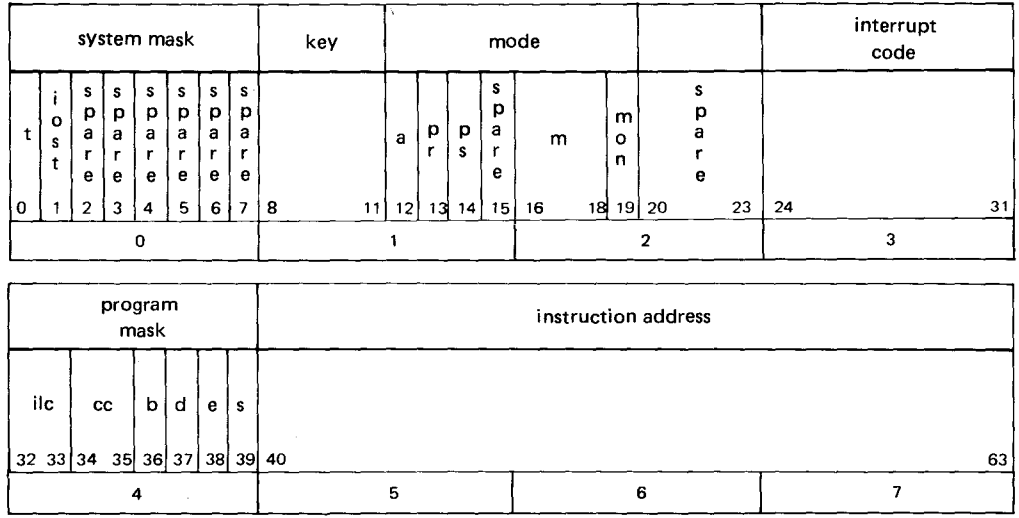
Loader debug option	To halt on loader errors (52—5F)	SET DE,LD	HPR code 991500 (Press RUN to continue.)
Shared code debug option	To halt on error during execution of shared code	SET DE,SC	HPR code 990809 on shared code errors (Press RUN to take a SYSDUMP and to continue.) HPR code 99130A when dynamic buffer pool links are destroyed.
Dynamic buffer debug option*	To halt on dynamic buffer overflow	SET DE,DB	HPR code 99130D
Screen format coordinator input/output debug option	To take a snapshot dump of all input and output buffer blocks when using the screen format coordinator	SET DE,INO	Writes snapshot dump to job log
Screen format coordinator input/output debug option	To take diagnostic snapshot if screen format coordinator error occurs	SE DE,SF	Causes snapshot to be taken

Summary of System Debugging Aids (cont)

Function	Use	Console Command	Results
Screen format coordinator format/input/output debug option	To take a snapshot dump of the format block; the input buffer (on input operations); the output buffer (on output operations) blocks; and, if errors occur, the screen format coordinator blocks	SET DE,FS	Writes snapshot dump to job log or system printer
Reset pause options	Resets all SE PA commands	SE PA,OFF	None
Reset halts	Resets all SE HA commands	SE HA,OFF	None
Reset debug options	Resets all SE DE commands	SE DE,OFF	None

*Supervisor debug option required at IPL

Program Status Word (PSW) Format



Legend for Program Status Word

Bits	Allocation	Function
0	Timer level interrupt mask	
1	I/O status tabler level interrupt mask (channel 7)	
2–7	Not used, must be zero	
8–11	Key	3-bit code assigning associated block of main storage to one of eight programs
12	ASCII mode	a = 1 (ASCII mode) a = 0 (EBCDIC mode)
13	Problem register mode	pr = 1 (problem registers selected) pr = 0 (supervisor general register selected)

Program Status Word (PSW) Format (cont)

Bits	Allocation	Function
14	Problem mode selection	ps = 1 (problem mode) ps = 0 (supervisor mode)
15	Not used; must be zero	
16–18	Mode	000 = 90/30 native mode 001 = 9200/9300 compatibility mode 010 = IBM 360/20 compatibility mode
19	Monitor mode	mon = 1 (monitor mode) mon = 0 (normal execution)
20–23	Not used; must be zero	
24–31	Interrupt code*	

*Refer to Program Exception Interrupt Codes and Machine Check Level Interrupt Codes.

Program Status Word (PSW) Format (cont)

Bits	Allocation	Function
32, 33	Instruction length code	00 = instruction suppressed 01 = one half word (RR) 10 = two half words (RX, RS, SI) 11 = three half words (SS)
34, 35	Condition code**	00 = test value is binary 8 (1000) 01 = test value is binary 4 (0100) 10 = test value is binary 2 (0010) 11 = test value is binary 1 (0001)
36 37 38 39	Program mask bits b = fixed-point overflow d = decimal overflow e = exponent underflow s = significance	1 = interrupt-allowed 0 = interrupt-inhibited
40–63	Instruction address	At interrupt, contains address of instruction following instruction causing interrupt

**Refer to CONDITION CODE SETTINGS.

Program Exception Interrupt Codes

Code		Condition
Binary	Hex.	
00000001	01	Operation exception
00000010	02	Privileged operation exception
00000011	03	Execute exception
00000100	04	Protection exception
00000101	05	Addressing exception
00000110	06	Specification exception
00000111	07	Data exception
00001000	08	Fixed-point overflow exception*
00001001	09	Fixed-point divide exception
00001010	0A	Decimal overflow exception*
00001011	0B	Decimal divide exception
00001100	0C	Exponent overflow exception
00001101	0D	Exponent underflow exception*
00001110	0E	Significance exception*
00001111	0F	Floating-point divide exception

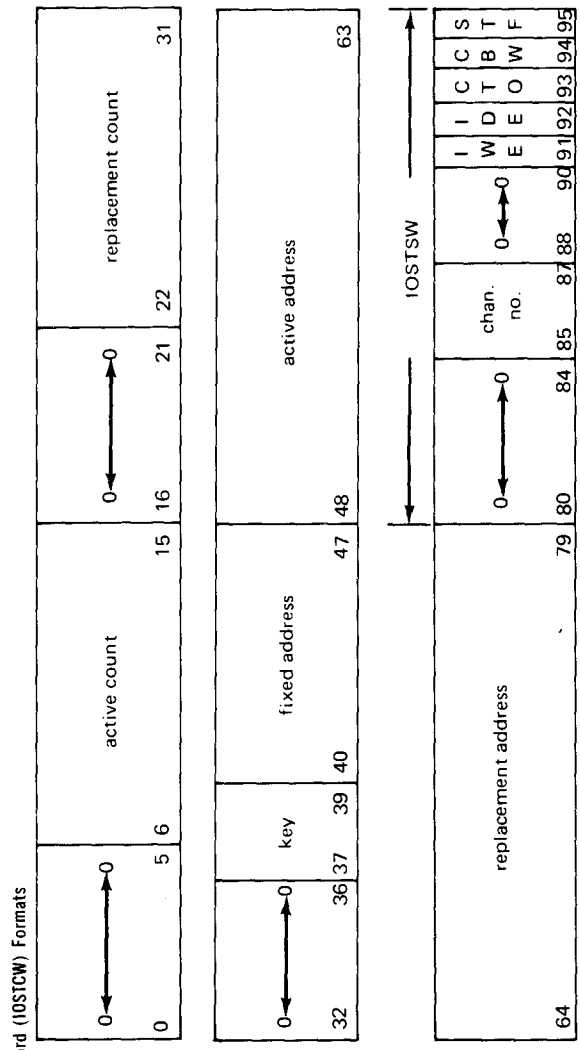
*Interrupt can be masked

Machine Check Level Interrupt Codes

Code		Condition
Binary	Hex.	
Processor Machine Check Class		
11100101	E5	Addressing or protection exception
11100110	E6	Control storage write bus check
11100111	E7	Storage parity check
11101000	E8	Address check
11101100	EC	Program exception interrupt request
11101111	EF	Processor stall timer
IOST Machine Check Class		
00000101	05	Addressing or protection exception on accessing IOSTCW
00001000	08	Address check or storage parity check on accessing IOSTCW
00001111	0F	Processor stall timer

5.2. I/O STATUS TABLER (IOST)

5.2.1. IOST Control Word (IOSTCW) Formats

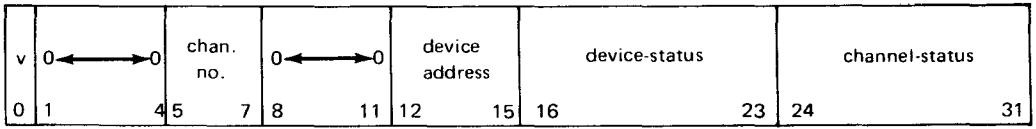


Bits	Allocation	Function
0–5	Not used; must be zero	
6–15	Active count	Number of words remaining in status word
16–21	Not used; must be zero	
22–31	Replacement count	Replaces active count field when active count is decremented to zero
32–36	Not used; must be zero	
37–39	Key	3-bit storage protection key
40–47	Fixed address	Fixed 8-bit field of status table address

48–63	Active address	Points to most significant byte of next IOSTIW location
64–79	Replacement address	Address written into active portion of address field when active count becomes zero
80–84	Set to zero	
85–87	Channel number	Channel being serviced by IOST when error condition occurred
88–90	Not used; must be zero	
91	Interrupt word error	Protection or addressing exception error detected by IOST
92	Interrupt data error	Address or data parity check error detected by IOST

93	Channel time-out	CT0 bit set when selected channel fails to respond to status service request acknowledge (SSRA) signal within specified time.
94	Channel buffer word	Error detected by selected channel
95	Status table full	Status table location when IOSTIW to be stored is full

IOST Interrupt Word (IOSTIW) Format for IDA and IPC



Bit	Allocation	IDA Function	IPC Function
0	V	Set to zero by IDA when storing an interrupt word	Set to zero by IPC when storing IOSTIW
1–4		Set to zero	Set to zero
5–7	Channel number	Set to binary 3 by IDA	Set to zero by IPC
8–11		Set to zero	Set to zero
13–15	Device address	Binary code indicating device associated with status entry	

12–15	Device address		4-bit field identifying subchannel and/or device to which channel and/or device status applies
16	Attention	One of attached disk drives affected by operator-initiated transition from stop state to run state	Same as IDA
17,18		Set to zero by IDA	
17–20			Set to zero by IPC
19	Busy	Addressed device completing previously initiated seek order, programmed offset, or has pending gated attention.	
20	Channel end	IDA able to accept another command	
21	Device end	With channel end = normal end of all commands except the seek (08) Alone = accessor movement complete, disc accessible	Completion of previously initiated command by subsystem and readiness to accept new command

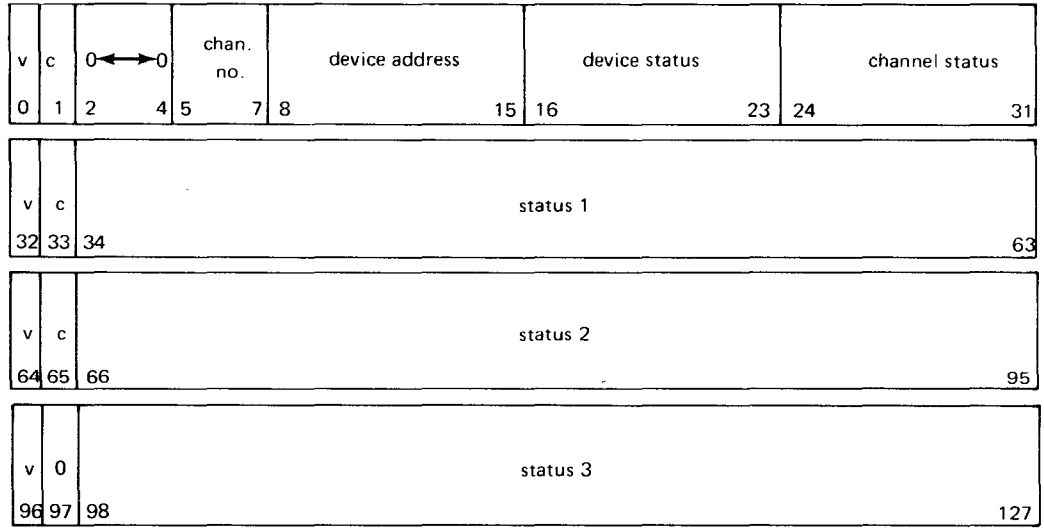
IOST Interrupt Word (IOSTIW) Format for IDA and IPC (cont)

Bit	Allocation	IDA Function	IPC Function
22	Unit check	Problem with addressed disk or IDA	Unusual condition detected at subsystem level
23	Unit exception	ECC check error on ID with read data command; ID of a record not associated with fields to be written, an ECC check error; ECC check or improper number of missing clocks detected in ID field with search read commands	Unusual condition occurred as a result of initiating operation; may not be an error
24–26		Set to zero by IDA	Set to zero
27	Invalid address	Addressing or protection exception when accessing main storage for data or BCW	Addressing or protection exception when accessing main storage except for IOSTIW references

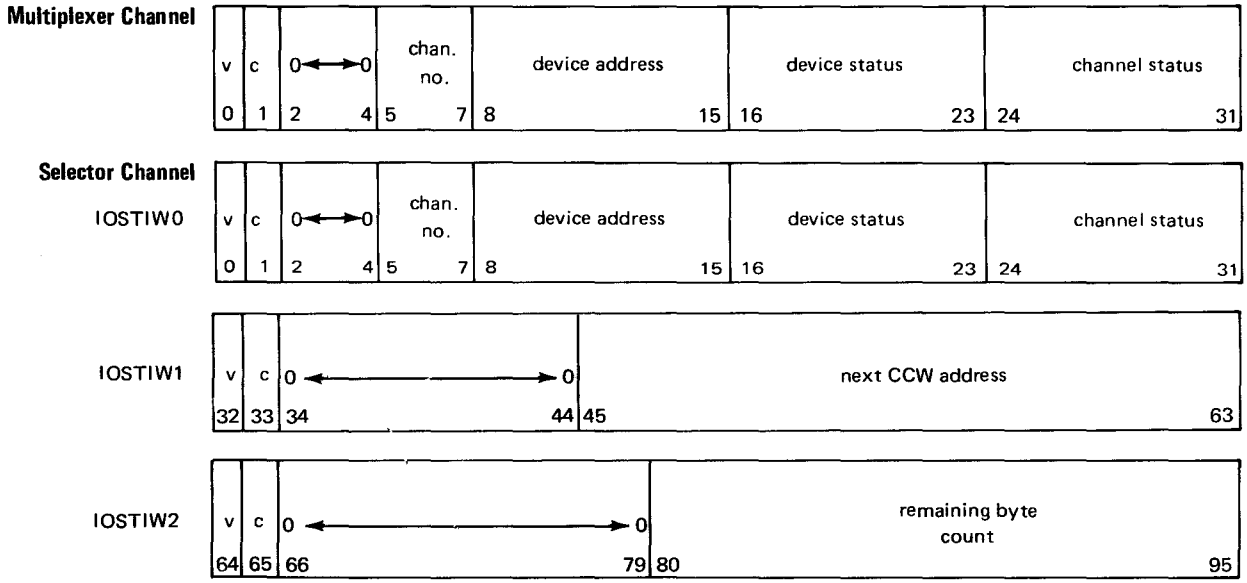
IOST Interrupt Word (IOSTIW) Format for IDA and IPC (cont)

28	Channel data check	Detection of storage parity check on data access to or from main storage	Same as IDA
29		Set to zero by IDA	Set to zero
30	Channel control check	Address check occurred during IPC operation with main storage excluding IOSTIW references	Bit set when storage parity check, addressing exception, or protection exception is detected when accessing portion of BCW; set on address check on BCW
31	Buffer terminate	Set to zero by IDA	IPC performed replacement operation required in data chaining operations

IOST Interrupt Word (IOSTIW) Formats for Multiplexer and Selector Channels



IOST Interrupt Word (IOSTIW) Formats for Multiplexer and Selector Channels (cont)



Legend for IOST Interrupt Word Bits

Bits	Allocation	Function
bits 0, 32 64, 96	Validation bit (V)*	V = 0 (before storing IOSTIW in BCSW) V = 1 (after processing status)
bits 1, 33, 65	Continuation bit**	Length of IOSTIW C = 0 (last full word of status presented) C = 1 (more than 1 full word of status is to be presented)
2–4		Not used; must be zero
5–7	Channel number†	Number of channel presenting status
8–15	Device address	Address of device or subsystem active on channel at time status is generated

*Set to zero by multiplexer and selector channels

**Bit 1, set to 1 by selector channel and zero by multiplexer channel; bits 33 and 65, set to 1 and zero, respectively, by selector channel

†Set to 100 (channel 4) or 110 (channel 6) by selector channel and 001 (channel 1) by multiplexer channel

Legend for IOST Interrupt Word Bits (cont)

Bits	Allocation	Function
16	Attention	Device status byte
17	Status modifier	
18	Control unit end	
19	Busy	
20	Channel end	
21	Device end	
22	Unit check	
23	Unit exception	
24	*Not used	Channel status byte
25	*Incorrect length	
26	*Program check	
27	Invalid address	
28	Channel data check	
29	Interface control check	
30	Channel control check	
31	*Buffer terminate	

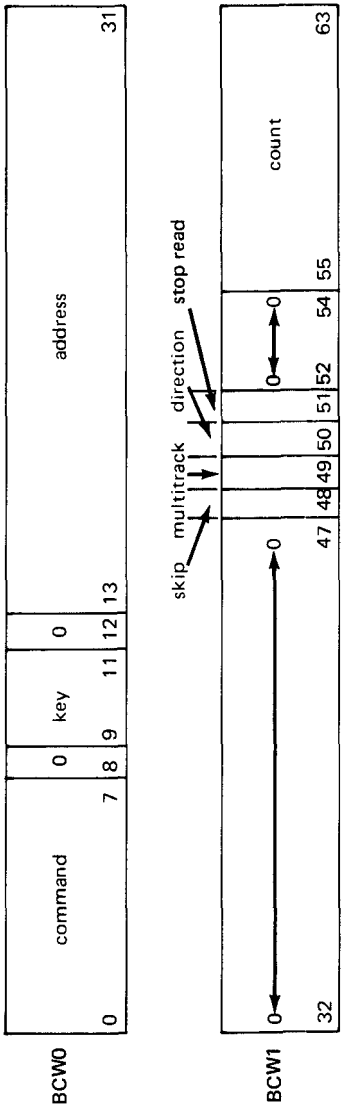
*Bits 24—26 set to zero by multiplexer channel; bit 31 set to zero by selector channel

Bits	Allocation	Function
34–44		Set to zero by channel
45–63	Next CCW address	Value of next channel command word address present in internal hardware when status word written
66–79		Set to zero by channel
80–95	Remaining byte count	Value of byte count present in internal channel hardware when status word written
34–63	Status 1	Additional 30 bits of status may be presented by a channel
64–95	Status 2	Additional 30 bits of status may be presented by a channel
96–127	Status 3	Additional 30 bits of status may be presented by a channel

Legend for IOST Interrupt Word Bits (cont)

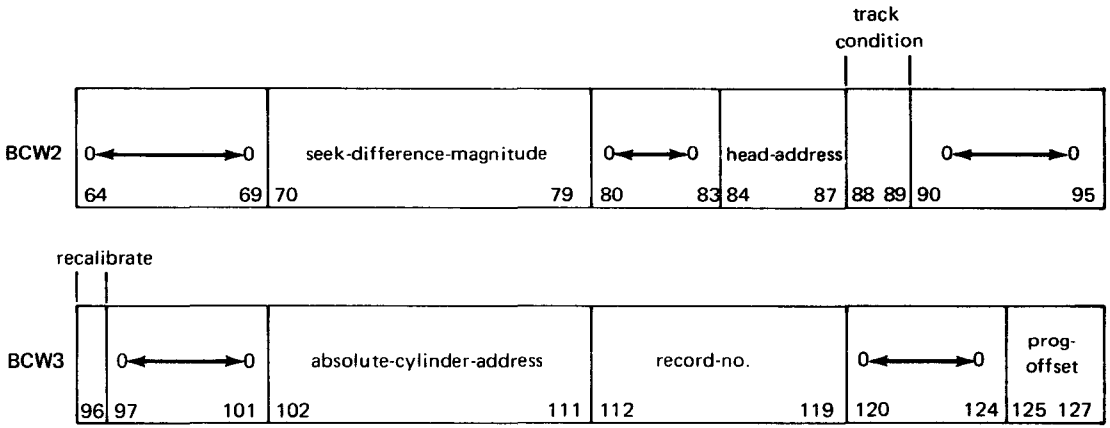
5.3. I/O CONTROL WORDS

5.3.1. Buffer Control Word (BCW) Format for IDA



Buffer Control Word (BCW) Format for IDA

Buffer Control Word (BCW) Format for IDA (cont)



Buffer Control Word (BCW) Format for IDA (cont)

Bits	Allocation	Function
0–7	Command	Command code to be executed by IDA; bits 0–3 must be zero
8		Unassigned; must be set to zero
9–11	Key	3-bit field containing storage protection key
12		Unassigned; must be set to zero
13–31	Address	Storage address on which command operates
32–47		Unassigned; must be set to zero
48	Skip sentinel	Set with read data command to indicate data transfers inhibited to main storage; set with search/read commands to indicate search begins at index

Bits	Allocation	Function
49	Multitrack sentinel	Set to 1 with search/read command to indicate search limited to cylinder boundaries rather than single track
50	Direction sentinel	If 1, specifies accessor moves in direction of decreasing cylinder numbers
51	Stop read	Stop read command on record which causes error
52–54		Unassigned; must be set to zero
55–63	Count	On search/read commands = number of bytes to be searched On data read or write commands = number of records to be processed

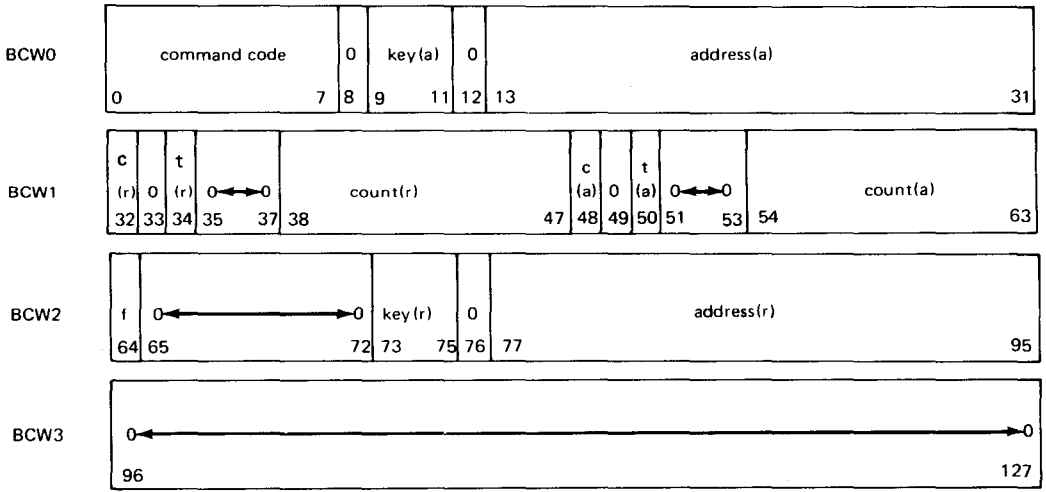
Buffer Control Word (BCW) Format for IDA (cont)

Buffer Control Word (BCW) Format for IDA (cont)

64–69		Unassigned; must be zero
70–79	Seek difference magnitude	During seek operation, specifies magnitude of difference between accessor present position and desired position
80–83		Unassigned; must be set to zero
84–87	Head address	4-bit field specifying current operation head address
88,89	Track condition	Condition of track where operation acts
90–95		Unassigned; must be set to zero
96	Recalibrate	Set to 1 = accessor reoriented and moved to cylinder 0; overrides bits 71–79 and 50
97–101		Unassigned; must be set to zero
102–111	Absolute cylinder address	Final position of accessor after completed seek or recalibrate

Bits	Allocation	Function
112–119	Record number	Number of record where operation is performed or initiated
120–124		Unassigned; must be set to zero
125–127	Programmed offset	Bit 125 = 1 programmed offset used for command Bit 125 = 0 programmed offset not used; bits 126 and 127 ignored Bit 126 = 1 major offset Bit 126 = 0 minor offset Bit 127 = 1 offset away from hub Bit 127 = 0 offset toward hub

Buffer Control Word (BCW) Format for IPC



Buffer Control Word (BCW) Format for IPC (cont)

Bits	Allocation	Function
0–7	Command code	Field accessed by IPC during SIO instruction
8		Unassigned; must be set to zero
9–11 and 73–75	Key (a, r)	3-bit field containing I/O storage protection key
12		Unassigned; must be set to zero
13–31 and 77–95	Address (a, r)	Allows IPC to reference any byte in main storage during data transfer sequences Bits 31 and 95 = 0 — most significant byte of addressed half word Bits 31 and 95 = 1 — least significant byte of addressed half word

32 and 48	c (r, a)	Specifies data chaining operations when set to 1
33		Unassigned; must be set to zero
34 and 50	t(r) and t(a)	Single control bit used with c(a) bit: c(a) = 0 and t = 0 — means use A fields for current data transfer sequence (no data chaining) c(a) = 0 and t = 1 — terminates control c(a) = 1 and t = 0 — use A fields for current data transfer sequence (data chaining initial A and R setting) c(a) = 1 and t = 1 — A fields depleted; replacement operation required

Buffer Control Word (BCW) Format for IPC (cont)

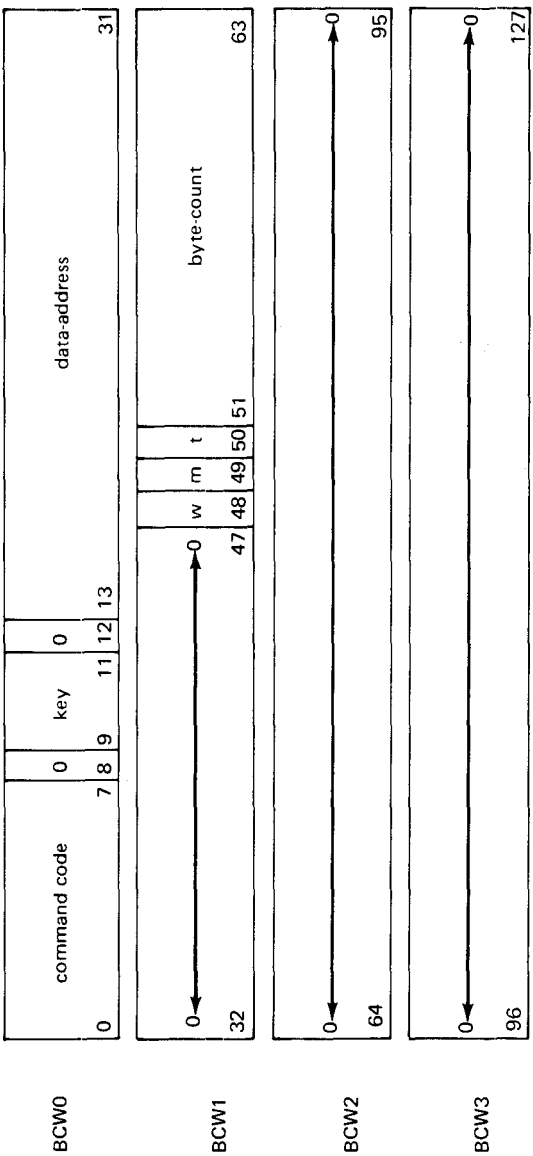
Bits	Allocation	Function
34 and 50 (cont)	t(r) and t(a) (cont)	If t(a) and c(a) = 1: f = 0 — terminates with buffer wraparound error f = 1, c(r) = 1 or 0, t(r) = 1 — terminates normally f = 1, c(r) = 0, t(r) = 0 — normal data transfer; no chaining f = 1, c(r) = 1, t(r) = 0 — normal data transfer with chaining
35–37		Unassigned; must be set to zero

38–47 and 54–63	Count (r) and count (a)	Byte count required for all data transfer operations
49		Unassigned; must be set to zero
51–53		Unassigned; must be set to zero
64	f (flag bit)	Indicates to IPC that current contents of r fields are valid for replacement operation
65–72, 76, and 96–127		Unassigned; must be set to zero

LEGEND:

a = active
c = chaining
f = flag
r = replacement
t = transfer

5.3.3. Buffer Control Word (BCW) Format for Multiplexer Channel



Buffer Control Word (BCW) Format for Multiplexer Channel

Buffer Control Word (BCW) Format for Multiplexer Channel (cont)

