UNISYS

OS/3 Hardware and Software

Programming Quick-Reference Guide

Relative to Release Level 11.0

Priced Item

August 1987

Printed in U S America
UP-8868 Rev. 2

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Previous Title: OS/3 Hardware and Software Summary

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PAGE STATUS SUMMARY

ISSUE: Update B – UP-8868 Rev. 2
RELEASE LEVEL: 11.0 Forward

Part/Section	Page Number	Update Level
Cover		B
Title Page/Disclaimer		B*
PSS	1, 2	B
Preface	1, 2	Orig.
	3	A
Contents	1	Orig.
	2 thru 5	B
Tab Breaker		Orig.
1	1 thru 30	Orig.
Tab Breaker		Orig.
2	1 thru 52	Orig.
Tab Breaker		Orig.
3	1 thru 30	Orig.
	31	A
	32	B
Tab Breaker		Orig.
4	1 thru 3	Orig.
	4	B
	4a	A
	4b, 4c	B
	4d thru 4h	A*
	4i	B*
	5	A
	6 thru 9	Orig.
	9a thru 9f	A*
	10 thru 13	Orig.
	13a, 13b	A*
	14, 15	Orig.

*New pages **Deleted pages

Part/Section	Page Number	Update Level
4 (cont)	15a thru 15c	A*
	16	A
	17	Orig.
	17a thru 17l	A*
	18	Orig.
	19	B
	20	Orig.
	20a, 20b	B
	20c	B**
	21 thru 60	Orig.
	61 thru 84	A
	85 thru 114	Orig.
	114a thru 114m	A*
	115 thru 138	Orig.
	138a thru 138c	A*
	139 thru 150	Orig.
	150a thru 150h	A*
	151	A
	152 thru 161	Orig.
	162	A
	162a thru 162yy	A*
	163 thru 216	Orig.
	216a, 216b	B
	216c	A
	216d	B
	216e	A
	216f	B
	216g	A
	216h	B
	216i	A
	216j	B
	216k	A
	216l	B
	216m	A
	216n thru 216p	B
	216q	A
	217 thru 252	B
Tab Breaker		Orig.
Appendix A	1, 2	Orig.
Appendix B	1	Orig.
User Comment Form		

Preface

This document is one in a series designed to describe the hardware and software of SPERRY System 80 and the Operating System/3 (OS/3). This particular summary is a quick-reference manual for use in detecting hardware errors and in analyzing dumps. It is not necessary to understand the content of this manual to successfully use System 80.

This manual consists of tables and figures abstracted from other OS/3 publications. The information presented is limited to facts; no introductory information or examples of use are provided. The descriptive information for the subjects summarized in this manual is contained in the System 80 processor programmer reference, UP-8881 (current version), the I/O integrated controllers programmer reference, UP-8742 (current version), the OS/3 assembler user guide, UP-8913 (current version), and the supervisor macroinstructions user guide/programmer reference, UP-8832 (current version).

The manual is divided into the following sections:

- Section 1. General

  Contains information of a general nature, including EBCDIC and ASCII character sets, tables for conversion, and a table for hexadecimal-decimal conversion.

- Section 2. Machine Code

  Contains information about the formats and functions of the general machine instructions. Instructions are listed by machine code and instruction name.

- Section 3. Supervisor

  Contains OS/3 supervisor related information such as the program status word (PSW) format, the control register format, the layout for low-order main storage, the input formats for the monitor and trace functions, and a summary of the system debugging aids.

- Section 4. PIOCS

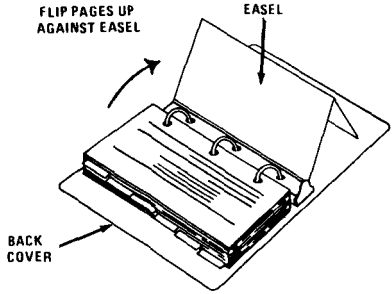
  Contains information primarily related to the OS/3 physical input/output control system, including the peripheral device addresses, command codes, status byte definitions, and I/O sense data byte definitions. This information cannot be used by a programmer for developing programs with physical I/O level interface.

- Appendixes

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

To use this manual most effectively, order the binder (BD-0023) and the fold-up easel (BD-0023.1) from your Sperry representative. To assemble, open the front cover and open the rings. Hook the folded vinyl easel onto the rings at the left-hand side. The shorter flap of the easel (the side without punched holes) should lie against the front cover of the open binder. Place the cover/title page and the following text and tabs on the rings on the right-hand side. Close the rings. Lay the book flat on your desk or workstation so that the long side of the back cover is facing you. Open the cover and unfold the easel so that it forms a triangle with the front cover of the book. Now raise the pages up against the easel. You can now flip through the text, guided by the tabs.

Text:	UP-8868 Rev. 2-A
Binder:	BD-0023
Easel:	BD-0023.1



NOTE: *To receive both the binder and easel, you must indicate both BD numbers to your Sperry representative.*

Contents

1.1. STATEMENT CONVENTIONS

Statement Conventions

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

	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	'	p
1	SOH	DC1	! ①	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w

ASCII CHARACTER CODES (cont)

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

② ③

④

NOTES:

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

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	DLE	DS (1)		SP	&	–						¦ (4)	¦ (4)	\ (4)	0
1	SOH	DC1	SOS (1)				/		a (4)	j	~ (4)		A	J		1
2	STX	DC2	FS (1)	SYN					b	k	s		B	K	S	2
3	ETX	DC3							c	l	t		C	L	T	3
4									d	m	u		D	M	U	4
5	HT		LF						e	n	v		E	N	V	5
6		BS	ETB						f	o	w		F	O	W	6
7	DEL		ESC	EOT					g	p	x		G	P	X	7
8		CAN							h	q	y		H	Q	Y	8
9		EM						(4)	i	r	z		I	R	Z	9

EBCDIC CHARACTER CODES (cont)

A					[	] ⑤	¦ ③	:								
B	VT				.	$	,	#								
C	FF	FS ⑤		DC4 ⑥	<	*	%	@								
D	CR	GS ⑤	ENQ	NAK	(	)	—	'								
E	SO ⑤	RS ⑤	ACK		+	;	>	=								
F	SI ⑤	US ⑤	BEL	SUB	! ② ⑤	¬ ②	?	"								

NOTES:

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.

⑤ The following substitutions are made for the UTS 400 handler:

SPROT	(start protected) for SO	FCC	(field control character) for US
EPROT	(end protected) for SI	MW	(message writing) for BEL
SB	(start blink) for FS	]	for !
EB	(end blink) for GS	!	for]
SOE	(start of entry) for RS		

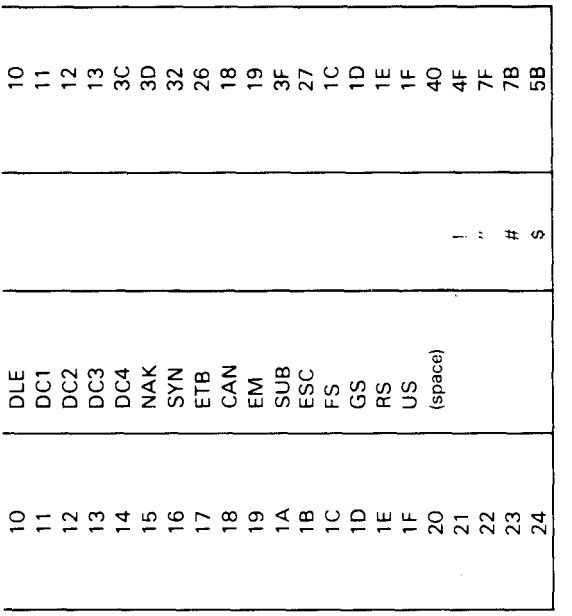
⑥ DC4 for the UTS 400 handler

1.4. HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS

Hexadecimal Character Codes

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)

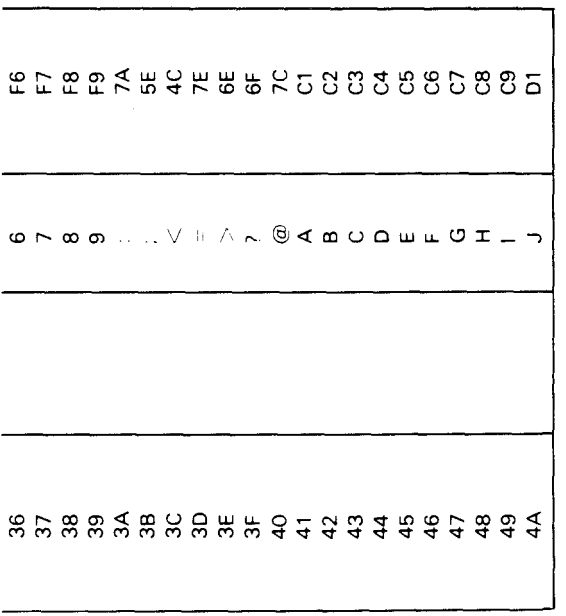


10	DLE			10
11	DC1			11
12	DC2			12
13	DC3			13
14	DC4			3C
15	NAK			3D
16	SYN			32
17	ETB			26
18	CAN			18
19	EM			19
1A	SUB			3F
1B	ESC			27
1C	FS			1C
1D	GS			1D
1E	RS			1E
1F	US			1F
20	(space)			40
21		!		4F
22		"		7F
23		#		7B
24		$		5B

Hexadecimal Character Codes (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

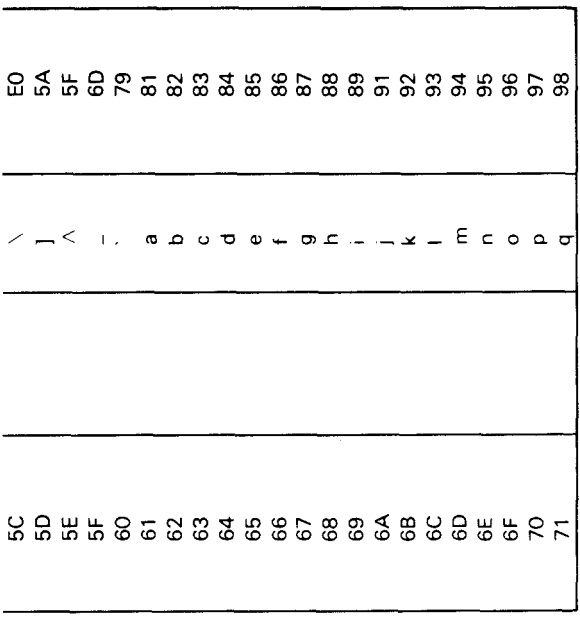
HEXADECIMAL CONVERSION TABLE FOR DUMP ANALYSIS (cont)



Hexadecimal Character Codes (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 Character Codes (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

CHARACTER CONVERSION TABLE (cont)

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

CHARACTER CONVERSION TABLE (cont)

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

CHARACTER CONVERSION TABLE (cont)

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	5A 4F	90 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

CHARACTER CONVERSION TABLE (cont)

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	4F 6A	79 106
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

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.

1.6. HEXADECIMAL-DECIMAL CONVERSION TABLE

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

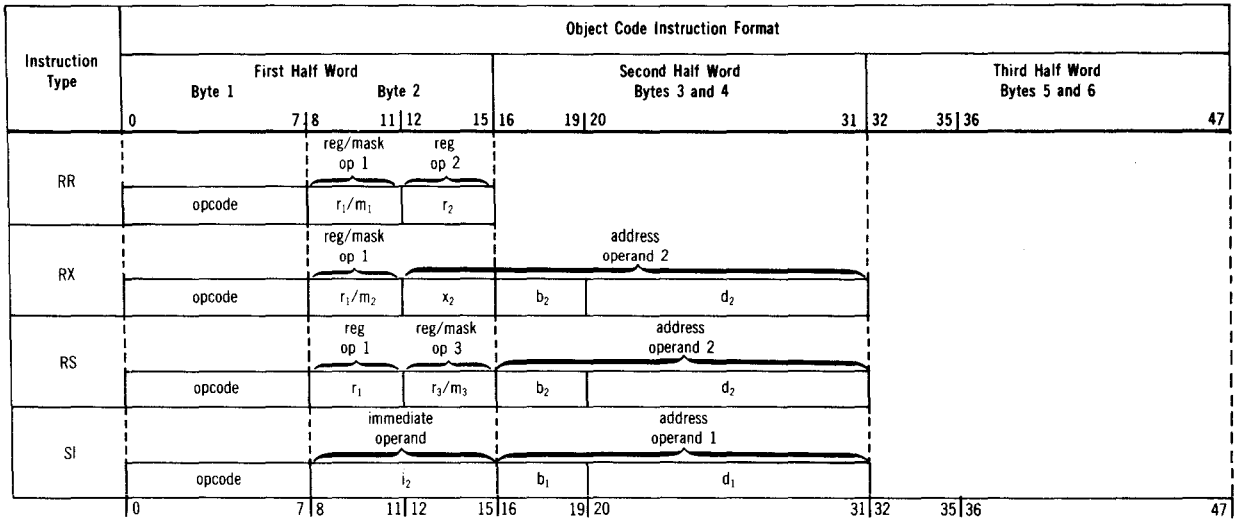
Sign Conventions

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	

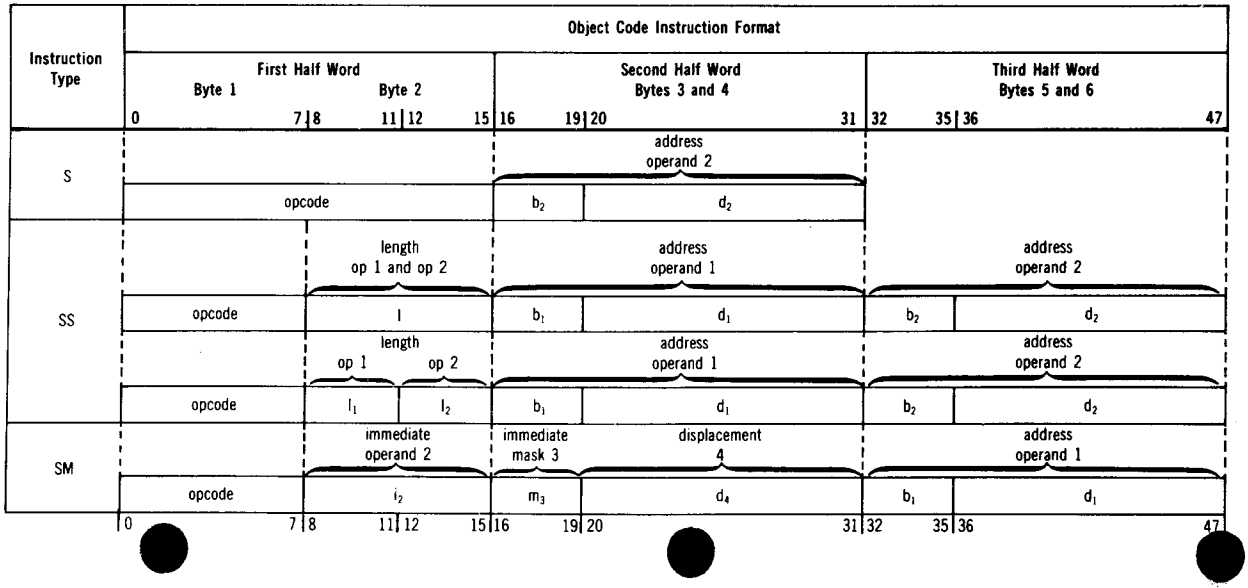
Linkage Register Conventions

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

2.1.1. Instruction Formats



Instruction Formats (cont)



Characters	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_2	The immediate data used as operand 2 of an SI instruction
l	The length of the operands as stated in object code*
l_1	The length of operand 1 as stated in object code*
l_2	The length of operand 2 as stated in object 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
d_4	The displacement used as operand 4 of an SM instruction
m_1	The mask used as operand 1
m_3	The mask used as operand 3
op_1	Operand 1
op_2	Operand 2
op_3	Operand 3

*Always one less than actual length.

2.1.2.1. Instructions by Machine Code

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
03	Service timer register	RR	(privileged)		PR, SP	25
04	Set program mask	RR	$PSW_{34-39} \leftarrow R1_{2-7}$	18		
05	Branch and link	RR	$R1 \leftarrow c(PSW)_{32-39}$; $\rightarrow c(R2)$			1
06	Branch on count	RR	$R1 \leftarrow c(R1) - 1$; $\rightarrow c(R2)$ if $c(R1) \neq 0$			
07	Branch on condition	RR	$\rightarrow c(R2)$ if (M1) cc = 1			
08	Set storage key	RR	(privileged; featured)		AC, OP, PR, SP	
09	Insert storage key	RR	(privileged; featured)		AC, OP, PR, SP	
0A	Supervisor call	RR	SVC interrupt; $(\text{old SVC PSW})_{24-31} \leftarrow I1$	19		
0B	Get IORB	RR	(privileged)	AC, PR	25	
0C	Put IORB	RR	(privileged)	AC, PR		
0E	Move characters long	RR	$c(R1) \leftarrow c(c(R2))$	1	AC, SP	2
0F	Compare logical long	RR		2	AC, SP	2
10	Load [illegible]tive	RR	$R1 \leftarrow \lvert c(R2) \rvert$	3	XO	

11	Load negative	RR	R1←—c|(R2)|	4		
12	Load and test	RR	R1←c(R2)	5		
13	Load complement	RR	R1←—c(R2)	6	XO	
14	AND	RR	R1←c(R1) AND c(R2)	7		
15	Compare logical	RR		2		
16	OR	RR	R1←c(R1) OR c(R2)	7		
17	Exclusive OR	RR	R1←c(R1) XOR c(R2)	7		
18	Load	RR	R1←c(R2)			
19	Compare	RR		2		
1A	Add	RR	R1←c(R1) + c(R2)	6	XO	
1B	Subtract	RR	R1←c(R1) — c(R2)	6	XO	
1C	Multiply	RR	[R1,R1 + 1]←c(R1 + 1) x c(R2)		SP	
1D	Divide	RR	R1←Remainder of [c(R1),c(R1 + 1)] /c(R2); R1 + 1←Quotient of [c(R1),c(R1 + 1)] /c(R2)		SP, XD	

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
1E	Add logical	RR	R1←c(R1) + c(R2)	8		
1F	Subtract logical	RR	R1←c(R1) — c(R2)	16		
20	Load positive, long	RR	FPR1←|c(FPR2)|	15	SP	3, 4
21	Load negative, long	RR	FPR1← — |c(FPR2)|	4	SP	3, 4
22	Load and test, long	RR	FPR1←c(FPR2)	5	SP	3, 4
23	Load complement, long	RR	FPR1← — c(FPR2)	5	SP	3, 4
24	Halve, long	RR	FPR1←c(FPR2)/2		SP, EU	3, 4
28	Load, long	RR	FPR1←c(FPR2)		SP	3, 4
29	Compare, long	RR		2	SP	3, 4
2A	Add normalized, long	RR	FPR1←c(FPR1) + c(FPR2)	5	SP, EO, EU, SG	3, 4
2B	Subtract normalized, long	RR	FPR1←c(FPR1) — c(FPR2)	5	SP, EO, EU, SG	3, 4
2C	Multiply, long	RR	FPR1←c(FPR1) x c(FPR2)		SP, EO, EU	3, 4

2D	Divide, long	RR	FPR1←c(FPR1)/c(FPR2)		SP, EO, EU, FD	3, 4
2E	Add unnormalized, long	RR	FPR1←c(FPR1) + c(FPR2)	5	SP, EO, SG	3, 4, 5
2F	Subtract unnormalized, long	RR	FPR1←c(FPR1) — c(FPR2)	5	SP, EO, SG	3, 4, 5
30	Load positive, short	RR	FPR1←|c(FPR2)|	15	SP	3
31	Load negative, short	RR	FPR1←|c(FPR2)| —	4	SP	3
32	Load and test, short	RR	FPR1←c(FPR2)	5	SP	3
33	Load complement, short	RR	FPR1← — c(FPR2)	5	SP	3
34	Halve, short	RR	FPR1←c(FPR2)/2		SP, EU	3
38	Load, short	RR	FPR1←c(FPR2)		SP	3
39	Compare, short	RR		2	SP	3
3A	Add normalized, short	RR	FPR1←c(FPR1) + c(FPR2)	5	SP, EO, EU, SG	3
3B	Subtract normalized, short	RR	FPR1←c(FPR1) — c(FPR2)	5	SP, EO, EU, SG	3
3C	Multiply, short	RR	FPR1←c(FPR1) x c(FPR2)		SP, EO, EU	3
3D	Divide, short	RR	FPR1←c(FPR1)/c(FPR2)		SP, EO, EU, FD	3

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
3E	Add unnormalized, short	RR	FPR1←c(FPR1) + c(FPR2)	5	SP, EO, SG	3, 5
3F	Subtract unnormalized, short	RR	FPR1←c(FPR1) — c(FPR2)	5	SP, EO, SG	3, 5
40	Store half word	RX	$S2_{0-15}$←$c(R1)_{16-31}$		AC, SP	
41	Load address	RX	$R1_{8-31}$←S2; $R1_{0-7}$←0			
42	Store character	RX	$S2_{0-7}$←$c(R1)_{24-31}$		AC	
43	Insert character	RX	$R1_{24-31}$←$c(S2)_{0-7}$		AC	
44	Execute	RX	Execute subject instruction at S2, modified by $c(R1)_{24-31}$	20	AC, SP, EX	6
45	Branch and link	RX	R1←$c(PSW)_{32-63}$; →S2			
46	Branch on count	RX	R1←c(R1)—1; →S2 if c(R1)≠0			
47	Branch on condition	RX	→S2 if (M1) $_{CC}$=1			
48	Load half word	RX	$R1_{16-31}$←$c(S2)_{0-15}$; $R1_{0-15}$←$c(S2)_0$		AC, SP	

49	Compare half word	RX		2	AC, SP	7
4A	Add half word	RX	R1←c(R1) + $c(S2)_{0-15}$	6	AC, SP, XO	7
4B	Subtract half word	RX	R1←c(R1) — $c(S2)_{0-15}$	6	AC, SP, XO	7
4C	Multiply half word	RX	R1←$(c(R1) \times c(S2)_{0-15})_{16-47}$		AC, SP	7
4E	Convert to decimal	RX	$S2_{0-63}$ (packed decimal)←c(R1) (binary)		AC, SP	
4F	Convert to binary	RX	R1(binary)←$c(S2)_{0-63}$ (packed decimal)		AC, SP, DT, XD	
50	Store	RX	S2←c(R1)		AC, SP	
51	Load directive address	RX	(privileged)		AC, PR, SP	
54	AND	RX	R1←c(R1) AND c(S2)	7	AC, SP	
55	Compare logical	RX		2	AC, SP	
56	OR	RX	R1←c(R1) OR c(S2)	7	AC, SP	
57	Exclusive OR	RX	R1←c(R1) XOR c(S2)	7	AC, SP	
58	Load	RX	R1←c(S2)		AC, SP	
59	Compare	RX		2	AC, SP	

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
5A	Add	RX	R1←c(R1) + c(S2)	6	AC, SP, XO	
5B	Subtract	RX	R1←c(R1) — c(S2)	6	AC, SP, XO	
5C	Multiply	RX	[R1,R1 + 1] ← c(R1 + 1) x c(S2)		AC, SP	
5D	Divide	RX	R1 Remainder of [c(R1),c(R1 + 1)] /c(S2); R1 + 1←Quotient of [c(R1),c(R1 + 1)] /c(S2)		AC, SP, XD	
5E	Add logical	RX	R1←c(R1) + c(S2)	8	AC, SP	
5F	Subtract logical	RX	R1←c(R1) — c(S2)	16	AC, SP	
60	Store, long	RX	S2←c(FPR1)		AC, SP	3, 4
61	Load I/O address	RX	(privileged)		PR, SP	
68	Load, long	RX	FPR1←c(S2)		AC, SP	3, 4
69	Compare, long	RX		2	AC, SP	3, 4

6A	Add normalized, long	RX	FPR1←c(FPR1) + c(S2)	5	AC, SP, EU, EO, SG	3, 4
6B	Subtract normalized, long	RX	FPR1←c(FPR1) — c(S2)	5	AC, SP, EU, EO, SG	3, 4
6C	Multiply, long	RX	FPR1←c(FPR1) x c(S2)		AC, SP, EU, EO	3, 4
6D	Divide, long	RX	FPR1←c(FPR1)/c(S2)		AC, SP, EU, EO, FD	3, 4
6E	Add unnormalized, long	RX	FPR1←c(FPR1) + c(S2)	5	AC, SP, EO, SG	3, 4, 5
6F	Subtract unnormalized, long	RX	FPR1←c(FPR1) — c(S2)	5	AC, SP, EO, SG	3, 4, 5
70	Store, short	RX	S2←c(FPR1)		AC, SP	3
78	Load, short	RX	FPR1←c(S2)		AC, SP	3
79	Compare, short	RX		2	AC, SP	3
7A	Add normalized, short	RX	FPR1←c(FPR1) + c(S2)	5	AC, SP, EU, EO, SG	3
7B	Subtract normalized, short	RX	FPR1←c(FPR1) — c(S2)	5	AC, SP, EU, EO, SG	3
7C	Multiply, short	RX	FPR1←c(FPR1) x c(S2)		AC, SP, EU, EO	3
7D	Divide, short	RX	FPR1←c(FPR1)/c(S2)		AC, SP, EU, EO, FD	3
7E	Add unnormalized, short	RX	FPR1←c(FPR1) + c(S2)	5	AC, SP, EO, SG	3, 5

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
7F	Subtract unnormalized, short	RX	FPR1←c(FPR1) — c(S2)	5	AC, SP, EO, SG	3, 5
80	Set system mask	S	(privileged)		AC, PR	
81	Move I/O	RS	(privileged)		AC, PR, SP	25
82	Load PSW	S	(privileged)		AC, PR, SP	25
8300	Execute diagnose	S	(privileged)		AC, EX, PR, SP	25
8301	Reset	S	(privileged)		OP, PR, SP	25
8302	Store status	S	(privileged)		AC, OP, PR, SP	
8303	Initial program load	S	(privileged)		PR	
830E	Longitudinal redundancy check	S	(privileged)		AC, PR, SP	25
830F	Switch list scan	S	(privileged)		PR, SP	25
86	Branch on index high	RS	R1←c(R1) + c(R3); if R3 is odd, →S2 if c(R1)>c(R3); if R3 is even, →S2 if c(R1)>c(R3 + 1)			

87	Branch on index low or equal	RS	R1←c(R1) + c(R3); if R3 is odd, →S2 if c(R1)≤c(R3); if R3 is even, →S2 if c(R1)≤c(R3+1)			
88	Shift right single logical	RS	Right shift $(R1)_{0-31}$, fill with 0's			8
89	Shift left single logical	RS	Left shift $(R1)_{0-31}$, fill with 0's			8
8A	Shift right single	RS	Right shift $(R1)_{1-31}$, fill with $c(R1)_0$	5		8
8B	Shift left single	RS	Left shift $(R1)_{1-31}$, fill with 0's	6	XO	8
8C	Shift right double logical	RS	Right shift $[R1,R1 + 1]_{0-63}$, fill with 0's		SP	8
8D	Shift left double logical	RS	Left shift $[R1,R1 + 1]_{0-63}$, fill with 0's		SP	8
8E	Shift right double	RS	Right shift $[R1,R1 + 1]_{1-63}$, fill with $c(R1)_0$	5	SP	8
8F	Shift left double	RS	Left shift $[R1,R1 + 1]_{1-63}$, fill with 0's	6	SP, XO	8
90	Store multiple	RS	S2,...←c(R1),c(R1 + 1),...,c(R3)		AC, SP	9
91	Test under mask	SI		9	AC	
92	Move immediate	SI	$S1_{0-7}$←I2		AC	

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
93	Test and set	S	$S1_{0-7}$←X'FF'	10	AC	
94	AND immediate	SI	$S1_{0-7}$←c$(S1)_{0-7}$AND I2	7	AC	
95	Compare logical immediate	SI		2	AC	
96	OR immediate	SI	$S1_{0-7}$←c$(S1)_{0-7}$ OR I2	7	AC	
97	Exclusive OR immediate	SI	$S1_{0-7}$←c$(S1)_{0-7}$ XOR I2	7	AC	
98	Load multiple	RS	R1, R1 + 1,...,R3←c(S2)		AC, SP	9
99	Halt and proceed	SI	(privileged)		PR	
9A	Add immediate	SI	$S1_{0-15}$←$S1_{0-15}$ + I2	6	AC, SP, XO	10
9B	Shift logical	RS	Shift R1 or [R1,R1 + 1] according to M3 bits	11	SP	8, 11
9C02	Start device	S	(privileged)		AC, PR, SP	25
9DX2	Clear device	RS	(privileged)		AC, PR, SP	25

9E01	Halt device	S	(privileged)		AC, PR	25
9F02	Clear channel	S	(privileged)		AC, PR, SP	25
9F03	Load channel register	S	(privileged)		AC, PR, SP	25
A2	Store relocation register	RS	(privileged)		AC, PR, SP	
A3	Load relocation register	RS	(privileged)		AC, PR, SP	
B0	Supervisor store multiple	RS	(privileged)		AC, PR, SP	
B6	Store control	RS	(privileged)		AC, PR, SP	
B7	Load control	RS	(privileged)		AC, PR, SP	
B8	Supervisor load multiple	RS	(privileged)		AC, PR, SP	

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
B9	Compare and swap under mask	RS	Compares c(S2) and c(R1 + 1) masked by c(R1); if comparands are equal, S2 (masked by c(R3)) ←c(R3 + 1)	2	AC, SP	12
BD	Compare logical characters under mask	RS		2	AC	13
BE	Store characters under mask	RS	S2←c(R1) under M3 mask		AC	13
BF	Insert characters under mask	RS	R1 (under M3 mask)←c(S2)	12	AC	13
D1	Move numerics	SS	S1←c(S2)		AC	14, 15
D2	Move	SS	S1←c(S2)		AC	14
D3	Move zones	SS	S1←c(S2)		AC	14, 16
D4	AND	SS	S1←c(S1) AND c(S2)	7	AC	14

D5	Compare logical	SS		2	AC	14
D6	OR	SS	S1←c(S1) OR c(S2)	7	AC	14
D7	Exclusive OR	SS	S1←c(S1) XOR c(S2)	7	AC	14
DC	Translate	SS	S1←c(S2)		AC	14, 17
DD	Translate and test	SS	Register 1_{8-31}←address of nonzero result byte Register 2_{24-31}←nonzero result byte	14	AC	14, 18
DE	Edit	SS	S1←c(S2)	17	AC, DT	19
DF	Edit and mark	SS	S1←c(S2); Register 1_{8-31}←address of first significant digit	17	AC, DT	19
E0	Enqueue I/O	SS	(privileged)		AC, PR, SP	25
E1	Compare logical immediate and skip	SM	→(PSW_{40-63} + D4) if condition code and M3 mask permit	13	AC, SP	20
E2	Test under mask and skip	SM	→(PSW_{40-63} + D4) if condition code and M3 mask permit	9	AC, SP	20

Instructions by Machine Code (cont)

Machine Code	Instruction Name	Type	Action*	CC Setting**	Exceptions†	Notes††
F0	Shift and round decimal	SS	c(S1) shifted right or left, rounded by factor I3	6	AC, DT, DO	8, 21
F1	Move with offset	SS	S1←c(S2)		AC	22, 23
F2	Pack	SS	S1(packed decimal)←c(S2) (zoned decimal)		AC	22
F3	Unpack	SS	S1(zoned decimal)←c(S2) (packed decimal)		AC	22
F8	Zero and add	SS	S1←packed decimal 0; S1←c(S1) + c(S2)	6	AC, DT, DO	22
F9	Compare decimal	SS		2	AC, DT	22
FA	Add decimal	SS	S1←c(S1) + c(S2)	6	AC, DT, DO	22
FB	Subtract decimal	SS	S1←c(S1) — c(S2)	6	AC, DT, DO	22
FC	Multiply decimal	SS	S1←c(S1) x c(S2)		AC, SP, DT	22
FD	Divide decimal	SS	S1←[quotient of c(S1)/c(S2), remainder of c(S1)/c(S2)]		AC, SP, DT, DD	22, 24

*The meaning of the abbreviations in this column are:

R1	the number of the general register used as operand 1
R2	the number of the general register used as operand 2
R3	the number of the general register used as operand 3
S1	the main storage address used as operand 1
S2	the main storage address used as operand 2
FPR1	the number of the floating-point register used as operand 1
FPR2	the number of the floating-point register used as operand 2
M1	the 4-bit mask used as operand 1
$(Mn)_{cc}$	the operand n mask bit corresponding to the current condition code, 0 to 3
M3	the 4-bit mask used as operand 3

Instructions by Machine Code (cont)

I1	the 8-bit immediate data used as the SVC instruction operand, bits 8—15 of the instruction
I2	the 8-bit immediate data used as operand 2
D4	the 12-bit binary displacement used as operand 4 of SM-type instructions
c(operand)	the contents of the specified operand; for example, S2 specifies the main storage address of operand 2 while c(S2) specifies the contents of operand 2.
operand $_{m[-n]}$	specifies that bit m of the operand is acted upon; if n is also specified, only bits m to n inclusive are acted upon. Bits are numbered left to right starting with 0.
[operand 1, operand 2]	concatenation of operands 1 and 2
[Rn,Rn+1]	the even-odd register pair addressed by register n.
PSW	program status word
←	replacement operator; signifies the replacement of data at the left operand with the right operand
→	branch; signifies that program control passes to the right operand location.

