

Digital ANSI-Compliant Printing Protocol

Level 2 Programming Reference Manual

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This document describes level 2 of Digital's ANSI-Compliant Printing Protocol (DEC PPL2). It contains information pertaining to all level 2 printers.

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Preface

Purpose

This document describes the printer functions that comprise level 2 of Digital's ANSI-Compliant Printing Protocol (DEC PPL2). It contains information pertaining to all level 2 printers. Use the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement* to reference information specific to a particular device.

Organization

This manual contains the following chapters and appendixes.

- Chapter 1, Protocol Concepts, provides an overview of the levels of the protocol and describes the relationship to the printing environment.
- Chapter 2, Character Processing, describes character processing concepts, character sets, and control function formats.
- Chapter 3, Page Coordinate System, describes the page coordinate system.
- Chapter 4, Fonts, contains general information on fonts and the font selection process.
- Chapter 5, Sixel Graphics, describes sixel graphics commands and concepts.
- Chapter 6, Control Characters, describes the C0 and C1 control characters used in DEC PPL2.
- Chapter 7, Command Dictionary, describes the DEC PPL2 commands and reports, including side effects and error handling.
- Appendix A, Character Sets, describes the supported character sets.

For More Information

This manual is associated with the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement* (referred to in this manual as the Programming Supplement), which supplies information about particular level 2 devices.

The following table lists the titles and order numbers of DEC PPL2 documentation and other Digital ANSI-Compliant Printing Protocol manuals. For ordering information, see “How to Order Additional Documentation” at the end of this book.

Manual	Comments	Order Number
<i>Digital ANSI-Compliant Printing Protocol Level 2 Programming Reference Manual</i>	Information relating to all DEC PPL2 devices	EK-PPLV2-PM
<i>Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement</i>	Information specific to particular DEC PPL2 devices	EK-PPLV2-PS
DEC PPL2 Documentation Kit	Set containing both DEC PPL2 manuals	EK-PPLV2-DK
<i>Digital ANSI-Compliant Printing Protocol Level 3 Programming Reference Manual</i>	Information relating to all DEC PPL3 devices	EK-PPLV3-PM
<i>Digital ANSI-Compliant Printing Protocol Level 3 Programming Supplement</i>	Information specific to particular DEC PPL3 devices	EK-PPLV3-PS
DEC PPL3 Documentation Kit	Set containing both DEC PPL3 manuals	EK-PPLV3-DK
<i>Font File Format User's Manual</i>	Technical font file information for use with DEC PPL3 devices	EK-CFFFM-UG

Conventions Used in This Manual

Table 1 shows conventions used in this manual.

Table 1 Documentation Conventions

Control Functions	Characters used in control functions appear in monospaced type. Below each character is a column/row number that indicates the coded character's position in a standard code table such as the one shown in Figure 2–1 and Figure 2–2.			
	ESC	#	6	← ASCII character form
	1/11	2/3	3/6	← Column/Row form
	Both the ASCII character form and the Column/Row form of the control function coding are provided. Note that if a character set other than ASCII is in use on the input device, the input character form is different.			
	Spaces appear between characters in sequences for clarity; they are not part of the format. Space is designated as SP when it is part of the format of a command or sequence.			
Ps	The term Ps indicates a selective parameter. See also Section 2.5.2.1			
Pn	The term Pn indicates a numeric parameter. See also Section 2.5.2.1			
Boldface text	Boldface text represents the introduction of a new term.			
<i>Italic text</i>	Italic text indicates items for which the software supplies a value.			

1

Protocol Concepts

This chapter describes the following topics:

- Levels of the protocol, Section 1.1
- Extensions and exceptions to the protocol, Section 1.2
- Relationship to the printing environment, Section 1.3

1.1 Levels of the Protocol

The Digital ANSI-Compliant Printing Protocol is divided into three functional levels. Digital printers support one or more levels of the protocol, implementing all of the functions defined by that level. Each higher level includes all of the functions defined by the lower levels.

This manual describes level 2 of the Digital ANSI-Compliant Printing Protocol (DEC PPL2).