Bits	Allocation	Function
0–7	command code*	Specifies operation to be performed by device and channel
8		Unassigned; must be set to zero
9–11	key	Contains I/O storage protection key
12		Unassigned; must be set to zero
13–31	data address	Allows multiplexer channel to reference any byte in main storage during data transfer sequences
32–47		Unassigned; must be set to zero
48	w	w = 0 input operation (read) w = 1 output operation (write)

Bits	Allocation	Function
49	m	m = 0 ascending address (forward sequence) m = 1 descending address (reverse sequence)
50	t	t = 0 transfer data t = 1 termination of data transfer
51–63	byte count	Contains byte count required for all data transfers
64–127		Unassigned; must be set to zero

Buffer Control Word (BCW) Format for Multiplexer Channel (cont)

*Command Codes:

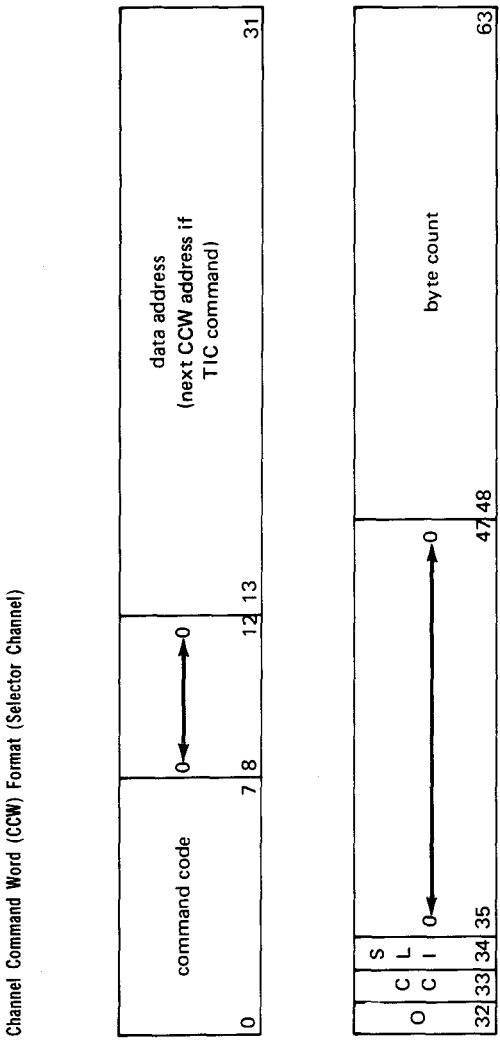
Code Bits								Command
0	1	2	3	4	5	6	7	
M	M	M	M	0	1	0	0	Sense
M	M	M	M	M	M	0	1	Write
M	M	M	M	M	M	1	0	Read
M	M	M	M	1	1	0	0	Read backward
M	M	M	M	M	M	1	1	Control
M	M	M	M	0	0	0	0	Test
M	M	M	M	1	0	0	0	Transfer in channel (TIC)

5.3.4. Channel Address Word (CAW) Format (Selector Channel)

Channel Address Word (CAW) Format (Selector Channel)

Bits	Allocation	Function
0–2	Key	I/O storage protection key used by channel for all storage accesses of data and CCWs
3–12		Bits set to zero
13–31	First CCW address instruction	Controls I/O operation initiated by SIO

5.3.5. Channel Command Word (CCW) Format (Selector Channel)



Channel Command Word (CCW) Format (Selector Channel)

Bits	Allocation	Function
0–7	Command code*	Specifies operation to be performed by device and channel
8–12		Bits set to zero
13–31	Data address	Address of location in main storage into or from which first byte of data is transferred
32		Bit set to zero
33	CC (chain command flag)	When valid ending device status received, new CCW fetched and operation specified by new command code initiated
34	SLI (suppress length indication flag)	If set to 1, incorrect length condition not indicated to program; if CC = 1 also, command chaining not suppressed

35–47		Unassigned; must be set to zero
48–63	Byte count	Byte count required for all data transfer operations

***Command codes:**

Code Bits								Command
0	1	2	3	4	5	6	7	
M	M	M	M	1	0	0	0	Transfer in channel (TIC)
M	M	M	M	0	1	0	0	Sense
M	M	M	M	M	M	0	1	Write
M	M	M	M	M	M	1	0	Read
M	M	M	M	1	1	0	0	Read backward
M	M	M	M	M	M	1	1	Control
M	M	M	M	0	0	0	0	Test

5.4.1.1. System Console

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
UNISCOPE 100 console	Read	A	X	X	X	X	F	1	0
	Write	A	B	C	X	X	F	0	1
	Sense	X	X	X	X	0	1	0	0

LEGEND:

Read command

A (modifier bit)
- 0 = normal read operation
- 1 = diagnostic use only

F (modifier bit)
- 0 = read in translate mode; all data transferred to processor in EBCDIC
- 1 = read in ASCII mode; all data to processor in ASCII code

X (bit ignored by console control unit)

LEGEND (cont):

Write command

A (modifier bit)
- 0 = normal write operation
- 1 = diagnostic use only

B (modifier bit)
- 0 = keyboard lock at completion of write sequence
- 1 = keyboard unlock at completion of write sequence

C (modifier bit)
- 0 = data transfer to UNISCOPE 100 terminal only
- 1 = data transfer to UNISCOPE 100 terminal and COP

F (modifier bit)
- 0 = write in translate mode; EBCDIC data from processor translated to ASCII
- 1 = write in ASCII mode; all data from processor in ASCII

5.4.1.2. Workstation

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
Workstation	System message write	0	0	0	0	0	0	0	1
	Diagnostic write	1	0	0	0	0	0	0	1
	User write	0	0	0	0	1	0	0	1
	System message read	0	0	0	0	0	0	1	0
	User read	0	0	0	0	1	0	1	0
	Diagnostic read	1	0	0	0	0	0	1	0
	NO-OP	0	0	0	0	0	0	1	1
	Enter work area mode	0	0	1	0	0	0	1	1
	Enter system response mode	0	1	0	0	0	0	1	1

Workstation (cont)

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
	Sense	0	0	0	0	0	1	1	0
	Workstation reset	0	0	0	0	1	0	1	1
	Read event	0	0	1	1	0	0	1	0
	Load RAM	0	0	0	0	0	1	0	1
	Message waiting	0	0	0	0	0	1	1	1
	Diagnostic read*	0	1	1	0	0	0	1	0
	Diagnostic write*	0	1	1	0	0	0	1	1
	Device halt	0	0	0	1	0	0	1	1

*Commands for IPCA rather than the WSC

5.4.1.3. 0773/0778 Printer Subsystems

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
0773/0778 Printer	Load vertical format buffer	0	1	1	0	0	0	1	1
	Load code buffer	1	1	1	1	1	0	1	1
	Print-advance	A	C	D	E	F	0	0	1
	Advance	A	C	D	E	F	1	1	1
	Load print line buffer*	1	1	1	0	0	0	1	1
	Read print line buffer*	X	X	X	0	0	0	1	0
	Read load code buffer*	X	X	X	0	1	0	1	0
	Read vertical format buffer*	A	X	X	1	0	0	1	0
	Diagnostic*	X	X	X	X	X	1	0	1
	Sense	X	X	X	X	0	1	0	0

*These commands are normally for diagnostic use only.

Detail Forms Advance Bits					
Bit A		Bits			
A=0	A=1	C	D	E	F
Advance 0 line	Filler code*	0	0	0	0
Advance 1 line	Form overflow	0	0	0	1
Advance 2 lines	Program selectable skip codes	0	0	1	0
Advance 3 lines		0	0	1	1
Advance 4 lines		0	1	0	0
Advance 5 lines		0	1	0	1
Advance 6 lines		0	1	1	0
Advance 7 lines	Home paper/end of forms	0	1	1	1

Detail Forms Advance Bits					
Bit A		Bits			
A=0	A=1	C	D	E	F
Advance 8 lines	Filler code*	1	0	0	0
Advance 9 lines	Form overflow	1	0	0	1
Advance 10 lines	Program selectable skip codes	1	0	1	0
Advance 11 lines		1	0	1	1
Advance 12 lines		1	1	0	0
Advance 13 lines		1	1	0	1
Advance 14 lines		1	1	1	0
Advance 15 lines	Home paper/end of forms	1	1	1	1

*This code should not normally be specified in the command.

5.4.1.4. 0717 Card Reader Subsystem

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
0717 Reader	Read control	A	B	X	D	E	F	1	0
	Sense*	X	X	X	X	0	1	0	0

*As a result of sense command, reader control transfers two sense-bytes to main storage.

LEGEND:

A (modifier bit)
- 0 = normal read operation
- 1 = diagnostic use only

B (modifier bit)
- 0 = normal read operation
- 1 = select read station 2 only, inhibit compare error

LEGEND (cont):

D & E (modifier bits)
- D = ignored, E = 0 } 80-column read
- D = 0, E = 1 } short-column (51 column) read
- D = 1, E = 1 } short-column (66 column) read

F (modifier bit)
- 0 = read in translate mode
- 1 = read in image mode

X (bit ignored by 0717 card reader)

5.4.1.5. 0719 Card Reader Subsystem

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
0719 Reader	Feed	0	1	0	0	0	0	0	0
	Read	0	0	1	0	0	0	0	0
	Deselect*	1	1	1	1	0	0	0	0

*This command must not be issued following a feed or read buffer command.

5.4.1.6. 0605 Card Punch Subsystem

Device	Command Byte	Bit Position							
		0	1	2	3	4	5	6	7
0605 Punch	Punch control	A	B	X	X	E	F	R	P
	Sense*	X	X	X	X	0	1	0	0

*Reader control transfers two sense bytes to main storage.

LEGEND:

A (modifier bit)
- 0 = normal punch/read operation
- 1 = diagnostic use only

B (modifier bit)
- 0 = stop on error
- 1 = sort errors and remain in run state

X (bit ignored by punch control unit)

LEGEND (cont):

E (modifier bit normally for diagnostic use)
- 0 = normal punch operation
- 1 = select reject stacker, terminate data transfers, and eject the card based on the punch data

F (modifier bit)
- 0 = normal punch operation
- 1 = punch and/or read in image mode

P & R (modifier bits)

P = 0 and R = 0	Invalid code results in a command reject
P = 0 and R = 1	Read operation specified with no punch operation
P = 1 and R = 0	Punch operation specified with no read operation
P = 1 and R = 1	Punch and read operation specified

5.4.1.7. 8413 Diskette Subsystem

Device	Command	Mnemonic	Bit Position							
			0	1	2	3	4	5	6	7
8413 Diskette	Load track and sector	LTS	0	0	1	0	0	0	0	1
						or				
			0	0	1	1	0	0	0	1
	Read index	RI	0	0	0	1	0	0	1	0
	Read index deleted	RID	0	1	0	1	0	0	1	0
	Write index	WI	0	0	0	1	0	0	0	1
	Write index deleted	WID	0	1	0	1	0	0	0	1
	Read	R	0	0	0	0	0	0	1	0
	Read deleted	RD	0	1	0	0	0	0	1	0

	Write	W	0	0	0	0	0	0	0	1	
	Write deleted	WD	0	1	0	0	0	0	0	1	
	Diagnostic read	DR	1	0	0	0	0	0	1	0	*
							to				
			1	1	1	1	0	0	1	0	
	Diagnostic write	DW	1	0	0	0	0	0	0	1	*
							to				
			1	1	1	1	0	0	0	1	
	Sense	Sense	X	X	X	X	0	1	0	0	**

*Any hexadecimal value within the stated ranges will execute the command.

**Any hexadecimal value may be used for the first digit (bit 0—3); the second value (4_{16}) is the significant value for the sense command.

5.4.1.8. Communications Adapter

Device	Command	Hex	Bits							
			0	1	2	3	4	5	6	7
Communications Adapter	No-op	00	0	0	0	0	0	0	0	0
	Enable data output	01	0	0	0	0	0	0	0	1
		or								
		41	0	1	0	0	0	0	0	1
	Enable data output with automatic turnaround	81	1	0	0	0	0	0	0	1
		or								
		C1	1	1	0	0	0	0	0	1
	Dial	05	0	0	0	0	0	1	0	1
	Send space	11	0	0	0	1	0	0	0	1

	Send mark	0D	0	0	0	0	1	1	0	1
	Send idle	09	0	0	0	0	1	0	0	1
	Enable data input	02	0	0	0	0	0	0	1	0
	New sync	0A	0	0	0	0	1	0	1	0
	Look for sync	06	0	0	0	0	0	1	1	0
	Turn off	03	0	0	0	0	0	0	1	1
	Clear active	0E	0	0	0	0	1	1	1	0
	Disconnect	13	0	0	0	1	0	0	1	1
	Sense	04	0	0	0	0	0	1	0	0
	Set busy	1F	0	0	0	1	1	1	1	1

Device	Command	Hex	Bits							
			0	1	2	3	4	5	6	7
Communications Adapter (cont)	LA clear	0F	0	0	0	0	1	1	1	1
	Enable data set ready monitor	17	0	0	0	1	0	1	1	1
	Set full duplex	1B	0	0	0	1	1	0	1	1
	Load control bytes:									
	Byte 1, 2, 3, 4	15	0	0	0	1	0	1	0	1
	Byte 2, 3, 4	55	0	1	0	1	0	1	0	1
	Byte 3, 4	95	1	0	0	1	0	1	0	1
	Byte 4	D5	1	1	0	1	0	1	0	1

Load control character detect table:									
Table 1	19	0	0	0	1	1	0	0	1
Table 2	59	0	1	0	1	1	0	0	1
Table 3	99	1	0	0	1	1	0	0	1
Table 4	D9	1	1	0	1	1	0	0	1
Load control interpretation table:									
Table 1	1D	0	0	0	1	1	1	0	1
Table 2	5D	0	1	0	1	1	1	0	1
Table 3	9D	1	0	0	1	1	1	0	1
Table 4	DD	1	1	0	1	1	1	0	1

Communications Adapter (cont)

Device	Command	Hex	Bits							
			0	1	2	3	4	5	6	7
Communications Adapter (cont)	LA test (diagnostic)	0B	0	0	0	0	1	0	1	1
	Modem test (diagnostic)	07	0	0	0	0	0	1	1	1
	Read port control word (diagnostic)	16	0	0	0	1	0	1	1	0

Read control character detect table:									
Table 1	1A	0	0	0	1	1	0	1	0
Table 2	5A	0	1	0	1	1	0	1	0
Table 3	9A	1	0	0	1	1	0	1	0
Table 4	DA	1	1	0	1	1	0	1	0
Read control interpretation table:									
Table 1	1E	0	0	0	1	1	1	1	0
Table 2	5E	0	1	0	1	1	1	1	0
Table 3	9E	1	0	0	1	1	1	1	0
Table 4	DE	1	1	1	0	1	1	1	0

5.4.2.1. IDA Channel Codes

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Format write	0	0	0	0	0	0	0	1
Write data	0	0	0	0	0	1	0	1
Search/read equal	0	0	0	0	1	0	0	1
Search/read HI or equal	0	0	0	0	1	1	0	1
Read ID	0	0	0	0	1	1	1	0
Read data	0	0	0	0	0	0	1	0
Seek	0	0	0	0	1	0	0	0
Sense	0	0	0	0	0	1	0	0
ECC sense	0	0	0	0	0	0	1	1
Diagnostic	0	0	0	0	0	1	1	0
ECC diagnostic	0	0	0	0	0	1	1	1

5.4.2.2. 8415/8416/8418 Disk Subsystems

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Format write	0	0	0	0	0	0	0	1
Write data	0	0	0	0	0	1	0	1
Search/read equal	0	0	0	0	1	0	0	1
Search/read high or equal	0	0	0	0	1	1	0	1
Read ID	0	0	0	0	1	1	1	0
Diagnostic	0	0	0	0	0	1	1	0
ECC diagnostic	0	0	0	0	0	1	1	1
Read data	0	0	0	0	0	0	1	0
Seek	0	0	0	0	1	0	0	0
Sense	0	0	0	0	0	1	0	0
ECC sense	0	0	0	0	0	0	1	1

5.4.3.1. 0768 Printer Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	1	1	0	0	0	0
				or				
	X	X	0	0	0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Read (diagnostic)	0	0	0	0	0	0	1	0
Load code	1	1	1	1	1	0	1	1
Commands With Form Control								
Print (write)	0	C	D	E	F	0	0	1
Advance-no print (control)	0	C	D	E	F	0	1	1

LEGEND:

Bit position 7 is the least significant bit.

X may be a 1 or 0 bit and is ignored.

C D E F (detail bits)

0 0 0 0 = no advance
0 0 0 1 = advance 1 line
0 0 1 0 = advance 2 lines
0 0 1 1 = advance 3 lines
} under program control

0 1 0 0 thru 1 1 1 Y = paper advanced under control of form control tape to the line corresponding to the same hole combination punched in the tape. Skip may be from 1 to 132 lines.

Y = 0 or 1

1 1 1 Y = home form and line selection code
when Y is 0 = 6 LPI
when Y is 1 = 8 LPI

1 0 0 1 = form overflow

5.4.3.2. 0770 Printer Subsystem

Command	Bit Positions								
	P	0	1	2	3	4	5	6	7
Test I/O	X X	X X	X 0	1 0	1 0	0 0	0 0	0 0	0 0
Set inhibit status	X	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	X	1	0	0	0	0	0
Sense I/O	0	0	0	0	0	0	1	0	0
Print advance*	X	A	C	D	E	F	0	0	1
Diagnostic write	0	1	1	1	0	0	0	1	1
Advance only*	X	A	C	D	E	F	1	1	1

0770 Printer Subsystem (cont)

Command	Bit Positions								
	P	0	1	2	3	4	5	6	7
Load code	0	1	1	1	1	1	0	1	1
Load vertical format*	1	0	1	1	0	0	0	1	1
Fold	0	0	1	0	0	0	0	1	1
Advance print*	X	A	C	D	E	F	1	0	1
Unfold	0	0	0	1	0	0	0	1	1
Inhibit data check	0	0	1	1	1	0	0	1	1
Allow data check	1	0	1	1	1	1	0	1	1
Read print line buffer	X	X	X	X	0	0	0	1	0

Raise cover*	0	0	1	1	0	1	0	1	1
No operation (No-op)	1	0	0	0	0	0	0	1	1
Read load code buffer	X	X	X	X	0	1	0	1	0
Read vertical format buffer*	X	X	X	X	1	0	0	1	0
Check read	1	0	0	0	0	0	1	1	0
Diagnostic gate	0	1	0	1	0	1	0	1	1

*I/O channel cannot initiate these commands when printer is in stop mode, having bit 1 set in sense byte 0 (intervention required). All other commands are sent by the channel and executed normally.

LEGEND:

P is an odd parity bit.
Bit position 7 is the least significant bit.
X may be a 1 or 0 bit and is ignored.
ACDEF detailed advance bits are as follows:

0770 Printer Subsystem (cont)

Bit A		Bits			
A = 0	A = 1	C	D	E	F
Space 0 line (note 1)	Advance repeat	0	0	0	0
Space 1 line	Skip to code 1	0	0	0	1
Space 2 lines	Skip to code 2	0	0	1	0
Space 3 lines	Skip to code 3	0	0	1	1
Space 4 lines	Skip to code 4	0	1	0	0
Space 5 lines	Skip to code 5	0	1	0	1
Space 6 lines	Skip to code 6	0	1	1	0
Space 7 lines	Skip to code 7	0	1	1	1
Space 8 lines	Skip to code 8	1	0	0	0
Space 9 lines (note 2)	Skip to code 9	1	0	0	1

Space 10 lines	Skip to code A	1	0	1	0
Space 11 lines	Skip to code B	1	0	1	1
Space 12 lines (note 3)	Skip to code C	1	1	0	0
Space 13 lines	Skip to code D	1	1	0	1
Space 14 lines	Skip to code E	1	1	1	0
Space 15 lines	Skip to code F	1	1	1	1

NOTES:

1. Code ACDEF = 100000 causes an advance in accordance with the ACDEF detail bits of the last ACDEF not equal to 100000 advance-only, print-advance, or advance-print command.

2. Code ACDEF = 01001 is reserved for use with code 9 (sense byte 2 bit 4) and causes a unit check status when detected in the vertical format buffer.

3. Code ACDEF = 01100 is reserved for use with unit exception status (forms overflow) when detected in the vertical format buffer.

5.4.3.3. 0776 Printer Subsystem

Command	Bit Position and Setting							
	0	1	2	3	4	5	6	7
Load Vertical Format Buffer ①	0	1	1	0	0	0	1	1
Load Code Buffer ①	1	1	1	1	1	0	1	1
Print Advance ①	A	C	D	E	F	0	0	1
Form Advance ①	A	C	D	E	F	1	1	1
Diagnostic Write ① ②	1	1	1	0	0	0	1	1
Read Print Line Buffer ① ②	X	X	X	0	0	0	1	0
Read Load Code Buffer ① ②	X	X	X	0	1	0	1	0
Read Vertical Format Buffer ①	X	X	X	1	0	0	1	0
Sense I/O	0	0	0	0	0	1	0	0

Test I/O	X	X	1	1	0	0	0	0
Test I/O	X	X	0	0	0	0	0	0
Set Inhibit Status	X	X	0	1	0	0	0	0
Reset Inhibit Status	X	X	1	0	0	0	0	0
Fold	0	1	0	0	0	0	1	1
Unfold	0	0	1	0	0	0	1	1
Inhibit Data Check	0	1	1	1	0	0	1	1
Allow Data Check	0	1	1	1	1	0	1	1
No-Op	0	0	0	0	0	0	1	1

LEGEND:

X bits are ignored by printer control.
A, C, D, E, F are modifier/detail bits.

NOTES:

(1) Channel cannot initiate command when printer is in STOP state. Intervention is required. (Sense byte 0, bit 1 is set to 1.) all other commands can be sent by the channel and are executed normally.

(2) Diagnostic use only.

5.4.3.4. 0716 Card Reader Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test-I/O	X	X	0	0 or 1	0	0	0	0
	X	X	1	1	0	0	0	0
Set-inhibit-status (invalid for C/SP)	X	X	0	1	0	0	0	0
Reset-inhibit-status (invalid for C/SP)	X	X	1	0	0	0	0	0
Sense	X	X	X	X	0	1	0	0
Read	A	B	C	D	E	F	1	0
Control (used for diagnostics)	X	X	X	X	X	X	1	1

LEGEND:

Bit position,7 is the least significant bit position.

X may be a 1 or 0 bit and is ignored by control unit.

A (read bit)
0 = read data

B
0 = stop on errors
1 = sort errors

D = 0, E = 0 — 80-column read

D = 0, E = 1 — short card 51-column read

D = 1, E = 1 — short card 66-column read

C = 1, F = 0 — dual translate feature

C = 0, F = 0 — read in translate mode

F (detail bit)
0 = read in translate mode
1 = read in image mode

A = 1, F = 1 — maintenance mode read

Cards are advanced but data is not read. Two bytes containing the 16 special diagnostic status bits are sent to the multiplexer channel for maintenance purposes.

To read 96-column cards, use the normal 80-column card read commands with the 96-column card adapter installed.

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	1	1	0	0	0	0
				or				
	X	X	0	0	0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	X	X	X	X	0	1	0	0
Control (used for nondata transfer commands)	A	X	C	D	E	X	1	1
Load buffer (write)	A	X	C	D	E	F	0	1
Unload buffer (read)	A	X	X	X	X	F	1	0

LEGEND:

X may be a 1 or 0 bit and is ignored.

A, C, D, E, F modified/detail bits are as follows.

A, C, D, E	Detail Bits for Control Command Interpretation
A=0	Denotes normal operation
A=1	Indicates transfer postpunch read data to the punch buffer (this function is a maintenance feature only)
C=1	Functions to advance the cards one station (feed a card) and to place the card punched on the previous punch order into the select stacker
D=1	Functions to feed and punch a card
E=1	Functions to feed a card

0604 Card Punch Subsystem (cont)

A, B, C, D, E, F	Detail Bits for Load Buffer Command Interpretation
A=0	Functions to load the punch buffer
A=1	Functions to load the read buffer (read buffer test function)
C=1	Functions to advance the cards one station (feed a card) and to place the card punched on the previous punch order into the select stacker
D=1	Functions to feed and punch a card
E=1	Functions to feed a card
F=0	Functions to cause cards to be punched in compress mode
F=1	Functions to cause cards to be punched in image mode

A,F	Detail Bits for Control Command Interpretation
A=0	Functions to unload the read buffer
A=1	Functions to unload the punch buffer
F=0	Functions to read data punched in the compressed mode
F=1	Functions to read data punched in the image mode

5.4.3.6. 9200/9300 Processor

Command codes for the printer, card reader, and card punch are the same as shown in 5.4.1 for these devices on the Integrated Peripheral Channel.

5.4.3.7. 8411/8414/8424/8425 Disc Subsystems

Command	Bit Positions							
	0	1	2	3	4	5	6	7
SEEK								
Seek	0	0	0	0	0	1	1	1
Seek-head	0	0	0	1	1	0	1	1
Seek-cylinder	0	0	0	0	1	0	1	1
WRITE								
Write-home-address	0	0	0	1	1	0	0	1
Write-TD-record	0	0	0	1	0	1	0	1
Write-count-key-and-data	0	0	0	1	1	1	0	1
Write-special-count-key-and-data	0	0	0	0	0	0	0	1
Write-data	0	0	0	0	0	1	0	1
Write-key-and-data	0	0	0	0	1	1	0	1

8411/8414/8424/8425 Disk Subsystems (cont)

Command	Bit Positions							
	0	1	2	3	4	5	6	7
READ								
Read-home-address	M	0	0	1	1	0	1	0
Read-TD-record	M	0	0	1	0	1	1	0
Read-count	M	0	0	1	0	0	1	0
Read-data	M	0	0	0	0	1	1	0
Read-key-and-data	M	0	0	0	1	1	1	0
Read-count-key-and-data	M	0	0	1	1	1	1	0
Initial-program-load	M	0	0	0	0	0	1	0

SEARCH								
Search-home-address-equal	M	0	1	1	1	0	0	1
Search-ID-equal	M	0	1	1	0	0	0	1
Search-ID-high	M	1	0	1	0	0	0	1
Search-ID-equal-or-high	M	1	1	1	0	0	0	1
Search-key-equal	M	0	1	0	1	0	0	1
Search-key-high	M	1	0	0	1	0	0	1
Search-key-equal-or-high	M	1	1	0	1	0	0	1
Search-key-and-data-equal	M	0	1	0	1	1	0	1
Search-key-and-data-high	M	1	0	0	1	1	0	1
Search-key-and-data-equal-or-high	M	1	1	0	1	1	0	1
Continue-scan-equal	M	0	1	0	0	1	0	1
Continue-scan-high	M	1	0	0	0	1	0	1
Continue-scan-equal-or-high	M	1	1	0	0	1	0	1
Continue-scan-no-compare	M	1	0	1	0	1	0	1
Continue-scan-set-compare	M	1	1	1	0	1	0	1
Continue-scan-set-compare	M	0	1	1	0	1	0	1

8411/8414/8424/8425 Disk Subsystems (cont)

Command	Bit Positions							
	0	1	2	3	4	5	6	7
SENSE								
Sense-I/O	0	0	0	0	0	1	0	0
Sense-reserve	1	1	1	1	0	1	0	0
Sense-release	1	1	0	1	0	1	0	0
MISCELLANEOUS								
Set-file-mask	0	0	0	1	1	1	1	1
Recalibrate	0	0	0	1	0	0	1	1
No-operation	0	0	0	0	0	0	1	1
Space-count	0	0	0	0	1	1	1	1
Erase	0	0	0	1	0	0	0	1
Test-I/O	0	0	0	0	0	0	0	0

LEGEND:

Bit positions in a byte, position 7 being the least significant bit position.

The M bit, when 0, establishes normal operation mode. The M bit, when 1, establishes multiple-track mode. This bit is ignored by the control unit on an initial-program-load command. When the M bit is set to 1 in the command, the disk unit upon encountering the index mark, increments the head register to switch to the next head. This M bit when set to 1 in a search-truncated command, and the track descriptor record (TDR) is used as a data record, enables the program to cascade down the cylinder switching to the next head after reaching the index mark. If the track descriptor record is not used as a data record, and the data length is 0 along with external interrupt status containing unit exception, disk transfer terminates. If the TDR does not have a data length of 0, the data within the TDR will then be presented, and the read/write, search-truncated, jump, and chain continue.