All operands are 32 bits long unless otherwise noted.

**The CC settings are:

1.	Op1 length = Op2 length	Op1 length < Op2 length	Op1 length > Op2 length	Destructive overlap; no move performed
2.	Op1 = Op2	Op1 < Op2	Op1 > Op2	
3.	Result = 0		Result > 0	Overflow
4.	Result = 0	Result < 0		
5.	Result = 0	Result < 0	Result > 0	
6.	Result = 0	Result < 0	Result > 0	Overflow
7.	Result = 0	Result ≠ 0		
8.	Result = 0, no carry	Result ≠ 0, no carry	Result = 0, carry	Result ≠ 0, carry

Instructions by Machine Code (cont)

9.	All selected bits = 0 or c(I2) = 0	Selected bits are mixed, some 0 and some 1		All selected bits = 1
10.	$c(S2)_0 = 0$	$c(S2)_0 = 1$		
11.	Result = 0, all 0's shifted out	Result = 0, 1 or more 1's shifted out	Result ≠ 0, all 0's shifted out	Result ≠ 0, 1 or more 1's shifted out
12.	All inserted bits = 0 or c(M3) = 0	High-order inserted bit = 1	High-order inserted bit = 0 but not all inserted bits are 0's	
13.	Op2 = Op3	Op2 < Op3	Op2 > Op3	
14.	All result bytes = 0	Result byte ≠ 0 and is not last byte of op1	Result byte ≠ 0 and is last byte of op1	
15.	Result = 0		Result > 0	
16.		Result ≠ 0, no carry	Result = 0, carry	Result ≠ 0, carry

17. Last field examined = 0 | Last field examined ≠ 0, and plus sign is not detected | Last field examined > 0

18. Set = to bit positions 2 and 3 of the first operand

19. Set = to bit positions 34 and 35 of the supervisor call new PSW (unchanged in the old PSW)

20. Condition code may be set by the subject instruction

†Exception codes, in parentheses, are those contained in program status word (PSW) bits 24—31.

AC access (protection (04) or addressing (05))

DT data (07)

DD decimal divide (0B)

DO decimal overflow (0A)

EX execute (03)

Instructions by Machine Code (cont)

EO exponent overflow (0C)

EU exponent underflow (0D)

XD fixed-point divide (09)

XO fixed-point overflow (08)

FD floating-point divide (0F)

OP operation (01)

PR privileged operation (02)

SG significance (0E)

SP specification (06)

††The explanations for this column are:

1. No branch is taken if R2 = 0.

2. Operands 1 and 2 both are even-odd register pairs. $c(R1+1)_{8-31}$ is the length of operand 1, $c(R2+1)_{8-31}$ is the length of operand 2, and $c(R2+1)_{0-7}$ is the pad byte.

3. Operands are in floating-point form and normalized except where noted.

4. Operands are 64 bits long.

5. Normalization is not performed on result.

6. Before subject instruction is executed, an OR operation using specified R1 bits is performed on bits 8—15 of the instruction.

7. Before the operation begins, the half-word operand is expanded to 32 bits by propagating $c(S2)_0$ through the high-order 16 bit positions.

8. Length of shift is given by low-order six bits of S2.

9. If R1 > R3, registers wrap around: ...,15,0,... IF R1 = R3, only that register is used. Main storage operand addresses the leftmost byte of main storage used. Length of operand is 4 bytes if R1 = R3, 4 x (R3 — R1 + 1) bytes if R3 > R1, or 4 x (R3 — R1 + 17) bytes if R3 < R1.

10. Prior to addition, the immediate operand is expaned to 16 bits, $(I2)_0$ being propagated through the high-order 8 bits.

11. Bits 12—15 in the instruction govern the shift as follows:

Bit 12: 0	discard bits shifted out; 1	circular shift
Bit 13: 0	shift left; 1	shift right

Instructions by Machine Code (cont)

Bit 14: 0	shift single register; 1	shift even-odd register pair
Bit 15: 0	shift in 0's; 1	shift in 1's

12. R1 and R3 contain 32-bit masks. For $_m$ = bit positions 0—31, c(R1+1) takes part in the comparison only if c(R1) $_m$ = 1, and c(R3+1) $_m$ replaces c(S2) $_m$ only if c(R3) $_m$=1.

13. The 4 bit mask contained in M3 determines which bytes of R1 take part in the operation. For n = mask bits 0 to 3, $c(R1)_{8n \text{ —} (8n+7)}$ takes part if M3 $_n$ = 1 but is masked out if M3 $_n$ = 0. Main storage bytes are contiguous.

14. The operand length minus 1 is given by bits 8—15 of the instruction.

15. Only the low-order 4 bits of each operand 2 byte are moved.

16. Only the high-order 4 bits of each operand 2 byte are moved.

17. Each byte of S1 is replaced by a byte addressed by S2 so that S1 ← $c(S2 + c(S1))_{0-7}$.

18. The instruction scans S1 until it finds a nonzero byte or until it has scanned all of S1.

19. Operand 2, which must be in packed format, is unpacked and edited under control of operand 1, the pattern, whose length is given in bits 8—15 of the instruction. See 2.1.3 for edit instruction settings.

20. Branch to PSW + D4 only if $c(M3)_{cc} = 1$; M3 is bits 16—19 of the instruction.

21. The low-order 4 bits of c(S1) are left unchanged and 0's are shifted in. The direction of the shift is determined by S2; the high-order bit of the 6-bit shift length in S2 is set to 0 for a left shift, or to 1 for a right shift.

22. The operand 1 length minus 1 is given by bits 8—11 of the instruction, the operand 2 length minus 1 given by bits 12—15.

23. The S2 bytes are shifted left one half byte when placed in S1, thus leaving the rightmost half byte of S1 unchanged.

24. The remainder occupies the rightmost bytes of the operand 1 result and is equal in length to the S2 divisor. The quotient occupies the rest of operand 1.

25. This privileged instruction has possible condition code settings that are not described in this summary due to their complexity. Refer to the assembler user guide, UP-8913 (current version), for further information.

2.1.2.2. Instructions by Instruction Name

Instruction Name	Machine Code	Mnemonic
Add	1A	AR
Add	5A	A
Add decimal	FA	AP
Add half word	4A	AH
Add immediate	9A	AI
Add logical	1E	ALR
Add logical	5E	AL
Add normalized, long	2A	ADR

Add normalized, long	6A	AD
Add normalized, short	3A	AER
Add normalized, short	7A	AE
Add unnormalized, long	2E	AWR
Add unnormalized, long	6E	AW
Add unnormalized, short	3E	AUR
Add unnormalized, short	7E	AU
AND	14	NR
AND	54	N
AND	94	NI
AND	D4	NC

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Branch and link	05	BALR
Branch and link	45	BAL
Branch on condition	07	BCR
Branch on condition	47	BC
Branch on count	06	BCTR
Branch on count	46	BCT
Branch on index high	86	BXH
Branch on index low or equal	87	BXLE
Clear channel—privileged	9F02	CLRCH

Clear device—privileged	9DX2	CLRDV
Compare	19	CR
Compare	59	C
Compare and swap under mask	B9	CSM
Compare decimal	F9	CP
Compare half word	49	CH
Compare logical	15	CLR
Compare logical	55	CL
Compare logical	95	CLI
Compare logical	D5	CLC
Compare logical characters under mask	BD	CLM

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Compare logical immediate and skip	E1	CLIS
Compare logical characters long	0F	CLCL
Compare long	29	CDR
Compare long	69	CD
Compare, short	39	CER
Compare, short	79	CE
Convert to binary	4F	CVB
Convert to decimal	4E	CVD

Divide	1D	DR
Divide	5D	D
Divide decimal	FD	DP
Divide, long	2D	DDR
Divide, long	6D	DD
Divide, short	3D	DER
Divide, short	7D	DE
Edit	DE	ED
Edit and mark	DF	EDMK
Enqueue I/O — privileged	E0	EIO

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Exclusive OR	17	XR
Exclusive OR	57	X
Exclusive OR	97	XI
Exclusive OR	D7	XC
Execute	44	EX
Execute diagnose — privileged	8300	EXD
GET IORB — privileged	0B	GRB
Halt and proceed — privileged	99	HPR
Halt device — privileged	9E01	HDV
Halve, long	24	HDR

Halve, short	34	HER
Initial program load — privileged	8303	IPL
Insert character	43	IC
Insert characters under mask	BF	ICM
Insert storage key — privileged	09	ISK*
Load	18	LR
Load	58	L
Load address	41	LA
Load and test	12	LTR
Load and test, long	22	LTDR
Load and test, short	32	LTER
Load channel register — privileged	9F03	LCHR

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Load complement	13	LCR
Load complement, long	23	LCDR
Load complement, short	33	LCER
Load control — privileged	B7	LCTL
Load directive address — privileged	51	LDA
Load half word	48	LH
Load I/O address — privileged	61	LIA
Load, long	28	LDR
Load, long	68	LD

Load multiple	98	LM
Load negative	11	LNR
Load negative, long	21	LNDR
Load negative, short	31	LNER
Load positive	10	LPR
Load positive, long	20	LPDR
Load positive, short	30	LPER
Load PSW — privileged	82	LPSW
Load relocation register — privileged	A3	LRR
Load, short	38	LER
Load, short	78	LE

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Longitudinal redundancy check — privileged	830E	LRC
Move	92	MVI
Move	D2	MVC
Move I/O — privileged	81	MIO
Move characters long	0E	MVCL
Move numerics	D1	MVN
Move with offset	F1	MVO
Move zones	D3	MVZ

Multiply	1C	MR
Multiply	5C	M
Multiply decimal	FC	MP
Multiply half word	4C	MH
Multiply, long	2C	MDR
Multiply, long	6C	MD
Multiply, short	3C	MER
Multiply, short	7C	ME
OR	16	OR
OR	56	O
OR	96	OI

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
OR	D6	OC
Pack	F2	PACK
Put IORB — Privileged	0C	PRB
Reset — privileged	8301	RESET
Service timer register — privileged	03	STR
Set program mask	04	SPM
Set storage key — privileged	08	SSK*
Set system mask — privileged	80	SSM
Shift and round decimal	F0	SRP
Shift left double	8F	SLDA

Shift left double logical	8D	SLDL
Shift left single	8B	SLA
Shift left single logical	89	SLL
Shift logical	9B	SHL
Shift right double	8E	SRDA
Shift right double logical	8C	SRDL
Shift right single	8A	SRA
Shift right single logical	88	SRL
Start device — privileged	9C02	SDV
Store	50	ST

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Store character	42	STC
Store characters under mask	BE	STCM
Store control — privileged	B6	STCTL
Store half word	40	STH
Store, long	60	STD
Store multiple	90	STM
Store relocation register — privileged	A2	STRR
Store, short	70	STE
Store status — privileged	8302	STS

Instructions by Instruction Name (cont)

Subtract	1B	SR
Subtract	5B	S
Subtract decimal	FB	SP
Subtract half word	4B	SH
Subtract logical	1F	SLR
Subtract logical	5F	SL
Subtract normalized, long	2B	SDR
Subtract normalized, long	6B	SD
Subtract normalized, short	3B	SER
Subtract normalized, short	7B	SE
Subtract unnormalized, long	2F	SWR

Instructions by Instruction Name (cont)

Instruction Name	Machine Code	Mnemonic
Subtract unnormalized, long	6F	SW
Subtract unnormalized, short	3F	SUR
Subtract unnormalized, short	7F	SU
Supervisor call	0A	SVC
Supervisor load multiple — privileged	B8	SLM
Supervisor store multiple — privileged	B0	SSTM
Switch list scan — privileged	830F	SWLS
Test and set	93	TS
Test under mask	91	TM
Test under mask and skip	E2	TMS

Translate	DC	TR
Translate and test	DD	TRT
Unpack	F3	UNPK
Zero and add	F8	ZAP

*Added as a feature.

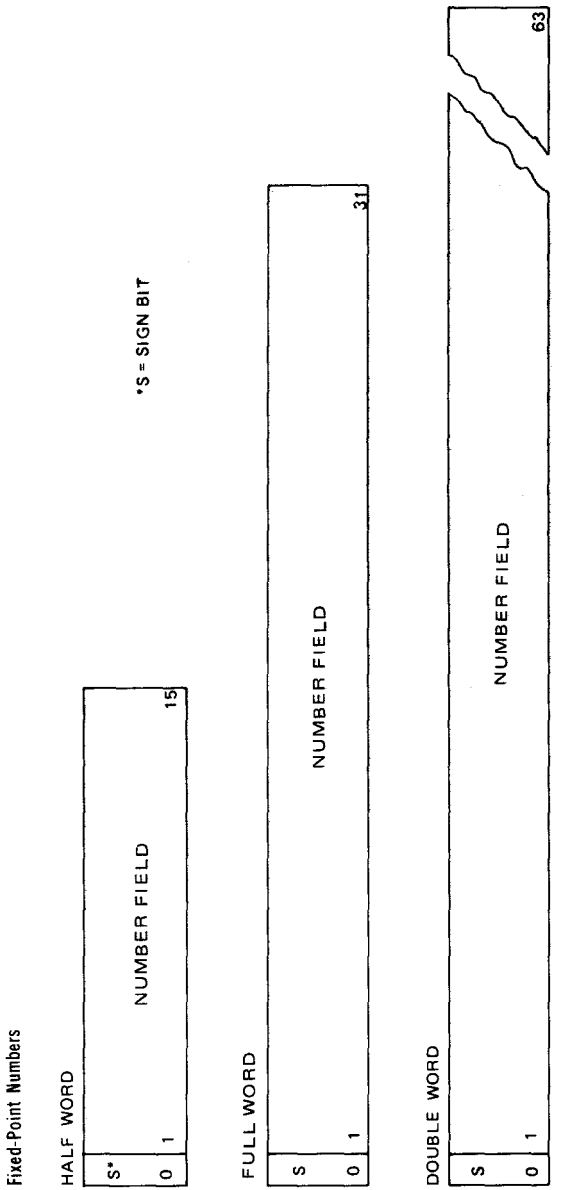
Edit Instruction Settings

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

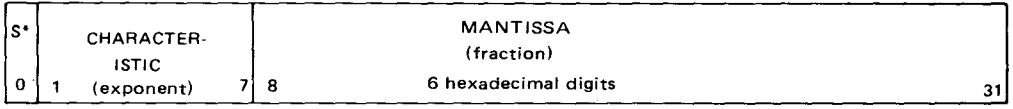
*Sign detection (examined simultaneously with operand 2 digit) affects the S switch as follows:

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.

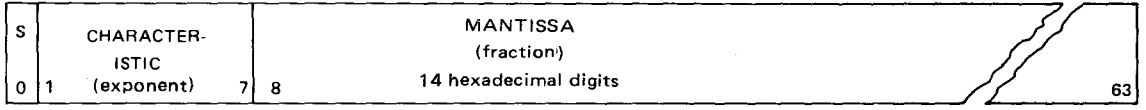

Fixed-Point Numbers
HALF WORD
S*
NUMBER FIELD
15
0
1
*S = SIGN BIT
FULL WORD
S
NUMBER FIELD
31
0
1
DOUBLE WORD
S
NUMBER FIELD
63
0
1

Floating-Point Numbers

FULL WORD (SHORT FORMAT)



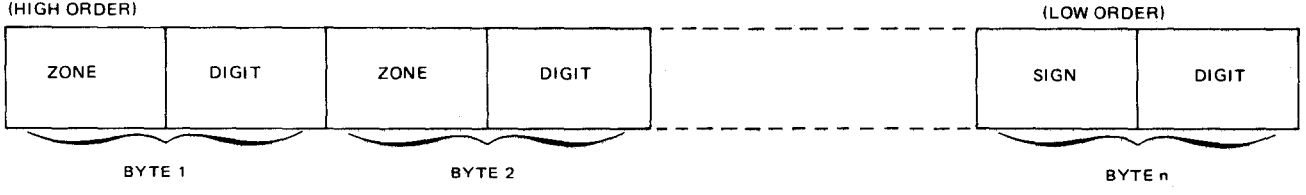
DOUBLE WORD (LONG FORMAT)



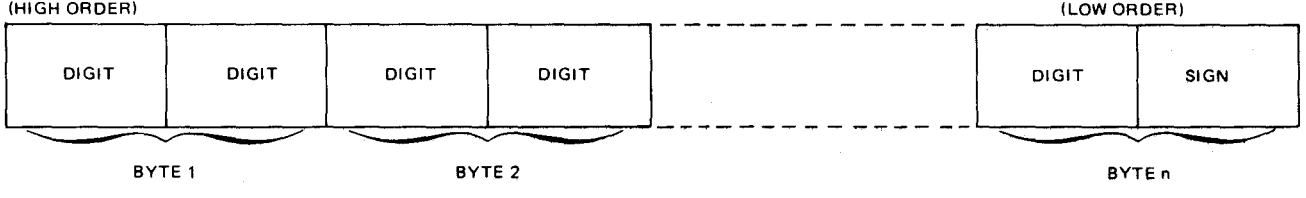
*S = SIGN BIT

Decimal Numbers

UNPACKED NUMBERS

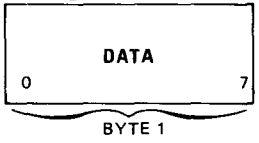


PACKED NUMBERS

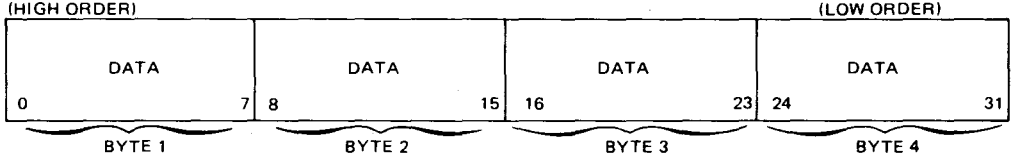


Logical Information

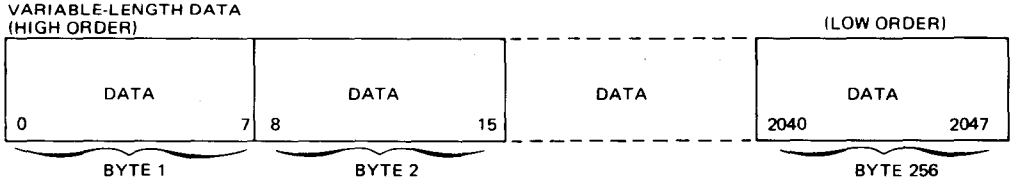
FIXED-LENGTH DATA



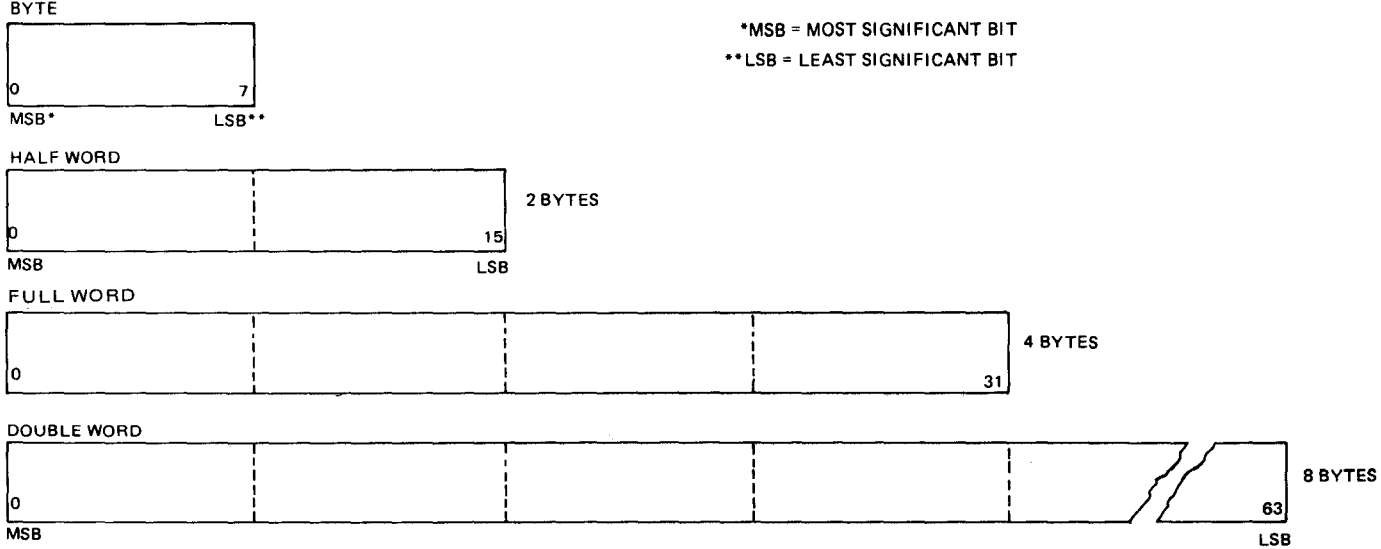
FULL WORD



VARIABLE-LENGTH DATA



Data Boundary Alignments



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

```
LABEL    ΔOPERATIONΔ  OPERAND        Δ              COMMENTS
1         10          16                                              72      80
         CNOP         0,4   0 BYTE OFFSET FROM FULL-WORD BOUNDARY
         CNOP         2,4   2 BYTE OFFSET FROM FULL-WORD BOUNDARY
         CNOP         0,8   0 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
```

3.1. MONITOR AND TRACE

3.1.1. 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

```
// JOB jobname                    }
.                                 }
.                                 } other required job control statements
.                                 }
// OPTION TRACE,...               (See note.)
// EXEC program-name
/$                                start of data                          }
task to be monitored              type (*U, *P, *S, or *T) = name or number }
option-1 action-1; ...; action-n  }                                      }
.                                 }                                      }
.                                 } option (S, A, or I) action (D, H, or Q) } monitor input
.                                 }                                      }
option-n action-1; ...; action-n  }                                      } (See note.)
$                                 end of monitor input                   }
/*                                end of data                            }
```

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

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

```
// PARAM.          (PARAM cards, if any)
/$                 start of data
                   user program data cards
/*                 end of data
/&                 end of job input
// FIN            end of card input
```

NOTE:

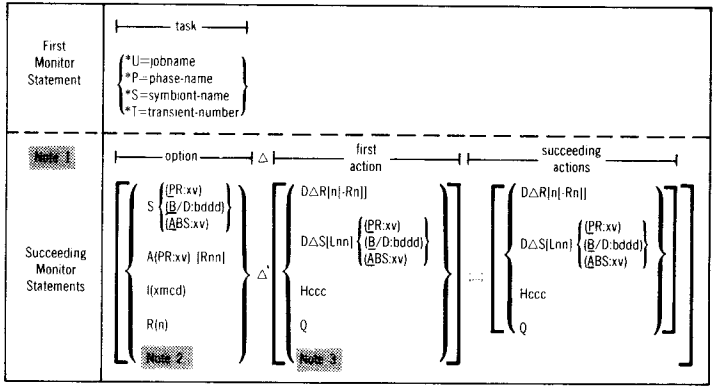
The TRACE entry is required if monitor input is entered via the job control stream.

3.1.2. 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

```
task to be monitored                type (*U, *P, *S, or *T) = name or number
option-1 action-1; ...; action-n  }
.                                 }
.                                 }  option (S, A, or I) action (D, H, or Q)
.                                 }
option-n action-1; ...; action-n  }
$                                   end of monitor input
```

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 3.1.4.)