- **Digital ANSI-Compliant Printing Protocol Level 1 (DEC PPL1)**
includes the functions for a basic character cell printer (for example, the LA50). Basic character cell printers are monospaced devices and may support different horizontal pitches. Functions for backwards vertical movement, vertical margins, or vertical tabs are not included in this level.
- **Digital ANSI-Compliant Printing Protocol Level 2 (DEC PPL2)**
includes the functions for an advanced character cell printer (for example, the LA75). Advanced character cell printers are also monospaced devices and support different horizontal pitches and fonts. Functions for limited backwards vertical movement, vertical margins, and vertical tabs are included in this level.
- **Digital ANSI-Compliant Printing Protocol Level 3 (DEC PPL3)**
includes the functions for a page printer (for example, the LN03). In page-oriented printers, positions on the page can be addressed in any order. Functions for proportionally spaced text are included in this level.

Printers are categorized by the highest level of the protocol that they support. For example, the LA75 is categorized as a level 2 printer because it supports level 1 and level 2 of the protocol.

Level 1 and level 2 printers are addressed in terms of **columns** and **lines**, similar to setting tabs on a typewriter. In order to be compatible with level 1 and level 2 printers, level 3 printers can also be addressed in terms of columns and lines. A level 3 printer can also be addressed in smaller units, such as centipoints, to use the advanced level 3 functions.

1.2 Extensions and Exceptions to the Protocol

The Digital ANSI-Compliant Printing Protocol also includes a number of functions that are specified as either **extensions** or **exceptions** to the protocol.

Extensions to the protocol are defined to allow additional features not provided on all printers to be used in a device-independent manner. Applications taking advantage of these functions are portable only among those devices that provide the additional feature. For example, paper tray selection functions are an extension to the protocol because not all devices support more than one paper tray. However, the protocol extension allows those devices that have more than one paper tray to be addressed in the same manner.

Exceptions are functions that allow applications to take advantage of unique or device-specific hardware features. Applications taking advantage of these functions are generally not portable from printer to printer.

Refer to the Programming Supplement for information on which extensions and exceptions to the protocol are supported by a particular device.

1.3 Relationship to the Printing Environment

The Digital ANSI-Compliant Printing Protocol recognizes a separation between document creation and printer management. In some printing environments, an application communicates directly with a printer connected to a port on a host computer. Sometimes, however, there is an intermediate entity called a driver, spooler, or **symbiont** between the application and the printer. This is often the case when several users share a device.

- The application is typically concerned with document creation, including page composition, font selection, and other document description, independent of the physical characteristics of the printer. The application may store the created document for later printing.

- The symbiont is any code or device that controls print-time functions, such as the physical configuration, printer memory configuration, and other printer management operations. The symbiont receives the printer's device attributes report, informs the user to load paper when necessary, or selects the proper paper tray, for example.

A separate symbiont or printer driver allows applications to drive several printers without requiring each application to manage the different physical characteristics of the printers.

In Chapter 7 of this document, each control function is labeled Symbiont or Application to specify which component should send the control function to perform the desired function.

Note

Digital does not recommend using symbiont commands in an application. Since the symbiont should be updated whenever a printer is released, the application can avoid making changes by not implementing symbiont functions in the application itself, or by putting the symbiont functions in a module that can be released in a separate revision when it is desirable to support another printer.

2

Character Processing

In the Digital ANSI-Compliant Printing Protocol, text and control information is represented by **coded characters**. Coded characters consist of a series of binary digits or **bits**. Older devices use 7 bits to encode each character. Newer devices use 8 bits, which provide more characters. The newer devices can also use 7-bit characters. This chapter describes how coded characters are processed.