5.4.3.8. 8430/8433 Disk Subsystems

Command	Command Code															
	Multiple Track OFF								Multiple Track ON (if applicable)							
	Bit Positions								Bit Positions							
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
CONTROL																
Seek	0	0	0	0	0	1	1	1								
Seek cylinder	0	0	0	0	1	0	1	1								
Seek head	0	0	0	1	1	0	1	1								
Set sector	0	0	1	0	0	0	1	1								
Seek and set sector	0	0	1	0	0	1	1	1								
Recalibrate	0	0	0	1	0	0	1	1								
Set file mask	0	0	0	1	1	1	1	1								
Space count	0	0	0	0	1	1	1	1								
Retry restart (1)	0	0	1	1	1	0	1	1								
No operation	0	0	0	0	0	0	1	1								
Restore	0	0	0	1	0	1	1	1								

8430/8433 Disk Subsystems (cont)

Command	Command Code															
	Multiple Track OFF								Multiple Track ON (if applicable)							
	Bit Positions								Bit Positions							
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
WRITE																
Home address	0	0	0	1	1	0	0	1								
Record 0	0	0	0	1	0	1	0	1								
Erase	0	0	0	1	0	0	0	1								
Count, key and data	0	0	0	1	1	1	0	1								
Special count, key and data	0	0	0	0	0	0	0	1								
Data	0	0	0	0	0	1	0	1								
Key and data	0	0	0	0	1	1	0	1								

SEARCH																		
Home address equal	0	0	1	1	1	0	0	1	1	0	1	1	1	0	0	0	1
Identifier equal	0	0	1	1	0	0	0	1	1	0	1	1	0	0	0	0	1
Identifier high	0	1	0	1	0	0	0	1	1	1	0	1	0	0	0	0	1
Identifier equal or high	0	1	1	1	0	0	0	1	1	1	1	1	0	0	0	0	1
Key equal	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	0	1
Key high	0	1	0	0	1	0	0	1	1	1	0	0	1	0	0	0	1
Key equal or high	0	1	1	0	1	0	0	1	1	1	1	0	1	0	0	0	1

8430/8433 Disk Subsystems (cont)

Command	Command Code															
	Multiple Track OFF								Multiple Track ON (if applicable)							
	Bit Positions								Bit Positions							
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
READ																
Home address	0	0	0	1	1	0	1	0	1	0	0	1	1	0	1	0
Count	0	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0
Record 0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
Data	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0
Key and data	0	0	0	0	1	1	1	0	1	0	0	0	1	1	1	0
Count, key and data	0	0	0	1	1	1	1	0	1	0	0	1	1	1	1	0
Multiple count, key and data	0	1	0	1	1	1	1	0								
IPL	0	0	0	0	0	0	1	0								
Sector	0	0	1	0	0	0	1	0								

SENSE								
Sense I/O	0	0	0	0	0	1	0	0
Command code sense	1	0	0	0	0	1	0	0
sense (2)								
Read reset buffered	1	0	1	0	0	1	0	0
log								
Release	1	0	0	1	0	1	0	0
Reserve	1	0	1	1	0	1	0	0
Test I/O	0	0	0	0	0	0	0	0
Read configuration	1	1	1	0	0	1	0	0

NOTES:

(1) Implemented on SPERRY UNIVAC 1100 Series systems only.
(2) Implemented on SPERRY UNIVAC Series 90 systems only.

5.4.3.9. **UNISERVO 10/14 Magnetic Tape Subsystem**

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	0	0	0	0	0	0
				or				
	X	X	1	1	0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Sense/reserve	1	1	1	1	0	1	0	0
Sense/release	1	1	0	1	0	1	0	0
Write	0	0	0	0	0	0	0	1
Read	0	0	0	1	0	0	1	0

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Read/backward	0	0	0	1	1	1	0	0
Control	0	0	C	C	C	1	1	1
Mode set	D	D	M	M	M	0	1	1

LEGEND:

X may be a 1 or 0 bit and is ignored.

I = 1 — Set unit check status if bit 4 of sense data byte 3 is set.
I = 0 — Do not set unit check status if bit 4 of sense data byte 3 is set.

CCC (control command code):

000 = rewind
001 = rewind with interlock
010 = erase
011 = write tape mark
100 = backspace block

LEGEND: (cont)

101 = backspace file
110 = forward space block
111 = forward space file

DDMMM (density set, mode modifier):

00011 = request TIE (9-track NRZI)
11000 = set 1600-bpi mode (This mode is set for 9-track operation when control unit is reset or the master unit is cleared.)
11001 = set 800-bpi mode for 9-track
00000 = no operation
00001 = reset simulate mode
01001 = set simulate mode
10001 = set monitor mode
01011 = set low gain (The gain condition applies to a read or space operation immediately following the mode-set command. At the end of the operation, the mode is reset to high gain.)
00MMM = set 200-bpi mode for 7-track
01MMM = set 556-bpi mode for 7-track Applies only for certain values of MMM.
10MMM = set 800-bpi mode for 7-track

Nine-track operation overrides, but does not reset, a 7-track mode setting. Seven-track operation overrides, but does not reset, a 9-track mode setting. Nine-track operation mode settings apply only to write, write-tape-mark, or erase commands executed from load point.

5.4.3.10. UNISERVO 12/16 Magnetic Tape Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	0	0 or 1	0	0	0	0
	X	X	1		0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Sense/reserve	1	1	1	1	0	1	0	0
Sense/release	1	1	0	1	0	1	0	0
Write	0	0	0	0	0	0	0	1
Read	0	0	0	X	0	0	1	0
Read backward	0	0	0	X	1	1	0	0
Control	0	0	C	C	C	1	1	1
Mode set	D	D	M	M	M	0	1	1

LEGEND:

Bit position 7 is the least significant bit position.

X may be either a 1 or 0 bit and is ignored.

CCC (control code):

000	=	rewind
001	=	rewind-with-interlock
010	=	erase
011	=	write tape mark
100	=	backspace block
101	=	backspace file
110	=	forward space block
111	=	forward space file

MMM (mode modifier):

000	=	no operation, 1600 bpi if DD = 11
001	=	failure-finding mode (maintenance personnel only), 800 bpi if DD = 11
010	=	odd parity recording, data converter ON, translator OFF, density per DD
011	=	low gain (applies only to read or space operation immediately following mode set command; gain is reset to normal gain at end of operation). DD must be 01. Track-in-error DD=00

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

LEGEND:

100 = even parity recording, data converter OFF, density per DD, translator OFF
101 = 7-track, even parity, translator ON, data converter OFF, density per DD
110 = odd parity recording, data converter OFF, translator OFF, density per DD
111 = 7-track, odd parity, translator ON, data converter OFF, density per DD

DD (density set), applicable to 7-track operation only:

00 = 200 bpi
01 = 556 bpi
10 = 800 bpi
11 = set 9-track mode

Nine-track operation forces 800 bpi and odd vertical parity recording.
Nine-track operation overrides but does not reset 7-track mode setting.

5.4.3.11. UNISERVO 20 Magnetic Tape Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	0	0 or 1	0	0	0	0
	X	X	1		0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Sense/reserve	1	1	1	1	0	1	0	0
Sense/release	1	1	0	1	0	1	0	0
Write	0	0	0	0	0	0	0	1

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Read	0	0	0	1	0	0	1	0
Read backward	0	0	0	1	1	1	0	0
Control	0	0	C	C	C	1	1	1
Mode set	D	D	M	M	M	0	1	1

UNISERVO 20 Magnetic Tape Subsystem (cont)

LEGEND:

X may be a 1 or 0 bit and is ignored.

I = 1 – Set unit check status if bit 4 of sense data byte 3 is set.

I = 0 – Do not set unit check status if bit 4 of sense data byte 3 is set.

CCC (control code):

000	=	rewind
001	=	rewind with interlock
010	=	erase
011	=	write tape mark
100	=	backspace block
101	=	backspace file
110	=	forward space block
111	=	forward space file

DDMMM (density set, mode modifier):

00011	=	request TIE (9-track NRZI)
11000	=	set 1600-bpi mode (This mode is set for 9-track operation when control unit is reset or the master unit is cleared.)
11001	=	set 800-bpi mode for 9-track
00000	=	no operation

LEGEND: (cont)

00001	=	reset simulate mode
01001	=	set simulate mode
10001	=	set monitor mode
01011	=	set low gain (The low gain condition applies to a read or space operation immediately following the mode-set command. At the end of the operation, the mode is reset to high gain.)
00MMM	=	set 200-bpi mode for 7-track
01MMM	=	set 556-bpi mode for 7-track
10MMM	=	set 800-bpi mode for 7-track

} applies only for certain values of MMM.

Nine-track operation overrides, but does not reset, a 7-track mode setting. Seven-track operation overrides, but does not reset, a 9-track mode setting. Nine-track operation mode settings apply only to write, write-tape-mark, or erase commands executed from load point.

5.4.3.12. UNISERVO VI-C Magnetic Tape Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	0	0	0	0	0	0
				or				
	X	X	1	1	0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Write	0	0	0	0	0	0	0	1
Read	0	0	0	X	0	0	1	0
Read backward	0	0	0	X	1	1	0	0
Control	0	0	C	C	C	1	1	1

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Mode set	D	D	M	M	M	0	1	1

LEGEND:

Bit position 7 is the least significant bit position.

X may be a 1 or 0 bit and is ignored.

CCC (control code):

000 = rewind
001 = rewind-with-interlock
010 = erase
011 = write tape mark
100 = backspace block
101 = backspace file
110 = forward space block
111 = forward space file

MMM (mode modifier):

000	=	no operation
001	=	reserved for failure-finding mode (maintenance personnel only)
010	=	odd parity recording, data converter ON, density per DD
011	=	low gain (applies only to read or space operation immediately following mode set command; gain is reset to normal gain at end of operation). DD must be 01.
100	=	even parity recording, data converter OFF, density per DD
101	=	invalid
110	=	odd parity recording, data converter OFF, density per DD
111	=	invalid

DD (density set), applicable to 7-track operation only:

00	=	200 bpi
01	=	556 bpi
10	=	800 bpi
11	=	not used (invalid command)

Nine-track operation forces 800 bpi and odd vertical parity recording.
Nine-track operation overrides but does not reset 7-track mode setting.

5.4.3.13. 0920 Paper Tape Subsystem

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Test	X	X	0	0 or 1	0	0	0	0
	X	X	1		0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Punch	0	0	0	0	0	A	0	1
Read	0	0	0	0	0	A	1	0
Control (used for nondata transfer commands)	1	0	0	0	0	0	1	1

LEGEND:

Bit position 7 is the least significant bit position.

X may be a 1 or 0 bit and is ignored.

Test-input/output-status (TIO) instruction is used with 9200/9200 II/9300/9300 II Systems only.
A = 0 indicates character recognition is operative.
A = 1 indicates operation in binary mode.

5.4.3.14. 2703 Optical Document Reader

Command Byte	Bit Positions							
	0	1	2	3	4	5	6	7
Operational								
Test I/O	X	X	X	X	0	0	0	0
Set inhibit status	X	X	0	1	0	0	0	0
Reset inhibit status	X	X	1	0	0	0	0	0
Sense	X	X	X	X	0	1	0	0
Read 1 backward	X	X	0	1	1	1	0	0
Read 2 backward	X	X	1	X	1	1	0	0
Read 0 backward	X	X	0	0	1	1	0	0
Stacker 2 immediate	X	X	1	0	0	0	1	1
Stacker 3 immediate	X	X	1	1	0	0	1	1
No-op	X	X	0	X	0	0	1	1
Read Select								
OCR read	X	0	0	0	0	1	1	1
No OCR read	X	0	0	1	0	1	1	1
OCR and mark read	0	0	1	0	0	1	1	1
Mark read	0	0	1	1	0	1	1	1

2703 Optical Document Reader (cont)

Command Byte	Bit Positions							
	0	1	2	3	4	5	6	7
OCR and card read	0	1	X	0	0	1	1	1
Card read	0	1	X	1	0	1	1	1
OCR read and card read translate	1	1	X	0	0	1	1	1
Card read translate	1	1	X	1	0	1	1	1
Mark read translate	1	0	1	1	0	1	1	1
OCR read and mark read translate	1	0	1	0	0	1	1	1
Mode								
Stacker 2 mode preselect	0	1	0	0	1	0	1	1
Stacker 3 mode preselect	0	1	0	1	1	0	1	1
Stacker 2 preselect and modulus 10 check digit mode	1	1	0	0	1	0	1	1
Stacker 3 preselect and modulus 10 check digit mode	1	1	0	1	1	0	1	1
Modulus 10 check digit select mode	1	0	0	X	1	0	1	1
Stacker preselect mode reset	0	0	X	0	1	0	1	1
Document length								
Document length 3.00 to 3.30	1	1	1	X	1	0	1	1
Document length 3.31 to 4.00	1	0	1	X	1	0	1	1
Document length 4.01 to 5.90	0	1	1	X	1	0	1	1
Document length 5.91 to 8.75	0	0	1	X	1	0	1	1

Mark read stacker								
Mark read stacker, row 0-1	0	0	0	1	1	1	1	1
Mark read stacker, row 2-3	0	0	1	1	1	1	1	1
Mark read stacker, row 4-5	0	1	0	1	1	1	1	1
Mark read stacker, row 6-7	0	1	1	1	1	1	1	1
Mark read stacker reset	0	X	X	0	1	1	1	1
Diagnostic								
Set diagnostic	1	X	X	X	1	1	1	1
Read diagnostic	X	X	X	X	X	X	1	0
Write diagnostic	X	X	X	X	X	X	0	1
Reset diagnostic	0	X	X	X	1	1	1	1

NOTE:

Bit position 7 is least significant bit position. X may be either a 1 or 0 bit.

5.4.3.15. 2521 Channel Transfer Switch

Command codes for the channel transfer switch are transparent to you.

5.4.3.16. 9000 Series Channel Adapter

Command	Bit Positions							
	0	1	2	3	4	5	6	7
Read	D	D	D	D	D	D	1	0
Read backward	D	D	D	D	1	1	0	0
Write	D	D	D	D	D	D	0	1
Control	D	D	D	D	D	D	1	1
Sense	D	D	D	D	0	1	0	0
Test I/O	X	0	X	X	0	0	0	0
Test I/O override	X	1	X	X	0	0	0	0
Illegal	X	X	X	X	1	0	0	0

LEGEND:

D = Command detail bit
X = Ignored by adapter

I/O Channel Number Assignment

Channel 0 =	Integrated Peripheral Channel (IPC)
Channel 1 =	Multiplexer channel
Channel 2 =	Unnassigned
Channel 3 =	Integrated Disc Adapter (IDA)

Channel 4 =	Selector channel 1
Channel 5 =	Communications Intelligence Channel (CIC)
Channel 6 =	Selector channel 2
Channel 7 =	I/O Status tabler

IDA Device Addresses

Device	Address Field Bits*							
	24	25	26	27	28	29	30	31
Disk drive 0	0	0	0	0	0	0	0	0
Disk drive 1	0	0	0	0	0	0	0	1
Disk drive 2	0	0	0	0	0	0	1	0
Disk drive 3	0	0	0	0	0	0	1	1
Disk drive 4**	0	0	0	0	0	1	0	0
Disk drive 5**	0	0	0	0	0	1	0	1
Disk drive 6**	0	0	0	0	0	1	1	0
Disk drive 7**	0	0	0	0	0	1	1	1

*Address field bits correspond to bits 24–31 of SIO instruction.

**Requires expansion feature for eight disk drives.

IPC Device Addresses

Device	Address Field Bits*							
	24	25	26	27	28	29	30	31
Console (UNISCOPE 100)	0	0	0	0	0	0	0	0
Workstation 1	0	0	0	1	1	0	0	0
Workstation 2	0	0	0	1	1	0	0	1
Workstation 3	0	0	0	1	1	0	1	0
Workstation 4	0	0	0	1	1	0	1	1
Workstation 5	0	0	0	1	1	1	0	0
Workstation 6	0	0	0	1	1	1	0	1
Workstation 7	0	0	0	1	1	1	1	0
Workstation 8	0	0	0	1	1	1	1	1
Workstation 9	0	0	0	1	0	1	0	0
Workstation 10	0	0	0	1	0	1	0	1
Workstation 11	0	0	0	1	0	1	1	0
Workstation 12	0	0	0	1	0	1	1	1
8413 diskette 0	0	0	0	1	0	0	0	0
8413 diskette 1	0	0	0	1	0	0	0	1
8413 diskette 2	0	0	0	1	0	0	1	0
8413 diskette 3	0	0	0	1	0	0	1	1
0717 reader	0	0	0	0	0	0	0	1
0719 reader	0	0	0	0	0	0	0	1
0773 printer	0	0	0	0	0	0	1	0
0778 printer	0	0	0	0	0	0	1	0
0605 punch	0	0	0	0	0	0	1	1
LA – 0 (CA – 1)	0	0	0	0	0	1	0	0
LA – 6 (CA – 1)	0	0	0	0	0	1	0	1
LA – 1 (CA – 1)	0	0	0	0	0	1	1	0
LA – 7 (CA – 1)	0	0	0	0	0	1	1	1
LA – 2 (CA – 1)	0	0	0	0	1	0	0	0
LA – 8 (CA – 1)	0	0	0	0	1	0	0	1
LA – 3 (CA – 1)	0	0	0	0	1	0	1	0
LA – 9 (CA – 1)	0	0	0	0	1	0	1	1
LA – 4 (CA – 1)	0	0	0	0	1	1	0	0

IPC Device Addresses (cont)

Device	Address Field Bits*							
	24	25	26	27	28	29	30	31
LA – 10 (CA – 1)	0	0	0	0	1	1	0	1
LA – 5 (CA – 1)	0	0	0	0	1	1	1	0
LA – 11 (CA – 1)	0	0	0	0	1	1	1	1
LA – 0 (CA – 2)	0	0	0	1	0	1	0	0
LA – 6 (CA – 2)	0	0	0	1	0	1	0	1
LA – 1 (CA – 2)	0	0	0	1	0	1	1	0
LA – 7 (CA – 2)	0	0	0	1	0	1	1	1
LA – 2 (CA – 2)	0	0	0	1	1	0	0	0
LA – 8 (CA – 2)	0	0	0	1	1	0	0	1

Device	Address Field Bits*							
	24	25	26	27	28	29	30	31
LA – 3 (CA – 2)	0	0	0	1	1	0	1	0
LA – 9 (CA – 2)	0	0	0	1	1	0	1	1
LA – 4 (CA – 2)	0	0	0	1	1	1	0	0
LA – 10 (CA – 2)	0	0	0	1	1	1	0	1
LA – 5 (CA – 2)	0	0	0	1	1	1	1	0
LA – 11 (CA – 2)	0	0	0	1	1	1	1	1

*Address field bits correspond to bits 24–31 of SIO instruction.

LEGEND:
LA = line adapter
CA = communication adapter

5.8. STATUS BYTE FORMATS

5.8.1. Status Byte Format for System Console, Printer, Diskette, Reader, and Punch

Status Byte Format for System Console, Printer, Diskette, Reader, and Punch

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates transition from stop state to run state
1		Set to zero by reader control
2		Set to zero by reader control
3		Set to zero by reader control
4		Set to zero by reader control
5	Device end	Indicates completion of command initiated by IPC and readiness to accept new command
6	Unit check*	Indicates at least one bit set in sense byte 0

Bit	Condition Which Sets Bits	Meaning
7**		Set to zero by reader control (applies to system console, reader, and punch)
	Unit exception	Indicates an abnormal condition occurred during operation (applies to diskette only)
	Unit exception	Indicates forms overflow. (Applies only to 0778 printer and is presented with device end status of print-advance or advance command.) Paper advances the number of positions specified by the command.

*Refer to conditions listed in 5.9, I/O sense data byte definitions.
Device status byte corresponds to bits 16–23 of IOSTIW.

**Status byte information in bits 0–6 applies to 8413 diskette and 0778 printer subsystems, as well as to the system console, readers, and punches. Bit 7 is an exception which is interpreted differently for system console, readers, and punches, than for 8413 diskette and 0778 printer subsystems.

Status Byte Format for Workstation

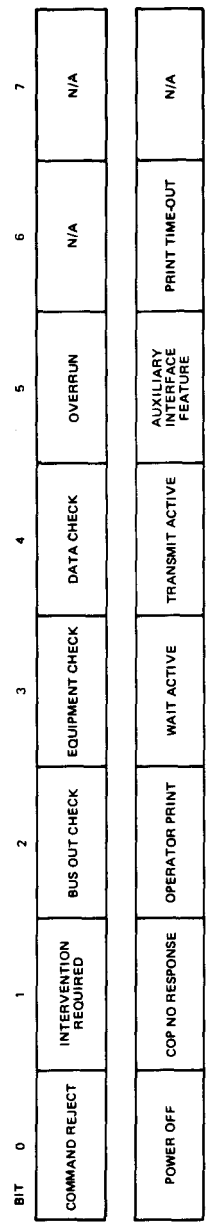
Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates that one of the following occurred at the workstation: ■ operator activation of the transmit key; ■ an implied transmit function (DC1, ESC DC1) contained in a write command; ■ operator activation of any one of 23 function keys; ■ operator activation of a mode change request from workstation mode to system mode or vice versa; ■ a RAM parity error occurred at the device; ■ a power condition occurred at the device; or ■ when presented with status bit 2 indicates catastrophic failure.

Bit	Condition Which Sets Bits	Meaning
1	Status modifier	Set if sense byte 0, bit 2, sense byte 0, bit 6, or the contents of sense bytes 3 through 5 are nonzero.
2	Control unit end	Indicates the first SIO returned with a busy condition code causing the IPCA to store this device address. When not busy, the IPCA generates a status interrupt with the stored address and sets this bit. Status is generated only for the first SIO. When presented with status bit 0, it indicates catastrophic failure.
3	Busy	Indicates addressed workstation is executing previous command.
4	Channel end	Indicates completion of the outstanding command.
5	Device end	Indicates successful completion of command and readiness to accept a new command.

Bit	Condition Which Sets Bits	Meaning
6	Unit check	Indicates some condition that prevented successful command completion occurred at the device or the workstation controller or the IPCA. Unit check implies that at least one bit in sense byte 0 or sense byte 6 is set to 1.
7	N/A	Always set to zero; not used

5.9. I/O SENSE DATA BYTE DEFINITIONS

5.9.1. I/O Sense Data Byte Definitions for IPC Devices



SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	N/A	N/A
1	POWER OFF	COP NO RESPONSE	OPERATOR PRINT	WAIT ACTIVE	TRANSMIT ACTIVE	AUXILIARY INTERFACE FEATURE	PRINT TIMEOUT	N/A

5.9.1.1. System Console

System Console (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set to 1 if an invalid command is issued, or the wait-active (SB1,3) or operator-print (SB1,2) sense bits are set when a read or write command is issued. Also set if the transmit-active (SB1,4) sense bit is set when a write command is issued.
1	Intervention required	Set to 1 if the system console power is off (SB1,0); COP no response (SB1,1) or equipment check (SB,3) sense bit is set.
2	Bus out check	Set to 0 (not used).
3	Equipment check	Set to 1 if a fuse fault, print test, interlock, or out-of-paper condition is detected during a write command with the C modifier bit set. Also set if a print-time-out (SB1,6) is detected. Always 0 if the auxiliary interface feature is not installed.
4	Data check	Set to 1 if the b8 bit position of the ASCII code is set to 1.
5	Overrun	An early termination of a read command occurred or the WAIT switch was pressed during execution of a read or write command.
6	N/A	Set to 0 by the system console control.
7	N/A	Set to 0 by the system console control.

Sense Data Byte 1		
0	Console power off	Set to 1 if the system console power has not sequenced up.
1	COP no response	Set to 1 if the auxiliary interface cannot perform print sequences because the COP is in a power-off state or is nonexistent. Always 0 if the auxiliary interface feature is not installed.
2	Operator print	Set to 1 if the auxiliary interface indicates a print sequence is in progress. Always 0 if the auxiliary interface feature is not installed.
3	Wait active	Set to 1 if the operator presses the WAIT switch, or power is turned on at the system console.
4	Transmit active	Set to 1 if the operator presses the TRANSMIT key or the text data contained a DC1 code.
5	Auxiliary interface feature	Set to 1 if the auxiliary interface feature is installed; otherwise always 0.
6	Print-time-out	Set to 1 if the 1-second interface timer expired during a print sequence.
7	N/A	Set to 0 by the system console control.

5.9.1.2. Workstation

SENSE DATA BYTE	0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	N/A	BUS IN CHECK	PROGRAM ALERT
1	INVALID DEVICE ADDRESS	WS NOT READY	WS RAM NOT LOADED	UNLOCK (OFFLINE)	LOAD ERROR AT WS	READ/WRITE CONTENTION	WS PERIPHERAL NOT AVAILABLE	INVALID COMMAND AT WS
2	WSC RAM ERROR	NRE PIU ERROR	POWER ON	RAM PARITY ERROR AT WS	TRANSMIT	FUNCTION CODE READY	MODE CHANGE REQUEST	SYSTEM MODE
3	WORKSTATION CONTROLLER DETECTED COMMUNICATION ERROR LOG COUNTER							

I/O Sense Data Byte Definitions for IPC Devices (cont)

4	WORKSTATION DETECTED COMMUNICATION ERROR LOG COUNTER							
5	KEYBOARD ERROR LOG COUNTER							
*6	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	D BUS FLAG CHECK	D BUS INTERFACE CHECK	BUS IN CHECK	EARLY TERMINATE
*7	IPCA RAM PARITY ERROR	IPCA NRE PIU ERROR	N/A	N/A	BUS RESET	CONTROL UNIT TO CHANNEL CHECK	N/A	N/A

*Generated by IPCA rather than the workstation controller

Workstation (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set to indicate that an invalid command was issued. Bit is set with program alert if either a user read was issued to the workstation in system mode or a system message read was issued to the workstation in workstation mode.
1	Intervention required	Set to indicate a device is not ready. Bit is set with program alert when an invalid device address is received (out-of-range device).
2	Bus out check	Set to indicate a parity error occurred on the D bus while receiving a byte of data from the channel

3	Equipment check	Set to indicate one or more of the following: ■ a parity error occurred within the workstation controller due to microcode; ■ a RAM parity error occurred at the workstation; ■ power on occurred at the workstation; ■ a nonrecoverable PIU error occurred; or ■ a check-sum error occurred during a load RAM command.
4	Data check	Set to indicate that an unsuccessful data transmission occurred between the workstation controller and the workstation in either direction
5	N/A	Always set to zero; not used
6	Bus in check	Set to indicate a parity error occurred on the D bus while sending a byte of data to channel

Workstation (cont)

Bit Position	Bit Designation	Definition
7	Program alert	Set to indicate one or more of the following: ■ a user write command was issued in system mode; ■ operator pressed unlock key while command was outstanding; ■ workstation reports an out-of-bounds vector address during a load RAM comand; ■ message waiting command was issued in system mode; or ■ load RAM command was issued in system mode. Bit is set with intervention if an invalid device address was received (out-of-range). Bit is set with command reject if a user read command was issued to the workstation in system mode or if a system message read was issued to the workstation in workstation mode.

Sense Data Byte 1		
0	Invalid device address	Set to indicate that a portion of the DA/FC byte was invalid during a command sequence
1	WS not ready	Sets bit if the workstation does not respond when a workstation reset message results from D bus reset; or if the workstation controller gets no response from the workstation during a command (other than sense or NO-OP).
2	WS RAM not loaded	Set to indicate that the system should load RAM. No operator action required.
3	Unlock (offline)	Set to indicate that the appropriate device must be online before any processing can be performed on that device.
4	Load error at WS	Bit is set with equipment check if the workstation reports a text record check-sum error during a load RAM command. Bit is set with program alert if the workstation reports a RAM vector address (contained in the initial record) that exceeds the RAM limits.

Workstation (cont)

Bit Position	Bit Designation	Definition
5	Read/write contention	Set to indicate that a READ and WRITE were issued concurrently. READ takes precedence. WRITE is aborted.
6	WS peripheral not available	Set to indicate that device is not available.
7	Invalid command at WS	Set to indicate that a user write command was sent to the workstation in system mode
Sense Data Byte 2		
0	WSC RAM error	Set to indicate a parity error was detected in the workstation controller during RAM access
1	NRE PIU error	Set to indicate a nonrecoverable D bus error occurred related to the PIU device
2	Power on	Set to indicate that the workstation successfully completed power on and the associated confidence test

3	RAM parity error	Set to indicate that the workstation reported a parity error
4	Transmit	Set to indicate that the transmit key on the workstation has been depressed since the last command
5	Function code	Set to indicate that the operator pressed either the message waiting key or one of the function keys
6	Mode change request	Set to indicate the operator changed the mode of the workstation from workstation mode to system mode or vice versa
7	System mode	Sets bit to 1 when the workstation is in system mode. Sets bit to zero when the workstation is in workstation mode.
Sense Data Byte 3		
0-7		A binary count of the number of times communication errors were detected by the workstation controller (WSC) on the workstation controller/workstation interface since last command

Workstation (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 4
0–7		A binary count of the number of times communication errors were detected by the workstation at the workstation/workstation controller interface since the last command
		Sense Data Byte 5
0–7		A binary count of the number of times keyboard parity errors occurred at the workstation/keyboard interface since the last command
		Sense Data Byte 6
0	Command reject	Set to indicate a parity error on the command issued or an invalid command
1	Intervention required	Set to indicate that the device is not ready, not online, or the device address issued is out of range for the devices available (hardware failure).