3. If no action is specified, the monitor routine produces a default display.

3.1.4. Summary of Actions and Program Information Printed

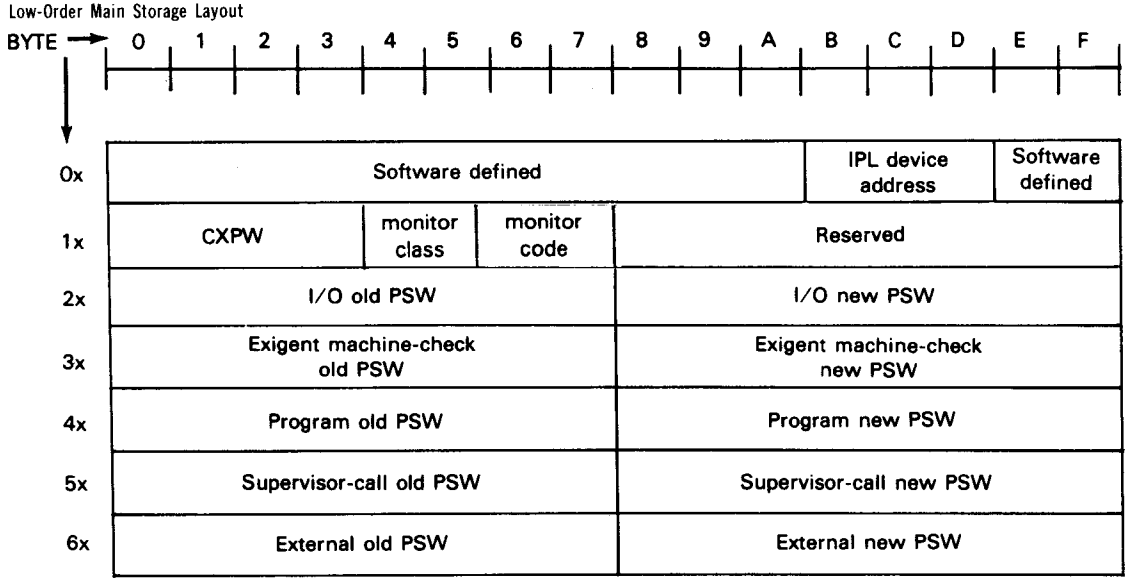
Summary of Actions and Program Information Printed

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				

Program Information Printed	Action				
	Display Register (D R)	Display Storage (D S)	Default Display	Halt (H)	Quit (Q)
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



Low-Order Main Storage Layout (cont)

BYTE	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
7x	Repressible machine-check old PSW								Repressible machine-check new PSW							
8x	PER old PSW								PER new PSW							
9x	Restart old PSW								Restart new PSW							
Ax	Reserved															
Bx	Reserved															
Cx	Exigent machine-check interruption code (EMCIC)															
Dx	Exigent machine-check interruption code (EMCIC)															

Ex	Registers for PER		
Fx	PER interruption register save area	Exigent machine-check save area	Repressible machine—check save area

LEGEND:

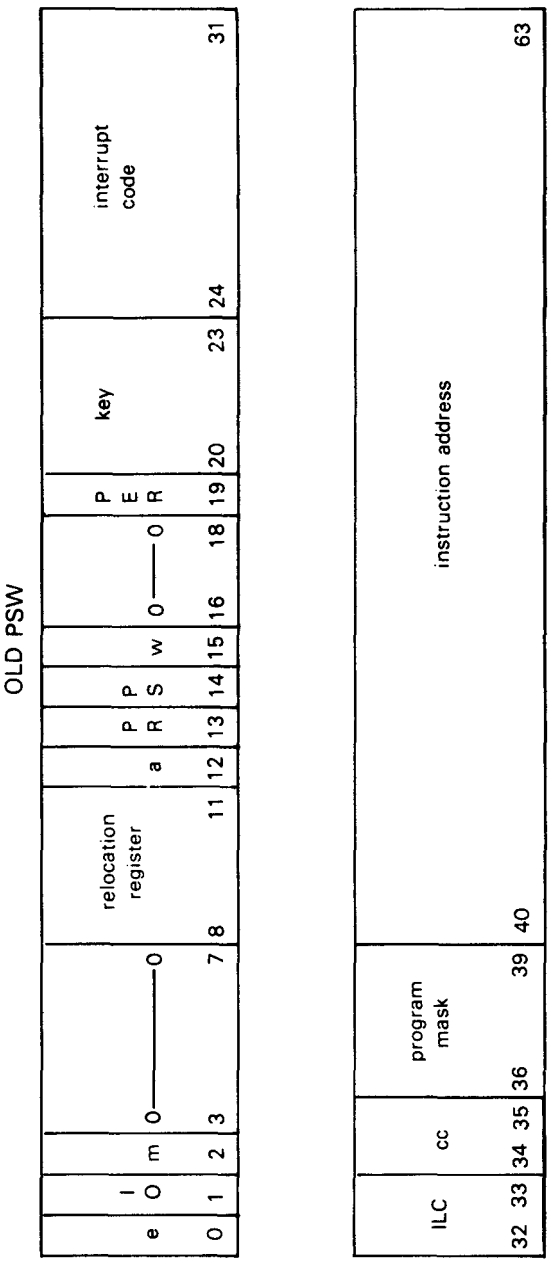
CXPW	Channel index pointer word
PER	Program event recording
PSW	Program status word

Program Status Word (PSW) Format

NEW PSW

e	I O	m	0 —— 0	relocation register	a	P R	P S	w	0 —— 0	P E R	key	r1	r2
0	1	2	3 — 7	8 — 11	12	13	14	15	16 — 18	19	20 — 23	24 — 27	28 — 31

ILC 0 — 0	cc	program mask	instruction address
32 33	34 35	36 — 39	40 — 63


OLD PSW
e
I O
m
0
0
relocation register
a
P R S
w
0
0
P E R
key
interrupt code
0 1 2 3 7 8 11 12 13 14 15 16 18 19 20 23 24 31
ILC
cc
program mask
instruction address
32 33 34 35 36 39 40 63

Program Status Word (PSW) Field Interpretation

Bits*	Field Name	Description
0	External mask (e)	Controls whether the CPU is enabled for interruption by an external interruption request. When the bit is 1, interruptions are permitted.
1	I/O mask (IO)	Controls whether the CPU is enabled for I/O interruptions. When the bit is 1, interruptions are permitted.
2	Repressible machine check mask (m)	Controls whether the CPU is enabled for repressible machine check interruptions. When this bit is 1, interruptions are permitted.
3—7	Reserved	Must be zero. The CPU will force these bits to zero when loaded regardless of their state in the new PSW. Stored as zeros in the old PSW.
8—11	Relocation register	The processor relocation key selects 1 of 16 keys and relocation registers which apply to all program-visible CPU references while this PSW is used as the current PSW.

12	ASCII mode (a)	The CPU operates in either ASCII or EBCDIC mode as specified by this bit: a = 1 ASCII mode a = 0 EBCDIC mode Certain CPU instructions interpret or generate code-sensitive characters in either ASCII or EBCDIC. The unpack, edit, and edit-and-mark instructions generate code-sensitive zones as follows: ASCII zone = 3_{16} EBCDIC zone = F_{16} The edit instructions detect the following code-sensitive control characters:

	ASCII	EBCDIC
Digit select	80_{16}	20_{16}
Significant start	81_{16}	21_{16}
Field separator	82_{16}	22_{16}

Program Status Word (PSW) Field Interpretation (cont)

Bits*	Field Name	Description
13	Problem register mode (PR)	The CPU provides 2 sets of 16 general registers: 1. Problem general registers 2. Supervisor general registers This bit selects which set is used in executing an instruction as follows: 1 = problem general registers 0 = supervisor general registers
14	Problem state (PS)	The CPU may operate in one of two states as selected by this bit: 1 = problem mode 0 = supervisor mode When operating in supervisor mode, all implemented instructions may be executed; however when operating in problem mode, only nonprivileged instructions may be executed and attempts to execute privileged instructions will result in a program interruption.

15	Wait state (w)	When 1, the CPU is in the wait state. When zero, the CPU is in the running state.
16—18	Reserved	Must be zero. The CPU will force these bits to zero when loaded regardless of their state in the new PSW. Stored as zeros in the old PSW.
19	Program event recording (PER)	When this bit is 1, a PER interruption is enabled.
20—23	Key	When set to 0, no PER interruption is allowed. Refer to bits 8—11.
24—27 (new PSW)	Service routine register (r1)	Specifies a general register pair for passing the address of the I/O service routine when a clear-channel instruction is executed or when an I/O interruption occurs; specifies the PER argument passing registers for a PER interruption.
24—31 (old PSW)	Interruption code	When the old PSW is stored on a program, external, I/O, machine check, and supervisor-call interruption, this field identifies the cause of the interruption. For other interruptions, zeros are stored in this field in the old PSW. See condition code settings 2.1.2.1 for exception codes contained in bits 24—31.

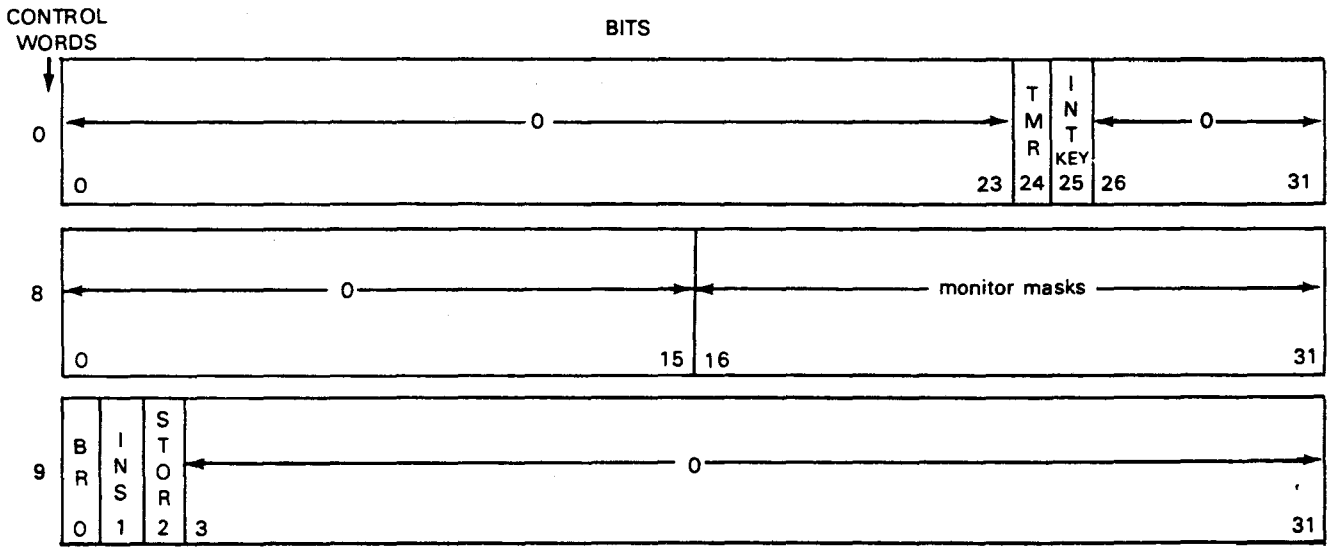
Program Status Word (PSW) Field Interpretation (cont)

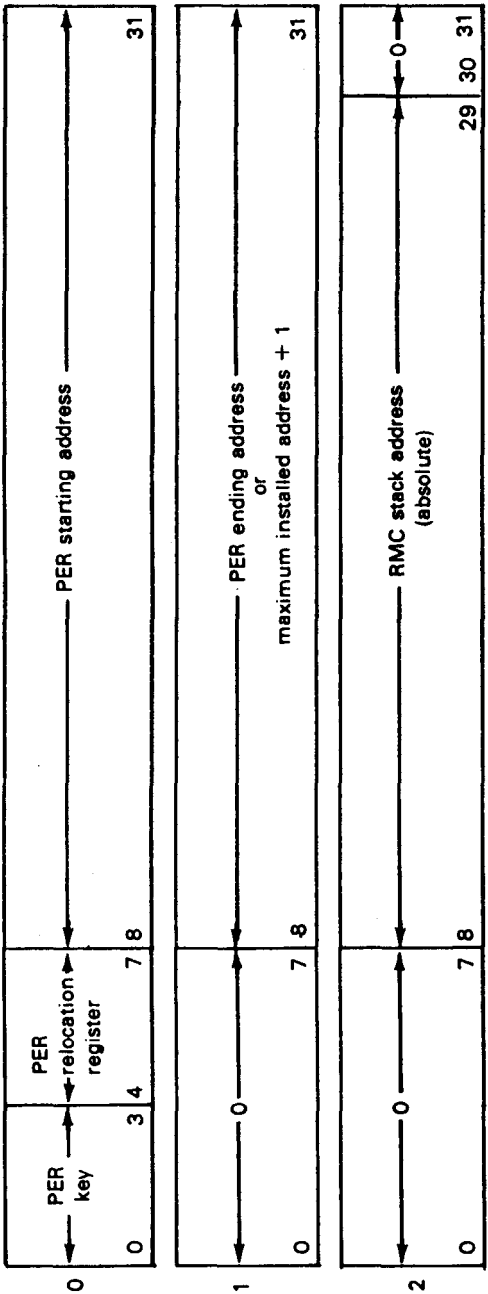
Bits*	Field Name	Description
28—31 (new PSW)	Register select (r2)	Specifies a general register pair for argument passing when an I/O interruption occurs or when a clear-channel instruction is executed.
32—33 (new PSW)	Instruction length code (ILC)	This field is forced to zero by CPU when a new PSW is introduced.
32—33 (old PSW)	Instruction length code (ILC)	The code in this field indicates the length of the last interpreted instruction when a program or supervisor-call interruption occurs or when a branch-and-link instruction is executed.
34—35 (new PSW)	Condition code (cc)	This field is the two bits of condition code that is loaded as part of the new PSW.
34—35 (old PSW)	Condition code (cc)	This field, two bits of condition code, is updated by execution of many instructions to reflect the result of the operation.
36—39	Program mask	This field provides the four program mask bits, each of which is associated with a program exception as follows:

		Program Mask Bit / Program Exception 36 Fixed-point overflow 37 Decimal overflow 38 Exponent underflow 39 Significance When the mask bit is 1, the exception results in an interruption. When the mask bit is zero, no interruption occurs. The significance-mask bit also determines the manner in which floating-point addition and subtraction are completed. NOTE: The floating-point instruction set is a feature; bits 38 and 39 have no effect when the feature is not installed.
40—63	Instruction Address	These 24 bits form the instruction address (logical address). This address designates the location of the leftmost byte of the next instruction.

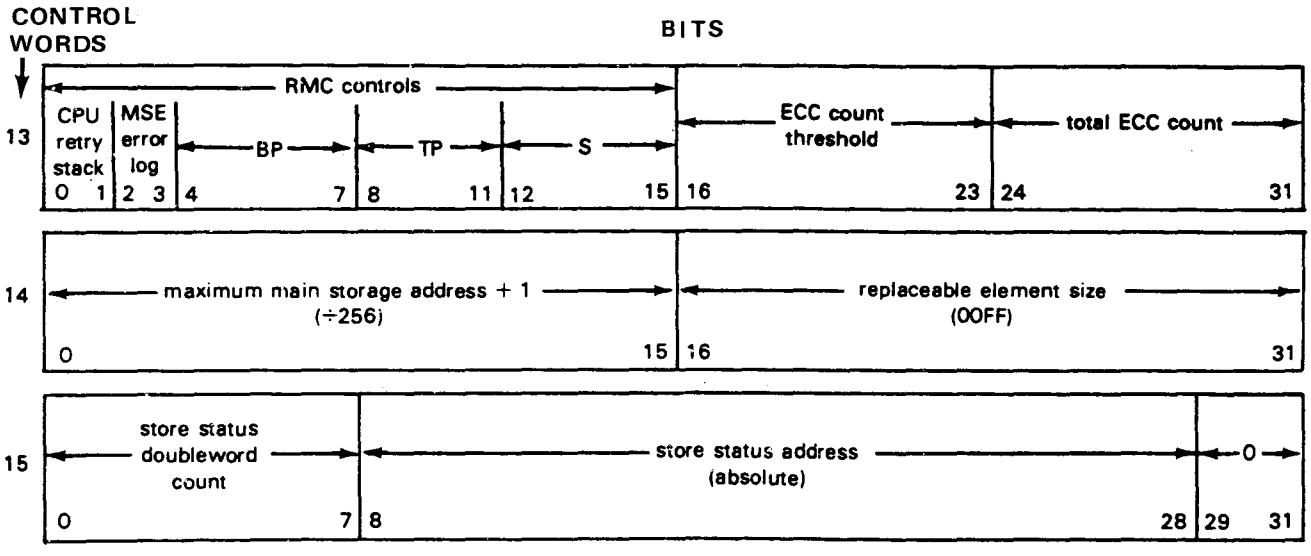
*Bits specified are for the old PSW and new PSW unless otherwise indicated.

Control Register Format




10
PER key
PER relocation register
PER starting address
0
3
4
7
8
31
11
0
PER ending address or maximum installed address + 1
0
7
8
31
12
0
RMC stack address (absolute)
0
7
8
29
30
31

Control Register Format (cont)



LEGEND:

BP	Bottom pointer	MSE	Main storage error	STOR	Storage
BR	Branch	PER	Program event record	TMR	Timer
ECC	Error correction code	RMC	Repressible machine check	TP	Top pointer
INS	Instruction	S	Storage (instruction format)		
INT	Interrupt key				

Control Register Field Assignments

Word	Bits	Field Name	Association	Initial Value
0	0—23	Not used (all zeros)	—	—
	24	Interval timer mask	Interval timer	0
	25	Interrupt key mask	Interrupt key	1
	26—31	Not used (all zeros)	—	—
8	0—15	Not used (all zeros)	—	—
	16—31	Monitor masks	Monitoring	0
9	0	Successful branch event mask	PER	0
	1	Instruction fetch event mask	PER	0
	2	Storage alteration event mask	PER	0
	3—31	Not used (zero)	—	0

10	0—3	PER key	PER	0
	4—7	PER relocation register	PER	0
	8—31	PER starting address	PER	0
11	0—7	Not used (zero)	—	0
	8—31	PER ending address	PER	Maximum installed address+1
12	0—7	Not used (zero)	—	0
	8—29	Repressible machine check absolute address (word boundary)	RMC and ECC logging	0
	30—36	Not used (zero)	—	—

Control Register Field Assignments (cont)

Word	Bits	Field Name	Association	Initial Value
13	0—15	RMC stack controls	RMC and ECC logging	0
	16—23	ECC threshold count	ECC logging	0
	24—31	Total ECC count	ECC logging	0
14	0—15	Maximum main storage address + 1 ÷ 256	ECC logging	Correction 11 ÷ 256
	16—31	Replaceable Element size	ECC logging	$00FF_{16}$
15	0—7	Store status double-word count	Store status and exigent MC	00_{16}
	8—28	Store status absolute address (doubleword boundary)	Store status and exigent MC	0
	28—31	Not used (zero)	—	0

Obtaining a System Dump (SYSDUMP)

You get a system dump with two steps:

1. Main storage write to the YDUMP file
2. SYSDUMP listing from the YDUMP file

In this situation:	You call the main storage write step with:	What happens next:
To get a SYSDUMP with the console workstation	SYSDUMP command	Job SYSDMPxx. This job is automatically scheduled to print SYSDUMP listing.
To get a SYSDUMP within a job	// OPTION SYSDUMP job control statement	This job runs module SYSDMP. It allows the system to run under your job but does no scheduling.

When a system error occurs, the main storage write step (SE 15 message displayed) is called automatically, followed by SYSDMPxx (where xx is the SYSDMP number).

To get a system dump after an HPR:

- For Models 3 through 6:
  Perform an IPL on the system according to directions in the operations handbook, taking care not to press FUNCTION and RESTART keys.
- For Model 8:
  Press ESCAPE key on console; then press M. Select L in menu and transmit. Press U and transmit. Do an IPL on the system.

IPL automatically schedules SYSDMPxx and run statement RV SYSDUMPO. At this point, you may enter the following parameters:

```
[,,DO=(ALL
       DUMP
       TRANSLATED
       JOBS
       SAVE
       RESTORE
       NONE)[,V={vsn      }][,P=did]
                {(vsn,A)}]
```

NOTES:

1. The options and suboptions of the DO= parameter allow for a more specific dump. For a more detailed description of the run statement, see the DUMP ANALYSIS user guide/programmer reference, UP-9980 (current version).
2. 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.

3.5.3. Obtaining a Job Dump or EOJ Dump

Obtaining a Job Dump or EOJ Dump

Job Dump:

```
// OPTION JOBDUMP
```

or

```
// OPTION ABRDUMP (abbreviated JOBDUMP)
```

EOJ Dump:

```
// OPTION DUMP
```

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 START to continue.)
Resident monitor*	To identify the instruction changing a particular byte	SET HA,RM,address [,job-name]	HPR code 99130404 (Press START 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 START 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 START 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 START 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 START 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 START 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 START to continue.)
Pause on shared code call*	To pause a task if and when certain (or all) shared code modules are called	SE PA,SC[,{module-name / prefix.}]	SE25 console message (Enter 'C' to continue.)
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.)

Summary of System Debugging Aids (cont)

Function	Use	Console Command	Results
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 START 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 (Press RESTART to take a SYSDUMP and continue.) HPR 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 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
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

*Supervisor debug option required at IPL

Summary of System Debugging Aids (cont)

Function	Use	Console Command	Results
Reset pause option	To reset all SE PA commands	SE PA,OFF	None
Reset halts	To reset all SE HA commands	SE HA,OFF	None
Reset debug option	To reset all SE DE commands	SE DE,OFF	None
Data management debug option	To produce an automatic system dump when specified error occurs	SE DE,DM,eess ee is DM error code, ss is DM sub code	Error code 3DE and an automatic system dump (see Consolidated Data Management Concepts and Facilities, UP-9978 Facilities, UP-9978 (current version))
Halt on ERROR	To halt on ERROR XXX	SE HA,SP,XXX	HPR 991C

4.1. I/O CHANNEL NUMBER ASSIGNMENT

I/O Channel Number Assignment

Channel 1 =	Direct memory access channel (DMA)
Channel 2 =	Multiple line communications multiplexor channel (MLCM)
Channel 3 =	Shared direct memory access channel (SMDA)

4.2. DEVICE ADDRESSES FOR SYSTEM 80 DEVICES

Device Addresses

Device Type	Device Address
System 80 console workstation	310①
Any System 80 workstation	311—318
Any additional System 80 workstation	341—343, 351—353
Any 8420/8422 diskette	320—323①
Any additional 8420/8422 diskette	341—343, 351—353
Any 8417/8419 disk	100—107①
0789/0776 printer	330①
Additional 0789/0776 printer	331, 340—341
Any 0789/0798 remote printer	340, 350
0719 card reader	332

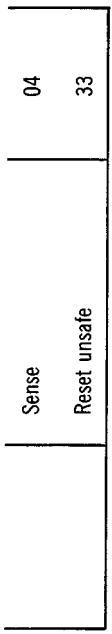
Additional 0719 card reader	333, 342—343
0608 card punch	333
Additional 0608 card punch	343
Any UNISERVO 10 magnetic tape	370—371②
SLCA 0	280—282
SLCA 1	290—292
SLCA 2	2A0—2A2
SLCA 3	2B0—2B2
SLCA 4	2C0—2C2
SLCA 5	2D0—2D2
SLCA 6	2E0—2E2
SLCA 7	2F0—2F2

① These device addresses must be configured with the associated device type. All other device addresses are suggestions. Any address within the proper channel can be used. For further information on using device addresses, refer to the system installation user guide/programmer reference, UP-8839 (current version).

② Default device address

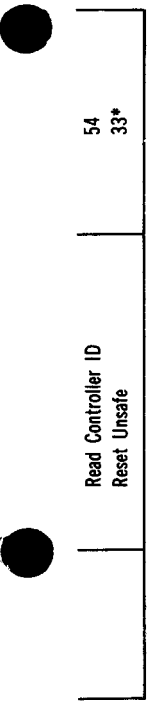
4.3.1. Command Codes for 8417/8419 Disk (DMA)

Device	Command	Operation Code
8417/8419 disk	Seek	07
	Recalibrate	17
	Format write	01
	Write data	05
	Search/read equal	22
	Search/read high or equal	32
	Read ID	0E
	Read data	02
	Diagnostic	12


04
33
Sense
Reset unsafe

4.3.1A. Command Codes for 8416/8418 and 8417/8419 Disk (IDCU)

Device	Command	Operation Code
8416/8418 and 8417/8419 Disk	Seek	07
	Seek Read	17
	Seek Write	77
	Recalibrate	13
	Format Write	01
	Write Data	05
	Search Read Equal	09
	Search Read High/Equal	0D
	IPL	02
	Read ID	0E
	Read	06
	Diagnostic	
	Verify Data Path	87
	Read IDCU Buffer	97
	Write Control Area	B7
	Execute Diagnostic	D7
	Sense	04
	No Op	03


Read Controller ID
Reset Unsafe
54
33*
*Only for 8417

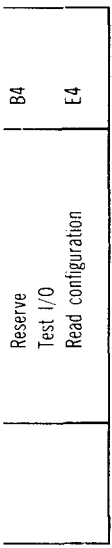
4.3.1B. Command Codes for 8430/8433 Disk

Device	Command	Operation Code
8430/8433 Disk	CONTROL	
	Seek	07
	Seek cylinder	0B
	Seek head	1B
	Set sector	23
	Seek and set sector	27
	Recalibrate	13
	Set file mask	1F
	Space count	0F
	No operation	03
	Restore	17
	WRITE	
	Home address	19
	Record 0	15
	Erase	11

	Count, key and data	10	
	Special count, key and data	01	
	Data	05	
	Key and data	0D	
	SEARCH		
	Home address equal	39	B9
	Identifier equal	31	B1
	Identifier high	51	D1
	Identifier equal or high	71	F1
	Key equal	29	A9
	Key high	49	C9
	Key equal or high	69	E9

Command Codes 8430/8433 (cont)

Device	Command	Operation Code	
8430/8433 Disk (cont)	READ		
	Home address	1A	9A
	Count	12	92
	Record 0	16	96
	Data	06	86
	Key and data	0E	8E
	Count, key and data	1E	9E
	Multiple count, key and data	5E	
	IPL	02	
	Sector	22	
	SENSE		
	Sense I/O	04	
	Read reset buffered log	A4	
	Release	94	


B4
E4
Reserve
Test I/O
Read configuration

4.3.1C. Command Codes for 8470/8480 Disk

Device	Command	Operation Code
8470 Disk	Seek	07
	Seek/Read	17
	Seek/Write	77
	Recalibrate	13
	Write Home Address Special	0B
	Format Write	01
	Write Data	05
	Search/Read Equal	09
	Search/Read Hi or Equal	0D
	IPL	02
	Read Home Address Special	0A
	Read ID	0E
	Read	06
	Verify Data Path	87
	Read IDCU Buffer	97
	Write Control Area	B7
	Execute Diagnostic	D7
	Sense Command	04

4.3.1C. Command Codes for 8470/8480 Disk

Device	Command	Operation Code
	Read Controller ID	54
	Reset Unsafe	33
	No-op	03
	Device Reserve	23
	Device Release	43

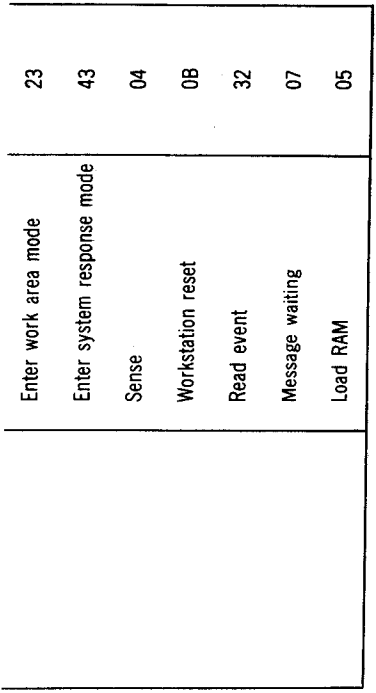
4.3.2. Command Codes for Single Line Communications Adapter (SLCA)

Device	Command	Operation Code
Single line communications adapter (SLCA)	NO-OP	03
	Sense	04
	Load memory address	0D
	Load RAM	05
	Read memory	06

4.3.3. Command Codes for System 80 Workstation/Console Workstation

Device	Command	Operation Code
System 80 workstation/ console workstation	System message write	01
	Diagnostic write	81
	Command write	21
	User write	09
	System message read	02
	Diagnostic read	82
	Command read	22
	User read	0A
	No-op	03

COMMAND CODES FOR SYSTEM 80 DEVICES (cont)



Enter work area mode	23
Enter system response mode	43
Sense	04
Workstation reset	0B
Read event	32
Message waiting	07
Load RAM	05

4.3.4. Command Codes for 8420/8422 Diskette

Device	Command	Operation Code
8420/8422 diskette	Sense	04
	Feed	23
	Format write	11
	Load track/side/sector	31
	Data set open	21
	Data set close	51
	Read	06
	Write	01
	Write control	41
	Diagnostic read subsystem area	66

COMMAND CODES FOR SYSTEM 80 DEVICES (cont)

	Diagnostic read subsystem buffer	76
	Read volume ID	56
	Diagnostic write enable	63
	Read control	46
	Diagnostic write subsystem buffer	71
	Recover	13
	Initial load	02
	Unload	33
	Nooperation	03
	Format read	16
	Load physical track	61

4.3.4A. Command Codes for 0770 Printer

Device	Command	Bit Positions								
		P	0	1	2	3	4	5	6	7
0770 Printer	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

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

Command Codes for 0770 Printer (cont)

Device	Command	Bit Positions								
		P	0	1	2	3	4	5	6	7
0770 Printer (cont)	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:

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

Command Codes for 0770 Printer (cont)

Bit A		Bits			
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.

4.3.5. Command Codes for 0776/0789 Printer

Device	Command	Operation Code
0776/0789 printer	Load vertical format buffer	43
	Print advance	X1, X9*
	Advance	X7, XF *
	Sense	04
	No-op	03

	Read vertical format buffer	12
	Unprintable character data check disable	73
	Unprintable character data check enable	7B
	Diagnostic write data buffer	75
	Diagnostic read data buffer	76
	Diagnostic write enable	63

* X equals the modifier VFB detail bits. For an explanation of these modifier bits, see the I/O controllers programmer reference, UP-8742 (current version).

4.3.6. Command Codes for 0789/0798 Remote Printer

Device	Command	Operation Code
0789 remote printer	Load memory address	0D
	Read memory	16
	Load-RAM	05
	Load vertical format buffer	43
	Print advance	X1, X9*
	Advance	X7, XF*
	Sense	04
	No-op	03
	Read vertical format buffer	12

	Unprintable character data check disable	73
	Unprintable characters data check enable	7B
	Diagnostic write data buffer	75
	Diagnostic read data buffer	76
	Diagnostic write enable	63

* X equals the modifier VFB detail bits. For an explanation of these modifier bits, see the I/O controliers programmer reference, UP-8742 (current version).

4.3.6A. Command Codes for 0716 Card Reader

Device	Command	Bit Positions							
		0	1	2	3	4	5	6	7
0716 Card Reader	Test-I/O	X	X	0	0 or 1	0	0	0	0
		X	X	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.

4.3.7. Command Codes for 0719 Card Reader

Device	Command	Operation Code
0719 card reader	Read translate mode	02
	Read image mode	06
	Sense	04
	No-op	03
	Diagnostic write data buffer	71
	Diagnostic read data buffer	76
	Diagnostic write enable	63

4.3.8. Command Codes for 0608 Card Punch

Device	Command	Operation Code
0608 card punch	Read translate mode	02
	Read image mode	06
	Punch translate mode	01
	Punch image mode	05
	Sense	04
	No-op	03
	Flush last card from wait station	23
	Diagnostic write data buffer	71
	Diagnostic read data buffer	76
	Diagnostic write enable	63

4.3.9. Command Codes for UNISERVO VI-C Magnetic Tape

Device	Command	Bit Positions							
		0	1	2	3	4	5	6	7
UNISERVO VI-C Magnetic Tape	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
	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

Command Codes for UNISERVO VI-C Magnetic Tape (cont)

LEGEND:

MMM (mode modifier)

000	=	no operation
001	=	reserved for failure-finding mode (maintenance personel 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.