The following topics are covered in this chapter:

- Coded characters, Section 2.1
- Printable characters, Section 2.2
- Control characters, Section 2.3
- Special characters, Section 2.4
- Control functions, Section 2.5

The American National Standards Institute (ANSI) and the International Organization for Standardization (ISO) specify standards for character encoding. This protocol is compatible with the following ANSI , JIS, and ISO standards:

ANSI X3.4-1986	American National Standard Code for Information Interchange (ASCII)
ANSI X3.32-1973	Graphic Representation of the Control Characters of the American National Standard Code for Information Interchange
ANSI X3.64-1979	Additional Controls for Use with the American National Standard Code for Information Interchange
JIS X 0201-1976	Japanese Industrial Standard Katakana character set
ISO 646:1983	Information processing — ISO 7-bit coded character set for information interchange

ISO 2022:1986	Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques
ISO 4873:1986	Information processing — ISO 8-bit code for information interchange — Structure and rules for implementation
ISO 6429:1988	Information processing — Control functions for 7-bit and 8-bit coded character sets
ISO 8859	Information processing — 8-bit, single-byte coded graphic character sets — See individual ISO character sets in Appendix A.
ISO 8859-8:1988	Information processing — 8-bit, single-byte coded graphic character sets — Part 8: Latin-Hebrew Alphabet
ISO/IEC DIS 10538	Information technology — Control functions for text communication

2.1 Coded Characters

Character processing is described in terms of the standard 8-bit coded character set that is divided into the following categories of coded characters:

- A set of 32 control characters called the C0 control set (0/0–1/15, inclusive).
- A set of 94 graphic characters called the GL (Graphics Left) graphics set (2/1–7/14, inclusive).
- A set of 32 control characters called the C1 control set (8/0–9/15, inclusive).
- A set of 94 graphic characters called the GR (Graphics Right) graphics set (10/1–15/14, inclusive).
- A set of special characters outside of these categories: 2/0, 7/15, 10/0, and 15/15.

Figure 2–1 and Figure 2–2 illustrate the Standard 8-Bit Code Table, using ASCII as the GL character set and DEC Supplemental as the GR character set. The Standard 8-Bit Code Table shows the character allocated to each position in the standard 8-bit coded character set.

In an 8-bit environment, the low-order 7 bits determine whether the character is printable or is a control character. The eighth bit of the character specifies the following active character sets:

Eighth Bit	Active Character Set
0	GL or C0
1	GR or C1

In some environments, only 7 bits are used to encode characters, using the standard 7-bit coded character set. The standard 7-bit set includes only the C0 and GL character sets and special characters 2/0 and 7/15. Figure 2–1, alone, is an example of the Standard 7-Bit Code Table.

Figure 2-1 Standard 8-Bit Code Table (Left Half)

Standard Left															
C0 Control Set				Graphics Left (GL)											
Column 01				2	3	4	5	6	7						
SP	40 32 20														
0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70						
1	SOH 11 1	DC1 (XON) 11 11	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71			
2	STX 22 2	DC2 18 12	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72			
3	ETX 33 3	DC3 (XOFF) 13 13	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73			
4	EOT 44 4	DC4 24 14	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74			
5	ENQ 55 5	NAK 25 15	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75			
6	ACK 66 6	SYN 26 16	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76			
7	BEL 77 7	ETB 27 17	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77			
8	BS 10 8 8	CAN 30 24 18	8	68 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78			
9	HT 11 9 9	EM 31 25 19	9	69 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79			
10	LF 12 10 A	SUB 32 26 1A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A			
11	VT 13 11 B	ESC 33 27 1B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B			
12	FF 14 12 C	FS 34 28 1C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C		174 124 7C			
13	CR 15 13 D	GS 35 29 1D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D			
14	SO 16 14 E	RS 36 30 1E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E			
15	SI 17 15 F	US 37 31 1F	?	77 63 3F	O	117 79 4F	—	137 95 5F	o	157 111 6F				DEL 177 127 7F	
ASCII Graphic Character Set															
LEGEND				GL	Column/Row										
A				101 65 41	Octal Decimal Hex										
MLO-00397															

Figure 2-2 Standard 8-Bit Code Table (Right Half)