2	Bus out check	Set to indicate a parity error occurred while transferring data between the IPCA and control unit
3	Equipment check	Set to indicate one or more of the following: ■ D bus error ■ nonrecoverable PIU error on IPCAs internal data bus ■ IPCA RAM parity error
4	D bus flag check	Set to indicate that an illegal combination of flag bits occurred on the D bus. (IPCA received bits from the workstation controller.)
5	D bus interface check	Set to indicate that the D-bus timer elapsed before the IPCA received the device address or was issued a control unit address error. (Workstation controller did not get off the D bus soon enough). IPCA terminates the halt device or read event commands with 0A status (catastrophic error).
6	Bus in check	Set to indicate that a parity error occurred while transferring data between the control unit and the IPCA on the D bus.

Workstation (cont)

Bit Position	Bit Designation	Definition
7	Early terminate	Set to indicate that the IPCA terminated data sequences before completion of a data transfer through IPC channel (problem between main storage interface and IPC).
Sense Data Byte 7		
0	IPCA RAM parity error	Set to indicate termination of data transfer from IPCA and issued a reset to the control unit. RAM parity error detected by IPCA (catastrophic error). Coupled with equipment check.
1	IPCA NRE PIU error	IPCA PIU error. Coupled with equipment check.
2	N/A	Always set to zero; not used
3	N/A	Always set to zero; not used
4	Bus reset	Set to indicate that a D-bus reset was issued by the IPCA.

5	Control units to channel check	Set to indicate that D-bus timer elapsed before the IPCA received the device address, an error in the control unit occurred or the control unit did not disconnect from the D bus within timer time range.
6	N/A	Always set to zero; not used
7	N/A	Always set to zero; not used

5.9.1.3. 0773/0778 Printer Subsystems

SENSE DATA BYTE

BIT	0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	STOP STATE	DEVICE CHECK
1	FORMS OUT	FORMS LOW*	VFB CHECK	FORMS CHECK	BAND CHECK	PRINT LINE BUFFER PARITY ERROR	VERTICAL FORMAT REQUEST/PARITY ERROR	LOAD CODE REQUEST/ PARITY ERROR

*See the following definitions for differences between the 0773 and 0778 printer subsystems.

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	This sense bit indicates a command reject. This bit is generated during an SIO sequence whenever output of the command register is not decoded as a valid command. Unit check status is set and printer control becomes active.
1	Intervention required	This sense bit indicates that an operator intervention is required.
2	Bus out check	Not used; set to 0.
3	Equipment check	This sense bit indicates a print check. It is set if an actuator circuit check or band check (SB1,4) error is detected and also if either fuse check or latch check is detected.
4	Data check	This sense bit indicates a parity error detected in the vertical format buffer (SB1,6).
5	Overrun	This sense bit indicates an overrun condition. It is generated when there is one or more unprintable characters in the print line buffer; no matching code is found in the code buffer.
6	Stop state	This sense bit indicates that the printer is in the stop state. The printer enters the stop state via the STOP switch or an error condition.

0773/0778 Printer Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
7	Device check	This sense bit indicates a device check is required. It is generated when one of the following errors occurs and causes printer control to enter the stop state: ■ blower or ribbon check ■ interlock active If device check status occurs during a print or advance command, the command is immediately terminated.
		Sense Data Byte 1
0	Forms out	This sense bit indicates that the printer is out of paper. It is generated when an advance to or past-home-paper position has occurred after a forms-low indication. Setting this bit causes entry into the stop mode and cannot be cleared until paper has been loaded in the printer.
1	Forms low	This sense bit is set if less than 6 inches of paper remains in the paper supply for the 0773 printer, and 4.7 inches of paper remains in the paper supply for the 0778 printer. The lower tractors may no longer contain paper. Setting this bit causes entry into the stop state; the run mode can be reentered until a forms out (SB1,0) is generated. Unit check status is only generated when this condition (forms low) is first detected.
2	VFB check	This sense bit indicates a paper runaway was detected during an advance setup sequence. It is set if an advance command is issued and the skip code, specified by the C, D, E, and F bits (A = 1), is not present in the vertical format buffer. No paper advance takes place.

3	Forms check	This sense bit indicates a forms check. It is set if any individual paper advance exceeds 1.1 seconds or a forms-jam condition was detected.
4	Band check	This sense bit is set if no timing marks are detected within 1 millisecond, or an incorrect number of timing marks is detected between 2 font marks. Detection of timing marks begins 5 seconds after power is applied to the print band motor.
5	Print line buffer parity error	This sense bit is set if a parity error is detected when reading the print line buffer or during a print setup sequence.
6	Vertical format request/parity error	This sense bit is set if one of the following conditions is present: 1. A parity error is detected when accessing the vertical format buffer. 2. A print-advance or advance command was received after power turn on, system reset, or operator initialization of VFB, and no load-vertical-format-buffer command was issued.
7	Load code request/ parity error	This sense bit is set if one of the following conditions is present: 1. A parity error is detected when accessing the load code buffer. 2. A print-advance or diagnostic command was received after power turn on, system reset, or operator initialization of VFB, and no load-code-buffer command was issued.

5.9.1.4. 0717/0719 Card Reader Subsystems

SENSE DATA BYTE

BIT	0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	STOP STATE	DEVICE CHECK
1	COLUMN 0 ERROR	VALIDITY CHECK ERROR	COMPARE ERROR	RESYNC ERROR	TRANSFER CHECK	N/A	51-COLUMN FEATURE	66-COLUMN FEATURE

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set to 1 if an invalid command is issued. Unit check status is set to 1 and card reader control does not go active.
1	Intervention required	Set to 1 if a condition is detected that requires manual intervention.
2	Bus out check	Not used and is set to 0 by the card reader control.
3	Equipment check	Set to 1 if a card transport error has occurred (card jam). The following conditions cause this error: 1. The read station photocells remain covered, indicating that a card has slowed or stopped in the read station. 2. A card covers the gate photocell and does not pass within the prescribed time count. The motors are turned off immediately and the stop state entered.

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4	Data check	Set to 1 if any of the following conditions are detected: ■ column 0 error (SB1,0) ■ validity check error (SB1,1) ■ compare error (SB1,2) ■ resync error (SB1,3)
5	Overrun	Set to 1 if an overrun condition on data transfer is detected.
6	Stop state	Set to 1 if the card reader is in the stop state. The card reader may enter the stop state by way of the STOP switch or an error condition.
7	Device check	Set to 1 if the card reader detects an interlock active. If device check occurs during a command, the command is terminated immediately.
		Sense Data Byte 1
0	Column 0 error	Set to 1 if all 12 read amplifiers are not off midway between the leading edge of a card and column 1.

1	Validity check error	Set to 1 if the command specified translate and the card reader control detected multiple punches in rows 1 through 7 for any individual column.
2	Compare error	Set to 1 if for any given column the data read in read station 1 does not compare when read in station 2.
3	Resync error	Set to 1 if the card reader control does not detect a punch hole after the read strobe has been synchronized. A read strobe is performed on every column. A resync is performed only when the leading edge of a hole is detected. If a resync occurs, a check is made to verify if the hole still exists (properly centered). The error occurs when the hole does not register properly.
4	Transfer check	Set to 1 if a card is fed from the hopper and detected by the read station photocells or the card patch sensor when a feed was not issued by the card reader control. The motors are turned off immediately and the stop state entered. No status indication is presented to the IPC until the next SIO sequence to the card reader control.
5	N/A	Set to 0 by the card reader control.
6	51-column feature	Set to 1 if F1627—00 is installed for 0717 card reader, or if F2324—00 is installed for 0719 card reader; otherwise 0.
7	66-column feature	Set to 1 if F1627—01 is installed for 0717 card reader, or if F2324—01 is installed for 0719 card reader; otherwise 0.

5.9.1.5. 0605 Card Punch Subsystem

SENSE DATA BYTE

BIT	0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	N/A	EQUIPMENT CHECK	DATA CHECK	OVERRUN	STOP STATE	DEVICE CHECK
1	COLUMN 0 ERROR	VALIDITY CHECK ERROR	STROBE ERROR	MISFEED ERROR	PUNCH CHECK ERROR	N/A	READ STATION FEATURE	N/A

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set to 1 if an invalid command is issued. Unit check status is set and the control is not active.
1	Intervention required	Set to 1 if a condition is detected which requires manual intervention.
2	N/A	Not applicable. Set to 0 by the control.

0605 Card Punch Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
3	Equipment check	Set to 1 if a card transport error has occurred. The following conditions can cause this error: ■ The advance wait station light sensor indicated a lit condition prior to feeding the card from the advance station to the punch station. ■ A card was fed through the read station, but the leading edge failed to be detected by the pre-punch sensor. ■ A card was pushed through the punch station, but the leading edge of the card failed to be detected by the post punch light sensor after the card was pushed 34 columns. ■ The eject card rollers were activated to transport a card to the output stacker but the post punch light sensor did not switch from dark to light within 250 milliseconds. ■ A card is in the read station for more than 150 milliseconds or any read station sensor (if F1617—00 is installed) is dark at column 84. ■ A card was fed from the advance station through the punch station, but the prepunch sensor did not switch from dark to light after the fifth push on the card.

4	Data check	Set to 1 if any of the following conditions exists: ■ column 0 error (SB1, 0) ■ validity check error (SB1,1) ■ strobe error (SB1,2) ■ punch check error (SB1,4)
5	Overrun	Set to 1 if an overrun condition on punch or read data transfers is detected. Data transfers for the current operation are terminated.
6	Stop state	Set to 1 if the subsystem is in the stop state. The subsystem may enter this state via the STOP switch, or an error condition.
7	Device check	Set to 1 if the subsystem has detected interlock active. If device check occurs during a command, the command is immediately terminated.

0605 Card Punch Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Column 0 error	Set to 1 if the read station is installed, and any 1 of the 12 read stations detect a hole between the leading edge of a card and column 1.
1	Validity check error	Set to 1 while operating in the translate mode and more than one punch per column was detected in rows 1 through 7.
2	Strobe error	Set to 1 if the read station feature is installed and a stroke signal detected incorrect data.
3	Misfeed error	Set to 1 if a card failed to feed from the card reader hopper.
4	Punch check error	Set to 1 if a mismatch occurs during the punch cycle, when the punch check performs an accuracy check.
5	N/A	Not applicable. Set to 0 by the control.
6	Read station feature	Set to 1 if read station feature is installed; otherwise set to 0 by the control.
7	N/A	Not applicable. Set to 0 by the control.

5.9.1.6. 8413 Diskette Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTER-VENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	NOT USED (0)	STOP STATE	DEVICE CHECK
1	ID FIELD CHECK	SN CHECK	TRACK/ SECTOR ADDRESS CHECK	TRACK MISMATCH	NO SECTOR FOUND	WRITE PROTECT CHECK	NO DATA SEPARATOR LOCK	CRC CHECK
2	DELETED DATA ADDRESS MARK	INVALID DATA SET LABEL	FDC PARITY ERROR	EOD/EOE	END OF VOLUME	NOT USED	RETRY	INVALID COMMAND SEQUENCE
3	DIRECT ACCESS MODE	FEATURE INSTALLED	HARDWARE WRITE PROTECT	SNR 0	SNR 1	SNR 2	SNR 3	SNR 4
4	NOT USED	TAR 0	TAR 1	TAR 2	TAR 3	TAR 4	TAR 5	TAR 6
5	NOT USED	NOT USED	NOT USED	SAR 0	SAR 1	SAR 2	SAR 3	SAR 4

0413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets for any of the following reasons: 1. Illegal command code is detected during SIO sequence. Illegal command also causes 01_2 condition code and unit check status. 2. Error condition detected during execution of a legal command code. Specific errors set individual sense bits as well as command reject bit. The error conditions cause device-end and unit-check status presentation to the IPC. The RDC sets the command reject sense bit when any of the following sense bits are also set: ■ SN check (SB1, bit 1) ■ Track or sector address check (SB1, bit 2)

- Write protect check (SB1, bit 5)
- Invalid data set label (SB2, bit 1)
- Hardware write protect (SB3, bit 2)

3. A DW (E1) command was issued without an enabling (F1) command immediately preceding it. This error condition results in a device-end and unit-check status to the IPC.
4. While in DAM (SB4, bit 0 is set), the following commands were issued: RI, RID, WI, WID, LTS 21 with track 0, or LTS 21 with track 0 but no sector number specified. This error causes device-end with unit-check status presentation to the IPC.
5. An SIO sequence that caused the FDC to reject all commands except sense, DR, or DW because the addressed diskette drive was in stop state or is not installed. This causes condition code (01_2), unit-check status, stop state (SB0, bit 6), and intervention required (SB0, bit 1) bits to be set.

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
1	Intervention required	Set by FDC to indicate that an RI, RID, R, RD, WI, WID, or LTS command was issued to a diskette drive that was in stop state (SB0, bit 6). This bit is also set when the FDC presents device-end and unit-check status to the IPC.
2	Bus out check	This bit is set when: 1. An incorrect parity in a command byte is detected during an SIO sequence. 2. A parity error is detected during an outbound data transfer. Upon completion of the take-4 sequence, the FDC, presents device-end and unit-check status to the IPC.

3	Equipment check	This bit is set when: 1. The diskette drive enters stop state (SB0, bit 6) while an RI, RID, R, RD, WI, WID, W, WD, or LTS command is being executed in that diskette drive. 2. The FDC sets the device-check (SB0, bit 7) sense bit. 3. The FDC sets the track-mismatch (SB1, bit 3) sense bit because a retry was unsuccessful. 4. The FDC sets the FDC parity error (SB2, bit 2) sense bit. For each of these errors, the FDC terminates the current command and presents device-end and unit-check status. For item 3, the FDC also sets unit-exception status.
4	Data check	This bit is set for various data errors related to the diskette or diskette drive. If a retry is unsuccessful, the same errors will also set the following sense bits: 1. ID field check (SB1, bit 0) 2. No data separator lock (SB1, bit 6)

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4 (cont)	Data check (cont)	3. CRC check (SB1, bit 7) 4. No sector found (SB1, bit 4) For each of these error conditions, the IPC terminates the current command and presents device-end, unit-check and unit-exception status to the IPC.
5		Not used; always set to 0.
6	Stop state	This bit is set when the addressed diskette drive is not ready for a command. A diskette drive is ready when the DRIVE SELECT signal is true, a diskette is inserted, the diskette door is closed, and two index pulses have been detected. If the diskette drive is not in use, the stop-state setting does not occur for any status presentations.

		When stop-state causes command-reject or equipment-check setting, the device-end and unit-check status is also presented to the IPC.
7	Device check	This bit is set when the FDC is executing the RI, RID, R, RD, WI, WID, W, or WD command but no index pulse is detected. With this condition, the FDC terminates the command and presents device-end and unit-check status to the IPC. In addition, the equipment-check and intervention-required sense bits are set when the device-check bit is set.
		Sense Data Byte 1
0	ID field check	This bit is set when the FDC detects an error in the ID field of any sector while read and write operations are being performed. The ID field includes address marks, track and sector identification, and CRC bytes that precede each data record. This sense bit is set when the FDC cannot read the ID field for a required sector. The errors may be caused by a CRC check, or a no-data-separator lock condition. The FDC attempts 12 retries on a given ID field before declaring an error condition. Device-end and unit-check status is presented whenever the ID field check sense bit is set and retry is unsuccessful.

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
1	SN check	This bit is set when the FDC encounters an invalid sector number during execution of any command that references a sector number register (SNR). One of 26 sectors on the index track of the diskette must be addressed by the SNR. If contents of the addressed SNR equal 0, or if the addressed value is higher than 26, the SN-check sense bit is set. Detection of the error causes termination of the command, the command-reject sense bit (SB0, bit 0) is set, and device-end and unit-check status is presented to the IPC.
2	Track or sector address check	This bit is set when software loads a track and/or sector address that is outside the range permitted for the diskette or data set described by the current data set label. When this bit is set, the FDC also sets the command-reject sense bit (SB0, bit 0), terminates the current command, and presents device-end and unit-check status to the IPC.

3	Track mismatch	An incorrect track encountered during seek operation causes the FDC to set this bit. If a retry is successful, the FDC sets the equipment check sense bit (SB0, bit 3), and device-end and unit-exception status. If the retry is unsuccessful, the FDC sets this bit as well as the equipment-check sense bit, and device-end, unit-check, and unit-exception status.
4	No sector found	Detection of two index pulses without locating a specified sector causes the FDC to set this bit. If retry is successful, the FDC sets this bit and presents device-end and unit-exception status. If retry is unsuccessful, the FDC sets this bit as well as data check sense bit (SB0, bit 4), and presents device-end, unit-check, and unit-exception status.
5	Write protect check	Issuing a W or WD command while the associated data set label's write-protected position contains a P character or while a hard-write-protected diskette is mounted in the diskette drive causes the FDC to set this bit. The error also causes the command-reject sense bit (SB0, bit 0) to be set and terminates the command, and device-end and unit-check status is presented by the IPC.

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
6	No data separator lock	A no-clocks condition encountered in the ID field of any sector addressed by the current command while processing an RI, RID, WI, WID, R, RD, W, or WD command causes the FDC to set this bit. The ID-field check sense bit (SB1, bit 0) is also set, the current command is terminated, and device-end and unit-check status is presented.
7	CRC check	A CRC error detected during an RI, RID, WI, WID, R, RD, W, or WD command causes the FDC to set this bit. The CRC may pertain to the data record or ID field of the associated sector. If the CRC error pertains to the ID field, the FDC also sets the ID-field-check sense bit (SB1, bit 0). When CRC-check sense bit is set but a retry is unsuccessful, the data-check sense bit (SB0, bit 4) is also set, the current command is terminated, and device-end, unit-check, and unit-exception status is presented to the IPC.

Sense Data Byte 2		
0	Deleted data address mark	A deleted record encountered during execution of an RID or RD command causes the FDC to set this bit. The deleted record, consisting of a data set label or record in the data set, is transferred to the IPC. Device-end and unit-exception status is presented to the IPC as an ending status. The FDC does not terminate data transfers after it transfers a deleted record to the IPC. Status is presented after all bytes specified by the command are transferred to the IPC.
1	Invalid data set label	An invalid data set label encountered during execution of an R, RD, W, or WD command causes this bit to be set. The FDC also sets command-reject sense bit (SB0, bit 0), terminates the current command, and presents device-end and unit-check status to the IPC.
2	FDC parity error	Detection of a read-only-memory (ROM) or read-and-write-memory (RAM) parity error causes any of the following conditions: ■ A RAM parity error occurring during execution of a command causes this bit to be set, and device-end and unit-exception status is presented.

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2 (cont)
2 (cont)	FDC parity error (cont)	■ A recoverable ROM parity error during execution of a command causes this bit to be set, and device-end and unit-check status is presented. ■ A nonrecoverable ROM parity error during a command causes either device-end and unit-check status or only unit-check status to be presented. Sense bits cannot be set with this type of error. If a subsequent command is required, it is presented with the not-operational condition code (11_2).
3	EOD/EOE	Encountering an EOD record during R and RD commands or an EOE record during W and WD commands causes the FDC to set this bit. The EOD/EOE record is transferred to or from the IPC, and subsequently the FDC presents device-end and unit-exception status to the IPC.

4	End of volume	An EOD/EOE condition encountered while the FDC is reading or writing a multivolume data set when another volume is required causes the FDC to set this bit. The EOD/EOE sense bit (SB2, bit 3) is not set when this bit is set. The FDC presents device-end and unit-exception to the IPC as ending status.
5		Not used, always set to 0.
6	Retry	When the FDC rereads a data set label or data set record during an RI, R, RID, or RD command, this bit is set. The bit is also set if the FDC is to re-initialize an implied seek operation because a track mismatch condition is detected. If a retry is successful, the FDC presents device-end and unit-exception status upon normal completion of the command. If a retry is unsuccessful, the command is terminated and device-end, unit-check, and unit-exception status are presented to the IPC.
7	Invalid command sequence	Indicates that software has issued an illegal command sequence to the 8413 diskette subsystem. Device-end and unit-check status will be presented. The command reject sense bit (SB0, bit 0) will also be set. The following invalid command sequences can occur: 1. A read command is issued when TAR and SAR values are equal to or greater than the EOD value.

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2 (cont)
7 (cont)	Invalid command sequence (cont)	2. An LTS 21 with a track value of 1—74 was issued after a power-up or door-closure condition.
		Sense Data Byte 3
0	Direct access mode	This bit is set when the FDC is operating in direct access mode (DAM). When the bit is not set, the FDC is operating in data set mode (DSM).
1	Feature installed	This bit is self-setting when the diskette expansion drive 3 to the subsystem. No status presentation is made when this bit is set. The bit may be tested by addressing any diskette drive.

2	Hardware write protect	Detection of an uncovered diskette write-protect hole causes this bit to be set by the FDC. If a W, WD, WI, or WID command addresses a diskette that is hardware-write protected, regardless of the command sequence, the sense bit is set and the command is terminated. In addition, the command-reject (SB0, bit 0) and write-protect-check (SB1, bit 5) sense bits are set, and device-end and unit-check status is presented to the IPC.
3–7	Sector number register (SNR)	The five sector number register bits 0 through 4 (SNR0 through SNR4) of the sector number register (SNR) addressed by the sense command are stored in the corresponding bit positions of sense byte 3. SNR0 is the highest-order bit. The SNR is used as a pointer to a specific sector of the index track.
	Sense Data Byte 4	
0		Not used
1–7	Track address register (TAR)	The seven track access register bits 0 through 6 (TA0 through TA6) of the track address register (TAR) addressed by the sense command are stored in the corresponding bit positions of sense byte 4. TA0 is the high-order bit. TA0 through TA6 reference the track where a given R, RD, W, or WD command began. These seven bits are loaded when an LTS 21 with TT=0 is issued, or when an R or W command is executed.

8413 Diskette Subsystem (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 5		
0–2		Not used
3–7	Sector address register (SAR)	The five sector address register bits 0 through 4 (SA0 through SA4) of the sector address register (SAR) addressed by the sense command are stored in the corresponding bit positions of sense byte 5. SA0 is the high-order bit. SA0 through SA4 reference the sector where a given R, RD, W, or WD command began. These five bits are loaded when an LTS 21 command with TT=0 is issued or when an R or W command is executed.

5.9.1.7. Communications Adapter

Bit	Designation	Definition
		Sense Byte 0
0	Command reject	A valid command was presented to the CA. Condition code 01_2 is set.
1	Idle overrun or idle check	An input data overrun or an input data error occurred while the port was in an inactive state. This bit is set if a break, disconnect, or open line condition occurs while the port is inactive.
2	Bus out check	a. A parity error was detected on a command code. Unit-check bit is set. Condition code 01_2 is set; or b. A data parity error on data was received from the IPC. Output data transfer on the affected port is halted immediately on detection of the error. The CA time fills in with SYNs (nontransparent synchronous), or marking (asynchronous) until a new command is received.

Communications Adapter (cont)

Bit	Designation	Definition
		Sense Byte 0 (cont)
3	Abort	An input message ended with an abort sequence (a character with CI bit 5=1, preceded by a start character). Unit-check bit and device-end bit are set.
4	Data check	An input LRC/CRC error, character parity error, or a missing stop bit error (asynchronous) has occurred on an input block, message, or supervisory sequence. Unit-check bit and device-end bit are set upon termination. Data-check bit is set for break, disconnect, or open line conditions if the port is active.
5	Overrun	Input data was late in being acknowledged by the IPC. Unit-check and device-end check bits are set upon termination.

6	Ring indicator or data set status	A ringing signal is being received from a modem, or a dialed connection has been successfully established by an automatic calling unit. The LA ring inhibit flip-flop must be cleared with an LA-clear command before ring status can be reported again. An enable-data-input, enable-data-output, or turn-off command should be sent to the CA in order to turn on data-terminal-ready sequence for a modem, or an LA-clear command should be sent to clear a call request to an automatic calling unit (ACU).
7	Carrier off or abandon call and retry	Loss of a carrier on a modem-equipped LA, or a connection was not established after a dial command.

Communications Adapter (cont)

Bit	Designation	Definition
		Sense Byte 1
0	Break	Reception of a spacing signal for at least 180 and less than 250 microseconds duration from a terminal. The signal is normally used to stop transmission. Break, disconnect, and open line are mutually exclusive.
1	Disconnect	The communications line has been disconnected via reception of either a DLE EOT or a space signal of at least 750 microseconds and less than 3 seconds. Unit-check and device-end bits are set. Break, disconnect, and open line are mutually exclusive.
2	Open Line	Reception of a spacing signal for at least 3 seconds, usually indicating an open telegraph line. Break, disconnect, and open line are mutually exclusive.
3	Line procedure time-out	The line procedure timer has run out.

4	–	Set to 0 by the CA.
5	Space to mark	Occurs when the space-to-mark transition occurs, provided the spacing exceeds 180 microseconds duration. NOTE: The space-to-mark sense bit is set concurrently with the break and disconnect sense bits. The space-to-mark bit may be set at some indeterminate point in time relative to the open-line indication. Break, disconnect, and open line are mutually exclusive.
6	Data set ready off	The data-set-ready bit has turned off, but data-terminal-ready bit is still on. Software should interrogate the terminal to ensure proper terminal identity when this condition occurs. Also, an enable-DSR-monitor command or LA-clear command must be issued so tha the DSR monitor is again in effect. If the DSR monitor is not in effect, no data can be transferred.

Communications Adapter (cont)

Bit	Designation	Definition
		Sense Byte 1 (cont)
7	Monitor	A monitor character has been detected. Normally used to indicate that an illegal character was detected in an output message. Transmission is automatically stopped until a new command is received. If an error occurs on a BCC following ITB, this bit becomes set.

5.9.2.1. 8415/8416/8418 Disk Subsystems

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	OUTPUT PARITY CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	STOP STATE	DEVICE CHECK
1	ID FIELD CHECK	TRACK OVERRUN	CYLINDER END	HIGH DENSITY	NO RECORD FOUND	FILE PROTECT	SYNC REGION ERROR	DATA FIELD CHECK
2	SEEK INCOMPLETE	COMPARISON PARITY CHECK	HEAD/CYLINDER MISCOMPARE	RECORD NUMBER MISCOMPARE	FLAG BYTE MISCOMPARE	UNSELECTED STATUS	ECC CHECK	NO CLOCKS
3	ALWAYS 0	ALWAYS 0	ALWAYS 0	ALWAYS 0	HEAD ADDRESS			
4	ALWAYS 0	ALWAYS 0	RECORD NUMBER					

8415/8416/8418 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	When set alone this indicates an invalid command code, an invalid head address, or an attempted write command when programmed offset was selected in the BCW. (Bit 125 is set to 1.) It may also be set with file protect (SB1,5) to indicate that a write command was issued to a file protected device.
1	Intervention required	Sets with stop state (SB0,6) to indicate that an operation was attempted on a device which was either nonexistent or in the stop state.
2	Output parity check	Indicates that a parity error was detected at the end of the output queue (i.e., the input to the shifter).

3	Equipment check	This bit is set to indicate that a serious hardware malfunction has occurred within the subsystem. If set alone, it indicates that the adapter control logic contains an error. If set with ECC check (SB2,6) it indicates a malfunction in the ECC logic during a write or format-write-command. It may also set with device check (SB0,7) to indicate that the device selected has a serious hardware failure (see device check listed separately), with seek incomplete (SB2,0) to indicate that a selected device was not able to complete a seek within a specified period of time, or with unselected status (SB2,5) to indicate that status has been received from a device not selected. It may also set with track overrun (SB1,1) to indicate that indexing occurred while a record was being processed. This implies that the disk is rotating too fast relative to the write oscillator.
4	Data check	Set with no-clocks (SB2,7) to indicate that no clocks have occurred for 10 ms while reading or writing, or with comparison parity check (SB2,1) to indicate a parity bit miscompare was detected at the comparator. It will also set with head/cylinder miscompare (SB2,2), with record number miscompare (SB2,3) or flag byte miscompare (SB2,4) to signify difficulty with a seek operation, difficulty in maintaining orientation in the read circuitry, or an incorrect flag byte, respectively, and no ECC check error was detected. Data check will also set with ID field check (SB1,0) or data field check (SB1,7) together with either sync region error (SB1,6) or ECC check (SB2,6). These bit combinations will indicate either that an error (such as an improperly detected index mark or an incorrect sync byte) has been detected in the sync region, or that an ECC check error was detected. They will also indicate whether the error was detected in an ID field or a data field.