4.3.9A Command Codes for UNISERVO 10 Magnetic Tape Type 0871

Device	Command	Operation Code
UNISERVO 10 Magnetic Tape Type 0871	Write	01
	Sense	04
	Read	02 or 12
	Read backward	0C or 1C
	Rewind	07
	Rewind with interlock	0F
	Erase	17
	Write tape mark	1F
	Backspace block	27

	Backspace file	2F
	Forward space block	37
	Forward space file	3F
	No operation	03
	Request tie	1B
	Set low threshold	5B
	Set 1600 BPI	C3
	Set 800 BPI	CB
	Set monitor	8B
	Set simulate	4B
	Reset simulate	0B

4.3.9B. Command Codes for UNISERVO 10/14 Magnetic Tape Type 0870

Device	Command	Bit Positions							
		0	1	2	3	4	5	6	7
UNISERVO 10/14 Magnetic Tape 0870	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
	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 = 0 - Do not set unit check status if bit 4 of sense data byte 3 is set.

I = 1 - 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
101	=	backspace file

Command Codes for UNISERVO 10/14 Magnetic Tape Type 0870 (cont)

LEGEND:

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 simlate mode
01001 = set simulate mode
10001 = set monitor mode
01011 = set low again (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
10MMM = set 800-bpi mode for 7-track

} Applies only for certain values of MMM.

Nine-track operation overrides, but does nopt 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.

4.3.9C. Command Codes to UNISERVO 12/16 Magnetic Tape Type 0861/0862

Device	Command	Bit Positions							
		0	1	2	3	4	5	6	7
UNISERVO 12/16 Magnetic Tape Type 0861/0862	Test	X X	X X	0 1	0 1	0 or 0	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
	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

Command Codes for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

LEGEND:

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
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.

4.3.9D. Command Codes for UNISERVO 20 Magnetic Tape Type 0864

Device	Command	Bit Positions							
		0	1	2	3	4	5	6	7
UNISERVO 20 Magnetic Tape Type 0864	Test	X X	X X	0 1	0 or 1 1	0 0	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
	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
	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 code):

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

Command Codes for UNISERVO 20 Magnetic Tape Type 0864 (cont)

LEGEND:

100 = backspace file
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 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.

4.3.10. Command Codes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884

Device	Command	Operation Code
T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884	WRITE	01 or 11
	READ	02 or 12
	SENSE	04
	READ BACKWARD	0C or 1C
	REQUEST TRACK IN ERROR	1B
	SET DIAGNOSE	4B
	LOOP WRITE-TO-READ	8B
	SENSE/RELEASE	D4
	SENSE/RESERVE	F4

COMMAND CODES FOR SYSTEM 80 DEVICES (cont)

	REWIND	07
	REWIND/UNLOAD	0F
	ERASE GAP	17
	WRITE TAPE MARK	1F
	BACKSPACE A BLOCK	27
	BACKSPACE A FILE	2F
	FORWARDSPACE A BLOCK	37
	FORWARDSPACE A FILE	3F
	DATA SECURITY ERASE	97
	TEST I/O	00
	NO OPERATION	03

Command Codes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Device	Command	Operation Code
T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)	DIAGNOSTIC MODE SET	0B
	SET/RESET MARGIN	XE
	SET LOW THRESHOLD	5B
	SET NRZI MODE	CB
	SET NRZI AND TRANSLATE	43
	SET PE MODE	C3
	SET PE AND TRANSLATE	F3
	SET GCR MODE	D3
	SET GCR AND TRANSLATE	E3

4.3.11. Command Codes for T3774 ITCU (U11/U22) Tape Devices

Device	Command	Operation Code
T3774 ITCU (U11/U22) Tape	Search Block Number	F1
	Write Block Number	21
	Load Microcode	05
	Load Write Translate Table	FD
	Load Read Translate Table	FF
	Store Read Translate Table	FE
	Read Controller ID	54
	Read Microcode ID	F6
	Read Device ID	74
	Data Security Erase	97
	Set High Speed Mode	F9
	Reset High Speed Mode	E9
	Set Translate Mode	43
	Load Memory Address	0D
	Read Memory	06
	Send Monitor Sense	48
	Loop Write to Read	8B

Command Codes for T3774 ITCU (U11/U22) Tape Devices (cont)

Device	Command	Operation Code
	Erase	17
	Back Space Block	27
	Back Space File	2F
	Forward Space Block	37
	Forward Space File	3F
	Read	02 or 12
	Read Backward	0C or 1C
	Rewind	07
	Rewind with Interlock	0F
	Sense	04
	Write	01
	Write Tape Mark	1F
	No Operation	03
	Set 800 BPI	CB
	Load Microcode	05


4B
0B
Set Simulate
Reset Simulate

4.4.1. Status Byte Format for 8417/8419 Disk

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates an unsolicited interruot took place in the controller. This bit can only be presented to the processor through the interruot process after a load-channel-register has been received.
1	Status modifier	Indicates an error in an ID field has been recovered for a record other than the first or a series being processed.
2	—	Not used; always set to zero.
3	Busy	Indicates the I/O device is presently doing a seek operation or that the controller is attempting to present status.
4	Channel end	Presented when a data transfer or control transfer is completed and the controller has no more need of the channel and will not appear busy after presentation as a result of the command for which it is presented. It may or may not be presented with device end.
5	Device end	Presented when the device has finished executing a command. It may be presented when the controller has finished. It will be presented with channel end or delayed as a result of an overlapping seek command. This status is similar to attention (bit 0) except the interrupt is solicited and asynchronous.

Status Byte Format for 8417/8419 Disk (cont)

6	Unit check	Indicates that an abnormal condition was detected by the controller. It is normally indicative of an error condition, although operations like no-record-found are not software errors, but construed as hardware errors.
7	Unit exception	Always set to zero for the DMA channel.

4.5.1. Status Byte Format for Single Line Communications Adapter (SLCA)

Bit	Condition Which Sets Bits	Meaning
0	Attention	Function is feature dependent. Usually set to zero.
1	Status modifier	Indicates successful error retry information is contained in sense bytes.
2	Control unit end	Indicates to the MLCM that the SLCA can accept another command for this port for a terminal other than the one which presented this control unit end status. (This bit is not seen by software).
3	Busy	Indicates that a command has addressed a device which is currently executing a command.
4	Channel end	Set along with device end.
5	Device end	Indicates that an outstanding command has completed for a given device. Device end is always accompanied by channel end.
6	Unit check	Indicates that the SLCA has encountered an error during the execution of a command or a command sequence and that one or more sense bits are set.
7	Unit exception	Function is feature dependent. Usually set to zero.

4.6.1. Status Byte Format for System 80 Workstation/Console Workstation

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates any of the following occurred: ■ operator activated TRANSMIT key; ■ an implied transmit function (DC1 or ESC DC1) was contained in a write command; ■ operator activated any one of 23 function keys; ■ operator activated a mode change request from workstation mode to system mode or vice versa; ■ a RAM parity error occurred at the device; or ■ a power on condition occurred at the device.

1	Status modifier	When set along with bit 0 (attention) indicates attention item merged with a successful error recovery. When set along with bit 4 (channel end) and bit 5 (device end), indicates the workstation controller (WSC) had to evoke an error recovery procedure in order to complete the outstanding command and the procedure was successful. When set along with bit 4 (channel end), bit 5 (device end), and bit 6 (unit check), indicates error recovery procedure evoked was unsuccessful.
2	—	Not used; always set to zero.
3	Busy	When set, indicates that a command has addressed a device that is currently executing a command.
4	Channel end	When set with bit 5 (device end), indicates WSC has successfully executed an outstanding command.
5	Device end	Indicates the termination of the execution of a command. It is always set along with bit 4 (channel end), or bits 4 (channel end) and 6 (unit check).

Status Byte Format for System 80 Workstation/Console Workstation (cont)

Bit	Condition Which Sets Bits	Meaning
6	Unit check	When set, indicates the workstation controller (WSC) has encountered an error condition in response to or during a command sequence; that is, the command cannot be executed. When set along with bit 4 (channel end) and bit 5 (device end), indicates some condition exists that prevented a successful command completion at the device or workstation controller (WSC). Unit check implies that at least one bit in sense byte 0 is set to a 1.
7	—	Not used; always set to zero.

4.6.2. Status Byte Format for 8420/8422 Diskette

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates that the device addressed is in the run state. When set with busy (bit 3), it indicates that a command was addressed to a diskette drive that is in the run state and is currently executing a command.

0	Attention (cont)	When set with status modifier (bit 1) it indicates the device addressed is busy in the run state and has initiated a successful automatic retry. When set with status modifier (bit 1) and busy (bit 3) it indicates the device addressed is busy, is in the run state, and has completed a successful automatic retry.
1	Status modifier	Is never set by itself. See the meaning for the following bits: ■ Attention (bit 0); ■ Control unit end (bit 2); ■ Busy (bit 3); ■ Channel end (bit 4); and ■ Unit check (bit 6)
2	Control unit end	Indicates the diskette controller successfully completed a command chain and the controller presented control unit busy status to the channel during the execution of this command.

Status Byte Format for 8420/8422 Diskette (cont)

Bit	Condition Which Sets Bits	Meaning
2 (cont)	Control unit end (cont)	When set with status modifier (bit 1), it indicates a successful automatic retry at the completion of a command chain and that the controller presented control unit busy status to the channel during the execution of this command.
3	Busy	Indicates a command has addressed a diskette drive that is currently executing a command. When set with status modifier (bit 1) it indicates that a command was sent to the diskette controller while currently executing a nonfeed command for any other diskette drive (control unit busy). When set with both the status modifier (bit 1) and control unit end (bit 2) it indicates a command was sent to the diskette controller while it was executing a nonfeed command for another diskette drive and when the diskette controller had completed a command chain and presented control unit busy status to the channel. When set with any of the folloing combinations it indicates that an addressed device was attempting to present status when addressed by the system. These combinations indicate the failure of the device handling software to wait for an interrupt:

3 (cont)	Busy (cont)	■ Channel end (bit 4) and device end (bit 5); ■ Status modifier (bit 1), channel end (bit 4), and device end (bit 5); ■ Channel end (bit 4), device end (bit 5), and unit exception (bit 7); ■ Status modifier (bit 1), channel end (bit 4), device end (bit 5), and unit exception (bit 7); ■ Channel end (bit 4), device end (bit 5), and unit check (bit 6); ■ Status modifier (bit 1), channel end (bit 4), device end (bit 5) and unit check (bit 6); ■ Channel end (bit 4), device end (bit 5), unit check (bit 6) and unit exception (bit 7); and ■ Status modifier (bit 1), channel end (bit 4), device end (bit 5), unit check (bit 6) and unit exception (bit 7).
4	Channel end	When set with device end (bit 5), it indicates that the diskette controller has sucessfully executed an outstanding command that was not preceded by a control unit busy status presentation or that it did not require any automatic retry.

Status Byte Format for 8420/8422 Diskette (cont)

Bit	Condition Which Sets Bits	Meaning
4 (cont)	Channel end (cont)	When set with status modifier (bit 1) and device end (bit 5), it indicates that the diskette controller has successfully completed a command that required an automatic retry. When set with device end (bit 5) and unit exception (bit 7) it indicates that the diskette has encountered the end of volume (EOV). When set with status modifier (bit 1), device end (bit 5), and unit exception (bit 7), it indicates the diskette has the EOV record during the execution of a read or write command and an automatic retry operation occurred. When set with device end (bit 5) and unit check (bit 6) it indicates that the diskette controller has accepted a command and has encountered an error condition during command execution. When set with status modifier (bit 1), device end (bit 5), and unit check (bit 6), it indicates that the diskette controller has accepted a command, an automatic retry operation occurred, and an error condition was encountered during command execution.

		When set with device end (bit 5), unit check (bit 6), and unit exception (bit 7), it indicates that the diskette controller has accepted a command, the EOV record was encountered, an automatic retry operation occurred, and an error condition was encountered during command execution.
5	Device end	Is never set by itself. See the meaning for the following bits: ■ Busy (bit 3); and ■ Channel end (bit 4).
6	Unit check	Indicates that the diskette controller has encountered an error condition in response to or during a command sequence. (Command cannot be executed.) When set with status modifier (bit 1) it indicates the diskette encountered a nonrecoverable error in response to or during a command sequence and a successful automatic retry was initiated.
7	Unit exception	Is never set by itself. See the meaning for the following bits: ■ Busy (bit 3); and ■ Channel end (bit 4).

4.6.3. Status Byte Format for 0776/0789 Printer

Bit	Condition Which Sets Bits	Meaning
0	Attention	Specifies transition from stop state to run state.
1	Status modifier	Set along with channel-end/device-end whenever the paper peripheral controller (PPC) had to evoke at least one error recovery procedure in order to complete the outstanding command. When status-modifier bit is set without bit 6 (unit check) set, this implies that with error recovery, the command was completed successufully. Autosense follows.
2	—	Not used; always set to zero.
3	Busy	Indicates the device cannot execute the command because it is executing a previously issued command.
4	Channel end	Set concurrently with bit 5 (device end) by the PPC.
5	Device end	Specifies the completion of a command initiated by the channel and readiness to accept a new command.
6	Unit check	Specifies at least one bit is set in sense byte 0, 1, 2, 3, or 4. Autosense follows.
7	Unit exception	Presented with channel end/device end of either a print-advance or advance command and indicates a forms overflow condition. Paper advance is performed and paper stops at position designated by the command detail bits.

4.6.4. Status Byte Format for 0789/0798 Remote Printer

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates transition from stop state to run state.
1	Status modifier	Set whenever the subsystem had to perform at least one error-recovery procedure in order to complete the outstanding command. Status modifier set without unit check implies that with error recovery, the command was completed. Autosense follows.
2	—	Not used; always set to zero.
3	Busy	Indicates that the device cannot execute the command because it is executing a previously issued command.
4	Channel end	Indicates that the subsystem is ready to accept a new command.
5	Device end	Indicates the completion of a command initiated by the channel.
6	Unit check	Specifies that at least one bit is set in sense byte 0. Autosense follows.
7	Unit exception	Presented with device end of either a print-advance or advance command and indicates a form-overflow condition. Paper advance is performed and paper stops at position designated by the command detail bits.

4.6.5. Status Byte Format for 0719 Card Reader

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates transition from stop state to run state.
1	Status modifier	Set along with channel end/device end whenever the paper peripheral controller (PPC) invokes at least one error recovery procedure in order to complete the outstanding command. Status modifier set without unit check implies that, with error recovery, the command was completed. Autosense follows.
2	—	Not used; always set to zero.
3	Busy	Indicates that the device cannot execute the command due to executing a previously issued command.
4	Channel end	Set concurrently with device end by the PPC.
5	Device end	Specifies completion of command by the PPC and readiness to accept a new command.
6	Unit check	Specifies that at least one bit is set in sense byte 0, 1, or 2. Autosense follows.
7	—	Not used; always set to zero.

4.6.6. Status Byte Format for 0608 Card Punch

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates transition from stop state to run state.
1	Status modifier	Set along with channel end/device end whenever the PPC calls at least one recovery procedure in order to complete the outstanding command. When the status modifier bit is set without the unit check being set, it implies that with error recovery, the command was completed successfully. Autosense follows.
2	—	Not used; always set to zero.
3	Busy	Indicates that the device cannot execute the command because it is executing a previously issued command.
4	Channel end	Set concurrently with the device end by the PPC.
5	Device end	Specifies command completion by PPC.
6	Unit check	Indicates at least one bit is set in sense byte 0, 1, or 2. Autosense follows.
7	—	Not used; always set to zero.

4.6.7. Status Byte Format for UNISERVO 10 Magnetic Tape Type 0871

Bit	Condition Which Sets Bits	Meaning
0	Attention	Indicates tape unit is ready for operation. Operator intervention (e.g., load new tape) is required. This status is unsolicited and not the result of any previous channel action.
1	Status modifier	Presented with the busy bit to indicate the controller is busy. Also may be presented with device end bit to indicate successful recovery from error.
2	Control unit end	Presented when an operation having control unit busy is complete.
3	Busy	Presented: ■ With status modifier bit to indicate controller is busy. ■ To indicate tape drive is busy executing a command.
4	—	Not used; always set to zero.

5	Device end	Indicates that: ■ An operation is complete at the controller level. When errors are detected before tape motion is initiated, device end is not presented with error status. Data transfer operations aborted while still in progress (e.g., due to equipment check) cause device end to be sent with unit check. ■ A rewind, as well as other operations, have completed at the tape drive. If control terminates unsuccessfully in the tape drive, device end bit is presented with unit check and control unit end.
6	Unit check	Sets bit when any of the following occurs: ■ A bit in sense byte 0 was set because of the current operation. If the error codition was detected before tape motion begins, unit check is presented without normal ending status end; ■ A rewind operation terminated unsuccessfully. Device-end bit is presented with unit check. ■ A read-backward, backspace-block, or backspace-file operation is attempted when tape is positioned at load point;

Status Byte Format for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit	Condition Which Sets Bits	Meaning
		■ A rewind with interlock was completed at the controller level; i.e., when the tape drive becomes nonready, device end is presented, and control unit end is presented if the operation is initiated; ■ The selected tape drive is busy; i.e., ready and rewinding. End status is not presented with unit check. When a rewind tape drive is selected the tape drive is busy until the device end associated with the end of rewind is accepted by the channel; or ■ Presented with device-end to indicate an error was unrecovered.
7	Unit exception	Presented with device-end bit when: ■ A write, write-tape-mark, or erase operation is performed in the end-of-tape area; or ■ A tape mark is sensed during a read, read-backward, forward-space-block, or backspace-block operation.

4.6.8. Status Byte Format for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884

Bit	Condition Which Sets Bits	Meaning
0	Attention	Not used; always set to 0.
1	Status modifier	This bit is always set with busy bit (3) to indicate a control unit busy sequence.

Status Byte Format for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	Condition Which Sets Bit	Meaning
2	Control unit end	Indicates one of the following conditions: ■ The TCU has responded to interrogation by a channel with a status byte containing the busy (3) and status modifier (1) bits, and is now available to communicate with the channel. ■ The TCU detected a unit check (6) or unit exception (7) condition, but after channel end (4) was accepted by the channel. *NOTE: If the control unit end is presented to just one interface of a dual channel control unit, a short busy sequence will be the response to an attempted selection by the other interface. Refer to the following busy bit (3) description.*

3	Busy bit	Indicates that a TCU or MTU cannot accept a command because: ■ It is executing a previously initiated operation. ■ A status condition is pending or stacked at initial selection time. **If this Condition Exists** — **This Occurs** The status condition causing the busy is for the MTU. — ■ The status modifier bit (1) is not set; ■ the busy bit is set; and ■ the existing status is set. The status condition causing the busy is not for the MTU. — ■ The status modifier bit (1) is set; and ■ the busy bit is set to indicate that the TCU is busy. A TCU with a dual channel feature has one channel interface connected. — The other channel interface will present a short busy signal.

Status Byte Format for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	Condition Which Sets Bit	Meaning
3 (cont)	Busy bit (cont)	If this Condition Exists: A TCU with a dual channel feature has a SYSTEM RESET or SELECTIVE RESET condition active on one channel interface. — This Occurs: The other channel interface will appear busy.
4	Channel end	Channel end is generated only once per each I/O operation; it indicates that transfer of the control information portion of an I/O operation between the channel end and the TCU is complete. Channel end is set when: ■ Some basic, mode set, or data transfer command has been completed. In such case, channel end is set with device end (5); refer to the following description. ■ Some control command has been accepted.

5	Device end	Indicates that one of the following conditions exists: ■ Some basic, mode set, or data transfer command has been completed. In such case, device end is set with channel end (4). ■ The MTU becomes ready (not busy) after a selection was attempted during a not ready (busy) state. ■ A REWIND/UNLOAD operation has been completed at the TCU level. ■ Some control command, with the exception of REWIND/UNLOAD, has been completed at the MTU level. ■ An MTU becomes not ready (busy) during execution of an operation. ■ A status change from not ready (busy) to ready (not busy) has occurred. In such case, the status presentation will be: – a TCU interrupt if the TCU was primed for that MTU; or – in the first initial selection sequence following the status change if the TCU was not primed.

Status Byte Format for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	Condition Which Sets Bit	Meaning
6	Unit check	Indicates that the MTU or TCU has detected one of the following error conditions: *NOTE: With the exception of the WRITE command (refer to the following list), the conditions causing a unit check are described by information available as sense data.* ■ Any bit in sense data byte 0 is set. ■ A READ BACKWARD, BACKSPACE BLOCK, or BACKSPACE FILE operation is initiated at or into the load point. ■ A REWIND/UNLOAD operation is completed at the TCU level. ■ Not capable (1,7) is set. ■ ID burst check (5,3) is set.

- Bit 3 of the READ or READ BACKWARD command is set *and* PE (3,5) *or* GCR (9,0) is set.
- Bit 3 of the WRITE command is set *and* GCR (9,0) is set.
- When the TCU is in downline load communication (stage 1), unit check is set when any of the following occurs with the setting of sense data:
  - There is an invalid parameter block of a SET DIAGNOSE command.
  - The load length transferred in a WRITE command and chained to a LOAD MICROCODE subcommand is greater than 4K bytes.
  - The data count transferred in a WRITE command and chained to a LOAD MICROCODE subcommand is not equal to the load length.
  - The microcode specified by a START MICROCODE subcommand is not yet loaded.
  - The functional microcode, of which the microcode ID is 10 hexadecimal through 1F hexadecimal, is specified to be run with running mode 1 by a START MICROCODE subcommand.

Status Byte Format for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	Condition Which Sets Bit	Meaning
6	Unit Check (cont)	– None of a START MICROCODE subcommand is executed before a READ MICROCODE subcommand is issued. – A SET SWITCH subcommand has been issued and needs a selected subtest, but the selected subtest is not yet loaded.
7	Unit exception	Indicates an unusual condition that is not necessarily an error. Unit exception is set when: ■ Tape indicate (4,2) is on during a WRITE, WRITE TAPE MARK, or ERASE GAP operation. ■ A TAPE MARK is sensed during a READ, READ BACKWARD, FORWARDSPACE BLOCK, or BACKSPACE BLOCK operation.

4.7.1. I/O Sense Data Byte Definitions for 8417/8419 Disk

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Indicates an illegal command code occurred. It could be a write command to a file-protected device, unassigned command codes, a write command with programmed offset, or out-of-bounds command parameters (invalid address).
1	Intervention required	Indicates that some manual intervention is required to make the device available to the system. It can be set with either stop-state or device-not-present and stop-state.
2	Output parity check	Indicates data transferred contains wrong parity at the time it was to be written onto the disk.
3	Equipment check	Indicates a serious malfunction occurred within the subsystem. If set alone, it indicates that the direct memory access (DMA) control logic contains an error. When set with device check, it indicates a serious problem within the device. When set with seek incomplete, it indicates the device, after having been issued a seek instruction, did not complete that movement within the required period of time. When set with unselected status, it indicates that one of the status lines between the controller and device was active when no devices were selected. When set with

I/O Sense Data Byte Definitions for 8417/8419 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
3 (cont)	Equipment check (cont)	track overrun, it indicates that a problem exists relative to the rotational speed or sensing of the disk drive. When set with no clocks, it indicates too much time elapsed with no data or clocks being supplied by the device.
4	Data check	Specifies that an abnormal pattern exists in the error correction code (ECC) bytes of the control unit. It can be set with the ID field check or data field check, together with either sync region or ECC check. These combinations of sense bits determine the location and nature of the error. When set with record number miscompare, it indicates positioning control errors, and is set with these bits only in the absence of an ECC error in the ID field.
5	Overrun	Indicates that either data was not accepted or data was not provided fast enough to satisfy the demands of the device. This condition normally indicates a problem in the controller data separation hardware.
6	Stop state	Indicates that the drive has no power applied and is not available for use. If a drive is not connected to the system but addressed, the same indication results.

7	Device check	Indicates that a device is unsafe due to loss of DC voltage, disk speed below 80% of normal, write oscillator not synchronous with servo track, or no write transitions when the write gate is active and address mark is not active, a seek failed to complete within 230 milliseconds, or a guard band was detected.
Sense Data Byte 1		
0	ID field check	Indicates the pertinent sense bits set during the processing of an ID field. This bit is used primarily for diagnostic purposes and serves in isolating problems.
1	Track overrun	Indicates an operating device encounters an index mark when it is oriented on an ID or data field, or the gap between the two.
2	Cylinder end	Indicates an attempt was made to increment the head number beyond the actual heads of the drive. When set with no record found, it indicates a search/read was unsuccessful.
3	Device type	Specifies the type of device selected by given address. When set, indicates a removable media disk drive.

I/O Sense Data Byte Definitions for 8417/8419 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
4	No record found	Indicates, when set alone, that two revolutions of index passed without satisfying the search argument. When set with sync region error, it indicates no address mark was detected on the disk surface. It also can indicate the record number in the ICW exceeds the highest record number written on the track, for example 60. With multitrack search/read commands, this bit is set with cylinder end, indicating that the search argument could not exceed the cylinder head limit.
5	File protect	Indicates that the selected device is unavailable for write operations. Data can be read from the file but any attempt to write will cause unit check status and command reject to be set.
6	Sync region error	Indicates either an error in gap data, gap detection hardware, or address mark write hardware.
7	Data field check	Indicates an error occurred when processing the data field. This bit is mainly used for diagnostic purposes.

Sense Data Byte 2		
0	Seek incomplete	Indicates a failure occurred within the device so that it was unable to complete accessor movement within a predetermined time interval.
1	Write protect/ offset unsafe	Indicates that a write has been attempted with the head offset active or write protect in the device. This implies either a malfunction in the execution of the nonoffset implied seek or write status verification or a device malfunction.
2	Head cylinder miscompare	Specifies a positioning error. For read-data and write-data commands, this indicator denotes that the head and cylinder information recovered from the disk surface does not compare with that provided by the ICW. This bit may be set with flag byte miscompare. It is not set with read-ID commands or if there is an ECC parity error for the ID field.
3	Record number miscompare	Sets bit with data check to indicate that the record number as read from the disk is not the one expected. (The record number reported in sense byte 4 will be for the expected record.) It indicates that one or more records could have been skipped or that some hardware failure occurred when the address mark or ID field was written.

I/O Sense Data Byte Definitions for 8417/8419 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2 (cont)
4	Flag byte miscompare	Indicates that the flag information read from the disk does not compare with that of the software. Occurs when encountering a defective or alternate track location. This bit is set only if there is not ECC parity error at the end of the ID field. Although some bits within the flag byte have no definition, they are compared during read operations and must compare exactly. The occurrence of a flag miscompare causes the operation to terminate immediately.
5	Unselected status	Indicates that one or more of the device status lines were active when no device was selected. When set with equipment check, it indicates an interface failure between the controller and device.
6	ECC check	Set with data check and either ID field check or data field check to indicate that a nonzero residue existed in the ECC register of the control after the field was read. When set with equipment check, it indicates a failure within the ECC hardware during a write operation.

7	No clocks	Set with equipment check to indicate that no clock pulses have been detected for a period of 1 millesecond while the controller was active.
Sense Data Byte 3		
0	Device not present	Indicates that the addressed device is not present in the system.
1	Fixed heads	Indicates that the 60 fixed heads are installed within the drive. If this signal is not present when the command attempts to address the heads, cylinder, head, or record capacity exceeded and command reject are also set.
2	Cylinder addressing feature	Indicates the cylinder addressing feature has been installed on an 8417 disk. This feature permits cylinder 0 through 560 to be addressed.
3	Cylinder, head or record capacity exceeded	Indicates an attempt was made to select a cylinder or head or record address that exceeded the valid limits for the particular features configured. It is set along with command reject.
4	Index passed	Indicates that the index has been passed once during a search/read command to allow a proper start.

I/O Sense Data Byte Definitions for 8417/8419 Disk (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 3 (cont)		
5	Low found	Indicates a low condition has been satisfied during a search/read operation prior to the sector on which the error was detected.
6	Search satisfied	Indicates that the search portion of a search/read command has been satisfied on the record specified, even though an error has been detected.
Sense Data Byte 4		
0—7	Record number	Contains the number of the track record that the associated sense information applies.
Sense Data Byte 5		
0—7	Physical read number	Contains the number of the device head selected at the time that the sense information applies.

Sense Data Byte 6				
0—7	Device status byte	Permits device status to be presented when both head select and device bus bit 7 are set. Each is defined as follows:		
		Bit	Name	Definition
		0	PLO sync unsafe	PLO synchronization loss due to missing servo data.
		1	Speed unsafe	Disk speed less than 80% of normal. Head positioned over landing zone.
		2	Guard band detected	Guard band 1 or 2 detected during a seek or when access ready is active.
		3	DC power unsafe	DC power loss or out of tolerance.
		4	PLO unsafe	Indicates loss of synchronization of the PLO during a write operation.