Standard Right

C1 Control Set				Graphics Right (GR)															
Column 89				101112131415															
Row 0		200 128 80	DCS	220 144 90		240 160 A0	◊	260 176 B0	À	300 192 C0		320 208 D0	à	340 224 E0		360 240 F0			
		201 129 81	PU1	221 145 91			±	261 177 B1	Á	301 193 C1	Ñ	321 209 D1	á	341 225 E1	ñ	361 241 F1			
		202 130 82	BPH	222 146 92			¢	262 178 B2	Â	302 194 C2	Ò	322 210 D2	â	342 226 E2	ò	362 242 F2			
		203 131 83	NBH	223 147 93			£	263 179 B3	Ã	303 195 C3	Ó	323 211 D3	ã	343 227 E3	ó	363 243 F3			
		204 132 84	IND	224 148 94				264 180 B4	Ä	304 196 C4	Ô	324 212 D4	ä	344 228 E4	ô	364 244 F4			
		205 133 85	NEL	225 149 95			¥	265 181 B5	Å	305 197 C5	Õ	325 213 D5	å	345 229 E5	õ	365 245 F5			
		206 134 86	SSA	226 150 96				266 182 B6	Æ	306 198 C6	Ö	326 214 D6	æ	346 230 E6	ö	366 246 F6			
		207 135 87	ESA	227 151 97			§	267 183 B7	Ç	307 199 C7	Œ	327 215 D7	ç	347 231 E7	œ	367 247 F7			
		210 136 88	HTS	230 152 98			✕	270 184 B8	È	310 200 C8	Ø	330 216 D8	è	350 232 E8	ø	370 248 F8			
		211 137 89	HTJ	231 153 99			©	271 185 B9	É	311 201 C9	Ù	331 217 D9	é	351 233 E9	ù	371 249 F9			
		212 138 8A	VTS	232 154 9A			ₐ	272 186 BA	Ê	312 202 CA	Ú	332 218 DA	ê	352 234 EA	ú	372 250 FA			
		213 139 8B	PLD	233 155 9B			<<	273 187 BB	Ë	313 203 CB	Û	333 219 DB	ë	353 235 EB	û	373 251 FB			
		214 140 8C	PLU	234 156 9C				274 188 BC	Ì	314 204 CC	Ü	334 220 DC	ì	354 236 EC	ü	374 252 FC			
		215 141 8D	RI	235 157 9D				275 189 BD	Í	315 205 CD	Ý	335 221 DD	í	355 237 ED	ý	375 253 FD			
		216 142 8E	SS2	236 158 9E				276 190 BE	Î	316 206 CE		336 222 DE	î	356 238 EE		376 254 FE			
		217 143 8F	SS3	237 159 9F															

	240 160 A0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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LEGEND

	GR	
	12/1	Column/Row
/	301	Octal
A	193	Decimal
	C1	Hex

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2.2 Printable Characters

The characters in GL in a 7-bit environment and the characters in GL and GR in an 8-bit environment are interpreted as printable characters whenever they are not part of a control function.

Both a font and a graphic character set must be specified to print a character. The graphic character set specifies what character (for example, a capital letter A) is printed. Each set is an ordered group of 94 or 96 characters, and is described by the code table for that graphic character set.

The font specifies the size, style, and design used to print the character. For example, a Courier 10-point font describes the type family (Courier) and size (10 point) of the character.

See Appendix A for the code tables of the character sets supported by DEC PPL2 devices. See Chapter 4 for more information on fonts.

2.2.1 Selecting Graphic Character Sets

Several graphic character sets reside in the device. Additional sets may be downline loaded or provided by font cartridges. See the Programming Supplement to determine whether cartridges or downline loading are available in a particular device. A graphic character set need not be selected every time the device is used; default character sets can be used. ASCII, DEC Supplemental, DEC Technical, and DEC Special Graphics are examples of graphic character sets.