8415/8416/8418 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
5	Overrun	Indicates during a write or search operation that main storage has not supplied data at a sufficient rate to satisfy the data rate of the device. Sets when the output queue is empty and a request is made of the queue for more data. It also sets during a read operation if main storage accepts information too slowly. Overrun sets when the input data register is full and the shifter is ready to transfer a full byte to it.
6	Stop state	Sets with intervention required (SB0,1) if an operation was attempted on a device nonexistent or in the stop state. It will be set alone if the device addressed by the sense command is nonexistent or in the stop state, but no operation was attempted on the device.
7	Device check	Sets with equipment check (SB0,3) to indicate that the device selected has a serious hardware error requiring maintenance and/or operator intervention. If conditions in the device prevail that cause device check to set when the device is not selected, device check may be presented alone; this occurs only if no attempt has been made to use that device. Some examples of errors that may cause this are: multiple head selection, write current on without having been selected, etc. Note that device check can be set if a seek (implied or seek command) is issued to a nonexistent cylinder (> 410 for 8416).

Sense Data Byte 1		
0	ID field check	Sets with data check (SB0,4) and either sync region error (SB1,6) or an ECC check (SB2,6) to indicate either that an error was encountered in the ID field preamble or in the ID field ECC bytes, respectively.
1	Track overrun	Sets with equipment check (SB0,3) to indicate that index was encountered while processing a record.
2	Cylinder end	Indicates an operation was incomplete at the end of a cylinder.
3	High density	Always set to zero for 8415 removable, 8416, and 8418 low density disc subsystems. Set to one for 8415 fixed and 8418 high density disc subsystems.

8415/8416/8418 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
4	No record found	Sets alone, during a search/read command to indicate that the search conditions were not satisfied after two passes of index if the multitrack bit is not set in the buffer control word. If the multitrack bit is set, it will be set in conjunction with cylinder end (SB1,2) if the search conditions were not satisfied by the end of the cylinder. No-record-found will also set in conjunction with sync region error (SB1,6) if no data was found on the selected track (i.e., two passes of index occurred without an intervening ID preamble.) It also sets alone on read-data or write-data commands if the record number specified in the BCW cannot be found.
5	File protect	Sets if the device selected is in file protect mode. Command reject (SB0,0) will also be set if a write operation were attempted on the device.
6	Sync region error	Sets with data check (SB0,4) and either ID field check (SB1,0) or data field check (SB1,7) to indicate that an error was detected in the preamble of either the ID field or the data field of a record, respectively.
7	Data field check	Sets with data check (SB0,4) and either sync region error (SB1,6) or ECC check (SB2,6) to indicate either that an error was encountered in the data field preamble or in the data field ECC bytes, respectively.

Sense Data Byte 2		
0	Seek incomplete	Sets with equipment check (SB0,3) to indicate that a seek operation could not be completed within a specified time, or that the positioner on a drive drifted off track while the drive was selected, but no head had yet been selected. Seek incomplete can only be cleared by issuing a recalibrate command to the drive that caused the error.
1	Comparison parity check	Indicates parity bits associated with bytes found to be identical by the comparator, are not identical.
2	Head/cylinder miscompare	Sets with data check (SB0,4) to indicate that the head and/or cylinder number specified in the BCW does not match the corresponding bytes on a record read from the disk and no ECC check error occurred.
3	Record number miscompare	Sets with data check (SB0,4) to indicate that the record number read from the disk is not the one expected after a string of records has begun to be processed. This bit implies that one or more records has accidentally been skipped.
4	Flag byte miscompare	Indicates that the flag bits read from the disk did not match those in the BCW. Data check (SB0,4) is also set when this bit is set.
5	Unselected status	Sets with equipment check (SB0,3) to indicate that a device has raised a status line when no device was selected.
6	ECC check	Sets with data check (SB0,4) and either ID field check (SB1,0) or data field check (SB1,7) to indicate that an ECC error was detected in either the ID field or the data field, respectively. It may also set with equipment check (SB0,3) to indicate an ECC malfunction during a write-or-format-write command.
7	No clocks	Sets with data check (SB0,4) to indicate that no clocks have occurred within 10 ms (±30%) while reading or writing.

Bit Position	Bit Designation	Definition
Sense Data Byte 3		
0–3	N/A	Set to zero by the IDA.
4–7	Head address	Indicates which head was last selected.
Sense Data Byte 4		
0–1	N/A	Set to zero by the IDA.
2–7	Record number	Indicates the last record number partially or completely processed at the time of termination of the operation.

Summary of Sense Bits Possible for Each Command

Commands	Byte 0								Byte 1								Byte 2							
Sense Bits	0 Command Reject	1 Intervention Required	2 Output Parity Check	3 Equipment Check	4 Data Check	5 Overrun	6 Stop State	7 Device Check	0 ID Field Check	1 Track Overrun	2 Cylinder End	3 —	4 No Record Found	5 File Protect	6 Sync Region Error	7 Data Field Check	0 Seek Incomplete	1 Comparison Parity Check	2 Head/Cyl Miscompare	3 Record No. Miscompare	4 Flag Byte Miscompare	5 Unselected Status	6 ECC Check	7 No Clocks
Format Write	X	X	X	X			X	X		X				X			X					X		X
Write Data	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X
Read Data	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Search/Read	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Read ID	X	X	X	X	X	X	X	X	X	X			X	X	X		X	X				X		X
Seek	X	X		X			X	X						X			X					X		

5.9.3.1. 0768 Printer Subsystem

5.9.3. I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED, FORMS OUT, RUNAWAY	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	INHIBIT STATUS	NOT READY
1	CODE BUFFER PARITY ERROR	DATA BUFFER PARITY ERROR	ONCE PER REVOLUTION ERROR	SPROCKET ERROR	SCAN ERROR	EARLY TERMINATE	STOP	SELECTIVE RESET/INTERFACE DISCONNECT

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	When set, this bit indicates that an invalid command was issued by the multiplexer channel.
1	Intervention required	When set, this bit indicates forms out or forms runaway.
2	Bus out check	When set, this bit indicates a parity error in a command or data transfer to the control unit. A parity error detected during a command causes immediate termination; on data transfers, there is no immediate termination.
3	Equipment check	When set, this bit indicates that a print hammer fuse fault signal was generated during the last printing operation.
4	Data check	When set, this bit indicates a parity error in either the print line or code drum buffer.
5	Overrun	When set, this bit indicates that the print line was not completed during one revolution of the print drum. This condition can be caused by a hardware error or by a character code placed in the print line buffer and no corresponding code in the code drum buffer.
6	Inhibit status	When set, this bit indicates that the inhibit status in flip-flop is set, preventing a status byte from being sent to the multiplexer channel.
7	Not ready	When set, this bit indicates a ribbon out or carriage out condition.

0768 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Code buffer parity error	When set, this bit indicates a parity error in the code drum buffer.
1	Data buffer parity error	When set, this bit indicates a parity error in the print line buffer.
2	Once per revolution error	When set, this bit indicates that the sprocket code counter did not contain a count of 63 when the once-per-revolution pulse occurred. (This indicates a hardware error.)
3	Sprocket error	When set, this bit indicates identical data pulses on two consecutive sprocket pulses. (This condition is a hardware fault, which requires corrective action.)
4	Scan error	When set, this bit indicates that a sprocket pulse occurred before the scan cycle was completed. (This condition is a hardware fault, which requires corrective action.)
5	Early terminate	When set, this bit indicates that the multiplexer channel terminated the transfer of data to the code drum buffer before 63 characters had been stored. This bit will be set only during a load code command.

6	Stop	Pressing the STOP switch/indicator causes this bit and the unit check bit (bit 6) of the status bit to be set. This is an operator action stop. It is set at the completion of the current operation. (An error condition causing the PRINT CHECK, FORMS RUNAWAY, FORMS OUT, or RIBBON CHECK indicators on the upper row of indicators on the right-hand control panel to light, sets this bit, unit check bit (bit 6), and the appropriate bits in the sense byte.) The test, sense, read, and load code commands can be performed when in the stop mode (and not offline). The read and load code commands cannot be executed during a power check, interlock, or temperature check alarm condition.
7	Selective reset/ interface disconnect	When set, this bit indicates that a selective reset/interface disconnect sequence occurred since the last sense command was issued.

5.9.3.2. 0770 Printer Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	VERTICAL FORMAT CHECK	BUFFER LOAD CHECK	COMMAND RETRY
1	EARLY TERMINATE	INHIBIT DATA CHECK	INHIBIT STATUS IN	FOLD DATA	DIAGNOSTIC GATE	INTERFACE DISCONNECT/ SELECTIVE RESET	VERTICAL FORMAT REQUEST	LOAD CODE REQUEST
2	ADVANCE CHECK	FORMS LOW	FORMS POSITION CHECK	CARTRIDGE CODE CHECK	CODE 9	FORMS CHECK	RIBBON CHECK	TYPE SPEED CHECK
3	LOAD CODE BUFFER PARITY CHECK	PRINT LINE BUFFER PARITY CHECK	VERTICAL FORMAT BUFFER PARITY CHECK	UNASSIGNED	PRINT ACTUATOR CHECK	UNASSIGNED	UNASSIGNED	UNASSIGNED
4	This byte contains diagnostic information during execution of a print-advance command when diagnostic mode is set.							
5	EXPANDED FONT	160 PRINT POSITIONS	LOW SPEED	UNASSIGNED	UNASSIGNED	UNASSIGNED	DIAGNOSTIC	DIAGNOSTIC

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	This bit is set when an invalid command was issued by the channel.
1	Intervention required	This bit is set when operator action is required because the printer is in the stop mode due to any of the following: ■ out of forms — forms low (sense data byte 2, bit 1) has been detected and the form has been advanced to the bottom of the form; ■ forms check (bit 5 of sense data byte 2); ■ stacker full; ■ STOP switch activated; ■ ribbon check (bit 6 of sense data byte 2); ■ interlock — power check — carriage check — casework check

0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
1	Intervention required (cont)	■ forms position check (bit 2 of sense data byte 2); ■ type speed check (bit 7 of sense data byte 2); or ■ advance check (bit 0 of sense data byte 2).
2	Bus out check	This bit is set when a parity error is detected on the channel during a transfer to the printer. A parity error detected in a command code causes an immediate termination. A parity error detected in a data transfer causes termination of the command following the data transfer sequence.
3	Equipment check	This bit is set when any of the following occurs: ■ actuator check (bit 4 of sense data byte 3); ■ advance check (bit 0 of sense data byte 2); ■ parity error in — load code buffer (bit 0 of sense data byte 3) — print line buffer (bit 1 of sense data byte 3) — vertical format buffer (bit 2 of sense data byte 3)

4	Data check	This is set when a noncompare is detected between a character in the print line buffer and the characters in the load code during the print compare sequence, provided inhibit data check is not active. When this bit is set, all characters are printed except those not compared, and the advance portion of a print-advance command is executed.
5	Vertical format check	This bit is set when a noncompare was detected between the skip code in a print-advance, advance-print, or an advance-only command, and codes in the vertical format buffer. When this bit is set, advance is not executed.
6	Buffer load check	This bit is set with any of the following sense data byte bits: ■ vertical format request (bit 6 of sense data byte 1); ■ load code request (bit 7 of sense data byte 1); or ■ early terminate (bit 0 of sense data byte 1).
7	Command retry	This bit is set during the print compare sequence when a parity error is detected in the print line buffer or in the load code buffer. All columns are printed except those affected by the parity error. If the equipment check bit (bit 3 of sense data byte 0) is set and load code buffer check (bit 0 of sense data byte 3) is set, the parity error occurred in the load code buffer. If the equipment check bit (bit 0 of sense data byte 0) is set and print line buffer check bit (bit 1 of sense data byte 3) is set, the parity error occurred in the print line buffer. When the command is reissued, the printer retries only those columns affected by the parity error.

0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
7	Command retry (cont)	When this bit is set, the advance portion of a print-advance command is not executed. If a faulty print-advance command was issued, the form advances in accordance with the successful retried command or according to the ACDEF detail bits of the advance-only command; however, if ACDEF = 10000 the form is advanced in accordance with the ACDEF detail bits of the faulty print-advance command that caused command retry. A successful retry or issuing an advance-only command resets the command retry bit.
		Sense Data Byte 1
0	Early terminate	This bit is set when: ■ less than 50 (59*) characters were transferred during loading of the load code buffer on a printer without expanded character feature (F1534—00); ■ less than 26 (35*) characters were transferred during loading of the load code buffer on a printer with expanded character feature (F1534—00); ■ end of form was not detected by the printer during load-vertical-format command. NOTE: If end of form is not detected by the 192nd byte, the data transfer sequence is terminated.

*If dualing is active.

1	Inhibit data check	This bit indicates inhibit-data-check flip-flop is set.
2	Inhibit status in	This indicates inhibit-status-in flip-flop is set.
3	Fold data	This bit indicates fold flip-flop is set.
4	Diagnostic gate	This bit indicates the printer is in diagnostic timing mode.
5	Interface disconnect/ selective reset	This bit indicates interface disconnect or selective reset occurred during the data transfer sequence. If this bit is set, it indicates the command was not executed.
6	Vertical format request	This bit indicates the vertical format buffer has not been properly loaded; that is, the buffer was not loaded, loaded with an early terminate (bit 0 of sense data byte 1), or bus out check (bit 2 of sense data byte 0) indication was present during loading. NOTE: The printer cannot execute an advance because the 6/8 ipi criterion for advancing has not been received.
7	Load code request	This bit indicates the load code buffer has not been properly loaded.

0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2
0	Advance check	This bit is set when the forms advance operation was not completed within: ■ 700 ms for type 0770—00/01 printer; ■ 500 ms for type 0770—02/03 printer; or ■ 400 ms for type 0770—04/05 printer. This condition could occur for any of the following: ■ stalled advance mechanism; ■ slow advance; or ■ forms runaway. This condition prevents the current print-advance, advance-print, or advance-only command from being executed.
1	Forms low	This bit is set when approximately 2.5 inches (8,35 cm) of the last form remains. When this bit is set it causes unit check bit to be set only once.
2	Forms position check	This bit is set when the forms advance operation detects the form did not stop in proper position. This condition prevents the current print-advance, advance-print, or advance-only command from being executed.

3	Cartridge code check	This bit is set when the cartridge identification code does not agree with the cartridge verification code issued with the load-code command. Also, it causes immediate termination of a print-advance or advance-print command if the stored cartridge verification code does not equal the cartridge identification code when the command is initiated.
4	Code 9	Presented with device end of a print-advance, advance-print, or advance-only command that has detail advance bit A = 0 (advance by spacing). This bit indicates the advance called for would have advanced the form to or beyond the line corresponding to code 9; therefore the form does not advance. The line is printed for a print-advance command but the forms advance operation is not executed. The line is not printed for an advance-print command and the forms advance operation is not executed. The form does not advance for an advance-only command. A test is not made for code 9 on the next print-advance, advance-print, or advance-only command; therefore this sense condition is not presented and the form advances according to the ACDEF detail bits in the new command. The form advances for detail bits ACDEF = 10000 (advance repeat) in accordance with ACDEF detail bits of the advance causing code 9.
5	Forms check	This bit is set when either a torn form or a forms-jam condition is detected. This condition prevents the current print-advance, advance-print, or advance-only command from being executed.
6	Ribbon check	This bit is set when a malfunction is detected during ribbon motion.
7	Type speed check	This bit is set during the print-compare sequence when the print band is not at proper speed or not synchronized with the logic. Some printing may have occurred prior to this bit being set; however, once set, it inhibits all further printing.

0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3
0	Load code buffer parity check	This bit is set when a parity error is detected in the load code buffer. If the error is detected during the print-compare sequence, it causes the command retry bit (bit 7 of sense data byte 0) to be set.
1	Print line buffer parity check	This bit is set when a parity error is detected in the print line buffer. If the error is detected during the print-compare sequence, it causes the command retry bit (bit 7 of sense data byte 0) to be set.
2	Vertical format buffer parity check	This bit is set when a parity error is detected in the vertical format buffer. If the parity error is detected with an advance-print or advance-only command, the command is not to be executed. If the error is detected with a print-advance command, the line is printed but the form is not advanced.
3	Unassigned	
4	Actuator check	This bit is set when an actuator fails to fire due to a malfunction of the actuator circuitry. When this condition is detected, all columns are printed except those with a malfunction.
5	Unassigned	
6	Unassigned	
7	Unassigned	

Sense Data Byte 4		
0–8		This byte contains diagnostic information during execution of a print-advance command when diagnostic mode is set.
Sense Data Byte 5		
0	Expanded font	This bit is set to indicate printer F1534–00 is installed.
1	160 position	This bit is set to indicate printer F1533–00 is installed.
2	Low speed	This bit is set when the printer is operating with the print band SPEED SELECT switch in LOW position.
3	Unassigned	
4	Unassigned	
5	Unassigned	
6	Diagnostic	Used to store overflow bits of the print hammer flight time in sense data byte 4.
7	Diagnostic	

5.9.3.3. 0776 Printer Subsystem

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
0	Command Reject	Intervention Required	Bus Out Check	Equipment Check	Data Check	Vertical Format Buffer Check	Buffer Load Check	Command Retry
1	Unassigned	Inhibit Data Check*	Inhibit Status In*	Fold Data*	Unassigned	Interface Disconnect and Selective Reset	Vertical Format Buffer Request	Load Code Buffer Request
2	Unassigned	Forms Low	Unassigned	Cartridge Code check	Unassigned	Forms Check	Unassigned	Type Speed Check
3	Load Code Buffer Parity Check	Print Line Buffer Parity Check	Vertical Format Buffer Parity Check	Unassigned	Actuator Check	Unassigned	Unassigned	Unassigned
4	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned
5	Expanded Font	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned

*Bit does not cause unit check status when set. NOTE: An area without an entry indicates an unassigned bit position, always reset to 0.

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command Reject	Set if an invalid command is issued, and causes unit check status to be set.
1	Intervention Required	Set if a condition is detected requiring manual intervention.
2	Bus Out Check	Set if a parity error is detected during a transfer from the channel to the printer. A parity error on a command code causes an immediate termination. A parity error on a data transfer causes termination of the command following the data transfer sequence.
3	Equipment Check	Set when any of the following occur: ■ Actuator check (byte 3, bit 4)

0776 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
3 (cont)	Equipment Check	■ Parity error in: — Load code buffer (byte 3, bit 0) — Print line buffer (byte 3, bit 1) — Vertical format buffer (byte 3, bit 2) ■ Type speed check ■ Forms check
4	Data Check	Can be set during the loading of data for a print advance command. Signifies that one or more character codes in print line buffer have no corresponding code in the load code buffer. The setting of data check may be inhibited by use of inhibit data check command. When this bit is set, the print advance command or the diagnostic write command is completely executed. Printed positions with data check characters appear on the printed line as spaces.

5	VFB Check	Set when a noncompare is detected between the skip code (A=1), in a print advance, an advance only command, and the codes in the vertical format buffer. When set, advance is not executed.
6	Buffer Load Check	Set with either of the following: ■ Vertical format request (SB1,6) ■ Load code request (SB1,7)
7	Command Retry	Set during the print-compare sequence of a print advance command if two once-per-font signals have occurred and either of the following conditions are present:

Bit Position	Bit Designation	Definition
7 (cont)	Command Retry	■ Not all "printed" bits are set. ■ Print-compare-match counter has not counted up to full count (136). Unit check is set and the advance portion of the command is not executed. Reset if the print advance command is reissued and is successful. May also be reset by an advance only command.

Sense Data Byte 1		
0	Unassigned	Always reset to 0
1	Inhibit Data Check	When set, indicates inhibit data check is active
2	Inhibit Status In	When set, indicates inhibit status in is active
3	Fold Data	When set, indicates fold data is active
4	Unassigned	Always reset to 0

0776 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
5	Selective Reset/ Interface Disconnect	When set, indicates interface disconnect or selective reset occurred during the data transfer sequence and command was not executed.
6	VFB Request	When set, indicates vertical format buffer is not properly loaded. Unit check is sent to the channel and a print-advance or advance only command is issued to the printer. Command is not executed.
7	LCB Request	When set, indicates the load code buffer is not properly loaded. Unit check is sent to the channel and a print-advance or diagnostic write command is issued to the printer. Command is not executed.

Sense Data Byte 2		
0	Unassigned	Always reset to 0
1	Forms Low	Set if less than 7 inches (17.78 cm) of form remain below the bottom tractor of the printer. Causes unit check to be set only once.
2	Unassigned	Always reset to 0
3	Cartridge Code Check	When set, indicates the print cartridge identification code does not agree with the cartridge verification code issued with the load command. Causes immediate termination of a load code command. Causes immediate termination of a print advance command if the stored verficiation code does not agree with the identification code when the command is initiated.
4	Unassigned	Always reset to 0

0776 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
5	Forms Check	Set if any individual paper advance exceeds 1.9 seconds or if a paper feed system failure has been detected. This condition causes the current print advance, or advance only command not to be executed.
6	Unassigned	Always reset to 0
7	Type Speed Check	Set if one or more of the following conditions are detected: ■ No timing marks detected within a 1 millisecond time period any time the front band is up to speed. ■ Timing marks signals from tractor sprockets are received out of tolerance,

Sense Data Byte 3		
0	LCB Parity Check	Set when a parity error is detected when reading the load code buffer.
1	PLB Parity Check	Set when a parity error is detected when reading the print line buffer.
2	VFB Parity Check	Set when a parity error is detected when reading the VFB. If the error is detected with a print-advance command, the line is printed but the form is not advanced. If the parity error is detected with an advance only command, the command is not executed.
3	Unassigned	Always reset to 0

0776 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 3		
4	Actuator Check	Set when an actuator circuit malfunction is detected. All columns are printed except those with a malfunction. Actuator power may be removed.
5	Unassigned	Always reset to 0
6	Unassigned	Always reset to 0
7	Unassigned	Always reset to 0

Sense Data Byte 4		
0–7	Uassigned	Always reset to 0
Sense Data Byte 5		
0	Expanded Font	When set, indicates the printer contains expanded character set control feature to handle print cartridges that contain character set arrays greater than 64.
1–7	Unassigned	Always reset to 0

5.9.3.4. 0716 Card Reader Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	CARD JAM	DATA CHECK	OVERRUN	INHIBIT STATUS IN	NONREPEAT ABNORMAL
1	STOP	VALIDITY CHECK	RESYNC ERROR	COMPARE ERROR	COLUMN 0 ERROR	TRANSFER CHECK	SHORT CARD SELECTION	DUAL TRANSLATE
2	COLUMN COUNTER NORMALIZED	COUNTER BIT 1	COUNTER BIT 2	COUNTER BIT 3	COUNTER BIT 4	COUNTER BIT 5	COUNTER BIT 6	COUNTER BIT 7

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set when an unspecified command is issued. If an incorrect parity is detected during the transfer of the command code, this bit is suppressed. Neither the channel end (bit 4) or device end (bit 5) in the status byte is set for this condition.
1	Intervention required	Set to indicate an abnormal condition during the previous operation. The error, in all cases, is an error that requires manual intervention to correct (empty hopper, stacker full, misfeed, read jam, etc.).
2	Bus out check	Set when a command byte parity error is detected during the initial selection sequence. If the control unit is not holding a pending status, immediate termination results. Neither channel end nor device end status bits will be set. If the control unit is holding a pending status when the command byte parity error is detected, the command byte is disregarded; the stored status is transferred to the multiplexer channel during the status transfer sequence.
3	Card jam	Set to indicate a faulty card transport. If a card jam occurs at the ready station, or output station, the FEED CHECK indicator on the operator control panel lights and the card reader stops.
4	Data check	Set to indicate that a mispunched card, improper registration, or a read head failure is detected.

0716 Card Reader Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
5	Overrun	Set to indicate that a new data byte is read before the channel acknowledges receipt of the previously transmitted data byte still stored in the control unit data register.
6	Inhibit status in	Set to indicate that the inhibit-status-in condition is set.
7	Nonrepeat abnormal	This bit is set to indicate that one of the following conditions was detected during the previous operation: ■ hopper empty ■ stacker full ■ interlock error ■ stacker jam
		Sense Data Byte 1
0	Stop	Set when the stop flip-flop is set.
1	Validity check	Set when a validity check error has been detected.
2	Resync error	Set if the reader does not detect a hole after the read strobe has been synchronized.

3	Compare error	Set if the data read in read station 1 does not compare to the data read in read station 2.
4	Column 0 error	Set if the read amplifiers are not all off at the leading edge of each card.
5	Transfer check	Set when a transfer check is detected.
6	Short card selection	Set when a 66- or 51-column read command is issued.
7	Dual translate	Set when bit 2 and bit 5 of a read command are 1 and 0, respectively.
	Sense Data Byte 2	
0	Column counter normalized	Set when the column counter has reached a count of 50 for 80-column cards, a count of 36 for 66-column cards, or a count of 21 for 51-column cards.
1	Counter bit 1	Set when the column counter bit 1 is set. Bit position 1 represents binary 1.
2	Counter bit 2	Set when the column counter bit 2 is set. Bit position 2 represents binary 2.
3	Counter bit 3	Set when the column counter bit 3 is set. Bit position 3 represents binary 4.
4	Counter bit 4	Set when the column counter bit 4 is set. Bit position 4 represents binary 8.
5	Counter bit 5	Set when the column counter bit 5 is set. Bit position 5 represents binary 16.
6	Counter bit 6	Set when the column counter bit 6 is set. Bit position 6 represents binary 32.
7	Counter bit 7	Set when the column counter bit 7 is set. Bit position 7 represents binary 64.

5.9.3.5. 0604 Card Punch Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	CARD JAM	DATA CHECK	DATA LATE	NONREPEAT ABNORMAL	INHIBIT STATUS IN
1	NOT USED	NOT USED	HCRPA	HCRPB	HCRPC	HCR2A	HCR2B	HCR2C

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Set when an unspecified command is issued. If an incorrect parity is detected during the transfer of the command code, this bit is suppressed. Neither the channel end bit (4) nor device end bit (5) in the status byte is set for this condition.
1	Intervention required	Set to indicate that an abnormal condition (other than a hole count error) was detected during the previous operation. In all cases, the error requires manual intervention to correct (that is, empty hopper, stacker full, etc).
2	Bus out check	Set when a command byte or data byte parity error is detected during the initial selection sequence. A command byte parity error causes the control unit to terminate operation immediately and to suppress the invalid command. If the control unit is holding a pending status when the command byte parity error is detected, the command byte is disregarded and the stored status is transferred to the multiplexer channel during the status transfer sequence. Neither the channel end nor the device end bit in the status byte is set for this condition. A data byte parity error during data transfer causes the control unit to terminate operation immediately. Channel end bit and device end bit in the status byte are set.

0604 Card Punch Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
3	Card jam	Set to indicate that a card transport error has occurred. A jam in the prepunch station causes the A JAM half of the MAN FEED A JAM/B JAM switch/indicator on the operator's control panel to light. A jam in the postpunch station causes the B JAM half of the MAN FEED A JAM/B JAM switch/indicator on the operator control panel to light.
4	Data check	Not used. This bit position contains a 0.
5	Data late	Set to indicate that the punch buffer has not been loaded prior to the initiation of a punch operation.
6	Nonrepeat abnormal	Set to indicate that one of the following conditions was detected during the previous operation: ■ hopper empty ■ chips (box full or not in place) ■ stacker jam ■ stacker full ■ interlock error

7	Inhibit		Set to indicate that the inhibit status bit in flip-flop is set (prevent a status byte from being sent to the multiplexer channel).
Sense Data Byte 1			
0	Not used		Sense data byte 2 is used for maintenance analysis functions in conjunction with failure routines. The status of various flip-flops in the control unit is transferred to this byte.
1	Not used		
2	HCRPA	Punch	
3	HCRPB	hole	
4	HCRPC	counter	
5	HCR2A	Post-read	
6	HCR2B	hole	
7	HCR2C	counter	

I/O Device/Status Indication*			
Bit Position	**Printer (DA=3)**	**Card Punch or Read Punch (DA=2)**	**Card Reader (DA=1)**
0	Abnormal or Not Ready	Stacker Jam, Interlock, Punch Entry, or Exit Check Error	Stacker Jam, Control Parity Error, or Photocell Check Error
1	Paper Runaway		Misfeed, Not Ready, Hopper Empty, or Stacker Full
2	Storage Overload	Punch Check Error	

3	Data Parity or Control Parity Error	Data Parity or Control Parity Error	
4	Bar Switch in Error	Photocell Check Error	Triple Strobe Error
5	Interrupt Request Pending	Interrupt Request Pending	Interrupt Request Pending
6	Forms Overflow	Hopper Empty or Stacker Full	
7	Paper Low		

*All 0's: function performed as specified

5.9.3.7. 8411/8414/8424/8425 Disk Subsystems

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	TRACK CONDITION CHECK	SEEK CHECK
1	COUNT AREA CHECK	TRACK OVERRUN	CYLINDER END	INVALID SEQUENCE	NO RECORD FOUND	FILE PROTECTED	MISSING ADDRESS MARKER	OVERFLOW INCOMPLETE
2	UNSAFE	NOT USED (ALWAYS 0)	NOT USED (ALWAYS 0)	NOT USED (ALWAYS 0)	NOT USED (ALWAYS 0)	UNSELECTED STATUS	NOT USED (ALWAYS 0)	NOT USED (ALWAYS 0)
3	READY	ONLINE	UNSAFE	NOT USED (ALWAYS 0)	NOT USED (ALWAYS 1)	END OF CYLINDER	NOT USED (ALWAYS 0)	SEEK INCOMPLETE
4	ALWAYS 0							
5	THIS BYTE IS ALL 0's EXCEPT WHEN BIT 7 OF BYTE 1 IS SET (OVERFLOW INCOMPLETE).							