I/O Sense Data Byte Definitions for 8417/8419 Disk (cont)

Bit Position	Bit Designation	Definition		
Sense Data Byte 6 (cont)				
0—7 (cont)	Device status byte (cont)	Bit	Name	Definition
		5	Seek too long	Seek operation exceeded 230 milliseconds.
		6	Write unsafe	Indicates one or more of the following: 1. Both read and write gates are active 2. Multiple leads selected 3. No write current or no transitions detected with write gate active 4. Write current exceeds maximum
		7	Write current unsafe	Write current not a proper level

Sense Data Byte 7		
—	Undefined	—
Sense Data Byte 8		
0—7	ECC displacement	Indicates the displacement in bytes from the beginning of the data field to the beginning of the error field to be corrected with the error pattern bytes.
Sense Data Byte 9		
0—7	First pattern byte	Indicates error pattern is to be used with ECC displacement.
Sense Data Byte 10		
0—7	Second pattern byte	Indicates error pattern byte to be used with ECC displacement.
Sense Data Byte 11		
—	Undefined	—

4.7.1.1. Summary of I/O Sense Data Bytes for 8417/8419 Disk

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	Device type	No record found	File protect	Sync region error	Data field check
2	Seek incomplete	Write protect/ offset unsafe	Head/cylinder miscompare	Record number miscompare	Flag byte miscompare	Unselected status	ECC check	No clocks
3	Device not present	Fixed heads	Cylinder addressing feature	Cylinder, head or record capacity exceeded	Index passed	Low found	Search satisfied	N/A
4	Record number							

I/O SENSE DATA BYTE DEFINITIONS FOR MODEL 3-6 DISKS (cont)

5	Physical head number							
6	PLO sync unsafe	Speed unsafe	Guard band undetected	DC power unsafe	PLO unsafe	Seek too long	Write unsafe	Write current unsafe
7	Not defined							
8	ECC displacement							
9	1st pattern byte							

I/O SENSE DATA BYTE DEFINITIONS FOR MODEL 3-6 DISKS (cont)

Summary of I/O Sense Data Bytes for 8417/8419 Disk (cont)

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
10	2nd pattern byte							
11	Not defined							

4.7.2. I/O Sense Data Byte Definitions for 8470/8480 Disk

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Indicates that an illegal command code or sequence was issued to the IDCU, such as: ■ A WRITE command to a file-protected device ■ An unassigned command code ■ A WRITE command issued but not preceded by a SEEK/WRITE command ■ An out-of-bounds command parameter
1	Intervention required	Some manual intervention is required to make the device available to the system. It can be set with stop state (0,6).

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
2	Output parity check	Data transferred within the IDCU had the wrong parity at the time it was to be written to the disk; the error occurred somewhere between the input to the IDCU and the queueing register at the interface to the data separator.
3	Equipment check	Indicates that a serious malfunction has occurred within the subsystem: If Set with — Indicates Alone — IDCU logic contains an error. Device check (0,7) — Serious problem exists within the device. Seek incomplete (2,0) — Device was issued a seek instruction but did not complete the required movement within the required period of time.

		Unselected status (2,5)	One of the status lines between the IDCU and the device was active when no device was selected.
		Track overrun (1,1)	Problem with rotational speed or sensing of the disk
		No clocks (2,7)	Too much time has elapsed with no data or clocks being supplied by the device.
		Microcode error (3,7)	An abnormal microcode error - e.g., a microcode parity error
4	Data check	Indicates that an abnormal pattern exists in the ECC bytes of the IDCU. It can be set with the following combinations to determine the location and type of error: ■ ID field check (1,0) ■ Data field check (1,7) ■ Sync region error (1,6) ■ ECC check (2,6)	

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4 (cont)	Data check (cont)	It can also be set with the following to indicate positioning or control errors; these errors will set only if there is no ECC error in the ID field: ■ Record number miscompare (2,3) ■ Flag byte miscompare (2,4) ■ Head/cylinder miscompare (2,2)
5	Overrun	Indicates one or more of the following: ■ Data was not transferred through the IDCU as quickly as required by the disk. ■ Data has been written or read incorrectly.

		■ There is a malfunction of clocks in the IDCU.
6	Stop state	The addressed device or drive has no power applied and is not available for use.
7	Device check (device unsafe)	This bit is set when: ■ A status line from the selected device indicates that the device is unsafe. ■ Any dc voltage loss occurs within the device. ■ The disk rotating speed is 80% below normal. ■ The write oscillator is not synchronous with the servo track. ■ No write transitions are detected when the write gate is active and the address mark is not active.

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	ID field check	Indicates that the setting of pertinent sense bits occurred during processing of an ID field. This setting is used primarily for diagnostic purposes and serves to isolate problems.
1	Track overrun	Indicates that one of the following has occurred: ■ An index mark was encountered when an operating device was oriented on an ID or data field or on the gap between the two, which can be caused by an improperly formatted track or by the device detecting a false index mark. ■ An index mark was encountered during the write portion of a FORMAT WRITE command before the track was completely written.

		NOTE: Both of the preceding conditions can occur only as the result of a hardware failure. ■ The extent (specified by the seek address and byte count) caused the subsequent READ or WRITE DATA command to go beyond the last cylinder, head, and record of the disk.
2	Cylinder end	The IDCU detected an attempt to step past the last track on a disk. This condition may occur on a SEARCH/READ command when the search was not satisfied.
3	Removable media	This bit will always be set to 0 for 8470 disks.
4	No record found	If Set with — Indicates Alone — The search argument was not satisfied within the requirements of the command. Sync region error (1,6) — Good ID was not detected on the selected track. SEARCH/READ command — The drive has reached the end of the specified area without satisfying the search portion of the command.

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
5	File protect	Data can be read from the selected device, but it is unavailable for WRITE operations. *NOTE: Any attempt to write to the selected device will cause device status unit check, as well as command reject (0,0), to be set along with this bit.*
6	Sync region error	Indicates an error in one of the following: ■ Gap data ■ Gap detection hardware ■ Address mark write hardware
7	Data field check	Indicates an error occurred when processing the data field. *NOTE: If set with other sense data, it serves to isolate and identify failing hardware.*

Sense Data Byte 2		
0	Seek incomplete	Indicates a failure within the device that makes it unable to complete accessor movement within a predetermined period of time. *NOTE: This condition can be cleared by issuing a RECALIBRATE command to the device.*
1	-	Not used; set to 0.
2	Head/cylinder miscompare	Indicates a positioning error. For READ DATA and WRITE DATA commands, this indicates that head and cylinder information recovered from the disk surface does not compare with that calculated from the command information. This bit will *not* be set if: ■ The flag byte miscompare (2,4) sense indicator is set. ■ The READ ID command is issued. ■ There is a parity (ECC) error for the ID field.

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 2 (cont)
3	Record number miscompare	This bit is set with data check (0,4) to indicate that the record number as read from the disk is not the one expected. This can occur only: ■ on multiple record operations; and ■ in the absence of an ECC error. This setting indicates a hardware failure, such as: ■ An erroneous WRITE operation ■ One or more records were skipped

4	Flag byte miscompare	This sense bit indicates that the flag information extracted from the disk surface does not compare with that expected. This condition typically occurs when a defective or alternate track location is encountered. This indicator will be set only if there is no parity (ECC) error at the end of the ID field. Although some bits within the flag byte have no meaning, they are compared during a READ operation and must compare exactly. *NOTE: A flag byte miscompare occurrence will cause the command to terminate immediately.*
5	Unselected status	Indicates that one or more of the device status lines were active when no device was selected, which in turn indicates an interface failure between the IDCU and the attached devices. This bit also causes equipment check (0,3) to be set. *NOTE: This condition is probed at the outset of a command before any attempt is made to use a device.*

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition	
Sense Data Byte 2 (cont)			
6	ECC check	If Set with	Indicates
		Data check (0,4) *and* ID field check (1,0); *or*	A nonzero residue existed in the ECC register of the IDCU after the field was read.
		Data check (0,4) *and* Data field check (1,7)	
		Equipment check (0,3)	A failure within the ECC hardware occurred during a WRITE operation.
7	No clocks	This bit is set with equipment check (0,3) to indicate that no clock pulses have been detected for a period of 1 millisecond while the IDCU has actively selected the device.	

Sense Data Byte 3		
0	-	Not used; set to 0.
1	Fixed heads	Fixed heads are not supported; this bit is set to 0.
2	-	Not used; set to 0.
3	Address error	An attempt was made to select a cylinder or head address which exceeded the valid limits of the device and/or feature configured. *NOTE: This bit will also cause command reject (0,0) to be set.*
4-5	-	Not used; set to 0.
6	Search satisfied	Indicates that the search portion of a SEARCH/READ command has been satisfied on the record specified. *NOTE: This bit will be set even if an error has been detected on the data portion of the record.*

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
7	Microcode error	This bit is set with equipment check (0,3) to indicate a microcode error that caused an abnormal termination of a normal IDCU operation.
		Sense Data Byte 4
0-7	Record number	This byte contains the record number associated with the head as described in the following sense data byte 5 definition.
		Sense Data Byte 5
0-7	Head number	This byte contains the head address number for which the associated sense information applies. Refer to the preceding sense data byte 4 definition.

		For this Operation	Address Is
		SEARCH/READ	Head where argument was found
		SEEK	Address desired in the event of a SEEK incomplete
		READ, WRITE	Head where the last record was processed when an error occurred
		Recovered error	Head with the error
Sense Data Byte 6			
0	Uncorrectable	Indicates that the IDCU attempted an error recovery but could not correct the malfunction. This will be set if a read error was detected but could not be corrected.	
1	Invalid sequence	Indicates that a command was issued out of required sequence - e.g., a WRITE DATA command was issued but was not preceded by a SEEK/WRITE command.	
2	Program error	This bit will be set to 1 if the IDCU detected an invalid condition in commands issued by the host system.	

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 6 (cont)
3	Mode	The IDCU is blocking records in 1024-byte format. *NOTE: Records are processed as 256 bytes per record when this bit is* not *set.*
4	Invalid track format	The IDCU has detected one of the following: ■ A record length field that does not specify 1024 bytes ■ A nonzero key field
5-7	-	Not used; set to 0.

Sense Data Byte 7		
0-7	Physical ID	When applicable, this byte contains the 3 of 6 code reflecting the physical device address of the addressed device.
Sense Data Byte 8		
0-7	ECC displacement	This byte is the first displacement byte; it identifies the beginning of the error field to be corrected.
Sense Data Byte 9		
0-7	ECC displacement	This byte is the second displacement byte; it identifies the remainder of the error field to be corrected.
Sense Data Byte 10		
0-7	First ECC pattern	This byte contains the first error pattern for correcting data.

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 11
0-7	Second ECC pattern	This byte contains the second error pattern for correcting data.
		Sense Data Byte 12
0-7	Third (last) ECC pattern	This byte contains the third and final error pattern for correcting data.
		Sense Data Byte 13
0	File select error	*NOTE: This byte detects internal hardware errors. It is meaningful only if equipment check (0,3) has also been set.* The IDCU has detected more than one disk responding after a selection was made.

1	Data next parity error	A parity error has occurred in the ECC data next register.
2	Device check	The selected disk has detected a device check condition.
3	Tag invalid	The disk where selection was attempted does not recognize the tag, possibly because the disk detected a parity error on the bus or tag lines from the IDCU.
4	Drive bus in parity	The IDCU has detected a parity error on the bus in from the selected disk.
5	PLO dead	The phase locked oscillator is not working properly.
6	-	Not used; set to 0.
7	Write diagnostic	A diagnostic check has been detected in the write path.

I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 14		
0	-	*NOTE: This byte detects internal hardware errors. It is meaningful only if equipment check (0,3) has also been set.* Not used; set to 0.
1	File bus/tag parity error	A parity error has been detected on the file bus or tag lines from the attached disk.
2	Clock sync error	The internal IDCU clock has lost sync.
3	Bit ring error	More than one bit has been detected in the bit ring counter.
4	Write data 0 parity error	A parity error has been detected in bits 0-7 of the 32-bit shift register data path.

5	Write data 8 parity error	A parity error has been detected in bits 8-15 of the 32-bit shift register data path.
6	Write data 16 parity error	A parity error has been detected in bits 16-23 of the 32-bit shift register data path.
7	Write data 24 parity error	A parity error has been detected in bits 24-31 of the 32-bit shift register data path.

4.7.2.1. Summary of I/O Sense Data Byte Definitions for 8470/8480 Disk (cont)

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 (device unsafe)
1	ID field check	Track overrun	Cylinder end	Removable media	No record found	File protect	Sync region error	Data field check
2	Seek incomplete	-	Head/ cylinder miscompare	Record number miscompare	Flag byte miscompare	Unselected status	ECC check	No clocks
3	-	Fixed heads	-	Address error	-	-	Search satisfied	Microcode error
4	Record number	Record number	Record number	Record number	Record number	Record number	Record number	Record number

I/O SENSE DATA BYTE DEFINITIONS FOR MODEL 3-6 DISKS (cont)

5	Head number	Head number	Head number	Head number	Head number	Head number	Head number	Head number
6	Uncorrect-able	Invalid sequence	Program error check	Mode	Invalid track format	-	-	-
7	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID
8	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement
9	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement

Summary of I/O Sense Data Byte Definitions for 8470/8480 Data (cont)

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
10	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern
11	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern
12	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern	Third (last) ECC pattern
13	File select error	Data next parity error	Device check	Tag invalid	Drive bus in parity	PLO dead	-	Write diagnostic
14	-	File bus/tag parity error	Clock sync error	Bit ring error	Write data 0 parity error	Write data 8 parity error	Write data 16 parity error	Write data 24 parity error

4.8.1. I/O Sense Data Byte Definitions for Single Line Communications Adapter (SLCA)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit if an invalid command is issued to the SLCA or a command sequence error occurs. See sense byte 1 bit 5 for details. Unit check status is set.
1	Intervention required	Not used; always set to zero
2	Bus out check	Sets bit if a byte is received by the SLCA on the D-bus with a parity error.
3	Equipment check	Sets bit if a parity error is detected by the SLCA during internal data manipulation in the SLCA. See sense byte 1 bits 0 and 1 for further details.
4	Data check	Function is feature dependent.
5	Overrun	Function is feature dependent.

I/O Sense Data Byte Definitions for Single Line Communications Adapter (SLCA) (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 0 (cont)		
6	Bus in check	Sets bit if a byte is received by the MCLM over the D-bus with a parity error.
7	Program alert	Sets bit if a command is issued to an invalid device address or if sense byte 1, bits 2, 3, 5, or 6 are set. Set the description of these bits in sense byte 1 for further details.
Sense Data Byte 1		
0	PIU parity error	Sets bit if a parity error is detected on the SLCA's internal data bus and not on the D-bus while the SLCA is performing a read or write operation with its PIU. Will be set in conjunction with sense byte 0, bit 3.
1	RAM parity error	Sets bit if a parity error is detected by the SLCA while reading a byte from its RAM. Will be set in conjunction with sense byte 0, bit 3.

2	MEM address error	The RAM address for a load RAM command exceeds RAM limits or the associated byte count would cause the address to exceed these limits, or the address for a load memory address command is not within the boundary of the RAM. Will be set in conjunction with sense byte 0, bit 7.
3	Check sum error	The check sum for a load RAM command does not equal the sum generated by the SLCA. Will be set in conjunction with sense byte 0, bit 7 if this error is on the check sum for one of the load RAM records. Will be set in conjunction with sense byte 0, bit 7 and sense byte 1, bit 6 if this error is on the overall check sum in the end record.
4	RAM not loaded	Sets bit if the SLCA's RAM is not yet flagged as executable.
5	Sequence error	Sets bit if any of the following occurs: ■ A read memory command is not immediately preceded by a load memory access command. Set in conjunction with sense byte 0, bit 0.

I/O Sense Data Byte Definitions for Single Line Communications Adapter (SLCA) (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
5 (cont)	Sequence error (cont)	■ A text or end record is received via load RAM command prior to the initialization of a valid load RAM sequence by reception of a valid start record. Set in conjunction with sense byte 0 bit 7.
6	Load RAM record error	Sets bit in conjunction with sense byte 0 bit 1 if a load RAM command results in the SLCA receiving any of the following: ■ A record with a format control character other than the three specified (hex 10, 20, or 40). ■ A text record with a number of valid bytes less than 8 (0008_{16}) or greater than 128 (0080_{16}). ■ A termination from the MLCM before receiving a full 128 byte record. Sets bit in conjunction with sense byte 0 bit 7 and sense byte 1 bit 3 if there is an error detected on the overall check sum contained in the end record.

7	Asynchronous feature	Sets bit if the asynchronous feature is installed in the SLCA.

4.8.1.1. Summary of I/O Sense Data Bytes for Single Line Communications Adapter (SLCA)

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 0	Command reject	Intervention required	Bus out check	Equipment check	Data check	Overrun	Bus in check	Program alert
1	PIU parity error	RAM parity error	MEM address error	Check sum error	RAM not loaded	Sequence error	Load RAM record error	Asynchronous feature

4.9.1. I/O Sense Data Byte Definitions for System 80 Workstation/Console Workstation

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit 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	Sets bit 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	Sets bit to indicate a parity error occurred on the D-bus while receiving a byte of data from the channel.
3	Equipment check	Sets bit 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 workstation; ■ a nonrecoverable programmable interface unit (PIU) error occurred at workstation; or ■ a check sum error occurred during a load RAM command.
4	Data check	Sets bit to indicate that an unsuccessful data transmission occurred between the workstation controller and the workstation in either direction.
5	—	Not used; always set to zero.
6	Bus in check	Sets bit to indicate a parity error occurred on the D-bus while sending a byte of data to the channel.
7	Program alert	Sets bit 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;

I/O Sense Data Byte Definitions for System 80 Workstation/Console Workstation (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
7 (cont)	Program alert (cont)	■ workstation reports an out-of-bounds vector address during a load RAM command; ■ 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	Sets bit to indicate that a portion of the DA/FC byte was invalid during a command.

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	—	Not used; always set to zero.
3	Interrupt active	Sets bit if the operator pressed the unlock key at the workstation while a command is outstanding for the workstation.
4	Load error	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.
5	—	Not used; always set to zero.
6	—	Not used; always set to zero.
7	Invalid command at WS	Sets bit to indicate that a user write command was sent to the workstation in system mode.

I/O Sense Data Byte Definitions for System 80 Workstation/Console Workstation (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2
0	WSC microcode error	Sets bit to indicate a parity error was detected in the workstation controller during RAM access.
1	NRE PIU error	Sets bit to indicate a nonrecoverable D-bus error occurred related to the PIU device.
2	Power on	Sets bit to indicate that the workstation successfully completed power on and the associated confidence test.
3	RAM parity error	Sets bit to indicate that the workstation reported a parity error.
4	Transmit	Sets bit to indicate that the transmit key on the workstation has been depressed since the last command.
5	Function code ready	Sets bit to indicate that the operator pressed either the message waiting key or one of the function keys.

6	Mode change request	Sets bit to indicate that the operator requested the system to change 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 0 when the workstation is in workstation mode.
Sense Data Byte 3		
0—7		A binary count of the number of times communication errors were dectected by the workstation controller (WSC) on the workstation controller/workstation interface since the last command.
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.

4.9.1.1. Summary of I/O Sense Data Bytes for System 80 Workstation/Console Workstation

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 0	Command reject	Intervention required	Bus out check	Equipment check	Data check	N/A	Bus in check	Program alert
1	Invalid device	WS not ready	N/A	Interrupt active	Load error	N/A	N/A	Invalid command at WS
2	WSC micro-code 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.							
4	Workstation detected communication error log counter.							

5	Keyboard error log counter.

4.9.2. I/O Sense Data Byte Definitions for 8420/8422 Diskette

Bit Position	Bit Designation	Definition
Sense Data Byte 0		
0	Command reject	Sets bit if: ■ an invalid command code is issued; ■ a valid command code is issued to a feature not installed; or ■ an invalid sequence of commands was received.

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
1	Intervention required	Sets bit if: ■ an invalid device address is presented; ■ addressed drive is not installed; ■ addressed drive is in stop state; ■ a manual feed is in progress; ■ an interlock condition exists; ■ the autoloader is not at home position; ■ stacker is full or the hopper empty;

		■ a malfunction occurred during the unload or feed cycles; ■ no index pulses occurred during execution; or ■ drive became not ready during command execution.
2	Bus out check	Sets bit if a parity retry or error was detected on the transfer of a byte of data to the diskette controller.
3	Equipment check	Sets bit if: ■ a PROM parity retry occurred; ■ a diskette controller parity error occurred; ■ no index pulses occurred during execution; ■ no track 0 detected during recalibrate; ■ no disk sense signal occurred during command execution; or ■ an autoloader time out/hang occurred.

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4	Data check	Sets bit when any of the following occurs: ■ read check error; ■ no data separator lock error; ■ ID CRC error; ■ track mismatch error; ■ side mismatch error; ■ sector mismatch error; ■ record length mismatch error;

		■ data CRC error; ■ control record error; ■ end-of-volume record error; or ■ illegal media.
5	—	Not used; always set to zero.
6	Bus in check	Sets bit if a parity retry or error was detected on the transfer of a byte of data from the subsystem.
7	Program alert	Sets bit if: ■ media (disk) is write protected; ■ data set label is not found or is invalid; ■ device is in the wrong operation mode; ■ not enough parameter bytes are transmitted;

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
7 (cont)	Program alert (cont)	■ side 2 is specified when a 1-sided diskette is installed; ■ a RAM parity error exists; ■ hexadecimal FF is specified in first parameter byte; ■ EOD record over-read; or ■ an invalid device address is specified.
		Sense Data Byte 1
0	Illegal media	Sets bit if: ■ ID feed track-byte is not 00 through 4C or FF;

		■ ID field side byte is not 00 or 01; ■ ID field sector byte is not 01 through 1A; ■ ID field length byte is not 00 through 02; or ■ the data AM was not detected or was invalid.
1	Invalid mode	Sets bit if device is in wrong operating mode.
2	Invalid sequence	Sets bit if: ■ diagnostic write command was not enabled; ■ not enough parameter bytes were transmitted; ■ hexadecimal FF was specified in first parameter byte; or ■ EOD record was over-read.

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
3	Invalid parameter	Sets bit if: ■ illegal parameter byte was transmitted; ■ invalid device address was presented; ■ side 2 was specified on 1-sided diskette; ■ hexadecimal FF was specified in first parameter byte; or ■ invalid command code was issued.
4	Not installed	Sets bit if: ■ invalid device address was presented;

		■ address drive was not installed; or ■ feature was not installed.
5	Parity error	Sets bit if: ■ bus-in parity retry or error occurs; ■ bus-out parity retry or error occurs; ■ PROM parity error occurs; or ■ subsystem parity error occurs.
6	Stop state error	Sets bit if: ■ the addressed drive is in the stop state; ■ the addressed drive became not ready during command execution; or ■ the addressed drive never became ready during feed command.

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 1 (cont)		
7	Interlock error	Sets bit when the interlock switch is tripped on addressed drive.
Sense Data Byte 2		
0	No data separator lock error	Sets bit if: ■ disk read circuits could not lock onto data from the diskette; or ■ no disk service-signal occurred after once having locked on.
1	Side error	Sets bit if: ■ a side mismatch occurred in ID field read; or ■ side 2 was specified when a 1-sided diskette was installed.

2	Track error	Sets bit if: ■ a track mismatch occurred in ID field read; or ■ no track 0 was detected during recalibrate.
3	Record length error	Sets bit if a record length mismatch occurred in ID.
4	Sector error	Sets bit if: ■ a sector mismatch occurred in field read; or ■ the sector specified is greater than the number of sectors on the cylinder.
5	ID CRC	Sets bit if an ID field CRC error occurred.
6	Data CRC	Sets bit if data field CRC error occurred.
7	Retry	Sets bit if: ■ a repositioning of the R/W head occurred;

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 2 (cont)		
7 (cont)	Retry (cont)	■ a reread of the ID or data field occurred; or ■ a retry of a parity error occurred.
Sense Data Byte 3		
0	DSL not found	Sets bit if the data set label was not found.
1	DSL invalid	Sets bit if the data set label was invalid.
2	Control AM	Sets bit if a record that was read was preceded by a control address mark.
3	DSL WP error	Sets bit if the data set label has a write protect indication.
4	Disk parity error	Sets bit if a parity error occurred within the disk logic during writes to the disk.

5	EOD/EOE	Sets bit if: ■ end of data (EOD): In DSM, the last valid record of the last or only volume of a file has been read. In DAM, the last sector of the diskette has been read. ■ end of extent (EOE): In DSM, the last valid record of the last or only volume of a file has been written. In DAM, the last sector of the diskette has been written.
6	Read check	Sets bit if a CRC error occurred while read checking a data field after a write command.
7	HWP	Sets bit if the diskette is hardware write protected.
Sense Data Byte 4		
0	Autoloader unload fault	Sets bit if a malfunction occurred during the unload portion of the cycle.
1	Autoloader feed fault	Sets bit if a malfunction occurred during the feed portion of the cycle.
2	Autoloader stacker full	Sets bit if the output stacker is full.

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 4 (cont)		
3	Autoloader hopper empty	Sets bit if the input hopper is empty.
4	Autoloader hang	Sets bit if a mechanism malfunction timeout occurred during operation.
5	Autoloader busy	Sets bit if a manual feed switch operation is in progress.
6	Autoloader jam	Sets bit if a diskette is jammed in the feed path.
7	Data late	Sets bit if a byte of data was lost due to the subsystem failing to respond in time.
Sense Data Byte 5		

<table>
<tr><td>0, 1, 2</td><td>Mode bits</td><td>Indicates the current operation mode of the addressed device as follows:

<table>
<tr><th>Mode bits</th><th>0</th><th>1</th><th>2</th><th></th><th>Mode</th></tr>
<tr><td></td><td>0</td><td>0</td><td>0</td><td>=</td><td>Format label</td></tr>
<tr><td></td><td>1</td><td>0</td><td>0</td><td>=</td><td>Data set label — R at BOE</td></tr>
<tr><td></td><td>1</td><td>0</td><td>1</td><td>=</td><td>Data set label — R/W at BOE</td></tr>
<tr><td></td><td>1</td><td>1</td><td>0</td><td>=</td><td>Data set label — R/W at EOD</td></tr>
</table>
</td></tr>
<tr><td>3</td><td>H autoloader installed</td><td>Indicate an autoloader mechanism is installed on the addressed drive when bit is set to 1.</td></tr>
<tr><td>4</td><td>Two-sided</td><td>Indicates type of diskette installed. When bit is set to 0, a 1-sided diskette is installed. When bit is set to 1, a 2-sided diskette is installed.</td></tr>
<tr><td>5*</td><td>H MFM density</td><td>Indicates the recording density on the diskette. When bit is set to 0, recording density is single density. When bit is set to 1, recording density is double density.</td></tr>
<tr><td>6*</td><td>FM density</td><td>Indicates the recording density on the diskette. When bit is set to 0, recording density is FM. When bit is set to 1, recording density is FM.</td></tr>
</table>

I/O Sense Data Byte Definitions for 8420/8422 Diskette (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 5 (cont)		
7	HWP	Indicates that installed diskette contains hardware write protect notch.
Sense Data Byte 6		
0—7	Track Address	Indicates the current track address in binary (bit 0 is MSB)
Sense Data Byte 7		
0	L side 0	Indicates the current side address. When bit is set to 0, side 0 is the current side. When bit is set to 1, side 1 is the current side.
1—7	Sector address	Indicates the current sector address in binary (bit 1 MSB).

*Bits 5 and 6 of sense byte 5 are not valid until after the first media related command has been executed on the addressed drive. If bit 5 and 6 are both 0, the recording density is not known.

4.9.2.1. Summary of I/O Sense Data Bytes for 8420/8422 Diskette

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
0	Command reject	Intervention required	Bus out check	Equipment check	Data check	Not used	Bus in check	Program alert
1	Illegal media	Invalid mode	Invalid sequence	Invalid parameter	Not installed	Parity error	Stop state error	Interlock error
2	No data separator lock error	Side error	Track error	Record length error	Sector error	ID CRC	Data CRC	Retry
3	DSL not found	DSL not valid	Control AM	DSL WP error	Disk parity error	EOD/EOE	Read check	HWP
4	Autoloader unload fault	Autoloader feed fault	Autoloader stacker full	Autoloader hopper empty	Autoloader hang	Autoloader busy	Autoloader jam	Data late

Summary of I/O Sense Data Bytes for 8420/8422 Diskette (cont)

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 5	Mode bit 0	Mode bit 1	Mode bit 2	H autoloader installed	Two-sided	H MFM density	FM density	HWP
6	The current track address.							
7	L side zero	The current sector address.						

4.9.2A. I/O Sense Data Byte Definition in 0770 Printer Subsystem

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 byter 2); ■ stacker full; ■ STOP switch activated; ■ ribbon check (bit 6 of sense data byte 2); ■ interlock - power check - carriage check - casework check

I/O Sense Data Byte Definitions for 0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
1 (cont)	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.

I/O Sense Data Byte Definition for 0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
7 (cont)	Command retry (cont)	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. 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.
1	Inhibit data check	This bit indicates inhibit-data-check flip-flop is set.
2	Inhibit status in	This bit indicates inhibit-data-check flip-flop is set.
3	Fold data	This bit indicates fold flip-flop is set.

* If dualing is active.

I/O Sense Data Byte Definition for 0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
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 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 lpi criterion for advancing has not been received.
7	Load code request	This bit indicates the load code buffer has not been properly loaded.

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-print, or advance-only command from being executed.

I/O Sense Data Byte Definition for 0770 Printer Subsystem (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2 (cont)
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.
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.

I/O Sense Data Byte Definitions for 0770 Printer Subsystem (cont)

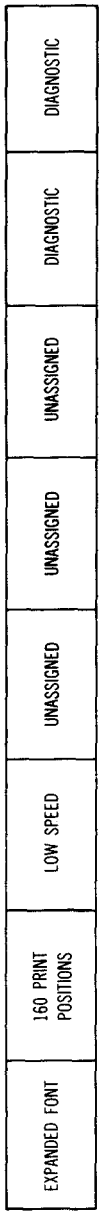
Bit Position	Bit Designation	Definition
Sense Data Byte 3 (cont)		
3	Unassigned	
4	Actuator check	This bit is set when an actuator fails to fire due to a malfunction of the actuator circuitry. When this condition is detected, all columns are printed except those with a malfunction.
5	Unassigned	
6	Unassigned	
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	

4.9.2A.1. Summary of I/O Sense Data Byte for 0770 Printer

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 FORAMT 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.						