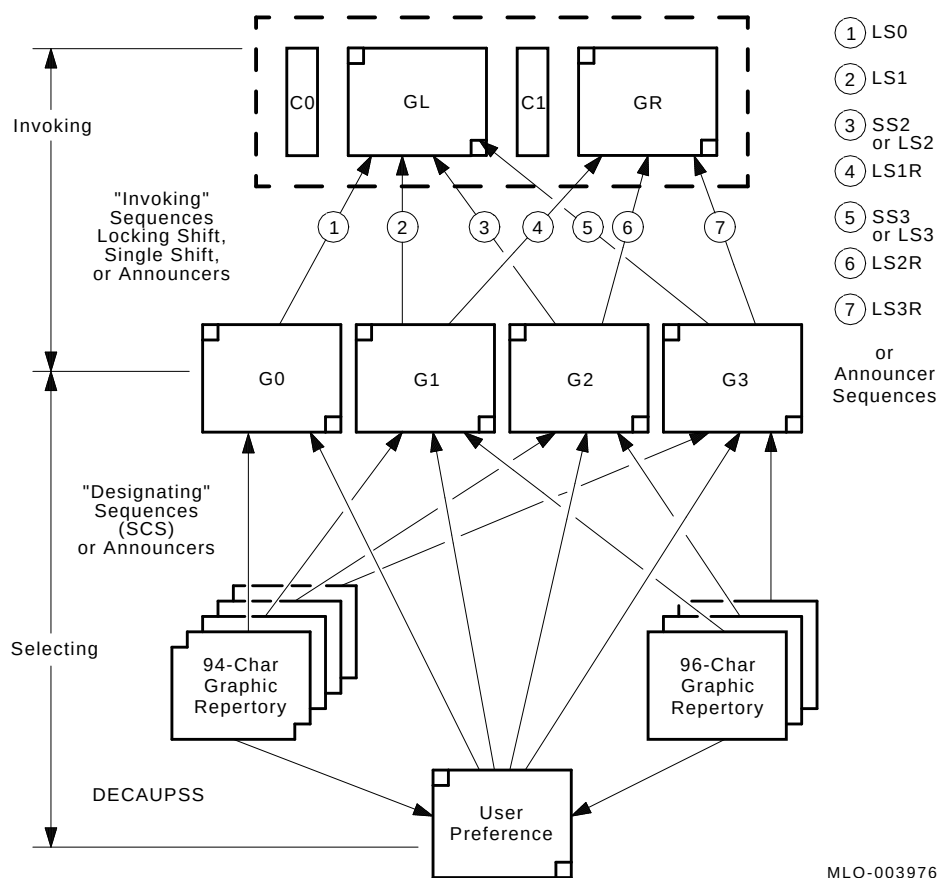
Graphic character sets are selected for printing as follows:

1. Designate the set as one of the logical G0, G1, G2, or G3 sets.
2. Map (invoke) one of the G-sets into the graphic left (GL) or graphic right (GR) logical set. (In a 7-bit environment, only the GL set is available.)

Figure 2-3 shows the process of designating and invoking character sets. The Select Character Set (SCS) command designates the graphic character set (see Chapter 7). The Locking Shift and Single Shift commands map the logical sets into the GL or GR set. See Locking and Single Shifts (LS*/LS*R/SS*) in Chapter 7.

In addition, the User Preference logical character set provides an extra level of indirection. This allows any one of several different character sets to be selected using the same designating command. See Assign User Preference Supplemental Set (DECAUPSS) in Chapter 7 for more information on the User Preference character set.

Figure 2-3 Designating and Invoking Character Sets



2.2.2 Line Terminators

In order to minimize print operations, optimize print quality, and optimize print speed, the device may buffer information. In this case, the device does not perform a print operation until a **line terminator** has been received. See the Programming Supplement for more information.

2.3 Control Characters

The characters in C0 in a 7-bit environment and the characters in C0 and C1 in an 8-bit environment are interpreted as control characters. They are processed as described in Chapter 6.

All C1 control characters abort an incomplete escape sequence, control sequence, or control string.

In a 7-bit environment, C1 control characters in the range 8/0–9/15 can be accessed by using an equivalent 2-character escape sequence with a final character in the range 4/0–5/15. For example, the escape sequence ESC K (1/11 4/11) is equivalent to the 8-bit control character PLD (8/11). Another example is CSI, which may be encoded as ESC [(1/11 5/11) or as CSI (9/11). Table 2–1 provides these equivalent sequences.