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	This bit is set: ■ when an invalid command, an invalid sequence of commands, or a command for a feature not installed is received; ■ when the command received is one restricted by set-file-mask; ■ when two set-file-mask commands are sent in the same command chain; ■ when a second disk drive unit is addressed during a command chain.
1	Intervention required	This bit is set when a nonexistent (either physically or electrically) disk drive unit is addressed.
2	Bus out check	This bit is set: ■ when a command or data arrives on the bus out lines with even (incorrect) parity; ■ when even parity is detected in the Q3 register during data and command transfers; ■ when even parity is detected in the shift register during a write data transfer, or on the input bus lines for a read transfer.
3	Equipment check	This bit is set to indicate an equipment fault within the subsystem and is set with bit 0 of sense data byte 2.
4	Data check	This bit is set when an error is detected in the information transferred from a disk drive to the control unit.

8411/8414/8424/8425 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
5	Overrun	This bit is set: ■ when the control unit does not receive data bytes within the prescribed time; ■ when data is received too late to be properly written and the remaining record area is filled with 0's; ■ when a subsequent command in a chain is received too late to be properly executed.
6	Track condition check	This bit is set when a read, write, or search command is attempted on a defective track (bit 6 of the flag byte on the record is set if the track is defective). These commands are inhibited for all data records but are permitted for home address and track descriptor records.
7	Seek check	This bit is set when an invalid address is sent for a seek command or if less than six address bytes are sent.
		Sense Data Byte 1
0	Count area check	This bit is set as the result of an error in the count area transferred from a disk drive to the control unit.

1	Track overrun	This bit is set when the writing on a track is not completed by the time the index marker is reached.
2	Cylinder end	This bit is set when a command chain is not completed by the time the end of a cylinder is reached.
3	Invalid sequence	This bit is set when two set-file-mask commands are sent in the same command chain. This bit, which is set along with bit 0 (command reject) of sense data byte 0, is also set for an invalid sequence of commands.
4	No record found	This bit can be set only when the M bit of read and search commands is 0 and one of the following conditions exists: Two index markers are detected, and there are no intervening read or write commands during the execution of a chain of search commands. ■ A read or search command has been issued for a blank track. ■ A home address and address marker are missing from a record R_0 track.
5	File protected	This bit is set when a seek or write command which has been prohibited by a set-file-mask command is issued.
6	Missing address marker	This bit is set along with bit 4 (data check) of sense data byte 0 when one of the following conditions exists: ■ Two index markers are passed without detecting any address markers.

8411/8414/8424/8425 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
6	Missing address marker (cont)	■ Two successive records are read in which the bit 0's of the flag bytes are equal (indicating that both records are odd or even), and there was no intervening index marker; thus an address marker was missed. An exception is when the command issued is a search-ID, and the error indication would be no record found.
7	Overflow incomplete	This bit is set when an overflow record is not completed because overflow came either from a defective track or from an alternate track. Bit 6 (defective track check) of sense data byte 0 also is set for these conditions.
		Sense Data Byte 2
0	Unsafe	This bit is set when a disk file malfunction is detected.
1	N/A	This bit is not used and is always 0.
2	N/A	This bit is not used and is always 0.
3	N/A	This bit is not used and is always 0.
4	N/A	This bit is not used and is always 0.
5	Unselected status	This bit is set when a file status line is active with no device selected.

6, 7	N/A	These bits are not used and are always 0.
Sense Data Byte 3		
0	Ready	This bit is set when the disk file is ready for operation.
1	Online	This bit is set when the disk file is online.
2	Unsafe	This bit is set when a disk file malfunction is detected.
3	N/A	This bit is not used and is always 0.
4	N/A	This bit is not used and is always 1.
5	End of cylinder	This bit is set along with bit 7 of sense data byte 1 when a seek command is not successfully completed.
6	N/A	This bit is not used and is always 0.
7	Seek incomplete	This bit is set when the end of a cylinder is detected.
Sense Data Byte 4		
0—8		The bits of sense data byte 4 are always 0.

8411/8414/8424/8425 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 5

This byte contains all 0's at all times except when the overflow incomplete bit is set (byte 1, bit 7). The codes in byte 5 indicate the type of command being executed when an overflow incomplete occurs. The codes and their meanings are:

Code in Hexadecimal	Meaning
06	A read command is in progress.
05	A write command is in progress.
25	A search-key-and-data-equal command is in progress, and the comparison is equal to this point.
45	A search-key-and-data-high command is in progress, and the comparison is equal to this point.
65	A search-key-and-data-equal-or-high command is in progress, and the comparison is equal up to this point.
55	Any search-key-and-data operation is in progress, and the comparison is low; or a search-key-and-data-equal is in progress, and the comparison is high.
75	A search-key-and-data-high command or a search-key-and-data-equal-or-high command is in progress, and the comparison is high.

5.9.3.8. 8430/8433 Disk Subsystems

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT PARITY	EQUIPMENT CHECK	DATA CHECK	OVERRUN	ALWAYS 0	ALWAYS 0
1	PERMANENT ERROR	INVALID TRACK FORMAT	END OF CYLINDER	ALWAYS 0	NO RECORD FOUND	FILE PROTECT	WRITE INHIBITED	OPERATION INCOMPLETE
2	ALWAYS 0	CORRECTABLE	ALWAYS 0	ENVIRONMENTAL DATA PRESENT	ALWAYS 0	ALWAYS 0	ALWAYS 0	ALWAYS 0

8430/8433 Disk Subsystems (cont)

3	RESTART COMMAND							
4	ALWAYS 0	STRING NUMBER	PHYSICAL ID					
5	CYLINDER							
6	REVERSE①	CYL (256)②	HIGH DIFF③		HEAD			
7	FORMAT DECODE				MESSAGE DECODE			

NOTES:

① Always 0 for 8433 disk
② CYL (512) for 8433 disk
③ CYL (255) for 8433 disk

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

NOTE: BYTES 0 THRU 6 ARE THE SAME FOR ALL FORMATS

BYTE 7 — FORMAT AND MESSAGE DECODE

BITS 0—3 = FORMAT DECODE

BITS 4—7 = MESSAGE DECODE

FORMAT 0 — MESSAGE ONLY

Message Decode	
0	NO MESSAGE
1	INVALID COMMAND
2	INVALID SEQUENCE
3	CCW COUNT LESS THAN REQUIRED
4	DATA VALUE NOT AS REQUIRED
5	UNUSED
6	CHANNEL DISCONTINUED RETRY OPERATION
7	CHANNEL RETURNED INCORRECT RETRY CCW
8	UNUSED
9	UNUSED
A	UNUSED
B	IMPROPER ALTERNATE TRACK POINTER
C	SERDES MALFUNCTION NO ST4'S
D	UNUSED
E	UNUSED
F	RETRY BYTE SECTOR VALUE COUNTER/ INCORRECT

FORMAT 1 — DEVICE ERRORS

Message Decode	
0	NO MESSAGE
1	SET SECTOR ERROR
2	ABNORMAL INTERRUPT FROM DRIVE
3	NO WRITE GATE AT DRIVE
4	NO WRITE CURRENT SENSE
5	UNUSED
6	SET CYLINDER ERROR
7	SET HEAD ERROR
8	SET DIFFERENCE ERROR
9	FILE STATUS NOT AS EXPECTED
A	SEEK ERROR
B	SEEK INCOMPLETE OR RETRY
C	NO INTERRUPT FROM DRIVE
D	UNUSED
E	RESERVE/RELEASE WRAP CHECK*
F	TIME OUT ON SHORT SELECT*

*Used only when disks are used with the SPERRY UNIVAC 5039—04/05 storage control unit.

FORMAT 2 — CU ERRORS

Message Decode	
0	NO MESSAGE
1	ECC P1 OR P3 COMPARE ERROR
2	ECC P2 COMPARE ERROR
3 to D	UNUSED

FORMAT 3 — SELECTIVE RESET

Message Decode	
0	NO MESSAGE
1 to D	UNUSED

FORMAT 4 — ECC UNCORRECTABLE

Message Decode	
0	HA FIELD ECC UNCORRECTABLE
1	COUNT FIELD ECC UNCORRECTABLE
2	KEY FIELD ECC UNCORRECTABLE
3	DATA FIELD ECC UNCORRECTABLE
4	HA FIELD NO SYNC BYTE FOUND
5	COUNT FIELD NO SYNC BYTE FOUND
6	KEY FIELD NO SYNC BYTE FOUND
7	DATA FIELD NO SYNC BYTE FOUND
8	UNUSED
9	AM DETECTION FAILURE ON RETRY
A to D	UNUSED

FORMAT 5 — ECC CORRECTABLE

Message Decode	
0	HA FIELD CORRECTABLE
1	COUNT FIELD CORRECTABLE
2	KEY FIELD CORRECTABLE
3	DATA FIELD CORRECTABLE
4 to D	UNUSED

FORMAT 6 — USAGE/ERROR COUNT

UNUSED

FORMATS 7 to E

UNUSED

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 1 — DEVICE ERRORS

BYTE 8 — FILE STATUS

P	
0	INDEX ERROR
1	OFFSET ACTIVE
2	SEEK INCOMPLETE
3	SEEK/FORMAT COMPLETE
4	ONLINE
5	PACK CHANGE
6	BUSY
7	RECORD SEARCH IN PROGRESS

BYTE 9

ZERO

BYTE 10 — CONDITION AT UNSAFE

8430—00/01

P	
0	LINEAR MODE
1	FIRST CYLINDER AND LINEAR MODE
2	ACCESS READY
3	ODD CYLINDER
4	DRIVE TO INNER GUARD BAND 1 (NOT EVEN CYLINDER)=0
5	DRIVE FORWARD 20 IPS-1 (NOT DIFFERENCE-1)=0
6	DRIVE FORWARD 5 IPS-1 (NOT DIFFERENCE-1)=0
7	HEAD LOAD

8433 — 00/01, 02/03

P	
0	LINEAR MODE
1	FIRST CYLINDER AND LINEAR MODE
2	ACCESS READY
3	GUARD BAND DETECTED
4	DRIVE TO INNER GUARD BAND 1
5	DRIVE FORWARD 20 IPS (DIFFERENCE=0)
6	DRIVE FORWARD 5 IPS—1 (DIFFERENCE=1)
7	HEAD LOAD

BYTE 11 — SERVO UNSAFE

8430—00/01

P	
0	
1	
2	
3	SERVO UNSAFE
4	ANY UNSAFE EXCEPT R/W
5	PACK SPEED UNSAFE
6	VELOCITY UNSAFE
7	30 VOLTS DC UNSAFE

8433—00/01, 02/03

P	
0	PERMANENT ERROR
1	
2	
3	SERVO/SEQ UNSAFE
4	PS UNSAFE EXCEPT 30 VDC
5	PACK SPEED UNSAFE
6	VELOCITY UNSAFE
7	30 VOLTS DC UNSAFE

BYTE 12 — R/W UNSAFE

8430—00/01

P	
0	WRITE OVERRUN
1	
2	WRITE READY UNSAFE
3	
4	HEADS UNSAFE
5	PLO UNSAFE
6	DC WRITE UNSAFE
7	AC WRITE UNSAFE

8433—00/01,02/03

P	
0	WRITE OVERRUN
1	INDEX ERROR WITH WRITE GATE
2	WRITE READY UNSAFE
3	
4	HEADS UNSAFE
5	PLO UNSAFE
6	DC WRITE UNSAFE
7	AC WRITE UNSAFE

BYTE 13 — FC REG

CONTENTS OF CUDI — BUS OUT

BYTE 14 — FB REG

CONTENTS OF CUDI — BUS IN

BYTE 15 — FT REG

P	
0	MODULE SELECT GATE
1	TAG GATE
2	ENABLE TAG VALID CHECK
3	
4	DECODE 8 BIT
5	DECODE 4 BIT
6	DECODE 2 BIT
7	DECODE 1 BIT

BYTES 16 to 20

ZERO

BYTE 21 — CUDI (IS REG)

P	
0	DRIVE SELECTION ERROR
1	TAG NOT VALID AT DEVICE
2	DEVICE CHECK
3	FILE BUS OUT PARITY ERROR
4	FILE BUS IN PARITY ERROR
5	TAG BUS OUT PARITY ERROR
6	
7	

BYTE 22

SECTOR DECREMENT

BYTE 23

STAT INTEGRATOR

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 2 — CONTROL UNIT ERRORS

BYTE 8 — CONTROL CHECK (CE REG)

P	
0	CHANNEL BUS IN PARITY ERROR A B
1	CHANNEL A INTERFACE CHECK
2	CHANNEL B INTERFACE CHECK
3	DATA TRANSFER CHECK
4	SERDES, CUDI, ECC CHECK
5	CHANNEL C INTERFACE CHECK
6	CHANNEL D INTERFACE CHECK
7	

BYTE 9 — SERDES (SE REG)

P	
0	CUDI UNSAFE
1	SERDES WRITE PARITY CHECK
2	SERDES READ PARITY CHECK
3	BIT RING
4	
5	ECC ERROR
6	
7	

BYTE 10 — ECC (EE REG)

P	
0	NO ONES FROM SERDES SINCE LAST ECC RESET
1	P0 OR WRITE ERROR
2	P1 or P3 ERROR
3	P2 ERROR
4	P1 ERROR
5	P3 ERROR
6	
7	

BYTES 11 — 12

ZERO

BYTES 13 — FC REG

CONTENTS OF CUDI BUS OUT

BYTE 14 — FB REG

CONTENTS OF CUDI BUS IN

BYTE 15 — FT REG

P	
0	MODULE SELECT GATE
1	TAG GATE
2	ENABLE TAG VALID CHECK
3	
4	DECODE 8 BIT
5	DECODE 4 BIT
6	DECODE 2 BIT
7	DECODE 1 BIT

BYTES 16 to 20

ZERO

BYTE 21 — CUDI (IS REG)

P	
0	DRIVE SELECTION ERROR
1	TAG NOT VALID AT DEVICE
2	DEVICE CHECK
3	FILE BUS OUT PARITY ERROR
4	FILE BUS IN PARITY ERROR
5	TAG BUS OUT PARITY ERROR
6	
7	

BYTE 22

SECTOR DECREMENT

BYTE 23

STAT INTEGRATOR

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 3 — SELECTIVE RESET

BYTE 8 — FAILING ADDRESS (AD REG)

P	
0	
1	MEMORY ADDRESS PARITY
2	
3	MEMORY ADDRESS BIT 0
4	MEMORY ADDRESS BIT 1
5	MEMORY ADDRESS BIT 2
6	MEMORY ADDRESS BIT 3
7	MEMORY ADDRESS BIT 4

BYTE 9 — FAILING ADDRESS (AD REG)

P	
0	MEMORY ADDRESS BIT 5
1	MEMORY ADDRESS BIT 6
2	MEMORY ADDRESS BIT 7
3	MEMORY ADDRESS BIT 8
4	MEMORY ADDRESS BIT 9
5	MEMORY ADDRESS 10
6	MEMORY ADDRESS BIT 11
7	MEMORY ADDRESS BIT 12

BYTE 10 — CU ERROR 1 (ET REG)

P	
0	MICRO PROGRAM FORCED ERROR FLAG
1	CLOCK ERROR
2	PC, CONTROL FIELD PARITY ERROR
3	PA, MEMORY ADDRESS PARITY ERROR
4	A BUS PARITY ERROR
5	B BUS PARITY ERROR
6	ALU COMPARE ERROR
7	PN CONTROL MEMORY ADDRESS PARITY ERROR

BYTES 11 — 12

ZERO

BYTE 13 — IG REG

P	
0	WRITE LATCH
1	READ LATCH
2	LAST BYTE REQUEST
3	OPERATIONAL IN
4	ADDRESS IN
5	STATUS IN
6	
7	

BYTE 14 — IP REG

P	
0	LONG SELECT
1	FREEZE DATA TRANSFER
2	DATA SEPARATOR ENABLE
3	
4	BLOCK SWITCH TO CHANNEL A
5	BLOCK SWITCH TO CHANNEL B
6	BLOCK SWITCH TO CHANNEL C
7	BLOCK SWITCH TO CHANNEL D

BYTES 15 to 23

ZERO

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 4 — ECC UNCORRECTABLE

BYTES 8-9 — CYLINDER

(LAST SEEK ADDRESS)

8 — HIGH ORDER BYTE

9 — LOW ORDER BYTE

BYTES 10-11 — HEAD

(LAST SEEK ADDRESS)

10 — HIGH ORDER BYTE

11 — LOW ORDER BYTE

BYTE 12 — RECORD

RECORD NUMBER OF RECORD IN ERROR

BYTE 13 — SECTOR

SECTOR NUMBER OF START OF RECORD IN ERROR

BYTE 14

8433—00/01

P	
0	
1	
2	400 μ INCHES
3	300 μ INCHES
4	100 μ INCHES
5	50 μ INCHES
6	25 μ INCHES
7	12.5 μ INCHES

8430, 8433—02/03

P	
0	
1	
2	800 μ INCHES
3	400 μ INCHES
4	200 μ INCHES
5	100 μ INCHES
6	50 μ INCHES
7	25 μ INCHES

BYTE 15 — RETRY COUNT

NUMBER OF RETRYS REQUIRED TO RECOVER FROM THE ERROR

BYTE 16 — SOURCE PHYSICAL ADDRESS

READ FROM ID BYTE XXX ITEM BEFORE EACH RECORD, IDENTIFIES CU AND DRIVE THAT WROTE THE RECORD.

BITS 0-1 CODE FOR CU

BITS 2—7 DRIVE 3 FOR 6 CODE

A = 111000	E = 011100
B = 110001	F = 010101
C = 101010	G = 001110
D = 100011	H = 000111

BYTE 17 — 23

ZERO

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 5 — ECC CORRECTABLE

BYTES 8-9 — CYLINDER
(LAST SEEK ADDRESS)

8 — HIGH ORDER BYTE

9 — LOW ORDER BYTE

BYTES 10-11 — HEAD
(LAST SEEK ADDRESS)

10 — HIGH ORDER BYTE

11 — LOW ORDER BYTE

BYTE 12 — RECORD

RECORD NUMBER OF RECORD IN ERROR

BYTE 13 — SECTOR

SECTOR NUMBER OF START OF RECORD IN ERROR

BYTE 14 — ACCESS OFFSET

8433—00/01

P	
0	
1	
2	400 μ INCHES
3	200 μ INCHES
4	100 μ INCHES
5	50 μ INCHES
6	25 μ INCHES
7	12.5 μ INCHES

8430, 8433—02/03

P	
0	
1	
2	800 μ INCHES
3	400 μ INCHES
4	200 μ INCHES
5	100 μ INCHES
6	50 μ INCHES
7	25 μ INCHES

BYTE 15 to 17 — RESTART DISPLACEMENT

15 — HIGH ORDER BYTE

17 — LOW ORDER BYTE

COUNT OF TOTAL NUMBER OF BYTES READ IN RECORD CAN INCLUDE OVERFLOW SEGMENTS

BYTE 18-19 — ERROR DISPLACEMENT

18 — HIGH ORDER BYTE

19 — LOW ORDER BYTE

COUNT OF NUMBER OF BYTES FROM FIRST ECC BYTE TO START OF DATA IN ERROR

BYTES 20 to 22 — PATTERN

20 — HIGH ORDER BYTE

22 — LOW ORDER BYTE

ECC GENERATED PATTERN TO CORRECT DATA IN ERROR INCLUDES ALL THREE BYTES

BYTE 23

CHANNEL TRUNCATION

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT 6 — USAGE/ERROR COUNT

BYTES 8 to 11 — BYTES READ

8 — HIGH ORDER BYTE

9 — LOW ORDER BYTE

TOTAL NUMBER OF BYTES READ UNDER THIS LOGICAL ADDRESS

BYTES 12-13 — CORRECTABLE DATA CHECKS

12 — HIGH ORDER BYTE

13 — LOW ORDER BYTE

NUMBER OF ECC CORRECTABLE DATA CHECKS UNDER THIS LOGICAL ADDRESS

BYTES 14-15 — UNCORRECTABLE DATA CHECKS

14 — HIGH ORDER BYTE

15 — LOW ORDER BYTE

NUMBER OF ECC UNCORRECTABLE DATA CHECKS UNDER THIS LOGICAL ADDRESS

BYTES 16-17 — SEEKS

16 — HIGH ORDER BYTE

17 — LOW ORDER BYTE

NUMBER OF SEEKS UNDER THIS LOGICAL ADDRESS

BYTE 18 — CHANNEL INDICATOR, BYTES 20-23

IF BIT 0 = 0
BYTES 20-23 REFER TO CHANNELS A AND B

IF BIT 0 = 1
BYTES 20-23 REFER TO CHANNELS C AND D

BYTE 19 — SEEK ERRORS

NUMBER OF SEEK CHECKS UNDER THIS LOGICAL ADDRESS

BYTE 20

NUMBER OF CHANNEL A OR C COMMAND OVERRUNS

BYTE 21

NUMBER OF CHANNEL A OR C DATA OVERRUNS

BYTE 22

NUMBER OF CHANNEL B OR D COMMAND OVERRUNS

BYTE 23

NUMBER OF CHANNEL B OR D DATA OVERRUNS

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

FORMAT F — INLINE SENSE DATA

BYTE 8 — FILE STATUS 1

P	
0	INDEX ERROR
1	OFFSET ACTIVE
2	SEEK INCOMPLETE
3	SEEK/FORMAT COMPLETE
4	ONLINE
5	PACK CHANGE
6	BUSY
7	RECORD SEARCH IN PROGRESS

BYTE 9 — FILE STATUS 2

8430—00/01

P	
0	INDEX ERROR
1	OFFSET ACTIVE
2	
3	READ ONLY
4	WRITE READY
5	INDEX
6	END OF CYL
7	WR CURR. SENSE

8433—00/01. 02/03

P	
0	INDEX ERROR
1	OFFSET ACTIVE
2	
3	READ ONLY
4	WRITE READY
5	INDEX
6	END OF CYL
7	WR CURR. SENSE

BYTE 10 — SERVO STATUS

8430—00/01

P	
0	LINEAR MODE
1	1ST CYL AND LINEAR MODE
2	ACCESS READY
3	DD CYL
4	DRIVE TO INNER GUARD BAND EVEN CYL
5	DRIVE FORWARD 20 IPS-1 (DIFFERENCE=0)
6	DRIVE FORWARD 5 IPS (DIFFERENCE=1)
7	HEAD LOAD

8433—00/01. 02/03

P	
0	LINEAR MODE
1	1ST CYL AND LINEAR MODE
2	ACCESS READY
3	GUARD BAND DETECTED
4	DRIVE TO INNER GUARD BAND
5	DRIVE FORWARD 20 IPS (DIFFERENCE=0)
6	DRIVE FORWARD 5 IPS (DIFFERENCE=1)
7	HEAD LOAD

BYTE 11 — SERVO UNSAFE

8430—00/01

P	
0	
1	
2	
3	SERVO UNSAFE
4	ANY UNSAFE EXCEPT R/W
5	PACK SPEED UNSAFE
6	VELOCITY UNSAFE
7	30 VDC UNSAFE

8433—00/01. 02/03

P	
0	PERMANENT ERROR
1	
2	
3	SERVO/SEQ UNSAFE
4	PS UNSAFE EXCEPT 30 VDC
5	PACK SPEED UNSAFE
6	VELOCITY UNSAFE
7	30 VDC UNSAFE

BYTE 12 — R/W UNSAFE

8430—00/01

P	
0	WRITE OVERRUN
1	
2	R/W READY UNSAFE
3	
4	HEADS UNSAFE
5	PLO UNSAFE
6	DC WRITE UNSAFE
7	AC WRITE UNSAFE

8433—00/01. 02/03

P	
0	WRITE OVERRUN
1	INDEX ERROR WITH WRITE GATE
2	WRITE READY UNSAFE
3	
4	HEADS UNSAFE
5	PLO UNSAFE
6	DC WRITE UNSAFE
7	AC WRITE UNSAFE

BYTE 13 — FC REG

CONTENTS OF CUDI BUS OUT

BYTE 14 — FB REG

CONTENTS OF CUDI BUS IN

BYTE 15 — FT REG

P	
0	MODULE SELECT GATE
1	TAG GATE
2	ENABLE TAG VALID CHECK
3	
4	DECODE 8 BIT TAG
5	DECODE 4 BIT TAG
6	DECODE 2 BIT TAG
7	DECODE 1 BIT TAG

I/O Sense Data Byte Definitions for Multiplexer and Selector Channel Devices (cont)

8430/8433 Disk Subsystems (cont)

BYTES 16 to 18 — CAR, HAR, DIFF

16 = CAR

17 = HAR

18 = DIFF

NOTE:

IN THE SEEK INCOMPLETE CASE, CAR, HAR, AND DIFF ARE THE VALUES LOADED PRIOR TO THE SEEK
BYTES 5 AND 6 ARE THE SEEK ADDRESS PRIOR TO THE SEEKING
IN THE SEEK COMPLETE CASE, BYTES 5 AND 6 ARE THE SAME AS BYTES 10 AND 11.

BYTE 19 — SAR

BYTE 20

CORRECT REGISTER CONTENTS OR SECTOR UNDER TEST (BYTE 16, 17, 18 OR 19)

BYTE 21 — CUDI (IS REG)

P	
0	DRIVE SELECTION ERROR
1	TAG NOT VALID AT DEVICE
2	DEVICE CHECK
3	FILE BUS OUT PARITY ERROR
4	FILE BUS IN PARITY ERROR
5	TAG BUS OUT PARITY ERROR
6	
7	

BYTES 22 — 23

ZERO

8430/8433 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Command reject generates a format 0 message which details the invalidity of the command. There is no error recovery as this is a programming condition. Command reject may appear with: ■ write inhibited (byte 1, bit 6). The drive READ ONLY switch is active. ■ file protect (byte 1, bit 5). The write operation attempted is prohibited by the file mask.
1	Intervention required	The drive is either logically or electrically offline. There is no error recovery (operational condition).
2	Bus out parity	A parity check occurred on a command or data byte from the channel. Retry one time.
3	Equipment check	Equipment check produces a format 0, 1, 2 or 3 sense which details the error. Equipment check with byte 1, bit 0 (permanent error) implies that the SCU has attempted recovery and failed. There is no further recovery. Equipment check without permanent error should be retried 10 times.

4	Data check	The processing of ECC bytes following a field indicated a data error. When posted with byte 1, bit 0 (permanent error) the data check is uncorrectable and byte 7 indicates the nature of the error. Permanent error is not set until the SCU has exhausted its error recovery procedures (27 retries at various offsets). There is no further recovery to be performed. When posted with byte 2, bit 1 (correctable) it indicates a correctable data error in a data field. Sense bytes 15 through 22 contain sufficient information to correct the error in main storage. There is one instance where data check can be posted on a write command. If an update write is performed on an overflow record in which the second or subsequent segment of the record has a data error in the home address or count field, data check and correctable are posted. The data error can be serviced in the normal manner (the error pattern is zero).
5	Overrun	The channel was late, in relation to the drive, to present a command or data byte or late in accepting a data byte. Overrun may appear with byte 1, bit 0 (permanent error) in which case, recovery attempts have been made by the SCU and there is nothing further to be done. Overrun without permanent error should be retried 10 times.
6		Always 0.
7		Always 0.