I/O SENSE DATA BYTE DEFINITIONS FOR SDMA DEVICES (cont)



4.9.3. I/O Sense Data Byte Definitions for 0776/0789 Printer

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit when invalid command is issued. Unit check status is set and no action is initiated by the PPC.
1	Intervention required	Sets bit if a condition is detected that requires manual intervention, if an out-of range address is detected, or if a feature that was called for was not installed.
2	Bus out check	Sets bit when a parity error is received during a D-bus data transfer on controller inbound data.
3	Equipment check	Sets bit when any of the following error conditions are detected within the PPC or device: ■ a parity error detected when reading VFB; ■ device check; ■ nonrecoverable PIU error;

I/O Sense Data Byte Definitions for 0776/0789 Printer (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
3 (cont)	Equipment check (cont)	■ PPC parity error; ■ a print or advance command exceeded the maximum time allowed; ■ paper feed motor motion error; ■ forms runaway; ■ temperature error; ■ actuator error; ■ printer RAM parity error; or ■ band error.

4	Data check	Sets bit when one of the following conditions is present, unless suppressed by the data check disable command: ■ an unprintable character received by printer; or ■ data parity occurred on data transferred to printer on each of four tries.
5	—	Not used; always set to zero.
6	Bus in check	Sets bit when bus parity error is received during a D-bus data transfer on controller outbound data.
7	Program alert	Sets bit when an out of range device address is presented to the PPC during command initiation or when a VFB sequence error or VFB check occurs.
Sense Data Byte 1		
0	Forms out	Sets bit when forms low indication is present and last form moved the paper to or past home paper position. Printer indicates not ready condition.

I/O Sense Data Byte Definitions for 0776/0789 Printer (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 1 (cont)		
1	Forms low	Sets bit when bottom edge of last form passed form detector switch. Printer remains ready until controller declares a paper-out condition. Unit check status is generated when condition is first detected.
2	VFB check	Sets bit when an advance command is issued and the skip code specified by D, E, and F bits (A=1) is not present in the VFB. No paper advance takes place.
3	Forms check	Sets bit when a forms runaway, jam, tear condition, or stacker full occurs.
4	Unprintable characters	Sets bit when one or more nonprintable characters were transmitted to printer. These characters are printed as a space, if enabled.
5	VFB parity error	Set if a parity error is detected when reading the VFB.

6	Stop state	Sets bit when printer is in stop state. Printer may enter stop state by way of stop switch or on error condition.
7	Printer parity error	Sets bit when one or more parity errors occur on the data transferred to printer on each of four tries.
Sense Data Byte 2		
0	Bit 1 print band sense	Used in conjunction with bit 2 to identify which print band is mounted on the printer.
1	Vertical format buffer sequence error	Sets bit if a print-advance or advance command was received after power-on system reset or if operator initialized the VFB and no load-VFB command was issued.
2	Bit 2 print band sense	Used in conjunction with bit 0 to identify which print band is mounted on the printer.
3	6/8 line spacing	Specifies 8 lines per inch
4	Nonrecoverable PIU error	Sets bit if a nonrecoverable D-bus error occurred related to the PIU device.

I/O Sense Data Byte Definitions for 0776/0789 Printer (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 2 (cont)		
5	Printer time-out	Sets bit if one of the following is present: ■ printer not installed; ■ printer offline; ■ printer power off; or ■ no response from printer.
6	PPC parity error	Sets bit when a parity error occurs in the PPC during data transfer.
7	Device check	Sets bit when printer detects hardware malfunction or a not-ready condition during printing or advancing paper.

Sense Data Byte 3		
0	—	Not used; always set to zero.
1	—	Not used; always set to zero.
2	Invalid sequence	Sets bit if the diagnostic write enable command has not preceded all other diagnostic write commands.
3	—	Not used; always set to zero.
4	—	Not used; always set to zero.
5	—	Not used; always set to zero.
6	—	Not used; always set to zero.
7	—	Not used; always set to zero.

I/O Sense Data Byte Definitions for 0776/0789 Printer (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 4
0	Stacker forms check	Sets bit when the forms stacker is full.
1	Forms jam	Sets bit when the paper has stopped moving while a line advance operation is being performed.
2	Paper feed motor motion error	Sets bit when the acceleration or deceleration of the paper is too slow.
3	Forms runaway	Sets bit when the form has been continuously advanced for an excessive period of time.
4	Temperature error	Sets bit when an abnormal temperature condition exists at the device.
5	Actuator error	Sets bit when either an open or short circuit exists in one of the print hammer actuators.
6	Printer RAM parity error	Sets bit when the printer has detected a parity error while reading its RAM.

7	Band error	Sets bit when the printer has failed to detect a sprocket signal, has detected an extra sprocket signal, or has failed to detect a font mark.

4.9.3.1. Summary of I/O Sense Data Bytes for 0776/0789 Printer

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
0	Command reject	Intervention required	Bus out check	Equipment check	Data check	—	Bus in check	Program alert
1	Forms out	Forms low	VFB check	Forms check	Unprintable characters	VFB parity error	Stop state	Printer parity error
2	Bit 1 print band sense	VFB sequence error	Bit 2 print band sense	6/8 line spacing	Nonrecoverable PIU error	Printer time-out	PPC parity error	Device check

Summary of I/O Sense Data Bytes for 0776/0789 Printer (cont)

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 3	—	—	Invalid sequence	—	—	—	—	—
4	Stacker forms check	Forms jam	Paper feed motor motion error	Forms runaway	Temperature error	Actuator error	Printer RAM parity error	Band error

4.9.4. I/O Sense Data Byte Definitions for 0789/0798 Remote Printer

Bit Position	Bit Designation	Definition
	Sense Data Byte 0	
0	Command reject	Set when either an invalid command or an invalid sequence of commands is issued. Also set if the contents of the RPI RAM are nonexecutable or a command is outside the basic set. Unit check status results, and no action is initiated by the subsystem.

1	Intervention required	Set when a condition is detected that requires manual intervention.
2	Bus out check	Set when a bus parity error is detected.
3	Equipment check	Set when any of the following conditions are detected: ■ parity error detected in the RPI, RPA, or by the printer; ■ print or advance operation exceeds time allotted; ■ error detected in a message on the cable; ■ forms jam; ■ paper feed motor motion error; ■ forms runaway; ■ temperature error; ■ actuator error; or ■ band error.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4	Data check	Set when any of the following conditions are present: ■ unprintable character received; or ■ check sum error detected.
5	—	Not used, set to 0.
6	Bus in check	A bus parity error received during a D-bus data transfer on controller outbound data.
7	Program alert	Set to indicate a possible programming error was detected as indicated by: ■ VFB check; ■ VFB sequence error;

		■ out-of-range address; ■ memory address error; ■ load RAM sequence error; ■ load RAM record error; ■ check sum error; or ■ invalid device address.
Sense Data Byte 1		
0	PIU parity error	When set, indicates a parity error detected on the RPI internal data bus while performing a read or write operation with its PIU. Is set in conjunction with sense byte 0, bit 3.
1	RPI RAM parity error	When set, indicates a parity error detected by the RPI while reading a byte from its RAM. Is set in conjunction with sense byte 0, bit 3.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
2	MEM address error	When set, indicates the RAM address for the load RAM command exceeds: ■ RAM limits; ■ associated byte count would cause the address to exceed these limits; or ■ address for a load memory command is not within the boundary of the RAM. Is set in conjunction with sense byte 0, bit 7.
3	Check sum error	When set, indicates the check sum for a load RAM command does not equal the sum generated by the RPI. Is set in conjunction with sense byte 0, bit 7 if this error is on the check sum for one of the load RAM records. Is set in conjunction with sense byte 0, bit 7 and sense byte 1, bit 6 if this error is on the overall check sum in the end record.

4	RPI RAM not loaded	When set, indicates the RPI RAM is not yet flagged as executable.
5	Sequence error	Set to 1 if: ■ read memory command is not immediately preceded by a load-memory address command. Is set in conjunction with sense byte 0, bit 0; or ■ text record is received by way of the load RAM command prior to the initiation of a valid load RAM sequence by reception of a valid start record. Is set in conjunction with sense byte 0, bit 7.
6	Load RAM record error	When set in conjunction with sense byte 0, bit 7, indicates a load RAM command resulted in the RPI receiving: ■ a record with a format control character other than the three specified: 10_{16}, 20_{16}, or 40_{16}; ■ a text record with a number of valid bytes having a value less than 8 (0008_{16}) or greater than 128 (0080_{16}); or ■ a termination from the channel before receiving a full 128-byte record. When set in conjunction with sense byte 0, bit 7 and sense byte 1, bit 3, an error is detected on the overall check sum contained in the end record.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Sense Data Byte 1 (cont)		
7	RPI feature	Always set to 1.
Sense Data Byte 2		
0	Forms out	When set, indicates forms low and the last form advanced the paper to or past the home paper position. Printer not ready status.
1	Forms low	When set, indicates bottom edge of last form passed the form detecter switch. Printer remains ready until controller declares a forms out condition. Unit check status is displayed when this condition is initially detected.
2	VFB check	When set, indicates an advance command was issued and the skip code specified by the D, E, and F bits (A=1) is not present in the VFB. Paper advance is inhibited.
3	Forms check	A printer forms runaway timeout condition was detected by the RPA.
4	Unprintable characters	When set, indicates that one or more unprintable characters were detected in the line buffer of the printer. The unprintable characters reprinted as a space.

5	—	Always set to 0.
6	Printer not ready	When set, indicates an inactive level is detected on the printer ready line from the printer.
7	Printer parity error	When set, indicates printer reported a parity error in data being received from the RPA.
	Sense Data Byte 3	
0	Bit 1 print band sense	Identifies print band mounted on the printer. Is set in conjunction with sense byte 3, bit 2.
1	Vertical format buffer sequence error	When set, indicates a print-advance or advance command was received after either power-on, system reset, or operator initialization of the VFB and no load VFB command was issued.
2	Bit 2 print band sense	Identifies print band mounted on the printer. Is set in conjunction with sense byte 3, bit 0.
3	6/8 line spacing	When set, indicates 6/8 lpi switch is set to the 8 lpi position.
4	—	Always set to 0.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
5	Printer time-out	When set, indicates printer did not complete either a print or a form advance operation in less than 8 seconds after having acknowledged the command.
6	—	Always set to 0.
7	Device check	When set, indicates the printer reported a hardware malfunction or a not-ready condition during printing or advancing paper.
		Sense Data Byte 4
0	RPA power-on	When set, indicates the RPA successfully completed its power-on-confidence test.
1	RPA message error	When set, indicates the RPI detected an error in a message from the RPA.
2	Invalid diagnostic sequence	When set, indicates a diagnostic write data buffer command that did not immediately follow a diagnostic write enable command was received from the channel.

3	RPI message error	When set, indicates the RPA reported an error in a message from the RPI.
4	No response from RPA	When set, indicates the RPI received no response while transmitting to the RPA.
5	Unrecoverable RPA message error	When set, indicates the RPI detected an error in four successive message transmissions from the RPA.
6	Unrecoverable RPI message error	When set, indicates the RPA reported an error in four successive message transmissions from the RPI.
7	—	Always set to 0.
	Sense Data Byte 5	
0	Stacker forms check	When set, indicates that the forms pullout stacker is full.
1	Forms jam	When set, indicates that the paper forms stopped moving during a line advance operation.
2	Paper feed motor error	When set, indicates starting and stopping of the paper forms is too slow.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 5 (cont)		
3	Forms runaway	When set, indicates paper forms have been advanced for an excessive period of time.
4	Temperature error	When set, indicates an abnormal temperature condition exists at the device.
5	Actuator error	When set, indicates either an open or short circuit exists in one of the print hammer actuators.
6	Printer RAM parity error	When set, indicates that the printer detected a parity error while reading its RAM.
7	Band error	When set, indicates the printer failed to detect a sprocket signal, detected an extra sprocket signal, or failed to detect a font mark.

Sense Data Byte 6		
0	Unrecoverable printer parity error	When set, indicates the printer reported a parity error in data received from the RPA during each of four successive transfers of the same print line.
1	Printer power-off	When set, indicates an inactive level was detected on the power signal line from the printer.
2	RPA RAM parity error	When set, indicates a parity error was detected by the RPA while reading a byte from its RAM.
3	No response from printer	When set, indicates printer did not acknowledge a command or data transfer from the RPA within one millisecond.
4 through 7	—	Always set to 0.

I/O Sense Data Byte Definitions for 0789/0798 Remote Printer (cont)

Bit Position	Bit Designation	Definition
	Sense Data Byte 7	
0	—	Always set to 0.
1	Command sequence number	Most significant bit.
2 through 6	Command sequence numbers	Intermediate bits.
7	Command sequence number	Least significant unit.

4.9.4.1. Summary of I/O Sense Data Bytes for 0789/0798 Remote Printer

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
0	Command reject	Intervention required	Bus out check	Equipment check	Data check	—	Bus in check	Program alert
1	PIU parity error	RPI RAM parity error	MEM address error	Check sum error	RPI RAM not loaded	Sequence error	Load RAM record error	RPI feature
2	Forms out	Forms low	VFB check	Forms check	Unprintable characters	—	Printer not ready	Printer parity error
3	Bit 1 print band sense	VFB sequence error	Bit 2 print band sense	6/8 line spacing	—	Printer time-out	—	Device check

Summary of I/O Sense Data Bytes for 0789/0798 Remote Printer (cont)

4	RPA power-on	RPA message error	Invalid diagnostic sequence	RPI message error	No response from RPA	Unrecoverable RPA message error	Unrecoverable RPI message error	—
5	Stacker forms check	Forms jam	Paper feed motor error	Forms runaway	Temperature error	Actuator error	Printer RAM parity error	Band error
6	Unrecoverable printer parity error	Printer power-off	RPA RAM parity error	No response from printer	—	—	—	—
7	—	Command sequence number (MSB)	Command sequence numbers					Command sequence number (LSB)

4.9.4A. I/O Sense Data Byte Definition for 0716 Card Reader

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 ocurs at the ready station, or output station, the FEED CHECK indicator on the operator control panel lights and the card reader stops.

I/O Sense Data Byte Definition for 0716 Card Reader (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4	Data check	Set to indicate that a mispunched card, improper registration, or a read head failure is detected.
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 ■ stack 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 detected 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

I/O Sense Data Byte Definition for 0716 Card Reader (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2
0	Column counter normalized	Set when the column counter has reached a count of 50 to 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.

4.9.2A.1. Summary of I/O Sense Data Byte for 0716 Card Reader

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

4.9.5. I/O Sense Data Byte Definitions for 0719 Card Reader

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit when an invalid command is issued. Unit check is also set, and no action is initiated by the PPC.
1	Intervention required	Sets bit when a condition is detected that requires manual intervention, such as: ■ Hopper empty ■ Stacker full ■ Not ready — Power off — Initial power-up clear

I/O Sense Data Byte Definitions for 0719 Card Reader (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 0 (cont)		
1 (cont)	Intervention required (cont)	— Door interlock open — Offline — STOP switch activated ■ Input check.
2	Bus out check	Sets bit when a bus parity error is received during D-bus transfer on controller inbound data.
3	Equipment check	Sets bit on PPC RAM data store parity error, such as PPC parity error, card operation not completed in maximum time, or nonrecoverable PIU error.

4	Data check	Sets bit on an incorrect parity from device, device read check, device input check, or multiple punch error.
5	Overrun	Not used; always set to zero.
6	Bus in check	Sets bit when a bus parity error is received during a D-bus transfer on controller outbound data.
7	Program alert	Sets bit when an out-of-range device address is presented to the PPC during command sequence.
Sense Data Byte 1		
0	Device not ready	Sets bit if the device is offline, power is off, interlock is open, feature not installed or STOP switch is depressed.
1	Stacker full	Sets bit when stacker is full.
2	Hopper empty	Sets bit when hopper is empty.
3	Input check	Sets bit if device detects a misfeed or mispick condition.
4	—	Not used; always set to zero.

I/O Sense Data Byte Definitions for 0719 Card Reader (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 1 (cont)		
5	Read check	Sets bit if device detects an error at read station.
6	Stop state	Sets bit if device is in stop state. It may be entered by stop or device error.
7	Parity check	Sets bit for parity error from device.
Sense Data Byte 2		
0	Multiple punch	Sets bit if the device detects more than one hole punched in columns 1 through 7.
1	—	Not used; always set to zero.

2	Invalid sequence	Sets bit if the diagnostic-write-enable command has not preceded all other diagnostic write commands.
3	—	Not used; always set to zero.
4	Nonrecoverable PIU error	Sets bit if a nonrecoverable error occurs related to the PIU device.
5	—	Not used; always set to zero.
6	PPC RAM parity error	Set if a parity error occurred in the PPC during a data transfer.
7	—	Not used; always set to zero.

4.9.5.1. Summary of I/O Sense Data Bytes for 0719 Card 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	—	Bus in check	Program alert
1	Device not ready	Stacker full	Hopper empty	Input check	—	Read check	Stop state	Parity check
2	Multiple punch	—	Invalid sequence	—	Nonrecoverable PIU error	—	PPC RAM parity error	—

4.9.6. I/O Sense Data Byte Definitions for 0608 Card Punch

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit when an invalid command or command sequence is issued. Unit check status is set and no action is initiated by the PPC.
1	Intervention required	Sets bit when any of the following conditions (that require manual intervention) occurs: ■ Hopper empty ■ Stacker full ■ Not ready — Power off — Initial power up clear — Door interlock open

I/O Sense Data Byte Definitions for 0608 Card Punch (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 0 (cont)		
1 (cont)	Intervention required (cont)	— Offline — STOP switch pressed ■ Input check ■ Output check
2	Bus out check	Sets bit when a bus parity error is received during D-bus data transfer on controller inbound data.
3	Equipment check	Sets bit when error conditions such as PPC parity error, card operation not completed in specified time, or nonrecoverable PIU error are detected within the PPC or device.

4	Data check	Sets bit on incorrect parity from device, device read-check, device input check, device output-check, device not ready, or multiple punch error.
5	—	Not used; always set to zero.
6	Bus in check	Sets bit when a bus parity error is received during D-bus transfer on PPC outbound data.
7	Program alert	Set when a read image command is issued to a 96-column reader, or an out-of-range device address is presented to PPC during command sequence.
Sense Data Byte 1		
0	Device not ready	Sets bit when device is offline, power is off, interlock is open, a feature is not installed that was called for, or STOP switch was depressed.
1	Stacker full	Sets bit if the stacker is full.
2	Hopper empty	Sets bit if the hopper is empty.
3	Input check	Sets bit if the device detects misfeed or mispick condition.

I/O Sense Data Byte Definitions for 0608 Card Punch (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 1 (cont)		
4	Output check	Sets bit if the device detects an output check error.
5	Read check	Sets bit if the device detects an error at the read station.
6	Stop state	Sets bit if the device is in stop state. It may be entered by way of stop or device error.
7	Parity check	Sets bit on parity check from device.
Sense Data Byte 2		
0	Multiple punch	Sets bit if the device detects more than one hole punched in columns 1 through 7.
1	96 column card reader	Set if 96-column card reader feature is installed.

2	Invalid sequence	Sets bit if the diagnostic write enable command has not preceded other diagnostic write commands.
3	—	Not used; always set to zero.
4	Nonrecoverable PIU error	Sets bit if a nonrecoverable D-bus error occurs related to the PIU device.
5	—	Not used; always set to zero.
6	PPC RAM parity error	Sets bit if parity error occurred in the PPC during a data transfer.
7	—	Not used; always set to zero.

4.9.6.1. Summary of I/O Sense Data Bytes for 0608 Card Punch

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
0	Command reject	Intervention required	Bus out check	Equipment check	Data check	—	Bus in check	Program alert
1	Device not ready	Stacker full	Hopper empty	Input check	Output check	Read check	Stop state	Parity check
2	Multiple punch	96-column reader	Invalid sequence	—	Nonrecoverable PIU error	—	PPC RAM parity error	—

4.9.7. I/O Sense Data Byte Definition for UNISERVO V1-C Magnetic Tape

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.

I/O Sense Data Byte Definition for UNISERVO VI-C Magnetic Tape (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
4	Data check	This bit increases 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.
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.

	Noise (cont)	For a writer or tape mark operation a tape fault occurred. In this case, the noise will be accompanied by the tape unit 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 logitudinal parity character turns on the noise bit and maintains tape motion but is not transferred. This condition may also be cause 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.

I/O Sense Data Byte Definition for UNISERVO VI-C Magnetic Tape (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
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 positional 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.
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-back 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 ready 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.

I/O Sense Data Byte Definition for UNISERVO VI-C Magnetic Tape (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
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.)
2,3,4		Always zero and reserved for the failure finding mode used 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 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.

4.9.7.1. Summary of I/O Sense Data Bytes for UNISERVO VI-C Magnetic Tape

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.

4.9.7A. I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Sets bit when: ■ a write, a write tape mark, or erase command was attempted on a file protected tape unit; ■ a backward type command was attempted when the tape was already at load point (sense byte 0, bit 7 and sense byte 1, bit 4 are set); ■ an invalid command is transmitted to the controller (this condition is not set if a bus out check occurred on a command transfer); or ■ the tape unit incompatibility bit was set (sense byte 1, bit 7).
1	Intervention required	Sets bit when tape unit status A is inactive; i.e., a nonexistent or nonready tape unit was selected on other than a sense command (bit 1 of sense byte 1 is not set).
2	Bus out check	Sets bit when even parity appears on the BUS OUT signal for data or command transfers. During write operations, if this condition is set on a data transfer, the operation is terminated and the error byte is not written on tape.

I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
3	Equipment check	Sets bit when an equipment check condition occurred; i.e., bits 0, 1, or 5 of sense byte 4 have been set.
4	Data check	Sets bit when a data check condition occurred; i.e., bit 0 of sense byte 1 or bits 0, 1, 2, 3, and 4 of sense byte 3 have been set.
5	Overrun	Sets bit when service is requested on the I/O interface, but data cannot be transferred due to a late response from the channel. If this occurs on the first data transfer of a write operation, word count zero is also set in conjunction with overrun (but not set on request-tie or sense commands).
6	Bus in check	Sets bit when the controller receives the outbound control flag for parity error.

7	Program alert	Sets bit when: ■ a command was issued while the tape was rewinding (sense byte 1, bits 1 and 2 are set); or ■ a backward type command was attempted when the tape was already at load point (sense byte 0, bit 0 and sense byte 1, bit 4 are set).
Sense Data Byte 1		
0	Noise	Sets bit if: ■ During reading or read checking a block of data, a data dropout occurs (i.e., all tracks inactive) that is less than 64 frame times in length (1.6 ms at 25 ips/635 mmps). End of block is set and postamble detected is not set. ■ During erase operations, data (or noise due to tape defect) was detected on read check while the tape was being erased. ■ During a read operation, a block consisting of less than 12 bytes is detected.

I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
1	Tape unit status A	Available condition: 0 = nonexistent (offline) 1 = available Other condition: 0 = rewinding to interlock 1 = rewinding to load point

2	Tape unit status B	Indicates not ready or rewinding

Status A	Status B	Tape Drive Status	Bit Set
0	0	Nonexistent or offline	Unit check
0	1	Not ready rewinding to interlock	Unit check
1	0	Available	—
1	1	Busy, i.e., rewinding	Unit check

3	7-track	Normally zero
4	Load point	Indicates tape positioned at load point
5	End of tape	Indicates tape positioned at end-of-tape area

I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
6	File protect	Indicates tape not using write enable ring
7	Tape unit incompatible	Indicates: 1. Tape unit is selected on any command requiring tape motion and any of the following conditions occur: ■ Addressed tape drive is 7-track mode but indicated PE mode. ■ Addressed tape drive is PE but indicating 7-track mode. ■ Addressed tape drive is 9-track mode and failed to reset to 1600 bpi (630 bpcm) mode (for load point only).

		2. Tape drive is selected for a read operation from load point but tape unit is 9-track mode and failed to set to 800 bpi (315 bpcm) when the tape is written in 800 bpi NRZI mode. *NOTE: No tape motion occurs as a result of attempted operation. In case of item 2, the condition detected after the first read operation is initiated. If a read command is to be attempted a second time, a rewind command should be executed first in order to reposition the tape.* 3. GCR ID burst is detected on read operation.
Sense Data Byte 2		
0—7	Track in error	Not used; always set to zero for phase encoded (PE). Used in nonreturn zero inverted NRZI.
Sense Data Byte 3		
0	Read/write VRC/RVRC	Indicates a vertical redundancy check occurred on a data frame on a write, read, or read-backward operation.

I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
1	Multiple dead track check/LRC	Indicates a marginal signal occurred in more than one track on a read or read-backward operation (uncorrectable).
2	Skew	Indicates excessive skew occurs during a write, read, or read-backward operation (deskew register overflow).
3	Postamble check/CRC	Indicates postamble following the data is not read correctly or is recognized before the actual end of data (early stop sentinal).
4	Dead track check/write VRC	Indicates any of the following: ■ At least one track has a marginal signal during write or write-tape mark operations that causes sense byte 0, bit 4 to set unit check.

		■ A marginal signal is present in only one track during read or read-backward operation (correctable error). This bit is 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 will be set. If this bit is set and I=0 is in the read command, however, unit check will not set. In either case, data is correct. ■ A tape mark was not properly detected on the read check of a write-tape-mark operation.
5	Tape unit 1600 bpi	Indicates the tape drive is set for 1600 bpi (630 bpcm) mode.
6	Backward	Indicates the tape drive is set for backward tape motion.
7	—	Not used; always set to zero.
Sense Data Byte 4		
0	Runaway check	Indicates: ■ While read checking recorded data during write or write-tape-mark operations, the end-of-block mark was not detected within 12.7 milliseconds after writing was terminated. ■ During any read operation, data is not detected within 13 seconds.

I/O Sense Data Byte Definitions for UNISERVO 10 Magnetic Tape Type 0871 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 4 (cont)
1	Tape motion fault	Indicates: ■ Tape drive failed to respond to a start command. Tape motion may or may not have started. ■ Tape motion stopped independently of the controller during an operation requiring tape movement. This condition is detected if a backward operation is executed into load point.
2	Speed check	Indicates excessive speed variation occurred during a write operation.
3	Data bus parity error	Indicates a parity error exists on the data bus during storage read.
4	Translate error	Not used; always set to zero.
5	—	Not used; always set to zero.

6	Tape fault	Indicates end of block was detected sooner than expected during write or write-tape-mark operation. False end of block can occur if a data dropout (all tracks) is longer than 1.6 milliseconds.
7	COS parity error	Indicates a parity error occurred in the control store, read-only memory (ROM).

*These bits reflect the current state of the selected tape unit. For example, if a nonready condition is detected and the operation is aborted early, the tape-unit-available bit will be reset and the intervention-required bit will become set in sense bytes 1 and 0, respectively. Between the time that operation was aborted and the sense command was executed, if the tape drive became ready, then the sense data returned to the channel indicates that intervention is required, and tape-unit-available bits are set.

4.9.7A.1. Summary of I/O Sense Data Bytes for UNISERVO 10 Magnetic Tape Type 0871

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	Bus in check	Program alert
1	Noise	Tape unit status A	Tape unit status B	7-track	Load point	End of tape	File protect	Tape unit incompatible
2	Track in error.							
3	Read/write VRC/RVRC	Multiple dead track check/LRC	Skew	Postamble check/CRC	Dead track check/write VRC	Tape unit 1600 bpi	Backward	—
4	Runaway check	Tape motion fault	Speed check	Data bus parity error	Translate error	—	Tape fault	COS parity error

4.9.7B. I/O Sense Data Byte Definitions for UNISERVO 10/14 Magnetic Tape Type 0870

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.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (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 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 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.	Same as phase encoding mode.
7	DATA CONVERTER CHECK	This bit is not used in phase encoding mode and is always 0.	Set on 7-track operations only.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (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 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 while the tape was being erased.

		■ 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). 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.	■ 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, a data drop that 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).

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1			
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.

Tape Unit Status	Tape Unit Status	Status Tape Unit	Bit Set In Status Byte
A	B		
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	
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.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
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.	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.

		■ 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. 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 0s.	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.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 2 (cont)			
			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 (uncorrectable).	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

		■ Excessive amount of speed variation occurred during a write operation. Set in conjunction with bit 2 sense byte 4.	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.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
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 operation.	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, 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.

I/O Sense Data Byte Definition for UNISERVO 10/14 Magnetic Tape Type 0870 (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 conditon 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.

4.9.7B.1. Summary of I/O Sense Data Bytes for UNISERVO 10/14 Magnetic Tape Type 0870

Bit / Sense Data Byte	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

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

4.9.7C. I/O Sense Data Byte Definitions for UNISERVO 12/16 Magnetic Tape Type 0861/0862

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.
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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 0 (cont)			
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 set, this bit indicates one of the following: ■ Tape mark - During write of write-tape mark operations, data (or

		■ 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 deativated 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.	noise due to tape detects) was detected on read check sooner than was expected. ■ During erase operations, data (or noise due to type 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. ■ 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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
0	Noise (cont)		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 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.

		Tape Unit Status	Tape Unit Status	Status Tape Unit	Bit Set In Status Byte	
		A	B			
		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 or under control of other control unit	Unit check	
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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
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: 1. Address 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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI 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 o'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.
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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
1	LRC/multiple dead track/track start failure	When set, indicates one of the following conditons 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 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.	A vertical redundancy check occurred on a data frame or CRC frame during a write or write-tape-mark operation.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
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: ■ 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.	Same as phase encoding mode.

		■ 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 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. 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.

I/O Sense Data Byte Definition for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (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 16 or UNISERVO VIII-C (if this is the case, a backspace may not reposition 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.

4.9.7C.1. Summary of I/O Sense Data Bytes for UNISERVO 12/16 Magnetic Tape Type 0861/0862

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 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

Summary of I/O Sense Data Bytes for UNISERVO 12/16 Magnetic Tape Type 0861/0862 (cont)

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.

4.9.7D. I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864

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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (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 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 terminte 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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (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 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 than was expected. ■ During erase operations, data (or noise due to tape defects) was detected on read check while the tape was being erased.

		■ 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). 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.	■ 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, 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).

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 1 (cont)			
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.