Table 2–1 7-Bit and 8-Bit Control Character Equivalence

8-Bit Column/Row	Mnemonic	7-Bit Equivalent Sequence	
8/0	Reserved	ESC @	1/11 4/0
8/1	Reserved	ESC A	1/11 4/1
8/2	BPH	ESC B	1/11 4/2
8/3	NBH	ESC C	1/11 4/3
8/4	IND	ESC D	1/11 4/4
8/5	NEL	ESC E	1/11 4/5
8/6	SSA	ESC F	1/11 4/6
8/7	ESA	ESC G	1/11 4/7
8/8	HTS	ESC H	1/11 4/8
8/9	HTJ	ESC I	1/11 4/9
8/10	VTB	ESC J	1/11 4/10
8/11	PLD	ESC K	1/11 4/11
8/12	PLU	ESC L	1/11 4/12
8/13	RI	ESC M	1/11 4/13
8/14	SS2	ESC N	1/11 4/14
8/15	SS3	ESC O	1/11 4/15
9/0	DCS	ESC P	1/11 5/0

(continued on next page)

Table 2–1 (Cont.) 7-Bit and 8-Bit Control Character Equivalence

8-Bit Column/Row	Mnemonic	7-Bit Equivalent Sequence	
9/1	PU1	ESC Q	1/11 5/1
9/2	PU2	ESC R	1/11 5/2
9/3	STS	ESC S	1/11 5/3
9/4	CCH	ESC T	1/11 5/4
9/5	MW	ESC U	1/11 5/5
9/6	SPA	ESC V	1/11 5/6
9/7	EPA	ESC W	1/11 5/7
9/8	SOS	ESC X	1/11 5/8
9/9	Reserved	ESC Y	1/11 5/9
9/10	SCI	ESC Z	1/11 5/10
9/11	CSI	ESC [	1/11 5/11
9/12	ST	ESC \	1/11 5/12
9/13	OSC	ESC]	1/11 5/13
9/14	PM	ESC ^	1/11 5/14
9/15	APC	ESC _	1/11 5/15

2.4 Special Characters

Special characters are characters that are part of the 8-bit code table but not part of the C0, GL, C1, or GR character sets. The special characters are:

- 2/0
- 7/15
- 10/0
- 15/15

In a 7-bit environment, only 2/0 and 7/15 are available.

2.4.1 Processing 2/0

If a 94-character graphic character set is selected into GL, 2/0 always prints a Space (SP).

If a 96-character graphic character set resides in GL, 2/0 prints the specified character from that set. If 2/0 is undefined in that set, the error character is printed.

2.4.2 Processing 7/15

If a 94-character graphic character set is selected into GL, 7/15 is always ignored.

If a 96-character graphic character set resides in GL, 7/15 prints the specified character from that set. If 7/15 is undefined in that set, the error character is printed.

2.4.3 Processing 10/0

If a 94-character graphic character set is selected into GR, 10/0 prints the error character.

If a 96-character graphic character set is selected into GR, 10/0 prints the specified character from that set. If 10/0 is undefined in that set, the error character is printed.

2.4.4 Processing 15/15

If a 94-character graphic character set is selected into GR, 15/15 is always ignored.

If a 96-character graphic character set is selected into GR, 15/15 prints the specified character from that set. If 15/15 is undefined in that set, the error character is printed.

2.5 Control Functions

Control functions consist of control characters, escape sequences, control sequences, and control strings. This section describes the format and processing of escape sequences, control sequences, and control strings, collectively termed **commands**.

The device recognizes the control function formats and ignores all commands that are not listed in Chapter 7 or the Programming Supplement.

2.5.1 Escape Sequence Format

The format of an escape sequence is:

ESC	I . . . I	F
1/11	2/0–2/15	3/0–7/14
Escape Sequence Introducer	Intermediate Characters (0 or more characters)	Final Character (1 character)

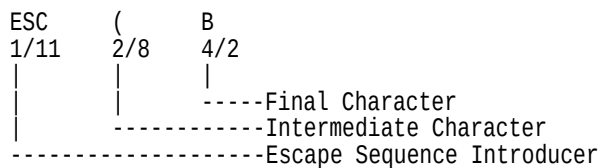
The ESC control character (1/11) is the **Escape Sequence Introducer**. After ESC is received, all characters received within the proper range are not printed but are stored as part of the sequence.

Intermediate characters are characters in the range 2/0–2/15 received after ESC. Escape sequences with a maximum of three intermediate characters are recognized and stored. If a fourth intermediate character is received, the event is noted and when the final character arrives, the entire escape sequence is ignored.

The **final character** is the character in the range 3/0–7/14 received after ESC and after 0 or more intermediate characters. The final character indicates the end of the escape sequence. The intermediate characters (if any) and the final character together define the function of the sequence.