8430/8433 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Permanent error	Permanent error indicates the SCU internal error recovery facilities are exhausted and there is nothing further to be done. Permanent error is always a modifier bit for other error indications: ■ equipment check ■ data check ■ overrun
1	Invalid track format	A write command has been specified to write past index. There is no recovery as this is a programming error.
2	End of cylinder	End-of-cylinder indicates that a multitrack-read or search or an overflow-record operation has attempted head switching beyond the highest head address. End-of-cylinder is a programming condition. End-of-cylinder is presented for an attempted switch at head 11 for any cylinder.
3		Always 0.
4	No record found	No-record-found is posted after index has been encountered twice in the same chain without:

		■ a read of the home address or a data field ■ a control, write, or sense operation There is no recovery as this is a programming condition.
5	File protect	A seek-file-mask violation has been detected. A proscribed seek or implied seek (multitrack or overflow) has been attempted. When posted with command-reject, file-protect indicates a proscribed write operation has been attempted. There is no recovery for this error as it is a programming condition.
6	Write inhibited	This bit modifies command-reject and indicates a write was attempted on a drive where the READ ONLY switch is set. There is no recovery as this is an operational condition.
7	Operation incomplete	Operation-incomplete may occur alone or with: ■ data check ■ file protect ■ end-of-cylinder Operation-incomplete indicates that an overflow record operation terminated prematurely. If operation-incomplete occurred in conjunction with one of the above, the other condition should be serviced first and the operation-incomplete serviced just prior to restarting the command chain. Sense byte 3 contains the proper restart command code.

8430/8433 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 2		
0		Always 0.
1	Correctable	This bit is a modifier for data checks and indicates that data check is correctable.
2		Always 0.
3	Environmental data present	Indicates that usage or error count information is present in sense bytes 7–24.
4		Always 0.
5		Always 0.
6		Always 0.
7		Always 0.
Sense Data Byte 3		
Restart command		The restart command is valid only for operation-incomplete.

	Sense Data Byte 4
Physical ID	The physical drive ID is defined by an internal plug (not the external module plug) formatted: 0 | 0/1 | 3 of 6 code Bit 1 is the string number. Bits 2 through 7 indicate 1 of 8 physical drives. There is no association between the physical and logical device address.
	Sense Data Byte 5
Cylinder	Contains the low order cylinder (i.e., C_2 of $C_1C_2H_1H_2R$) currently addressed.
	Sense Data Byte 6
Head	Bit 0 = reverse Bit 1 = C_1; bit 7 Bit 2 = high order difference Bits 3–7 = head address } 8430, 8433-02/03 disk subsystems = zero = C_1; bit 6 = C_1; bit 7 = head address } 8433-00/01 disk subsystems Byte 6 completes the physical seek address where the access arm is positioned. Bytes 5 and 6 are useful for error recovery restart command chains.

8430/8433 Disk Subsystems (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 7

Sense byte 7 indicates the format of the sense bytes 8—23 and indicates a message number indicating the error type. Bits 0—3 of byte 7 indicate the format:

Format	Description
0	Programming and SCU errors
1	Device checks
2	SCU checks
3	Selective reset
4	ECC uncorrectable data errors
5	ECC correctable data errors
6	Error and usage counts
X'F'	Inline sense

Bits 4—7 of byte 7 indicate a message number. The meaning of each message number varies by the format number.

5.9.3.9. UNISERVO 10/14 Magnetic Tape Subsystem

SENSE DATA BYTE	0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTER-VENTION REQUIRED	BUS OUT CHECK	EQUIP-MENT CHECK	DATA CHECK	OVERRUN	WORD COUNT ZERO	DATA CON-VERTER CHECK
1	NOISE	TAPE UNIT STATUS A*	TAPE UNIT STATUS B*	7-TRACK*	LOAD POINT*	END-OF-TAPE*	FILE PROTECT*	TAPE UNIT INCOMPAT-IBILITY
2	TRACK IN ERROR							

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

3	R/W VRC	MDT CHECK TRACK START FAILURE/ LRC	SKEW	POSTAMBLE CHECK/CRC	W/VRC DEAD TRACK	TAPE UNIT 1600 BPI*	BACK-WARD*	NOT USED; ALWAYS 0

4	RUNAWAY CHECK	TAPE MOTION FAULT	SPEED CHECK (UNISERVO 20 ONLY)	TEST		STALL	TAPE FAULT	TEST
				ALWAYS 0 BITS				

NOTE:

Asterisk (*) indicates a bit that is conditioned by current status of tape unit.

LEGEND:

CRC — Cyclic redundancy check
LRC — Longitudinal redundancy check
R/W — Read/write
VRC — Vertical redundancy check

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 0			
0	COMMAND REJECT	This bit is set if a write, write-tape-mark, or erase operation was attempted on a file protected tape unit or if an invalid command was received by the control unit (in the latter case, the bit is not set if the bus out check bit is set). Also, this bit is set if the tape unit incompatibility bit (bit 7, sense byte 1) is set.	Same as phase encoding mode.
1	INTERVENTION REQUIRED	When set, this bit indicates that a nonexistent or nonready tape unit was addressed by a command other than a sense command. If this bit is set, the tape unit status A bit (in sense data byte 1) is set.	Same as phase encoding mode.

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 0 (cont)			
2	BUS OUT CHECK	When set, this bit indicates that a command or data was received with even parity on the interface bus-out lines. If this condition is set on a data transfer during a write operation, the operation is terminated and the faulty byte is not written. If the parity error is detected on a first data transfer, this bit and the word count 0 bit (bit 6) will both be set.	Same as phase encoding mode. If this condition is detected during the data transfer on a request-TIE command, the operation terminates but the information received is ignored. Any TIE information already stored is not affected.
3	EQUIPMENT CHECK	When set, this bit indicates an equipment fault. It is set whenever bit 0 (runaway check), bit 1 (tape motion fault), or bit 5 (stall) of sense data byte 4 is set.	Same as phase encoding mode.

4	DATA CHECK	When set, this bit indicates a data fault. It is set whenever bit 0 (noise) of sense data byte 1 is set, or bit 0 (read VRC error), bit 2 (skew), bit 3 (postamble check/CRC) or bit 4 (write VRC error) of sense data byte 3 is set.	Same as phase encoding mode.
5	OVERRUN	This bit is set if service is requested on the interface lines but data cannot be transferred because of a late SERVICE OUT signal from the I/O channel. This bit is not set on the sense or request-TIE commands. If this condition occurs on the first data transfer of a write operation, word count zero will be set in conjunction with this bit.	Same as phase encoding mode.
6	WORD COUNT ZERO	This bit is set if data transfer is prevented during a write operation when the first data byte is requested. This can be due to a command out response to a data byte request, even parity detected for the data byte transfer, or a channel overload. No tape motion occurs when this condition is detected. If nonstop operation is indicated, the previous operation will terminate	Same as phase encoding mode.

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 0			
6	WORD COUNT ZERO(cont)	properly. This bit is set if end-of-block is detected on a read or read-backward operation prior to detecting data (missed start sentinel). For this condition, the tape has moved past one block and is positioned in the next IBG gap.	
7	DATA CONVERTER CHECK	This bit is not used in phase encoding mode and is always 0.	Set on 7-track operations only.
Sense Data Byte 1			
0	NOISE	When reading or read checking data from phase encoded tapes, the checks performed to set the noise bit are essentially the same as those performed for NRZI recorded tapes. The variation in the checks are as follows:	When set, this bit indicates one of the following: ■ Tape hash — During write

- When checking for tape hash, the outputs of the block detector circuits for each track are monitored. Since these circuits tend to reject noise, a single bit pickup would not activate the block detector outputs and the noise bit would not be set. In NRZI recording, the noise bit would be set, since the data lines are monitored directly.

- When checking for gaps in the data, or data drop-outs, all block detector outputs must be deactivated together, before the noise bit is set. In phase encoding recording, a signal results from writing either a 1 bit or a 0 bit. Therefore, within the block, a signal is normally present in all tracks, and only a relatively serious condition could cause the noise bit to be set (that is, a lateral crease in the tape). In NRZI recording, however, a signal is present only when 1 bits are written. Thus, a small defect in one track, when recording 1 bits only in that track, causes the noise bit to be set.

or write-tape-mark operations, data (or noise due to tape defects) was detected on read check sooner then was expected.

- During erase operations, data (or noise due to tape defects) was detected on read check while the tape was being erased.

- During write or write-tape-mark operations, while read checking the recorded data, a gap detected in the data was not long enough to set the end-of-block condition.

- During read, read-backward, forward-space-block, and backspace-block operations,

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
0	NOISE (cont)	The noise bit, should be set relatively infrequently, as compared to the NRZI mode.	a data drop out which occurred on read was not long enough for the end-of-block condition to be detected. For above conditions, tape motion does not cease in the middle of the block. Writing or erasing continues until the normal termination point. ■ Bit 6 of sense byte 4 was set (tape fault).
1*	TAPE UNIT STATUS A	When set, this bit indicates that the tape unit is selected and ready.	Same as phase encoding mode.

Sense Data Byte 1 (cont)

2*	TAPE UNIT STATUS B	When set, this bit indicates that the tape unit is rewinding, not ready, or under control of another control unit.				Same as phase encoding mode.
		Tape Unit Status A	Tape Unit Status B	Status Tape Unit	Bit Set In Status Byte	
		0	0	Nonexistent or offline	Unit check	
		0	1	Not ready	Unit check	
		1	0	Ready and not busy	-------	
		1	1	Ready and busy; that is, rewinding	Unit check	

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
3*	7-TRACK	When set, this bit indicates that the selected tape unit is a 7-track unit.	The selected unit has a 7-track head installed.
4*	LOAD POINT	When set, this bit indicates that the selected unit is positioned at load point. NOTE: Reading backward over the first block on a tape does *not* put the tape at load point.	Same as phase encoding mode.
5*	END OF TAPE	When set, this bit indicates that the selected tape unit is positioned in the end-of-tape area.	Same as phase encoding mode.

6*	FILE PROTECT	When set, this bit indicates that the tape reel on the selected unit does not have a write enable ring.	Same as phase encoding mode.
7	TAPE UNIT INCOMPATIBILITY	When set, this bit indicates one of the following conditions is present: ■ Addressed tape unit is a 7-track unit and is indicating the phase encoding mode of operation. Tape motion does not occur as a result of attempted operation. ■ Addressed tape unit is a 9-track unit and failed to reset to 1600-bpi mode (load point only). Tape motion does not occur as a result of attempted operation. ■ Tape unit is selected for a read operation from load point and addressed tape unit is a 9-track unit and failed to set to 800-bpi mode when the tape was written in the 800-bpi NRZI mode.	Same as phase encoding mode. Tape unit is selected for write operation from load point and unit addressed is a 9-track unit and failed to set to 800-bpi mode. A rewind command must be executed before issuing a write-type command.

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
7	TAPE UNIT INCOMPATIBILITY (cont)	This condition is detected after the first read operation is initiated. If a read command is to be attempted again, a rewind command is required to reposition the tape.	
Sense Data Byte 2			
0–7	TRACK IN ERROR	Not applicable. Always set to 0's.	This byte is utilized to indicate track errors when a data check has occurred at the conclusion of a read or read-backward operation. A single 1 bit in any bit position indicates a single track in error;

			the bit position indicates the track in error. A 1 bit in bit positions 6 and 7 indicates that a multiple track error has occurred and no track error identification has been made. Binary 0's in bits 0–7 imply bit P. At the completion of a properly executed read or read-backward operation with no data check, sense byte 2 contains at least bits 6 and 7 set to 1's. No error correction is attempted when operating with 7-track tape units. Bits 6 and 7 are set to 1's in sense byte 2.

isk (*) indicates a bit that is conditioned by current status of tape unit.

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3			
0	R/W VRC SPEED CHECK	When set, this bit indicates the following: ■ Vertical redundancy check (VRC) has occurred on a data frame without a dead track indication during a write, read, or read-backward operation (uncorrectable). ■ Excessive amount of speed variation occurred during a write operation. Set in conjunction with bit 2 of sense byte 4.	When set, this bit indicates the following: ■ A vertical redundancy check occurred on a data frame or CRC frame during a read or read-backward operation. This indicator is not set after an overrun indication. ■ A speed check error occurred during a write or write-tape-mark operation.

1	LRC/MULTIPLE DEAD TRACK/ TRACK START FAILURE	When set, indicates one of the following conditions: ■ A marginal signal occurred in more than one track on a read or read-backward operation (uncorrectable). ■ Valid information was not detected in at least one track while read checking the preamble during a write operation. This indicates a track start failure, possibly indicating the track was never written on the tape. This check is performed only during the preamble before the circuits that detect marginal signal are operable. Normally bit 4 of sense byte 3 is set in conjunction with this bit if the track is missing entirely.	When set, this bit indicates that a longitudinal redundancy check occurred during a write, write-tape-mark, read, or read-backward operation.
2	SKEW	When set, this bit indicates that excessive skew was detected during a write, read, or read-backward operation (deskew register overflow).	Excessive skew detected while read checking data on write or write-tape-mark operation.

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
3	POSTAMBLE CHECK/CRC	Set when the postamble following the data is not read correctly or is recognized before the actual end of data (early stop sentinel).	A CRC error was detected during a read or read-backward operation (9-track only).
4	DEAD TRACK CHECK/W VRC	When set, this bit indicates one of the following conditions: ■ At least one track with marginal signal during write or write-tape-mark operation. ■ A marginal signal in only one track during a read or read-backward operation (correctable error). This bit does not set if a multiple-track	A vertical redundancy check occurred on a data frame or CRC frame during a write or write-tape-mark operation.

		error occurs. (See bit 1.) If I = 1 in the read command code and this bit is set, data check is set. However, if this bit is set and I = 0 in the read command code, data check is not set. In either case, the data is correct. ■ Indicates that a tape mark was not properly detected on the read check of a write-tape-mark operation.	
5*	TAPE UNIT 1600 BPI	When set, this bit indicates the selected tape unit is set to 1600-bpi mode.	Same as phase encoding mode. Bit is always set to 0 when selecting 7-track tape unit.
6*	BACKWARD	When set, this bit indicates the selected tape unit is conditioned for backward tape motion.	Same as phase encoding mode.
7		This bit is not used and is always 0.	Same as phase encoding mode.

UNISERVO 10/14 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 4			
0	RUNAWAY CHECK	This bit is set by any of the following conditions: ■ While read checking recorded data during a write or write-tape-mark operation, the end of block was not detected under the read head within at least 1.7 usec (UNISERVO 10) or 1.4 usec (UNISERVO 14) after writing ceased. ■ During all read operations, if data is not detected within at least 7.0 seconds.	Same as phase encoding mode.
1	TAPE MOTION FAULT	This bit is set by any of the following conditions: ■ The tape unit failed to respond to a start command. Tape motion may or may not have occurred.	Same as phase encoding mode.

		■ Tape motion stopped independently of the control unit during an operation requiring tape movement. (This condition will occur if a backward operation extends motion into the load point.) This bit sets in conjunction with bit 2, sense byte 4.	
2, 3, 4, and 7	TEST	These bits are not used, are always 0, and are reserved for the failure finding mode used by customer engineer.	Same as phase encoding mode.
5	STALL	When set, this bit indicates that the control unit is "hung up" for more than 2.5 seconds. Stall sense bit will not set if either bits 0 or 1 of sense byte 4 is set.	Same as phase encoding mode.
6	TAPE FAULT	When set, this bit indicates that during a write or write-tape-mark operation an end-of-block gap was detected sooner than expected. This false end of block may be due to a loss of data for more than 1.35 usec on a UNISERVO 10, or 560 usec on a UNISERVO 14.	Same as phase encoding mode.

5.9.3.10. UNISERVO 12/16 Magnetic Tape Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTER-VENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	WORD COUNT ZERO	DATA CON-VERTER CHECK
1	NOISE	TAPE UNIT STATUS A*	TAPE UNIT STATUS B*	7-TRACK*	LOAD POINT*	END-OF-TAPE*	FILE PROTECT*	TAPE UNIT INCOMPATIBILITY
2	TRACK IN ERROR							
3	R/W VRC	MDT CHECK TRACK START FAILURE/LRC	SKEW	POSTAMBLE CHECK/CRC	W/VRC DEAD TRACK	TAPE UNIT 1600 BPI	BACKWARD*	NOT USED; ALWAYS 0
4	RUNAWAY CHECK	TAPE MOTION FAULT	FAILURE FINDING / ALWAYS 0 BITS			STALL	TAPE FAULT	FAILURE FINDING

*Indicates bit that is conditioned by current status of tape unit.

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 0	
0	Command reject	This bit is set if a write, write-tape-mark, or erase operation was attempted on a file protected tape unit or if an invalid command was received by the control unit (in the latter case, the bit is not set if the bus out check bit is set). Also, this bit is set if the tape unit incompatibility bit (bit 7, sense byte 1) is set.	Same as phase encoding mode.
1	Intervention required	When set, this bit indicates that a nonexistent or nonready tape unit was addressed by a command other than a sense command. If this bit is set, the tape unit status A bit (in sense data byte 1) is not set.	Same as phase encoding mode.
2	Output bus check	When set, this bit indicates that a command or data was received with even parity on the interface bus out lines. If this condition is set on a data transfer during a write operation, the operation is terminated and the faulty byte is not written. If the parity error is detected on a first data transfer, this bit and the word count zero bit (bit 6) will both be set.	Same as phase encoding mode. If this condition is detected during the data transfer on a request-TIE-command, the operation terminates but the information received is ignored. Any TIE information already stored is not affected.

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 0 (cont)	
3	Equipment check	When set, this bit indicates an equipment fault. It is set whenever bit 0 (runaway check), bit 1 (tape motion fault), or bit 5 (stall) of sense data byte 4 is set.	Same as phase encoding mode.
4	Data check	When set, this bit indicates a data fault. It is set whenever bit 0 (noise) of sense data byte 1 is set, or bit 0 (read VRC error), bit 2 (skew), or bit 4 (write VRC error) of sense data byte 3 is set.	Same as phase encoding mode with bit 1 and bit 3 of sense byte 1 set.
5	Overrun	This bit is set if service is requested on the interface lines but data cannot be transferred because of a late SERVICE OUT signal from the selector channel. This bit is not set on the sense- or track-in-error commands. If this condition occurs on the first data transfer of a write operation, word count zero will be set in conjunction with this bit.	Same as phase encoding mode.
6	Word count zero	This bit is set if during a write operation data transfer is prevented when the first data byte is requested. No tape motion occurs when this condition is detected. This bit is set if end of block is detected on a read or read backward operation prior to detecting data.	Same as phase encoding mode.
7	Data converter check	This bit is not used and is always 0.	Set on 7-track operations only.

Sense Data Byte 1			
0	Noise	When reading or read checking data from phase encoded tapes, the checks performed to set the noise bit are essentially the same as those performed for NRZI recorded tapes. The variation in the checks are as follows: ■ When checking for tape hash, the outputs of the block detector circuits for each track are monitored. Since these circuits tend to reject noise, a single "bit-pick-up" would not activate the block detector outputs and the noise bit would not set. In NRZI recording, the noise bit would set, since the data lines are monitored directly. ■ When checking for gaps in the data, or data "dropouts", all block detector outputs must be deactivated together, before the noise bit sets. In phase encoding recording, a signal results from writing either a 1 bit or a 0 bit. Therefore, within the block, a signal is normally present in all tracks, and only a relatively serious condition could cause the noise bit to set (that is, a lateral crease in the tape). In NRZI recording, however, a signal is present only when 1 bits are written. Thus, a small defect in one track, when recording 1 bits only in that track, causes the noise bit to set.	When set, this bit indicates one of the following: ■ Tape mark — During write or write-tape-mark operations, data (or noise due to tape defects) was detected on read check sooner then was expected. ■ During erase operations, data (or noise due to tape defects) was detected on read check while the tape was being erased. ■ During write or write-tape-mark operations, while read checking the recorded data, a gap detected in the the data was not long enough to set the end-of-block condition.

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 1 (cont)	
0	Noise (cont)		■ During read, read-backward, forward-space-block, and backspace-block operations, a data "dropout" which occurred on read was not long enough for the end-of-block condition to be detected. For above conditions, tape motion does not cease in the middle of the block. Writing or erasing continues until the normal termination point.
1	Tape unit status A	When set, this bit indicates that the tape unit is selected and ready.	Same as phase encoding.
2	Tape unit status B	When set, this bit indicates that the tape unit is rewinding, not ready, or under control of another control unit.	Same as phase encoding mode.

<table>
<tr><td></td><td></td><td>
<table>
<tr><th>Tape Unit Status</th><th>Tape Unit Status</th><th>Status Definition</th><th>Bit Set In Status Byte</th></tr>
<tr><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>0</td><td>0</td><td>Nonexistent</td><td>Unit check</td></tr>
<tr><td>0</td><td>1</td><td>Not ready</td><td>Unit check</td></tr>
<tr><td>1</td><td>0</td><td>Ready and not busy</td><td>—</td></tr>
<tr><td>1</td><td>1</td><td>Ready and busy, that is, rewinding or under control of other control unit</td><td>Unit check</td></tr>
</table>
</td><td></td></tr>
<tr><td>3</td><td>7-Track</td><td>When set, this bit indicates that the selected tape unit is a 7-track unit.</td><td>The selected unit has a 7-track head installed.</td></tr>
<tr><td>4</td><td>Load point</td><td>When set, this bit indicates that the selected unit is positioned at load point.

NOTE:
Reading backward over the first block on a tape does not put the tape at load point.</td><td>Same as phase encoding mode.</td></tr>
</table>

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 1 (cont)	
5	End-of-tape	When set, this bit indicates that the selected tape unit is positioned in the end-of-tape area.	Same as phase encoding mode.
6	File protect	When set, this bit indicates that the tape reel on the selected unit does not have a write enable ring.	Same as phase encoding mode.
7	Tape unit incompatibility	When set, this bit indicates one of the following conditions is present: 1. Addressed tape unit is a UNISERVO 12 or 16 7-track tape unit and is indicating the phase encoding mode of operation. 2. Addressed tape unit is a UNISERVO 12 or 16 9-track tape unit and failed to reset to 1600-bpi mode (load point only). 3. Tape unit is selected for a read operation from load point and addressed tape unit is a 9-track UNISERVO 12 or 16 tape unit and failed to set to 800-bpi mode when the tape was written in the 800-bpi mode. 4. A write operation was attempted with a UNISERVO 12 tape unit on the second control unit.	Same as phase encoding mode. Tape unit is selected for "write-type" operation from load point and unit addressed is a UNISERVO 12 or UNISERVO 16 9-track tape unit and failed to set to 800-bpi mode.

Sense Data Byte 2			
0	Track in error	Not Applicable	This bit is utilized to indicate track errors when a data check has occurred at the conclusion of a read or read-backward operation. A single 1-bit in any track indicates the track in error; a 1-bit in bit positions 6 and 7 indicates that a multiple track error has occurred and no track and no track error identification has been made. Binary 0's in bits 0 through 7 imply list P. At the completion of a properly executed read or read-backward operation with no data check, sense byte 2 contains at least bits 6 and 7 set to 1's. No error correction is attempted when operating with 7-track tape units. Bits 6 and 7 are set to 1's in sense byte 2.

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3			
0	R/W VRC	When set, this bit indicates vertical redundancy check occurred on a data frame when no marginal signal was detected in any track.	When set, this bit indicates the following: ■ A vertical redundancy check occurred on a data frame or CRC frame during a read or read-backward operation. This indicator is not set after an overrun indication. ■ A speed check error occurred during a write or write-tape-mark operation.

1	LRC/multiple dead track/ track start failure	When set, indicates one of the following conditions has occurred: ■ A marginal signal occurred in more than one track on a read or read-backward operation. ■ Valid information was not detected in at least one track while read checking the preamble during a write operation. This indicates a track start failure, possibly indicating the track was never written on the tape. This check is performed only during the preamble before the circuits. Normally bit 4 of sense byte 3 is set in conjunction with this bit if the track is missing entirely.	When set, this bit indicates that a longitudinal redundancy check occurred during a write, write-tape-mark, read, or read-backward operation.
2	Skew	When set, this bit indicates that excessive skew was detected during the automatic readback for a write or write-tape-mark operation.	Excessive skew detected while read checking during write or write-tape-mark operation.
3	Postamble check/CRC	Set when the postamble following the data is not read correctly.	A CRC occurred during a read or read-backward operation (9-track only).
4	Dead track check/W VRC	When set, this bit indicates one of the following conditions has occurred: ■ At least one track with marginal signal during write or write-tape-mark operations.	A vertical redundancy check occurred on a data frame or CRC frame during a write or write-tape-mark operation.

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 3 (cont)	
4	Dead track check/W VRC (cont)	■ A marginal signal in only one track during a read or read-backward operation (correctable error). This bit does not set if a multiple track error occurs. (See bit 1.) If I=1 in the read command code and this bit is set and I=0 in the read command code, data check will not set. In either case, the data is correct. ■ Indicates that a tape mark was not properly detected on the read check of a write-tape-mark operation.	
5	Tape unit-1600 bpi	When set, this bit indicates the selected tape unit is set to 1600-bpi mode.	Same as phase encoding mode. Bit is always set to 0 when selecting 7-track tape unit.
6	Backward	When set, this bit indicates the selected tape unit is conditioned for backward tape motion.	Same as phase encoding mode.
7		This bit is not used and is always 0.	Same as phase encoding mode.
		Sense Data Byte 4	
0	Runaway check	This bit is set by any of the following conditions:	Same as phase encoding mode.

		■ During a write or write-tape-mark operation, the end of block was not detected under the read head within at least 8.3 ms (UNISERVO 12) or 2.1 ms (UNISERVO 16) after writing ceased. ■ During all read operations, if data is not detected within at least 7.0 seconds (UNISERVO 12) or 2.5 seconds (UNISERVO 16).	
1	Tape motion fault	This bit is set by any of the following conditions: ■ The tape unit failed to respond to a start command. Tape motion may or may not have occurred. ■ Tape motion stopped independently of the control unit during an operation requiring tape movement. (This condition will occur if a backward operation extends motion into the load point.)	Same as phase encoding mode.
2, 3, and 4		These bits are not used, are always 0, and are reserved for the failure finding mode used by maintenance personnel.	Same as phase encoding mode.
5	Stall	When set, this bit indicates that the control unit is "hung up" for more than 2.5 seconds. The unit check bit (status byte) is set, and the control unit terminates the operation by initiating a status request.	Same as phase encoding mode.

UNISERVO 12/16 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 4 (cont)			
6	Tape fault	When set, this bit indicates that during a write or write-tape-mark operation an interblock gap was detected sooner than expected. This false end of block may be due to a loss of data for more than 790 microseconds on a UNISERVO 12 or UNISERVO VI-C, or more than 280 microseconds on a UNISERVO 16 or UNISERVO VIII-C (if this is the case, a backspace may not re-position the tape to the beginning of the written block).	Same as phase encoding mode.
7		This bit is not used and is always 0. It is reserved for the failure finding mode used by maintenance personnel.	Same as phase encoding mode.

5.9.3.11. UNISERVO 20 Magnetic Tape Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	WORD COUNT ZERO	DATA CONVERTER CHECK
1	NOISE	TAPE UNIT STATUS A*	TAPE UNIT STATUS B*	7-TRACK*	LOAD POINT*	END-OF-TAPE*	FILE PROTECT*	TAPE UNIT INCOMPATIBILITY
2	TRACK IN ERROR							
3	R/W VRC	MDT CHECK TRACK START FAILURE/LRC	SKEW	POSTAMBLE CHECK/CRC	W/VRC DEAD TRACK	TAPE UNIT 1600 BPI*	BACKWARD*	NOT USED; ALWAYS 0
4	RUNAWAY CHECK	TAPE MOTION FAULT	SPEED CHECK (UNISERVO 20 ONLY)	TEST / ALWAYS 0 BITS		STALL	TAPE FAULT	TEST

*Indicates bit that is conditioned by current status of tape unit.

UNISERVO 20 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 0	
0	Command reject	This bit is set if a write, write-tape-mark, or erase operation was attempted on a file protected tape unit or if an invalid command was received by the control unit (in the latter case, the bit is not set if the bus out check bit is set). Also, this bit is set if the tape unit incompatibility bit (bit 7, sense byte 1) is set.	Same as phase encoding mode.
1	Intervention required	When set, this bit indicates that a nonexistent or nonready tape unit was addressed by a command other than a sense command. If this bit is set, the tape unit status A bit (in sense data byte 1) is not set.	Same as phase encoding mode.
2	Bus out check	When set, this bit indicates that a command or data was received with even parity on the interface bus-out lines. If this condition is set on a data transfer during a write operation, the operation is terminated and the faulty byte is not written. If the parity error is detected on a first data transfer, this bit and the word count 0 bit (bit 6) will both be set.	Same as phase encoding mode. If this condition is detected during the data transfer on a request-TIE command, the operation terminates but the information received is ignored. Any TIE information already stored is not affected.
3	Equipment check	When set, this bit indicates an equipment fault. It is set whenever bit 0 (runaway check), bit 1 (tape motion fault), or bit 5 (stall) of sense data byte 4 is set.	Same as phase encoding mode.