Tape Unit Status	Tape Unit Status	Status Tape Unit	Bit Set In Status Byte
A	B		
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 or under control of other control unit	Unit check	
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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (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: ■ 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).	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 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. 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.	Tape motion does not occur as a result of attempted operation.
		Sense Data Byte 2	
0-7	Track in error	Not applicable	This byte indicates 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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 2 (cont)			
			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 when 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 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.	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

		■ 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.	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. ■ 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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 3 (cont)			
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 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, 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.	

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (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 8.3 msec (UNISERVO 12), 2.9 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).	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	Speed check (UNIVERSO 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.

I/O Sense Data Byte Definitions for UNISERVO 20 Magnetic Tape Type 0864 (cont)

Bit Position	Bit Designation	Definition	
		Phase Encoding Mode	NRZI Mode
Sense Data Byte 4 (cont)			
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.

* Indicates bit that is conditioned by current status of the tape unit.

4.9.7D.1. Summary of I/O Sense Data Bytes for UNISERVO 20 Magnetic Tape Type 0864

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.

4.9.8. I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884

Bit Position	Bit Designation	Definition
		Sense Date Byte 0
0	Command reject	This bit is set if: ■ A WRITE or similar command was issued to a file-protected tape unit. ■ An undefined command code was received by the controller. ■ A DSE command was issued, but it was not chained to an ERASE GAP command. ■ A SENSE RESERVE or RELEASE command was issued: - to a controller that does not have a dual channel; or - not as the first command in a chain sequence.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
0 (cont)	Command reject (cont)	■ A MODE SET command was issued without the appropriate feature installed. ■ Any bit in sense data byte 16 is set.
1	Intervention required	The addressed tape unit is not ready or is nonexistent. *NOTE: If the tape unit goes into a not ready state while performing a command, status byte format bit 6 (unit check) will be set, along with any other pertinent termination status bits.*
2	Bus out check	The bus out has incorrect (even) parity during a command or data byte transfer.

3	Equipment check	This bit is set on a controller operation if: ■ Runaway (4,0) or reject tape unit (4,1) is set. ■ Any bit in sense data byte 10 is set. ■ Power check (18,0) or temperature check (18,1) is set.
4	Data check	This bit is set if: ■ An end of block is sensed before any data bytes are detected during a GCR or PE READ or READ BACKWARD operation. *NOTE: In such case, noise (1,0) will also be set.* ■ Any bit in sense data byte 3 is set. ■ A write driver error (4,3) is set. ■ Any bit in sense data byte 5 is set.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
4 (cont)	Data check (cont)	■ IBG detected (8,0) is set. ■ CRC error (9,3) is set.
5	Overrun	This bit is set if the channel cannot: ■ Supply data to the controller fast enough on a WRITE operation. ■ Receive data fast enough from the controller on a READ operation. *NOTE: If data check (0,4) has been set, then overrun is suppressed.*

6	Word count zero	This bit is set if: ■ The channel stops the data transfer on a WRITE operation before the first byte is received by the controller. ■ The interface disconnect sequence is received after receipt of the WRITE command but before tape motion is initiated. ■ A WRITE or READ command has finished its execution but tape motion has not been initiated.
7	Data converter check	Bit 7 is used with 7-track operations only; otherwise, it's set to 0.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Noise	This bit is set if: ■ A data check (4,0) occurs during a GCR or PE READ or READ BACKWARD operation. ■ No data is transferred on a READ or READ BACKWARD operation. ■ Data is detected on a ERASE operation. ■ Data is detected during the ERASE portion of a WRITE TAPE MARK operation.
1	Tape unit status A	This bit is set when an addressed tape unit is selected and ready (not busy). Refer to the following tape unit status B (1,2) definition.

2	Tape unit status B	This bit is set when an addressed tape unit is rewinding, under the control of another controller, or not ready (busy). ■ If there is an outstanding device end (5) status, then device end is presented and tape unit status B is suppressed. ■ If there is no outstanding device end (5) status, bits 1 and 2 determine the response to the initial selection as follows:

Tape Unit Status A	Tape Unit Status B	Tape Unit Status	Response to Initial Selection	Note 1
OFF	OFF	Nonexistent or power OFF	Unit check	Note 2
OFF	ON	Not ready (busy)	Unit check	Note 2
ON	OFF	Ready and not rewinding	Status with no error	-
ON	ON	Reading and rewinding or in use by another controller	Busy	Note 3

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
2 (cont)		*NOTES:* *1. The stack status flag is OFF and no device end (5) is outstanding.* *2. Unit check (6) is not signaled for a SENSE operation. Following a unit check (due to a nonexistent or not ready indication), device end (5) is signaled when the tape unit becomes ready and is not rewinding or in use by another controller.* *3. The type 0884 is executing a DSE command.*
3	Seven track	Bit 3 is used with 7-track operations only; otherwise, it's set to 0.
4	Load point	The selected tape unit is at the BOT position.
5	Write status	The selected tape unit is in write status.

6	File protect	The selected tape unit is in file protect status.
7	Not capable	This bit is set when: ■ On a READ or FORWARDSPACE command from the load point, the tape unit feature, the controller feature, and the tape format do not agree. In such case: – Tape motion is halted. – Channel end (4), device end (5), and unit check (6) are set for a READ operation. – Control unit end (2), device end (5), and unit check (6) are set for a FORWARDSPACE operation. ■ The density of the tape unit does not match the capability of the controller on a WRITE or READ operation.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 2
0 - 7	Track in error (TIE)	The track in error (TIE) bits are set at the end of a READ, READ BACKWARD, WRITE, or LOOP WRITE-TO-READ (LWR) command. The following bits are set for a 9-track NRZI operation: For this Operation — This Bit Is Set WRITE and LOOP WRITE-TO-READ (LWR) — Bits 6 and 7 READ and READ BACKWARD ■ Any bit in byte 2 and data check (0,4) indicate track in error (TIE). ■ Bits 6 and 7 with data check (0,4) indicate an uncorrectable error.

		■ Bits 6 and 7 without data check (0,4) indicate normal operation.
Sense Data Byte 3		
0	Read/write vertical redundancy check (VRC)	This bit setting has a different meaning under different conditions: In this Mode — Bit 0 Is Set if Group-coded recording (GCR) — In error correction mode, but the track or tracks in error cannot be found. Phase encoded (PE) — There is a VRC error without a dead track or phase error. NRZI — ■ A VRC occurred during a READ or READ BACKWARD operation; or ■ a lost byte was detected.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
1	Multiple track error/ longitudinal redundancy check (LRC)	This bit setting has a different meaning under different conditions: In this Mode — Bit 1 Is Set if Group-coded recording (GCR) or phase encoded (PE) — Multiple tracks in error are detected but not corrected. NRZI — An LRC check occurred during a READ, READ BACKWARD, or WRITE TAPE MARK operation.

2	Skew error	This bit is set when an excessive skew error was detected on: ■ A GCR or PE WRITE, READ, or READ BACKWARD operation ■ An NRZI READ operation
3	End data check/ cyclic redundancy check (CRC)	This bit is set under the following conditions: ■ During PE READ operations, if: - the ending marker is not detected; or - the postamble has less than 6 or more than 50 bytes. ■ A CRC error (9,3) has been set.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
4	Envelope/error correction check (ECC)	This bit setting has a different meaning under different conditions: In this Mode — Bit 4 Is Set if Group-coded recording (GCR) — A dead track is set on a READ or WRITE operation. *NOTE: This does not set data check (0,4).* Phase encoded (PE) — There is a phase error or a dead track on a READ or WRITE operation. *NOTE: If a phase error or a dead track occurs on a WRITE operation, then data check (0,4) is also set.*

		NRZI — A byte with incorrect parity has been detected during a WRITE or WRITE TAPE MARK operation.
5	1600 CPI set in tape unit (PE)	The selected tape unit is in PE mode.
6	Backward	The selected tape unit is in backward status.
7	C/P compare	The hardware logic has detected an internal parity error on read and write data paths.
Sense Data Byte 4		
0	Runaway	This bit is set when no data is recognized within a minimum length of 25 feet in PE or NRZI mode, or within 15 feet in GCR mode.
1	Reject tape unit	The selected tape unit became not ready during execution of some command calling for tape motion.
2	Tape indicate	The EOT marker has been sensed during a FORWARD TAPE operation.
3	Write driver error	A write trigger VRC error in the data being written by the write driver was detected.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 4 (cont)
4	Translator on	This bit is set when the ASCII/EBCDIC translator is in the ON state.
5	Loop write-to-read (LWR)	This bit is set when the last command was LOOP WRITE-TO-READ (LWR).
6	Tape unit check	For this Tape Unit — This Bit Is Type 0876 — Not used and always set to 0 Type 0884 — Set to indicate 0884 tape unit errors, such as: ■ Loss of column vacuum ■ Write or erase head failure
7	–	Not used; set to 0.

Sense Data Byte 5		
0	Track in error (TIE) P	This bit contains the P bit of the TIE indicator.
1	-	Not used; set to 0.
2	Write tape mark check	A tape mark was not written properly: ■ The tape mark block was not detected at the read head within 0.16 inches after the writing terminated. ■ The tape mark block was written incorrectly and cannot be backspaced without losing tape position. ■ An IBG was not detected following the tape mark.
3	ID burst check	The GCR or PE identification burst, or the ARA burst in the GCR mode, is not written correctly following the load point.
4	Start read check	An IBG was detected during a preamble burst.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 5 (cont)
5	Partial record	An IBG appeared before the end of data is recognized.
6	Postamble error	A postamble error was detected.
7	-	Not used; set to 0.
		Sense Data Byte 6
0	Seven-track tape unit	Bit 0 is used with 7-track operations only; otherwise, it's set to 0.
1	Write current failure	Write current was supplied while the tape unit type 0884 was in read or rewind status. *NOTE: For tape unit type 0876, bit 1 is not used and is set to 0.*

2	Dual density	This bit is always set to 1 for this tape unit.
3	Not set to 1600 CPI	When Bit 3 Is — Tape Unit Mode Is ON — NRZI or GCR OFF — PE
4 - 7	Tape unit model ID	This bit indicates some unique model information, as follows: When this Bit — Is — Tape Unit Mode Is 4 — ON — GCR or PE *NOTE: This applies to tape unit type 0884 only.* 4 — OFF — PE or NRZI *NOTE: This applies to tape unit type 0876 only.* 5 — OFF 6 — ON 7 — ON — 75 ips

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 6 (cont)		
4 - 7 (cont)	Tape unit model ID (cont)	When this Bit / Is / Tape Unit Mode Is 5 ON 6 OFF } 125 ips 7 OFF
Sense Data Byte 7		
0	EOT failure	Indicates an EOT lamp or sensor failure.
1 - 2	-	Not used; set to 0.

NOTE: The following definitions refer to tape unit type 0884 only, with the exception of the bit 4 definition, which is true for both tape unit types 0884 and 0876.

For tape unit type 0876, bits 3, 5, 6, and 7 are not used and are set to 0.

3	Reset key	The tape unit is not ready because the RESET switch is pressed.
4	Data security erase (DSE)	A data security erase (DSE) is in process. *NOTE: This bit will go off upon normal completion of a DSE (i.e., when the tape unit reaches the EOT marker).*
5	Erase head failure	This bit is set if: ■ No erase head or write head bias current was flowing during a WRITE operation. ■ Erase head current was flowing during a READ operation.
6	Air bearing pressure failure	The air pressure for the air bearing has dropped below the critical level.
7	Load failure	The tape unit has failed in loading tapes.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 8		
0	IBG detected	This bit is set during a WRITE GCR or PE operation if: ■ An IBG was detected while writing the data portion. ■ The beginning of the record was not detected within a specified time after one track in each zone is detected.
1 - 2	-	Not used; set to 0.
3	Early begin check	Block beginning comes too soon on a WRITE or WRITE TAPE MARK operation.
4 - 5	-	Not used; set to 0.
6	Slow end check	End of data is not detected after writing is terminated on a WRITE or WRITE TAPE MARK operation.

7	-	Not used; set to 0.
Sense Date Byte 9		
0	6250 CPI correction (GCR)	Indicates that a 1- or 2-track correction was made. *NOTE: This bit is set to provide information, not to indicate an error.*
1	-	Not used; set to 0.
2	Channel buffer check	Data into the CIC read/write buffer does not match data out of the channel buffer.
3	CRC error	A CRC or AUX CRC error was detected in an NRZI or GCR READ operation.
4	6250 CPI tape control	This bit is always set to 1 for this tape unit.
5 - 6	-	Not used; set to 0.
7	Tape control unit reserved	The tape control unit is in reserved status.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
	Sense Data Byte 10	
0	Command status reject	The tape unit failed to return to the proper command status.
1	Tape motion	The controller has sent a TAPE MOTION command to the tape unit.
2	Control status reject	The tape unit has failed to return the proper control status to the controller.
3	Record not detected	A record could not be found on a WRITE or WRITE TAPE MARK operation on a read back check.
4	Dynamic reversal check	The tape unit has lost control of tape positioning during a dynamic reversal.

NOTE: The following definitions refer to tape unit type 0884 only.

For tape unit type 0876, bits 5, 6, and 7 are not used and are set to 0.

5	Tach start failure	The capstan did not reach normal speed within a specified time during a START motion.
6	No BOT	The BOT marker was not detected within a specified length of tape.
7	Velocity check	An excessive velocity change was detected during a WRITE, ERASE, or READ operation.
Sense Data Byte 11		
NOTE: The following definitions refer to tape unit type 0884 only. *For tape unit type 0876, bits 0 - 7 are not used and are set to 0.*		
0	Servo fault supply reel motor	The supply reel motor voltage failed at the driver circuit.
1	Servo fault take-up reel motor	The take-up reel motor voltage failed at the driver circuit.
2	Servo fault capstan motor	The capstan motor voltage failed at the driver circuit.
3	Servo fault cartridge motor	The cartridge motor voltage failed at the driver circuit.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
Sense Date Byte 11 (cont)		
4	Loop out take-up - upper	The tape went out of loop at the top of the take-up vacuum column.
5	Loop out take-up - lower	The tape went out of loop at the bottom of the take-up vacuum column.
6	Loop out supply - upper	The tape went out of loop at the top of the supply vacuum column.
7	Loop out supply - lower	The tape went out of loop at the bottom of the supply vacuum column.

Sense Data Byte 12		
NOTE: The following definitions refer to tape unit type 0884 only. *For tape unit type 0876, bits 0 - 7 are not used and are set to 0.* *The range for the following tape unit type 0884 definitions is described in the type 0884 equipment specification.*		
0	Voltage fault +12 V	This bit is set when +12 V is out of range.
1	Voltage fault -12 V	This bit is set when -12 V is out of range.
2	Voltage fault +24 V unregulated	Unregulated +24 V is out of range.
3	Voltage fault +50 V unregulated	Unregulated +50 V is out of range.
4 - 7	-	Not used for tape unit type 0884; set to 0.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
	Sense Data Byte 13	
	NOTE: The following definitions refer to tape unit type 0884 only. *For tape unit type 0876, bits 0 - 7 are not used and are set to 0.*	
0	Unload failure	The selected tape unit failed to unload tape properly.
1	Vacuum failure	The source vacuum cannot generate adequate vacuum to the loop box.
2	Positioning failure	The IBG is not being properly detected.
3	Over reversal	This bit is set only when dynamic reversal check (10,4) is set and the reversal motion is over-positioned.

4	Under reversal	This bit is set only when dynamic reversal check (10,4) is set and the reversal motion is under-positioned.
5 - 7	-	Not used for tape unit type 0884; set to 0.
Sense Data Bytes 14 and 15		
0 - 7	-	Not used; set to 0.
Sense Data Byte 16		
0	Not operational	Indicates that the online microcode is not yet loaded.
1	Parameter error	Indicates that: ■ Parameter block of SET DIAGNOSE command contains an error. ■ Tape units 4 through 7 were addressed when the 8-tape-unit interface feature (F2452) is not installed. ■ EXECUTE DIAGNOSE subcommand was issued to an offline diagnostics.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 16 (cont)
2 - 3	-	Not used; set to 0.
4 - 5	Load device status	Indicates the status of the load device feature (F3927) as follows: When this Bit Is: Bit 4 OFF, Bit 5 OFF — Status Is: No error When this Bit Is: Bit 4 OFF, Bit 5 ON — Status Is: Device is not ready. When this Bit Is: Bit 4 ON, Bit 5 OFF — Status Is: Specified microcode does not exist. When this Bit Is: Bit 4 ON, Bit 5 ON — Status Is: Floppy read error

6 - 7	Tape unit status	Indicates addressed tape unit type 0884 status as follows: When this Bit Is / Status Is Bit 6 / Bit 7 OFF / OFF — No error OFF / ON — Tape unit type 0884 is not online. ON / OFF — Tape unit type 0884 failed to communicate. ON / ON — Tape unit type 0884 (U26/28) failed to communicate with T5055 (control unit).
Sense Data Byte 17		
0	Dual channel	This bit is set when the dual channel feature is installed.
1 - 7	-	Not used; set to 0.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 18
0	Power check	The tape unit voltage is out of range at ±4%.
1	Temperature check	The logic module temperature is greater than the maximum limit of 53 °C.
2 - 3	-	Not used; set to 0.
4 - 5	Voltage margin on	Indicates voltage margin status as follows: When this Bit Is — Bit 4: OFF, Bit 5: OFF — Status Is: Normal margin

		ON	OFF	This condition should not occur under normal conditions.
		OFF	ON	Low voltage margin (-5%)
		ON	ON	High voltage margin (+5%)
6 - 7	Timing margin on	Indicates timing margin status as follows:		
		When this Bit Is		Status Is
		Bit 6	Bit 7	
		OFF	OFF	Normal margin
		ON	OFF	This condition should not occur under normal conditions.
		OFF	ON	Low timing margin (-5%)
		ON	ON	High timing margin (+5%)

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 19		
0	Device end priming	Primed for device end tape unit 7
1	Device end priming	Primed for device end tape unit 6
2	Device end priming	Primed for device end tape unit 5
3	Device end priming	Primed for device end tape unit 4
4	Device end priming	Primed for device end tape unit 3
5	Device end priming	Primed for device end tape unit 2
6	Device end priming	Primed for device end tape unit 1
7	Device end priming	Primed for device end tape unit 0

Sense Data Byte 20

0 - 7	-	Not used; set to 0.

Sense Data Byte 21

0 - 7	Controller field replaceable unit (FRU)	This byte contains controller field replaceable unit (FRU) information as follows:

FRU Code	Error Description	FRU Code	Error Description
00	No error	05	Floppy load error
03	Controller main storage (RAM or EPROM) parity error	06	The designated file was not found on the diskette inserted into the floppy drive.
04	Flopy disk drive is not ready.		

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition			
Sense Date Byte 21 (cont)					
0-7 (cont)		FRU Code	Error Description	FRU Code	Error Description
		07	Voltage margin could not set.	24	Ready change error of tape unit 4
		08	Voltage out of range error	25	Ready change error of tape unit 5
		09	High temperature	26	Ready change error of tape unit 6
		0A	Controller is stalled.		
		10	Translate ROM compare error on the write control card	27	Ready change error of tape unit 7

		11	Write control main storage parity error	28	Tape unit error of tape unit 0 during REWIND or DSE operation
		12	Write trigger VRC error		
		1F	Tape unit type 0884 could not respond for SENSE or READ EQUIPMENT ID command.	29	Tape unit error of tape unit 1 during REWIND or DSE operation
		20	Ready change error of tape unit 0	2A	Tape unit error of tape unit 2 during REWIND or DSE operation
		21	Ready change error of tape unit 1	2B	Tape unit error of tape unit 3 during REWIND or DSE operation
		22	Ready change error of tape unit 2		
		23	Ready change error of tape unit 3		

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition			
Sense Date Byte 21 (cont)					
0-7 (cont)		FRU Code	Error Description	FRU Code	Error Description
		2C	Tape unit error of tape unit 4 during REWIND or DSE operation	37	No AUX-CRC on read control card equal to AUX-CRC or with BC in hexadecimal code on channel control card
		2D	Tape unit error of tape unit 5 during REWIND or DSE operation	50	Channel processor halted
				51	Channel control main storage parity error

		2E	Tape unit error of tape unit 6 during REWIND or DSE operation	52	Channel working RAM parity error
				53	Channel decoded ROM parity error
		2F	Tape unit error of tape unit 7 during REWIND or DSE operation	57	No AUX-CRC generator equal to AUX-CRC checker on channel control card
		30	Translate ROM compare error on read control card	58	Channel input buffer in parity error
		32	Read translate flip-flop illegal set	59	Channel input buffer out parity error
		36	No AUX-CRC-C equal to AUX-CRC-A on read control card	5A	Channel input buffer shift in error

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition			
Sense Date Byte 21 (cont)					
0-7 (cont)		FRU Code	Error Description	FRU Code	Error Description
		5C	Channel input buffer shift out error	65	Uncorrectable error status bit was set (I/O port 4E, bit 6)
		5D	Channel output buffer parity error	66	LRC match error status bit was set (I/O port 64, bit 1)
		5E	Channel output buffer shift in error	67	VRC match error status bit was set. (I/O port 64, bit 2)
		5F	Channel output buffer shift out error		

		60	No read CRC-F equal to D7 in hexadecimal code	68	Skew error status bit was set (I/O port 64, bit 7 in NRZI mode; I/O port 47, bit 0 in PE/GCR mode)
		61	No read AUX-CRC-C equal to BC in hexadecimal code	70	No read CRC-F equal to D7 in hexadecimal code
		62	Lost byte error status bit was set (I/O port 64, bit 5)	71	No read AUX-CRC-C equla to BC in hexadecimal code
		63	Single track error status bit was set (I/O port 4E, bit 4)	73	Single track error status bit was set (I/O port 4E, bit 4)
		64	Multitrack error status bit was set (I/O port 4E, bit 7)		

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 21 (cont)		
0 - 7 (cont)		FRU Code / Error Description 74 — Multitrack error status bit was set (I/O port 4E, bit 7) 75 — Uncorrectable error status bit was set (I/O port 4E, bit 6) 78 — Skew error status bit was set (I/O port 64, bit 7 in NRZI mode; I/O port 47, bit 0 in PE/GCR mode)

		Sense Data Byte 22			
0 - 7	Controller field replaceable unit (FRU)	This byte contains controller field replaceable unit (FRU) information as follows:			
		FRU Code	Error Description	FRU Code	Error Description
		10	NRZI ID error	17	No ID found
		11	PE ID error	18	Blank tape
		12	GCR ID error	20	Noise in an ERASE operation
		13	GCR ARA burst error	21	TM error
		14	GCR ARA ID burst error	22	Noise after TM
		15	PE noise after ID	23	IBG detected before EOD
		16	GCR noise after ARA ID		

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition			
Sense Data Byte 22 (cont)					
0 - 7 (cont)		FRU Code	Error Description	FRU Code	Error Description
		24	WR ERR1: EOD and IBG could not be detected within a tape move of 0.3 inch after a WRITE operation.	34	Capstan speed error
				35	Tape unit not NRZI capable
				36	Controller not NRZI capable
		25	WR ERR2: Although EOD and IBG could be detected within a tape move of 0.3 inch, the postamble is too long.	37	Tape unit not GCR capable
				38	Expansion tape unit I/F does not exist.
				39	Tape unit does not exist.

		26	WR ERR3: EOD, but not IBG, could be detected within a tape move of 0.3 inch after a WRITE operation.	40	Tape unit not ready
				41	Write protected
				42	Backward from BOT
		27	Postamble error (too short)	43	Forward from BOT
		28	Postamble error (too long)	44	DSE from EOT
				45	Illegal command
		29	Read data error	46	Illegal tape unit status
		30	Write data error	47	Translate feature does not exist.
		31	BOT hit		
		32	Noise in a DSE operation	48	Tape unit sense error (parity error)
		33	Tape unit sense error		

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition			
Sense Data Byte 22 (cont)					
0 - 7 (cont)		FRU Code	Error Description	FRU Code	Error Description
		49	Could not set density	84	Channel processor did not respond to Z80 after Z80 cleared the status valid.
		53	Tape unit drops ready		
		54	Tape unit not drop ready	90	Data compare error
		60	Illegal SET DIAGNOSE command		
		61	The file on a diskette inserted into the floppy drive unit was not found.		

I/O SENSE DATA BYTE DEFINITIONS FOR SDMA DEVICES (cont)

62	The microprogram in the controller main storage was not found.
70	Tape unit not in erase mode
71	Tape unit in erase mode
80	Channel processor could not re-start after timing margin swung.
81	Channel processor could not re-start after timing margin cleared.
82	Channel processor did not respond to Z80 after Z80 received the system/selective reset.
83	Channel processor did not respond to Z80 after Z80 issued the status valid.

I/O Sense Data Byte Definitions for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 23
0 - 7	Tape unit field replaceable unit (FRU)	This byte contains tape unit field replaceable unit (FRU) information for the selected tape unit type 0884. Refer to the tape unit type 0884 equipment specification for details. *NOTE: For tape unit type 0876, this byte is not used; bits 0 - 7 are set to 0.*

4.9.8.1. Summary of I/O Sense Data Bytes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884

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 head *
1	Noise	Tape unit status A	Tape unit status B	Seven track *	Load point	Write status	File protect	Not capable
2	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)	Track in error (TIE)
3	Read/write vertical redundancy check (VRC)	MTE longitudinal redundancy check (LRC)	Skew error	End data check/ cyclic redundancy check (EDC/CRC)	Envelope/error correction check (Env/ECC)	1600 CPI set in tape unit (PE)	Backward status	C/P compare

* Applies to 7-track tapes only. If 9-track tapes are used, these bits are set to 0.

Summary of I/O Sense Data Bytes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
4	Runaway	Reject tape unit	Tape indicate	Write driver error	Translate on	Loop write-to-read (LWR)	Tape unit check	-
5	Track in error (TIE) P	-	Write tape mark (WTM) check	ID burst check	Start read check	Partial record	Postamble error	-
6	7-track tape unit *	Write current failure	Dual density	Not set to 1600 CPI	Tape unit model ID	Tape unit model ID	Tape unit model ID	Tape unit model ID
7	EOT failure	-	-	Reset key	Data security erase (DSE)	Erase head failure	Air bearing pressure failure	Load failure

* Applies to 7-track tapes only. If 9-track tapes are used, these bits are set to 0.

8	IBG detected	-	-	Early begin check	-	-	Slow end check	-
9	6250 CPI correction (GCR)	-	Channel buffer check	CRC error check	6250 CPI tape control *	-	-	Controller reserved
10	Command reject status	Tape motion	Control status reject	Record not detected	Dynamic reversal check	Tach start failure	No BOT	Velocity check
11	Servo fault supply reel motor	Servo fault take-up reel motor	Servo fault capstan motor	Servo fault cartridge motor	Loop drop take-up - upper	Loop drop take-up - lower	Loop drop supply - upper	Loop drop supply - lower
12	Voltage fault +12 V	Voltage fault -12 V	Voltage fault +24 V unregulated	Voltage fault +50 V unregulated	-	-	-	-

* This bit is always set to 1.

Summary of I/O Sense Data Bytes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 13	Unload failure	Vacuum failure	Positioning failure	Over reversal	Under reversal	-	-	-
14	-	-	-		-	-	-	-
15	-	-	-	-	-	-	-	-
16	Not operational	Parameter error	-	-	Load device status 1	Load device status 2	Tape unit status 1	Tape unit status 2

17	Dual channel	-	-	-	-	-	-	-
18	Power check	Temperature check	-	-	Voltage margin 1	Voltage margin 2	Timing margin 1	Timing margin 2
19	Device end tape unit 7	Device end tape unit 6	Device end tape unit 5	Device end tape unit 4	Device end tape unit 3	Device end tape unit 2	Device end tape unit 1	Device end tape unit 0
20	-	-	-	-	-	-	-	-
21	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller

Summary of I/O Sense Data Bytes for T5055 (U22/24/26/28) Magnetic Tape Type 0876/0884 (cont)

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 22	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller	FRU information for controller
23	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit	FRU information for tape unit

4.9.10. I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command Reject	Is set for the following conditions: 1. A Data Security Erase command that is not chained to an Erase Gap command is issued to the ITCU. 2. A command is isssued that is not recognized by the ITCU or is for a feature not installed in the ITCU. This bit is not set if a Bus Out Check occurs during the command transfer. 3. A Mode Set command is issued to the ITCU without the appropriate feature installed. 4. A command is issued to a tape unit that is not preceded by the proper sequence of commands. 5. A Write, Write Tape Mark, Erase Gap, or Data Security Erase command is issued to a file protected tape unit. 6. Is set if sense byte 1 bit 7 (Not Compatible) is set. 7. Another command is issued to a tape unit that is rewinding.
1	Intervention Required	Is set any time the addressed tape unit is not ready or nonexistent.

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 0 (cont)
2	Bus Out Check	Is set any time the byte on the SDMA channel indicates incorrect (even) parity for a command or data byte. If this condition occurs during a data transfer for a write operation, the operation is terminated and the error byte is not written on tape.
3	Equipment Check	Is set for the following conditions: 1. Sense byte 4 bit 1 (Reject Tape Unit) is set. 2. The tape mark block was not detected at the read head within 0.3 inches after writing terminated. 3. The tape mark block was not written correctly and cannot be backspaced without losing tape position. 4. An IBG was not detected following the tape mark. 5. This bit is also set with sense byte 4 bits 0 or 1.
4	Data Check	Is set for any of the following read or write operations: 1. Sense byte 3 bit 0 (R/W VRC) is set. 2. Sense byte 3 bit 1 (MTE) is set. 3. Sense byte 3 bit 2 (Skew) is set. 4. Sense byte 3 bit 3 (End) is set. 5. Sense byte 3 bit 4 (ENV/STE) is set.

		6. Sense byte 3 bit 7 (C/P Compare) is set. 7. Sense byte 5 bit 5 (Partial Record) is set. 8. Sense Byte 5 bit 2 (WTM Check) is set. 9. Sense byte 5 bit 6 (Postamble Error) is set. 10. Sense byte 1 bit 0 (Noise) is set. 11. Hard error is set on the streaming tape and the conditions that set sense byte 3 bits 0 thru 4 can not be differentiated. No other sense bits are set with Data Check. 12. Sense byte 5 bit 3 (ID Burst Check) is set.
5	Overrun	Is set when the ITCU data transfer rate exceeds that of the SDMA channel for a read or write operation. If Overrun occurs during a write operation, the operation is terminated, tape motion is halted, and additional data is not requested from the SDMA channel. If Overrun occurs during a read operation, data transfer is terminated and tape motion continues until an IBG is detected.
6	Bus In Check	Is set to indicate improper parity was detected on the D Bus during a transfer from the control unit.
7	Program Alert	Indicates a possible programming error was detected. A Backward command was issued at load point, or an invalid device address was received.

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	Noise	Is set for any of the following conditions: 1. Data was not transferred on a read or read backward operation and the block was not detected as a tape mark. 2. Data was detected during an Erase Gap or during the erase portion of the WTM operation. 3. A Data Check condition occurred during a read or read backward operation.
1	TU Status A	Is set if the addressed tape unit (TU) is selected, ready, or not busy.
2	TU Status B	Is set if the addressed tape unit is not ready or ready and rewinding (busy).
3	Not Used	Always zero.
4	Load Point	Is set if the addressed tape unit is positioned at the beginning of tape (BOT).
5	End of Tape	Is set when the End of Tape marker is sensed during forward tape motion.

6	File Protected	Is set when the addressed tape unit does not have the write enable ring installed on the file reel.
7	Not Compatible	Is set for the following conditions: 1. ITCU or tape unit features are not compatible with the data format of the tape being read. 2. The device feature is not installed to accommodate a specific command.
	Sense Data Byte 2	
0 thru 7	Track in Error (TIE) Byte	Indicates the track number if in NRZI mode.
	Dead Track	If PE mode, it indicates the dead track register information for both read and write operations.
	Overskewed Track	Indicates the overskewed track number if there is a Skew Error (sense byte 3 bit 2).

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3
0	R/W VRC	Is set for PE read or write operations when the data byte indicates incorrect parity and there are no phase errors or dead tracks.
1	MTE	Is set for any combination of 2 or more dead tracks or phase error conditions for PE read or write operations.
2	Skew	Is set if there is excessive skew for PE read, read backward, or write operations.
3	End Check	Is set for the following conditions: 1. When the beginning of the postamble is not detected or is detected before or after the actual end of data for PE read operations. 2. When an IBG is detected before end of data for PE read operations.
4	ENV/STE	Is set for the following conditions: 1. If an IBG is detected when writing data for PE write operations. 2. If the tapemark block is not written correctly but can be backspaced without being tape position.

		3. If error correction is required for PE read or read backward operations. (Data Check is not set for this condition unless the I bit is set to one in the Read command.)
5	1600 BPI	The addressed tape unit is set for 1600 BPI density.
6	Backward	Indicates the addressed tape unit was moving tape in the backward direction.
7	Formatter Check	Is set when an error is detected in the formatter hardware or firmware.
		Sense Data Byte 4
0	Runaway	Is set if data is not detected for 25 feet during a read operation.
1	Reject TU	Is set for any of the following conditions: 1. Sense byte 4 bit 0 (Runaway) is set. 2. If data is not detected within 0.3 inches after writing terminated for a Write or Write Tape Mark (WTM) operation. 3. The tape unit drops ready during the execution of a command. 4. The tape unit changed from write to read operation during a write function or from read to write operation during a read function. 5. An IBG is not detected following an ID burst written after load point.

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 4 (cont)
2	Not Used	Always zero.
3	Not Used	Always zero.
4	Translate Error	Is set if the translate tables are not properly loaded, or a parity error is detected during a translate operation.
5	Loop Write to Read (LWR)	Is set when a Loop Write To Read command is executed.
6	Not Used	Always zero.
7	Not Used	Always zero.

Sense Data Byte 5		
0	No Motion	Indicates tape on the addressed tape unit is not moving.
1	Not Used	Always zero.
2	WTM Check	Is set when the tape mark is not written properly.
3	ID Burst Check	Is set if the ID burst is not properly written after load point.
4	Not Used	Always zero.
5	Partial Record	If set when an IBG is detected before the end of data for PE read operations.
6	Postamble Error	Is set when the postamble is too long for read operations.

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 5 (cont)
7	Block Number Error	Is set for any of the following conditions: 1. A block number error is detected on a Read, Read Backward, or Search Block Number command that follows a Write Block Number command. 2. If the block number read from the tape on a Read or Read Backward command does not match the block number sent by the Write Block Number command. 3. Unsuccessful termination of a Search Block Number command. 4. If a higher numbered block, EOT, or double tape mark is found when searching forward during a Search Block Number operation. 5. If a lower numbered block or if load point is found when searching backward during a Search Block Number operation.
		Sense Data Byte 6
0	PIUR Parity Error	Is set if a parity error is detected on the internal data bus of the ITCU and not on the D Bus when the ITCU is performing a read or write operation with its PIUR. (Sense byte 0 bit 3 is also set.)

1	RAM Parity Error	Is set if the RAM parity error is detected by the ITCU. (Sense byte 0 bit 3 is also set.)
2	Memory Address Error	Is set if the RAM address for a Load RAM command exceeds RAM limits, if the associated byte count can cause the address to exceed RAM limits, or if the address for a Load Memory Address command is not within the boundaries of RAM.
3	Check Sum Error	Is set if the check sum for a load RAM command does not equal the sum generated by the ITCU. Is set with sense byte 0 bit 7 if this error is on the check sum for one of the Load RAM records. Is set with sense byte 0 bit 7 and sense byte 1 bit 6 if this error is on the overall check sum in the end record.
4	RAM Not Loaded	Is set if the RAM code of the ITCU is not yet flagged as executable. (Sense byte 0 bit 7 is also set.)
5	Sequence Error	Is set for either of the following conditions: 1. A Read Memory command is not immediately preceded by a Load Memory Address command. (Sense byte 0 bit 0 is also set.) 2. A text or end record is received from a Load RAM command before a valid start record. (Sense byte 0 bit 7 is also set.)

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 6 (cont)
6	Load RAM Record Error	Set with sense byte 0 bit 7 if a Load RAM command causes the ITCU to receive a record with a Format Control Character other than hex 10, 20, or 40; a text record with a Valid Bytes value less than 8 (0008) or greater than 128 (0080); or a termination from the D Bus before receiving a full 128 byte record.
7	Not Used	Always zero.
		Sense Data Byte 7
0	C Bus Parity Compare Error	Is set if a parity compare error is detected on the internal data bus (C Bus) of the ITCU during a read/write cycle when executing a block transfer microinstruction. (Sense byte 0 bit 3 is also set.)
1	FIFO Control Error	Is set if a compare error is detected from the outputs of the dual FIFO RAM controllers when reading from or writing to the 2K FIFO buffer. (Sense byte 0 bit 3 is also set.)
2	FIFO Parity Error	Is set if a parity error is detected on the FIFO data bus (F Bus) of the ITCU when the data sequencer is reading from the 2K FIFO RAM. (Sense byte 0 bit 3 is also set.)

3	AUX Interface Parity Error	Is set if a parity error is detected when reading the AUX Input Data Bus of the ITCU during a read data operation from the addressed tape unit or during a read status operation. (Sense byte 0 bit 3 is also set.)
4	AUX Interface Error	Is set if: 1. A parity error was detected on a command byte or on output data from the interface. 2. An interface protocol error has occurred. 3. A data late or overrun condition has occurred (the host has failed to supply or accept data fast enough for the tape drive).
5	Internal Bus Parity Error	Is set if a parity error is detected on the internal data bus (C Bus) of the ITCU when doing a read operation from any of the following: the 2K FIFO RAM. 1K Translate RAM Write/Read registers. Q Buffer registers, Block Number registers, or the AUX Input register. (Sense byte 0 bit 3 is also set.)
6	AUX Device Time Out	Is set if a tape unit failed to respond to the ITCU within a specific time limit. (Sense byte 0 bit 3 is also set.)
7	AUX Command Reject	Is set if the tape unit has rejected a command (Sense byte 0 bit 3 is also set.)

I/O Sense Data Byte Definitions T3774 ITCU (U11/U22) Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 8
0 thru 7	Block Number MSG	This is the most significant byte (MSB) of the last block number written to or read from the addressed tape unit when in block numbering mode.
		Sense Data Byte 9
0 thru 7	Block Number Second Byte	This is the second byte of the last block number written to or read from the addressed tape unit when in block numbering mode.
		Sense Data Byte 10
0 thru 7	Block Number Third Byte	This is the third byte of the last block number written to or read from the addressed tape unit when in block numbering mode.

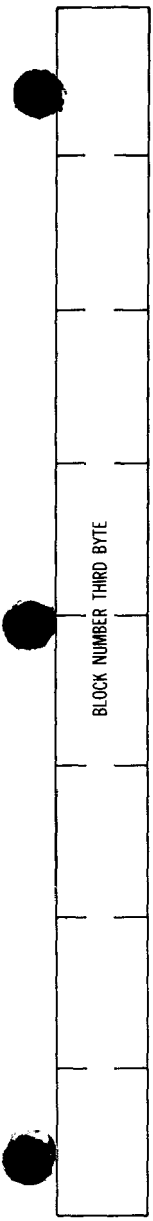
4.9.10.1. Summary of I/O Sense Data Bytes for U11/U22 Tapes

Bit	0	1	2	3	4	5	6	7
Sense Data Byte 0	COMMAND REJECT	INTERVENTION REQUIRED	BUS OUT CHECK	EQUIPMENT CHECK	DATA CHECK	OVERRUN	BUS IN CHECK	PROGRAM ALERT
1	NOISE	TU STATUS A	TU STATUS B	0	LOAD POINT	END OF TAPE	FILE PROTECT	NOT COMPATIBLE
2	TRACK IN ERROR IF NRZI							
3	R/W VRC	MTE	SKEW	END CHECK	ENV/STE	1600 BPI	BACKWARD STATUS	FORMATTER CHECK
4	RUNAWAY	REJECT TU	0	0	TRANSLATE ERROR	WRITE TO READ	0	0

Summary of I/O Sense Data Bytes for U11/U22 Tapes (cont)

5	NO MOTION	0	WTM CHECK	ID BURST CHECK	0	PARTIAL RECORD	POSTAMBLE ERROR	BLOCK NUMBER ERROR
6	PIUR PARITY ERROR	RAM PARITY ERROR	MEMORY ADDRESS ERROR	CHECK SUM ERROR	RAM NOT LOADED	SEQUENCE ERROR	LOAD RAM RECORD ERROR	0
7	C BUS COMPARE ERROR	FIFO CONTROL ERROR	FIFO PARITY ERROR	AUX I/F PARITY ERROR	AUX I/F ERROR	INTERNAL BUS PARITY ERROR	AUX. DEVICE TIME OUT	AUX. COMMAND REJECT
8	BLOCK NUMBER MSB							
9	BLOCK NUMBER SECOND BYTE							

I/O SENSE DATA BYTE DEFINITIONS FOR SDMA DEVICES (cont)



4.10.1. I/O Sense Data Byte Definitions for U11/U22 Tapes

Bit Position	Bit Designation	Definition
Sense Data Byte 0		
0	Command reject	An illegal command code or sequence was issued to the IDCU, such as: ■ A WRITE command to a file-protected device ■ An unassigned command code ■ A WRITE command with a programmed offset ■ An out-of-bounds command parameter
1	Intervention required	Some manual intervention is required to make the device available to the system. This bit can be set with stop state (0,6).

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
2	Output parity check	Data transferred within the IDCU had the wrong parity at the time it was to be written to the disk; the error occurred somewhere between the input to the IDCU and the queueing register at the interface to the data separator.
3	Equipment check	A serious malfunction has occurred within the subsystem: If Set with — Indicates Alone — IDCU logic contains an error. Device check (0,7) — Serious problem exists within the device. Seek incomplete (2,0) — Device was issued a SEEK instruction but did not complete the required movement within the required period of time.

		Unselected status (2,5) — One of the status lines between the IDCU and the device was active when no device was selected. Track overrun (1,1) — Problem with rotational speed or sensing of the disk No clocks (2,7) — Too much time has elapsed with no data or clocks being supplied by the device. Microcode error (3,7) — An abnormal microcode error – e.g., a microcode parity error – has occurred.
4	Data check	An abnormal pattern exists in the ECC bytes of the IDCU. This bit can be set with the following to determine the location and type of error: ■ ID field check (1,0) ■ Data field check (1,7) ■ Sync region error (1,6) ■ ECC check (2,6)

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
4 (cont)	Data check (cont)	It can also be set with the following to indicate positioning or control errors; these errors will be set only if there is *no* ECC error in the ID field: ■ Record number miscompare (2,3) ■ Flag byte miscompare (2,4) ■ Head/cylinder miscompare (2,2)
5	Overrun	Indicates that one or more of the following has occurred: ■ Data was not transferred through the IDCU as quickly as required by the disk. ■ Data has been written or read incorrectly.

		■ There has been a malfunction of clocks in the IDCU.
6	Stop state	The addressed device or drive has no power applied and is not available for use.
7	Device check (device unsafe)	This bit is set when: ■ A status line from a selected device indicates that the device is unsafe. ■ The dc voltage for any device is less than its allowed limit. ■ The disk rotational speed is less than 90% of nominal with heads extended. ■ The write oscillator is not synchronous with the servo track. ■ The write gate or write current is not present at the proper times. ■ The guard band is not detected during a HEAD LOAD or RECALIBRATE operation. *NOTE: These errors may be temporary. Recovery efforts as defined in the ESIOR should be attempted.*

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1
0	ID field check	The setting of pertinent sense bits occurred during processing of an ID field. This setting is used primarily for diagnostic purposes and serves to isolate problems.
1	Track overrun	Indicates that one of the following has occurred: ■ An index mark was encountered when an operating device was oriented on an ID or data field or on the gap between the two, which can be caused by an improperly formatted track or by the device detecting a false index mark. ■ An index mark was encountered during the write portion of a FORMAT WRITE command before the track was completely written.

		NOTE: Both the preceding conditions can occur only as the result of a hardware failure. ■ The extent (specified by the seek address and byte count) caused the subsequent READ or WRITE DATA command to go beyond the last cylinder, head, and record of the disk.
2	Cylinder end	The IDCU detected an attempt to step past the last track on a disk. This condition may occur on a SEARCH/READ command when the search portion was not satisfied.
3	Removable media	This bit will always be set to 1 for 8416/8418 disks.
4	No record found	If Set with — Indicates Alone — The search argument was not satisfied within the requirements of the command. Sync region error (1,6) — Good ID was not detected on the selected track.

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 1 (cont)
4 (cont)	No record found (cont)	If Set with — Indicates SEARCH/READ commands — The drive has reached the end of the specified area without satisfying the SEARCH command.
5	File protect	Data can be read from the device, but it is unavailable for WRITE operations. *NOTE: Any attempt to write to the selected device will also cause device status unit check, as well as command reject (0,0), to be set along with this bit.*
6	Sync region error	Indicates an error in one of the following: ■ Gap data ■ Gap detection hardware

		■ Address mark write hardware
7	Data field check	Indicates that an error occurred when processing the data field. *NOTE: If set with other sense data, it serves to isolate and identify failing hardware.*
Sense Data Byte 2		
0	Seek incomplete	Indicates a failure within the device that makes it unable to complete accessor movement within a predetermined time period. *NOTE: This condition can be cleared by issuing a RECALIBRATE command to the device.*
1	-	Not used; set to 0.
2	Head/cylinder miscompare	Indicates a positioning error. For SEEK, SEEK/WRITE, and SEEK/READ commands, this indicates that head and cylinder information recovered from the disk surface does not compare with that from the command information.

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 2 (cont)
2 (cont)	Head/cylinder miscompare (cont)	This bit will *not* be set if: ■ The flag byte miscompare (2,4) sense indicator is set. ■ The READ ID command is issued. ■ There is a parity (ECC) error for the ID field.
3	Record number miscompare	This bit is set with data check (0,4) to indicate that the record number as read from the disk is not the one expected. This can occur only on record operations and in the absence of an ECC error. ■ If the first addressed record to be processed is not found, its address will be placed in sense data bytes 4 and 5.

		■ If an unexpected (erroneous) record is detected on any record after the first, the address of the expected (missed) record will be placed in sense data bytes 4 and 5. *NOTE: An unexpected record can be the result of an undetected address mark, an improperly written ID, or a hardware failure.*
4	Flag byte miscompare	The flag information extracted from the disk surface does not compare with that expected: ■ When an ID is processed under normal conditions, all flags encountered will be either a normal or defective track (not an alternate track); and ■ only an alternate track flag will be found during alternate track processing (not a normal or defective track). This indicator will be set only if there is no parity (ECC) error at the end of the ID field. Although some bits within the flag byte have no meaning, they are compared during a READ operation and must compare exactly. *NOTE: A flag byte miscompare occurrence will cause the command to terminate immediately.*

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 2 (cont)
5	Unselected status	One or more of the device status lines were active when no device was selected, which in turn indicates an interface failure between the IDCU and the attached devices. This bit also causes equipment check (0,3) to be set. *NOTE: This condition is probed at the outset of a command before any attempt is made to use a device.*
6	ECC check	If Set with — Indicates Data check (0,4) *and* ID field check (1,0) — An ID ECC error was detected. Data check (0,4) *and* data field check (1,7) — Uncorrectable data field errors

		Equipment check (0,3) A failure in ECC hardware during a WRITE operation
7	No clocks	This bit is set with equipment check (0,3) to indicate that no clock pulses have been detected for a period of 1 millisecond while the IDCU has actively selected the device.
Sense Data Byte 3		
0	Device not present	This bit is set when the IDCU detects that the addressed disk is not physically attached to the system.
1	Fixed heads	Fixed heads are not supported; this bit is set to 0.
2	Cylinder address feature	Cylinders 0 through 808 can be addressed on the disk, and the addressed disk has returned the high density mode signal.
3	Address error	The host system issued a POSITION command for a position beyond the last cylinder and/or head of the disk. *NOTE: This bit setting will also cause command reject (0,0) to be set.*

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3 (cont)
4 - 5	-	Not used; set to 0.
6	Search satisfied	The search portion of a SEARCH/READ command has been satisfied on the record specified. *NOTE: This bit will be set even if an error has been detected on the data portion of the record.*
7	Microcode error	This bit is set with equipment check (0,3) to indicate a microcode error that caused an abnormal termination of a normal IDCU operation.
		Sense Data Byte 4
0 - 7	Record number	This byte contains the record number associated with the head as described in the sense data byte 5 definition following.

Sense Data Byte 5		
0 - 7	Head number	This byte contains the head address number for which the associated sense information applies. Refer to the preceding sense data byte 4 definition. For this Operation — Address Is SEARCH/READ command — Head where the argument was found SEEK command — Address desired in the event of a seek incomplete READ and WRITE commands — Head where the last record was processed when an error occurred Recovered error — Head with the error

I/O Sense Data Byte Definitions for U11/U22 Tapes (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 6
0	Uncorrectable	The IDCU attempted an error recovery but could not correct the malfunction after retries and/or data correction attempts.
1	Invalid sequence	A command was issued out of required sequence – e.g., a WRITE DATA command was issued but was not preceded by a SEEK/WRITE command.
2	Program error	This bit will be set to 1 if the IDCU detected an invalid condition in commands issued by the host system.
3 – 7	–	Not used; set to 0.
		Sense Data Byte 7
0 – 7	–	Not used; set to 0.

Sense Data Byte 8		
0 - 7	ECC displacement	This byte contains the displacement of the beginning of the error field to be corrected. Subsequent bytes contain the correction pattern.
Sense Data Byte 9		
0 - 7	First ECC pattern	This byte contains the error pattern to be used with the ECC displacement (8,0-7).
Sense Data Byte 10		
0 - 7	Second (last) ECC pattern	This byte contains the error pattern to be used with the ECC displacement (8,0-7).
Sense Data Byte 11		
0 - 7	-	This byte is reserved and is set to 0.

4.10.1.1. Summary of I/O Sense Data Bytes for 8416/8418 Disk

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	Removable media	No record found	File protect	Sync region error	Data field check
2	Seek incomplete	-	Head/ cylinder miscompare	Record number miscompare	Flag byte miscompare	Unselected status	ECC check	No clocks
3	Device not present	Fixed heads	Cylinder address feature	Address error	-	-	Search satisfied	Microcode error

I/O SENSE DATA BYTE DEFINITIONS FOR MODELS 8/10/20 DISKS (cont)

4	Record number	Record number	Record number	Record number	Record number	Record number	Record number	Record number
5	Head number	Head number	Head number	Head number	Head number	Head number	Head number	Head number
6	Uncorrect-able	Invalid sequence	Program error	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement	ECC displacement

Summary of I/O Sense Data Bytes for 8416/8418 Disk (cont)

Sense Data Byte	Bit 0	1	2	3	4	5	6	7
9	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern	First ECC pattern
10	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern	Second ECC pattern
11	-	-	-	-	-	-	-	-

4.10.2. I/O Sense Data Byte Definitions for 8417/8419 Disk

The sense data byte definitions for 8417/8419 disks are identical to those for 8416/8418 disks (refer to 4.10.1), with the following exceptions:

Removable media (1,3) – This bit will be set to 0 for 8417 disks, and to 1 for 8419 disks.

Cylinder address feature (3,2) – This bit is not used for 8417/8419 disks and is set to 0.

4.10.2.1. Summary of I/O Sense Data Bytes for 8417/8419 Disk

The sense data bytes for 8417/8419 disks are identical to those for 8416/8418 disks. Refer to 4.10.1.1 for summary information.

4.10.3. I/O Sense Data Byte Definitions for 8430/8433 Disk

Bit Position	Bit Designation	Definition
		Sense Data Byte 0
0	Command reject	Command reject generates a format 0 message that details the invalidity of the command. There is no error recovery as this is a programming condition. This bit may be set with: ■ Write inhibited (1,6) - The drive READ ONLY switch is active. ■ File protect (1,5) - The WRITE operation is prohibited by the file mask.
1	Intervention required	The drive is either logically or electrically offline. There is no error recovery as this is an operational condition.
2	Bus out parity	A parity check occurred on a command or data byte from the channel. This may be retried one time.

I/O Sense Data Byte Definitions for 8430/8433 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
3	Equipment check	Equipment check produces a format 0, 1, 2, or 3 sense that details the error. If set with permanent error (1,0), this indicates that the storage control unit (SCU) has attempted recovery but failed. There is no further recovery. If set without permanent error (1,0), this may be retried 10 times.
4	Data check	The processing of ECC bytes following a field indicated a data error. If Set with — Indicates Permanent error (1,0) — The data error is uncorrectable; byte 7 indicates the nature of the error. Note that 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 tried.
		Correctable (2,1)	The data error is correctable. Sense bytes 15 through 22 contain sufficient information to correct the error in main storage.
		Correctable (2,1) after 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, both data check and correctable (2,1) are set. The data can be serviced in the normal manner (the error pattern is zero).
5	Overrun	The channel was late (in relation to the drive) in presenting a command or data byte, or in accepting a data byte.	

I/O Sense Data Byte Definitions for 8430/8433 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Date Byte 0 (cont)
5 (cont)	Overrun (cont)	■ If set with permanent error (1,0), recovery attempts have already been exhausted by the SCU. ■ Overrun set without permanent error (1,0) should be retried 10 times.
6-7	-	Not used; set to 0.
		Sense Data Byte 1
0	Permanent error	This setting indicates that the SCU has attempted all possible recovery procedures and there is nothing else to be done. Permanent error is always a modifier for other error indications: ■ Equipment check (0,3)

		■ Data check (0,4) ■ Overrun (0,5)
1	Invalid track format	A WRITE command has been specified to write past the index. There is no recovery because this is a programming error.
2	End of cylinder	Indicates that a multitrack READ, SEARCH, or OVERFLOW RECORD operation has attempted head switching beyond the highest head address (head 11 for any cylinder). This is a programming condition.
3	-	Not used; set to 0.
4	No record found	An index has been encountered twice in the same chain without: ■ A READ of the home address or data field ■ A CONTROL, WRITE, or SENSE operation There is no recovery as this is a programming condition.

I/O Sense Data Byte Definitions for 8416/8418 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 1 (cont)
5	File protect	A seek-file-mask violation has been detected. A proscribed or implied seek (multitrack or overflow) has been attempted. If set with command reject (0,0), it indicates that a WRITE operation has been attempted. There is no recovery for this error as it is a programming condition.
6	Write inhibited	This bit is set with command reject (0,0) to indicate that a WRITE operation 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	An OVERFLOW RECORD operation terminated prematurely. If set with one of the following, the following condition should be serviced first and operation incomplete should be serviced just before restarting the command chain:

		■ Data check (0,4) ■ File protect (1,5) ■ End of cylinder (1,2) Sense byte 3 contains the proper restart command code.
Sense Data Byte 2		
0	-	Not used; set to 0.
1	Correctable	This bit is set with data check (0,4) to indicate that the data check error is correctable.
2	-	Not used; set to 0.
3	Environmental data present	Usage or error count information is present in sense bytes 7-23.
4-7	-	Not used; set to 0.

I/O Sense Data Byte Definitions for 8416/8418 Disk (cont)

Bit Position	Bit Designation	Definition
		Sense Data Byte 3
0–7	Restart command	This byte contains the restart command code, which is valid only for operation incomplete (1,7).
		Sense Data Byte 4
0–7	Physical ID	The physical drive ID is defined by an internal plug (not the external module plug) being formatted as follows: 0 | 0/1 | 3 of 6 code ■ Bit 1 is the string number. ■ Bits 2–7 each indicate one of eight physical drives. ■ There is no association between the physical and logical device address.

Sense Data Byte 5		
0-7	Cylinder	This byte contains the low order cylinder (i.e., C_2 of $C_1C_2H_1H_2R$) currently addressed.

Sense Data Byte 6			
0-7	Head	Byte 6 completes the physical seek address where the access arm is positioned.	
		Bit	8430/8433-02/03 Disk	8433-00/01 Disk
		0	Reverse	Zero
		1	C_1; bit 7	C_1; bit 6
		2	High order difference	C_1; bit 7
		3-7	Head address	Head address
		NOTE: Bytes 5 and 6 are useful for error recovery restart command chains.		

I/O Sense Data Byte Definitions for 8430/8433 Disk (Cont)

Bit Position	Bit Designation	Definition
Sense Data Byte 7		
0-3	Format	*NOTE: This byte indicates the format of sense data bytes 8-23 and a message number indicating the error type.* 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
4-7	Message number	Refer to the product description (T-65010) for the 5039 storage control unit for message number definitions.	
Sense Data Bytes 8 through 23			
NOTE: Refer to the product description (T-65010) for the 5039 storage control unit for definitions of these bytes.			

4.10.3.1. Summary of I/O Sense Data Bytes for 8430/8433 Disk

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	-	-
1	Permanent error	Invalid track format	End of cylinder	-	No record found	File protect	Write inhibited	Operation incomplete
2	-	Correctable	-	Environmental data present	-	-	-	-
3	Restart command	Restart command	Restart command	Restart command	Restart command	Restart command	Restart command	Restart command

4	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID	Physical ID
5	Cylinder	Cylinder	Cylinder	Cylinder	Cylinder	Cylinder	Cylinder	Cylinder
6	Head	Head	Head	Head	Head	Head	Head	Head
7	Format decode	Format decode	Format decode	Format decode	Message decode	Message decode	Message decode	Message decode
8-23	*NOTE: Refer to the product description (T-65010) for the 5039 storage control unit for definitions of these bytes.*							

4.10.4. I/O Sense Data Byte Definitions for 8470 Disk

The I/O sense data byte definitions for 8470 disk, model 8, are identical to those for the 8470 disk, models 3-6. Refer to 4.7.2 for definitions.

4.10.4.1. Summary of I/O Sense Data Bytes for 8470 Disk

The sense data bytes for 8470 disk, model 8, are identical to those for the 8470 disk, models 3-6. Refer to 4.7.2.1 for summary information.

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)

n	2^n	2^{-n}
20	1 048 576	0.000 000 953 674 316 406 25
21	2 097 152	0.000 000 476 837 158 203 125
22	4 194 304	0.000 000 238 418 579 101 562 5
23	8 388 608	0.000 000 119 209 289 550 781 25
24	16 777 216	0.000 000 059 604 644 775 390 625
25	33 554 432	0.000 000 029 802 322 387 695 312 5
26	67 108 864	0.000 000 014 901 161 193 847 656 25
27	134 217 728	0.000 000 007 450 580 596 923 828 125
28	268 435 456	0.000 000 003 725 290 298 461 914 062 5
29	536 870 912	0.000 000 001 862 645 149 230 957 031 25
30	1 073 741 824	0.000 000 000 931 322 574 615 478 515 625
31	2 147 483 648	0.000 000 000 465 661 287 307 739 257 812 5
32	4 294 967 296	0.000 000 000 232 830 643 653 869 628 906 25
33	8 589 934 592	0.000 000 000 116 415 321 826 934 814 453 125
34	17 179 869 184	0.000 000 000 058 207 660 913 467 407 226 562 5
35	34 359 738 368	0.000 000 000 029 103 830 456 733 703 613 281 25
36	68 719 476 736	0.000 000 000 014 551 915 228 366 851 806 640 625
37	137 438 953 472	0.000 000 000 007 275 957 614 183 425 903 320 312 5
38	274 877 906 944	0.000 000 000 003 637 978 807 091 712 951 660 156 25
39	549 755 813 888	0.000 000 000 001 818 989 403 545 856 475 830 078 125
40	1 099 511 627 776	0.000 000 000 000 909 494 701 772 928 237 915 039 062 5

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.