4	Data check	When set, this bit indicates a data fault. It is set whenever bit 0 (noise) of sense data byte 1 is set, or bit 0 (read VRC error), bit 2 (skew), bit 3 (postamble check/CRC) or bit 4 (write VRC error) of sense data byte 3 is set.	Same phase encoding mode.
5	Overrun	This bit is set if service is requested on the interface lines but data cannot be transferred because of a late SERVICE OUT signal from the MSA. This bit is not set on the sense or request-TIE commands. If this condition occurs on the first data transfer of a write operation, word count zero will be set in conjunction with this bit.	Same as phase encoding mode.
6	Word count zero	This bit is set if data transfer is prevented during a write operation when the first data byte is requested. This can be due to a command out response to a data byte request, even parity detected for the data byte transfer, or a channel overload. No tape motion occurs when this condition is detected. If nonstop operation is indicated, the previous operation will terminate properly. This bit is set if end of block is detected on a read or read-backward operation prior to detecting data (missed start sentinel).	Same as phase encoding mode.
7	Data converter check	This bit is not used and is always 0.	Set on 7-track operations only.

UNISERVO 20 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 1	
0	Noise	When reading or read checking data from phase encoded tapes, the checks performed to set the noise bit are essentially the same as those performed for NRZI recorded tapes. The variation in the checks are as follows: ■ When checking for tape hash, the outputs of the block detector circuits for each track are monitored. Since these circuits tend to reject noise, a single bit pickup would not activate the block detector outputs and the noise bit would not be set. In NRZI recording, the noise bit would be set, since the data lines are monitored directly. ■ When checking for gaps in the data, or data dropouts, all block detector outputs must be deactivated together, before the noise bit is set. In phase encoding recording, a signal results from writing either a 1 bit or a 0 bit. Therefore, within the block, a signal is normally present in all tracks, and only a relatively serious condition could cause the noise bit to be set (that is, a lateral crease in the tape).	When set, this bit indicates one of the following: ■ Tape hash – During write or write-tape-mark operations, data (or noise due to tape defects) was detected on read check sooner then was expected. ■ During erase operations, data (or noise due to tape defects) was detected on read check wile the tape was being erased. ■ During write or write-tape-mark operations, while read checking the recorded data, a gap detected in the data was not long enough to set

		In NRZI recording, however, a signal is present only when 1 bits are written. Thus, a small defect in one track, when recording 1 bits only in that track, causes the noise bit to be set. The noise bit, should be set relatively infrequently, as compared to the NRZI mode.	the end-of-block condition. ■ During read, read-backward, forward-space-block, and backspace-block operations, a data drop out which occurred on read was not long enough for the end-of-block condition to be detected. For above conditions, tape motion does not cease in the middle of the block. Writing or erasing continues until the normal termination point. ■ Bit 6 of sense byte 4 was set (tape fault).
1*	Tape unit status A	When set, this bit indicates that the tape unit is selected and ready.	Same as phase encoding mode.
2*	Tape unit Status B	When set, this bit indicates that the tape unit is rewinding, not ready, or under control of another control unit.	Same as phase encoding mode.

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
		<table><tr><th>Tape Unit Status A</th><th>Tape Unit Status B</th><th>Status Tape Unit</th><th>Bit Set In Status Byte</th></tr><tr><td>0</td><td>0</td><td>Nonexistent</td><td>Unit Check</td></tr><tr><td>0</td><td>1</td><td>Not ready</td><td>Unit check</td></tr><tr><td>1</td><td>0</td><td>Ready and not busy</td><td>—</td></tr><tr><td>1</td><td>1</td><td>Ready and busy; that is, rewinding or under control of other control unit</td><td>Unit check</td></tr></table>	
3*	7-Track	When set, this bit indicates that the selected tape unit is a 7-track unit.	The selected unit has a 7-track head installed.

4*	Load point	When set, this bit indicates that the selected unit is positioned at load point. NOTE: Reading backward over the first block on a tape does not put the tape at load point.	Same as phase encoding mode.
5*	End of tape	When set, this bit indicates that the selected tape unit is positioned in the end-of-tape area.	Same as phase encoding mode.
6*	File protect	When set, this bit indicates that the tape reel on the selected unit does not have a write enable ring.	Same as phase encoding mode.
7	Tape unit incompatibility	When set, this bit indicates one of the following conditions is present: ■ Addressed tape unit is a 7-track UNISERVO 12 or 16 and is indicating the phase encoding mode of operation. ■ Addressed tape unit is a 9-track UNISERVO 12, 16, or 20 and failed to reset to 1600-bpi mode (load point only). ■ Tape unit is selected for a read operation from load point and addressed tape unit is a 9-track UNISERVO 12, 16, or 20 and failed to set to 800-bpi mode when the tape was written in the 800-bpi mode.	Same as phase encoding mode. Tape unit is selected for write operation from load point and unit addressed is a 9-track UNISERVO 12, 16, or 20 and failed to set to 800-bpi mode. NOTE: Tape motion does not occur as a result of attempted operation.

*Indicates bit that is conditioned by current status of the tape unit.

UNISERVO 20 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
7 (cont)		This condition is detected after the first read operation is initiated. If a read command is to be attempted again, a rewind command is required to reposition the tape.	
Sense Data Byte 2			
0—7	Track in error	Not applicable	This byte is utilized to indicate track errors when a data check has occurred at the conclusion of a read or read-backward operation. A single 1-bit in any track indicates a single track in error; the bit position indicates the track in error. A 1-bit in bit positions 6 and 7 indicates that a multiple track error has occurred and no track error identification has been made. Binary 0's in bits 0—7 imply bit P. At the completion of a properly executed read or read-backward

			operation with no data check, sense byte 2 contains at least bits 6 and 7 set to 1's. No error correction is attempted when operating with 7-track tape units. Bits 6 and 7 are set to 1's in sense byte 2.
Sense Data Byte 3			
0	R/W VRC speed check	When set, this bit indicates the following: ■ Vertical redundancy check (VRC) has occurred on a data frame without a dead track indication during a write, read, or read-backward operation. ■ Excessive amount of speed variation occurred during a write operation. Set in conjunction with bit 2 of sense byte 4 for UNISERVO 20 control unit only.	When set, this bit indicates the following: ■ A vertical redundancy check occurred on a data frame or CRC frame during a read or read backward operation. This indicator is not set after an overrun indication. ■ A speed check error occurred during a write or write-tape-mark operation.
1	LRC/multiple dead track/ track start failure	When set, indicates one of the following conditions: ■ A marginal signal occurred in more than one track on a read or read-backward operation.	When set, this bit indicates that a longitudinal redundancy check occurred during a write, write-tape-mark, read, or read-backward operation.

UNISERVO 20 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
1 (cont)		■ Valid information was not detected in at least one track while read checking the preamble during a write operation. This indicates a track start failure, possibly indicating the track was never written on the tape. This check is performed only during the preamble before the circuits that detect marginal signal are operable. Normally bit 4 of sense byte 3 is set in conjunction with this bit if the track is missing entirely.	
2	Skew	When set, this bit indicates that excessive skew was detected during a write, read, or read-backward operation (deskew register overflow).	Excessive skew detected while read checking data on write or write-tape-mark operation.
3	Postamble check/CRC	Set when the postamble following the data is not read correctly or is recognized before the actual end of data (early stop sentinel).	A CRC error was detected during a read or read-backward operation (9-track only).
4	Dead track check/W VRC	When set, this bit indicates one of the following conditions: ■ At least one track with marginal signal during write or write-tape-mark operations.	A vertical redundancy check occurred on a data frame or CRC frame during a write or write-tape-mark operation.

		■ A marginal signal in only one track during a read or read-backward operation (correctable error). This bit does not set if a multiple-track error occurs. (See bit 1.) If I = 1 in the read command code and this bit is set, unit check is set. However, if this bit is set and I = 0 in the read command code, unit check is not set. In either case, the data is correct. ■ Indicates that a tape mark was not properly detected on the read check of a write-tape-mark operation.	
5*	Tape unit-1600 bpi	When set, this bit indicates the selected tape unit is set to 1600-bpi mode.	Same as phase encoding mode. Bit is always set to 0 when selecting 7-track tape unit.
6*	Backward	When set, this bit indicates the selected tape unit is conditioned for backward tape motion.	Same as phase encoding mode.
7		This bit is not used and is always 0.	
		Sense Data Byte 4	
0	Runaway check	This bit is set by any of the following conditions: ■ While read checking recorded data during a write or write-tape-mark operation, the end of block was not detected under the read head within at least 8.3 msec (UNISERVO 12), 2.9	Same as phase encoding mode.

UNISERVO 20 Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
		Sense Data Byte 4 (cont)	
0 (cont)		msec (UNISERVO 16), 0.91 msec (UNISERVO 20) after writing ceased. ■ During all read operations, if data is not detected within at least 7.0 seconds (UNISERVO 12) or 2.5 seconds (UNISERVO 16 or 20).	
1	Tape motion fault	This bit is set by any of the following conditions: ■ The tape unit failed to respond to a start command. Tape motion may or may not have occurred. ■ Tape motion stopped independently of the control unit during an operation requiring tape movement. (This condition will occur if a backward operation extends motion into the load point.) This bit sets in conjunction with bit 2, sense byte 4.	Same as phase encoding mode.

2	Speed check (UNISERVO 20 control unit only)	This bit is set by any of the following conditions: ■ An excessive amount of speed variation during a write operation. Set in conjunction with bit 0 of sense byte 3. ■ During a write operation, the tape unit fails to: — accelerate to specified speed, or — achieve minimum interblock gap spacing. Set in conjunction with bit 1 of sense byte 9.	Always set to 0.
3, 4, and 7	Test	These bits are not used, are always 0, and are reserved for the failure finding mode used by customer engineer.	Same as phase encoding mode.
5	Stall	When set, this bit indicates that the control unit is "hung up" for more than 2.5 seconds. Stall sense bit will not set if either bits 0 or 1 of sense byte 4 is set.	Same as phase encoding mode.
6	Tape fault	When set, this bit indicates that during a write or write-tape-mark operation an end-of-block gap was detected sooner than expected. This false end of block may be due to a loss of data for more than 790 microseconds on a UNISERVO 12, more than 280 microseconds on a UNISERVO 16, or 2 bit times for a UNISERVO 20.	Same as phase encoding mode.

5.9.3.12. UNISERVO VI-C Magnetic Tape Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	INVALID FUNCTION	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	DATA LATE	WORD COUNT ZERO	DATA CONVERTER CHECK
1	NOISE	TAPE UNIT STATUS A*	TAPE UNIT STATUS B*	7-TRACK*	LOAD POINT*	END-OF-TAPE*	FILE PROTECT*	NOT USED; ALWAYS ZERO
2	NOT USED							
	ALWAYS 0 BITS						ALWAYS 1 BITS	
3	READ VP ERROR	LP ERROR	SKEW	CRC READ ERROR	WRITE VP ERROR	NOT USED; ALWAYS 0	BACKWARD*	NOT USED; ALWAYS ZERO
	ALWAYS 0 BITS							ALWAYS 0 BITS
4	RUNAWAY CHECK	TAPE MOTION FAULT	RESERVED FOR FAILURE-FINDING MODE			STALL	TAPE FAULT	RESERVED FOR FAILURE-FINDING MODE

*Indicates bit that is conditioned by current status of tape unit.

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Invalid function	This bit is set if a write, write-tape-mark or erase operation was attempted on a file protected tape unit or if an invalid function was received by the control unit (in the second case, the bit will not be set if the bus out check bit is set).
1	Intervention required	Indicates that a nonexistent or nonready tape unit was addressed by a function other than a sense function. If this bit is set, the tape unit status A bit is not set (sense data byte 1).
2	Bus out check	Indicates that a function or data arrived with even parity on the bus out lines. If this condition is set on a data transfer during a write operation, the operation is terminated and the faulty byte is not written. If the parity error is detected on a first data transfer, the word count zero bit is also set. If the bus out check bit is set, the invalid function bit will not be set for a function transfer.
3	Equipment check	This bit indicates an equipment fault and is set whenever bit 0, 1, or 5 of sense data byte 4 is set.
4	Data check	This bit indicates a fault in data and is set whenever bit 0 of sense data byte 1 is set, or bit 0, 1, 2, 3, or 4 of sense data byte 3 is set.

UNISERVO VI-C Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
5	Data late	This bit is set if service is requested on the interface lines but data cannot be transferred because of a late SERVICE OUT signal from the multiplexer channel. This bit is not set for the sense function.
6	Word count zero	This bit is set if during a write operation a data transfer is prevented when the first data byte is requested. No tape motion occurs when this condition is detected.
7	Data converter check	This bit, together with the unit check bit, (of the status bytes) indicates the number of bytes read during data conversion (where the data conversion feature is present) was incorrect.
		Sense Data Byte 1
0	Noise	For a write or write-tape-mark operation, an unsuccessful write occurred. because data (or electrical noise) was detected in the area allotted to the interblock gap. For a write or tape mark operation a tape fault occurred. In this case, the noise bit will be accompanied by the tape fault bit in sense data byte 4.

		For a read, read-backward, forward-space-block, or backspace-block operation, this bit indicates that data was detected in the interblock gap. Data after the longitudinal parity character turns on the noise bit and maintains tape motion but is not transferred. This condition may also be caused by a "dropout" of data in the block, causing false detection of longitudinal parity character. Such a dropout can be caused by bad tape (for example, wrinkled tape). This indication can usually be ignored on a space operation. If noise is detected after a true longitudinal parity character, successful completion of the operation is indicated; however, in most cases, the longitudinal parity error bit (sense data byte 3) will be set. Note that the dropout of two identical frames cannot be detected by the longitudinal parity character.
1	Tape unit status A	This bit indicates that the tape unit is selected and ready. If this bit is not set, the settings of bits 3—6 in sense data byte 1 are unreliable.
2	Tape unit status B	This bit indicates that the tape unit is rewinding, not ready, or under control of the other control unit.
3	7-Track	This bit indicates that the selected tape unit is a 7-track unit.
4	Load point	This bit indicates that the selected unit is positioned at load point. NOTE: Reading backward over the first block on a tape will not put the tape at load point.
5	End-of-tape	This bit indicates that the selected unit is positioned in the end-of-tape area.
6	File protect	This bit indicates that the tape on the selected unit does not have a write enable ring installed.

UNISERVO VI-C Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
7	Tape handler busy	This bit is not used and is always a 0 bit.
		Sense Data Byte 2
		Sense data byte 2 is not used. Positions 0—5 always contain 0 bits; positions 6 and 7 always contain 1 bits.
		Sense Data Byte 3
0	READ VP error	A vertical parity (VP) error is detected on a cyclic redundancy check character (9-track only) or on a data character during a read or read-backward operation. The data late bit in sense data byte 0 (if set) will inhibit setting of this bit for the parity error condition. Data was not detected at the read head within 10 milliseconds after data recording commenced for a write or write-tape-mark operation.
1	Read LP error	This bit indicates that a longitudinal parity error was detected during a read or read backward operation, or during the automatic readback for a write or write-tape-mark operation.

2	Skew	This bit indicates that excessive skew was detected during the automatic readback for a write or write-tape-mark operation.
3	CRC read error	9-track only. This bit indicates that the cyclic redundancy character (CRC) calculated during a read operation is not the same as the stored CRC.
4	Write VP error	This bit indicates detection of a vertical parity (VP) error in a data frame or the CRC in the automatic readback during a write or write-tape-mark operation.
5		This bit is not used and is always a 0 bit.
6	Backward	Bit 6. Backward. This bit indicates that the selected unit is in a backward condition.
7		Bit 7. This bit is not used and is always a 0 bit.
Sense Data Byte 4		
0	Runaway check	During a write or write-tape-mark operation, no data was detected under the read head in the automatic readback within 10 milliseconds after writing commenced. During any read operation, no data was detected within 20 seconds.
1	Tape motion fault	The tape unit failed to respond to a START command. Tape motion may or may not have occurred. Tape motion stopped independently of the control unit during an operation requiring movement. The equipment check bit (sense data byte 0) will also be set. (This condition will occur if a backward operation extends motion into load point.)

UNISERVO VI-C Magnetic Tape Subsystem (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 4 (cont)		
2, 3, 4		Always zero and reserved for the failure finding mode using by maintenance personnel.
5	Stall	This bit indicates that the control unit is "hung-up" for more than 20 seconds. The unit check bit is set and the channel terminates the operation by initiating a status request.
6	Tape fault	This bit indicates that during a write or write-tape-mark operation an interblock gap was detected sooner than expected. This false end-of-block may be due to a loss of data for more than 800 microseconds (if this is the case, a backspace may not reposition the tape to the beginning of the written block).
7		Always zero and reserved for the failure finding mode used by maintenance personnel.

5.9.3.13. 0920 Paper Tape Subsystem

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	INVALID COMMAND	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	NOT USED	INHIBIT STATUS IN SET	EOT READER OR LOW TAPE ON PUNCH
1	READER STOP FF SET	PUNCH STOP FF SET	FORMAT CONNECTOR OUT	NOT USED	PUNCH TAKE-UP REEL FULL	LOW PAPER SUPPLY ON PUNCH	BROKEN READ TAPE	NORMAL EOT ON READER

0920 Paper Tape Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Invalid command	Set when an unspecified command is issued. If an incorrect parity is detected during the transfer of the command code, this bit is suppressed. Neither the channel end bit (4) nor the device end bit (5) in the status byte is set for this condition.
1	Intervention required	Set to indicate that an abnormal condition was detected during the previous operation. In all cases, the error requires manual intervention to correct. One or more of the following conditions could exist: 1. program connectors not inserted properly on reader or punch; 2. punch supply reel not in operating condition; 3. punch take-up reel full; 4. broken tape on reader; 5. end of tape on reader; 6. low tape supply on punch; 7. reader in stop mode; or

		8. punch in stop mode.
2	Bus out check	Set when a command byte or data byte parity error is detected during the initial selection sequence. A command byte parity error causes the control unit to terminate operation immediately and to suppress the invalid command. If the control unit is holding a pending status when the command byte parity error is detected, the command byte is disregarded and the stored status is transferred to the multiplexer channel during the status transfer sequence. Neither the channel end nor the device end bit in the status byte is set for this condition. A data byte parity error during data transfer causes the control unit to terminate operation immediately. The channel end bit and the device end bit in the status byte are set.
3	Equipment check	Set to indicate that a reader overshoot condition is detected (reader stopped, paper moved).
4	Data check	Set to indicate that a read parity error exists.
5		Not used.
6	Inhibit status in set	Set to indicate that the inhibit-status-in flip-flop is set and to prevent a status byte from being sent to the multiplexer channel.
7	EOT reader or low tape on punch	Set to indicate an end-of-tape condition on the reader or low tape supply on punch.

0920 Paper Tape Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Reader stop FF set	The status of various flip-flops in the control unit is transferred to this byte, which is used to indicate that an abnormal condition was detected during the previous operation. In all cases, manual intervention is required to correct such abnormal conditions.
1	Punch stop FF set	
2	Program connector not inserted	
3	Not used	
4	Punch take-up reel full	
5	Low tape on punch	
6	Broken read tape	
7	Normal EOT on reader	

5.9.3.14. 2703 Optical Document Reader

SENSE DATA BYTE	BIT 0	1	2	3	4	5	6	7
0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	INHIBIT STATUS	JAM
1	TRANSLATE	CARD READ	MARK READ	OCR CAMERA INHIBIT	MODULUS 10 CHECK DIGIT	STACKER MODE STACKER 2	STACKER MODE STACKER 3	DIAGNOSTIC MODE
2 (NOT MAINTENANCE MODE)	MULTIPLE READ	MODULUS 10 CHECK DIGIT ERROR	COLUMN 81 TEST	VALIDITY CHECK ERROR	MULTIPLE STROBE ERROR	MULTIPLE FEED	DOCUMENTS TOO CLOSE	BLANK DOCUMENT
2 (MAINTENANCE MODE)	DOCUMENT PRIMED	FEED FLIP-FLOP	FEED CELL1	FEED CELL 2	FEED CELL 3	FEED CELL 4	DOCUMENT PRESENCE	DIVERTER GATE
3	CHARACTER 0	CHARACTER 1	CHARACTER 2	CHARACTER 3	CHARACTER 4	CHARACTER 5	CHARACTER 6	CHARACTER 7
4	CHARACTER 8	CHARACTER 9	SYMBOL OR N	SYMBOL OR F	SYMBOL OR \	NOT USED	LVM	MULTIPLE

2703 Optical Document Reader (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	This bit is set when an invalid command is issued or a command requires an uninstalled feature. Neither the channel end or device end bit in the status bytes is set for this condition.
1	Intervention required	This bit is set when an abnormal condition was detected or if a command could not be executed. In all cases the ODR has gone out of the ready state, and manual intervention is required.
2	Bus out check	This bit is set for an invalid parity in command or data.
3	Equipment check	This bit is set when: ■ document spacing is incorrect; document is directed to stacker reject; ■ the time for issuing a stacker command has expired.
4	Data check	This bit is set to indicate that one of the following conditions was detected during the previous operation: ■ multiple read error feed ■ modulus 10 check digit error

		■ validity check error ■ card reading error If the ODR is in stacker mode, these documents are directed to the reject stacker.
5	Overrun	This bit is set to indicate that at least one character is lost because the processor multiplexer channel did not service the ODR on time. If the ODR is in stacker mode, the document is directed to the reject stacker.
6	Inhibit status	This bit sets the inhibit status flip-flop.
7	Jam	This bit is set when a document jams.
	Sense Data Byte 1	
0	Translate	This bit is set when data from the mark/card read station can be translated.*
1	Card read	This bit is set when the card read mode is selected.*
2	Mark read	This bit is set when the mark read mode is selected.*
3	OCR camera inhibit	This bit is set when the OCR mode is not selected.
4	Modulus 10 check digit	This bit is set when the modulus-10-check-digit mode is selected.*
5	Stacker mode, stacker 2	This bit is set when the ODR is in the stacker mode and stacker 2 is selected.

2703 Optical Document Reader (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
6	Stacker mode, stacker 3	This bit is set when the ODR is in the stacker mode and stacker 3 is selected.
7	Diagnostic mode	This bit is set to indicate that the ODR is in the diagnostic mode.
**This bit is usable only when the applicable feature has been installed.*		
		Sense Data Byte 2 (Not Maintenance Mode)
The following bits are set with the data check bit:		
0	Multiple read	This bit is set if more than one character was identified in a single character space. Example: A 3 was identified as an 8 as well as a 3; the multiple read bit is set, and the character is not accepted.
1	Modulus 10 check digit error	This bit is set when a modulus-10-check-digit error is detected.

2	Column 81 test	This bit is set when a mark is detected by the photocells in the margin of the card (column 81).
3	Validity check error	This bit is set when a validity check error is detected; more than one mark or punch per column on the document.
4	Multiple strobe error	This bit is set to indicate an error in reading the punched card.
The following bits are set with the equipment check bit:		
5	Multiple feed	This bit is set when more than one document is fed from the input hopper.
6	Documents too close	This bit is set when the spacing between documents is incorrect. The document is rejected.
The following bits are set with the unit check bit:		
7	Blank document	This bit is set when a blank document has been detected. The document is rejected.
Sense Data Byte 2 (Maintenance Mode)		
0	Document primed	These bits are set when the ODR is in the maintenance mode.
1	Feed flip-flop	
2	Feed cell 1	These bits are set when the ODR is in the maintenance mode.
3	Feed cell 2	
4	Feed cell 3	

2703 Optical Document Reader (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2 (Not Maintenance Mode) (cont)
5	Feed cell 4	These bits are set when the ODR is in the maintenance mode.
6	Document presence	
7	Diverter gate	
		Sense Data Byte 3
0	Character 0	Character 0 was recognized by the recognition logic.
1	Character 1	Character 1 was recognized by the recognition logic.
2	Character 2	Character 2 was recognized by the recognition logic.
3	Character 3	Character 3 was recognized by the recognition logic.
4	Character 4	Character 4 was recognized by the recognition logic.
5	Character 5	Character 5 was recognized by the recognition logic.
6	Character 6	Character 6 was recognized by the recognition logic.
7	Character 7	Character 7 was recognized by the recognition logic.

Sense Data Byte 4		
0	Character 8	Character 8 was recognized by the recognition logic.
1	Character 9	Character 9 was recognized by the recognition logic.
2	Character ⎍ or N	Symbol ⎍ of the USASCOCR font selection or symbol N of the UNIVAC H–14 font selection was recognized by the recognition logic.
3	Symbol ⍦ or F	Symbol ⍦ of the USASCOCR font selection or symbol F of the UNIVAC H–14 font selection was recognized by the recognition logic.
4	Symbol ⍈ or \	Symbol ⍈ of the USASCSOCR font selection or symbol \ of the UNIVAC H–14 font selection was recognized by the recognition logic.
5		Not used. Bit always 0.
6	lvm	The long vertical mark of the UNIVAC H–14 or USASCSOCR font selections was recognized by the recognition logic.
7	Multiple	A multiple character was detected by the recognition logic.

5.9.3.15. 2521 Channel Transfer Switch

I/O sense data byte information for the channel transfer switch is transparent to you.

5.9.3.16. 9000 Series Channel Adapter

Bit Position	Bit Designation	Definition
0	Command reject	
1		Not used
2	Bus out check	
3	Equipment check	Indicates that a selective reset or bus out check occurred on the opposite processor
4	Data check	
5		Not used
6	Reject	Indicates that a test I/O override was generated by the opposite processor or that an interface disconnect sequence occurred on the opposite processor before a match
7		Not used

APPENDIX A. POWERS OF 2 TABLE

POWERS OF 2 TABLE

2^n	n	2^{-n}						
1	0	1.0						
2	1	0.5						
4	2	0.25						
8	3	0.125						
16	4	0.062	5					
32	5	0.031	25					
64	6	0.015	625					
128	7	0.007	812	5				
256	8	0.003	906	25				
512	9	0.001	953	125				
1 024	10	0.000	976	562	5			
2 048	11	0.000	488	281	25			
4 096	12	0.000	244	140	625			
8 192	13	0.000	122	070	312	5		
16 384	14	0.000	061	035	156	25		
32 768	15	0.000	030	517	578	125		
65 536	16	0.000	015	258	789	062	5	
131 072	17	0.000	007	629	394	531	25	
262 144	18	0.000	003	814	697	265	625	
524 288	19	0.000	001	907	348	632	812	5

POWERS OF 2 TABLE (cont)

2^n	n	2^{-n}
1 048 576	20	0.000 000 953 674 316 406 25
2 097 152	21	0.000 000 476 837 158 203 125
4 194 304	22	0.000 000 238 418 579 101 562 5
8 388 608	23	0.000 000 119 209 289 550 781 25
16 777 216	24	0.000 000 059 604 644 775 390 625
33 554 432	25	0.000 000 029 802 322 387 695 312 5
67 108 864	26	0.000 000 014 901 161 193 847 656 25
134 217 728	27	0.000 000 007 450 580 596 923 828 125
268 435 456	28	0.000 000 003 725 290 298 461 914 062 5
536 870 912	29	0.000 000 001 862 645 149 230 957 031 25
1 073 741 824	30	0.000 000 000 931 322 574 615 478 515 625
2 147 483 648	31	0.000 000 000 465 661 287 307 739 257 812 5
4 294 967 296	32	0.000 000 000 232 830 643 653 869 628 906 25
8 589 934 592	33	0.000 000 000 116 415 321 826 934 814 453 125
17 179 869 184	34	0.000 000 000 058 207 660 913 467 407 226 562 5
34 359 738 368	35	0.000 000 000 029 103 830 456 733 703 613 281 25
68 719 476 736	36	0.000 000 000 014 551 915 228 366 851 806 640 625
137 438 953 472	37	0.000 000 000 007 275 957 614 183 425 903 320 312 5
274 877 906 944	38	0.000 000 000 003 637 978 807 091 712 951 660 156 25
549 755 813 888	39	0.000 000 000 001 818 989 403 545 856 475 830 078 125
1 099 511 627 776	40	0.000 000 000 000 909 494 701 772 928 237 915 039 062 5

POWERS OF 2 TABLE (cont)

APPENDIX B. POWERS OF 16 TABLE

POWERS OF 16 TABLE

16^n	n
1	0
16	1
256	2
4 096	3
65 536	4
1 048 576	5
16 777 216	6
268 435 456	7
4 294 967 296	8
68 719 476 736	9
1 099 511 627 776	10
17 592 186 044 416	11
281 474 976 710 656	12
4 503 599 627 370 496	13
72 057 594 037 927 936	14
1 152 921 504 606 846 976	15

These powers of 16 are especially useful in determining the value of floating-point numbers.