Figure 2–4 shows an example of an escape sequence.

Figure 2–4 Escape Sequence Example



2.5.2 Control Sequence Format

The format of a control sequence is:

CSI	P . . . P	I . . . I	F
9/11	3/0–3/15	2/0–2/15	4/0–7/14
Control Sequence Introducer	Parameter Characters (0 or more characters)	Intermediate Characters (0 or more characters)	Final Character (1 character)

The CSI control character is the **Control Sequence Introducer**. CSI has an 8-bit code of 9/11. This is equivalent to the escape sequence consisting of the ESC (1/11) and “[” (5/11) characters. Both encodings are recognized as CSI. After CSI is received, all characters up to and including the final character are not printed but are stored as part of the sequence.

Parameter characters are characters in the range 3/0–3/15, received after CSI and before any intermediate characters or the final character. A parameter character modifies the action or interpretation of the sequence. Generally, a parameter character is an ASCII digit and modifies the sequence as a numerical index. Parameter characters are grouped to form **parameters**. The occurrence of the ? character (3/15) or > character (3/14) at the beginning of a parameter string indicates Digital private parameters. See Section 2.5.2.2 for more information.

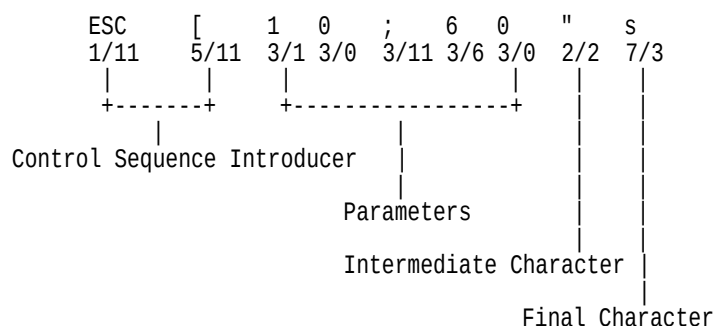
If the : character (3/10), < character (3/12), or = character (3/13) is received during processing of a parameter string, or if 3/14 or 3/15 is received after the first character of a parameter string, the event is noted and when the final character arrives, the entire sequence is ignored.

Intermediate characters are characters in the range 2/0–2/15, received after CSI and after the parameter characters, if any. Only control sequences with 0 or 1 intermediate character are recognized by the device.

The **final character** is the character in the range 4/0–7/14, received after the CSI and after the parameter or intermediate characters, if any. The final character indicates the end of the control sequence. The parameters and intermediate characters (if any) and the final character together define the function of the sequence.

Figure 2–5 shows an example of a control sequence.

Figure 2–5 Control Sequence Example



2.5.2.1 Parameter Values in Control Sequences

There are two types of parameters: numeric and selective.

- A **numeric parameter** is interpreted as a number of units that specify a distance or quantity pertaining to the control function. In this document **Pn** is used to denote a numeric parameter value.
- A **selective parameter** is interpreted as identifying an entry from a list of options pertaining to the control function. In this document **Ps** is used to denote a selective parameter value.

Parameters are interpreted as unsigned decimal integers, with the most significant digit sent first. Leading zeros are allowed but are ignored. Plus and minus signs are not allowed.

If no value is received for a parameter in a sequence, a value of zero is assumed for that parameter. The maximum value for a numeric parameter is at least as great as the greatest value needed by any supported control sequence. Any larger value received is replaced by the maximum value.

If multiple parameters are encoded in a single sequence, they are separated by a ; (semicolon, 3/11). A maximum of 16 parameters is allowed. If more than 16 parameter values are received, only the first 16 are evaluated. The extra parameters do not invalidate the entire control sequence.

Some sequences require a fixed number of selective parameters. Others accept a variable number. Unless otherwise stated, if one of a variable-length string of selective parameters is out of range for a particular control function, the parameter is ignored. See individual control functions in Chapter 7 for error handling of fixed-length selective parameter strings.

Side effects of commands are performed even if one or more parameters are out of range for that function.

2.5.2.2 Private Parameters

If the ? character (3/15) or the > character (3/14) occurs at the beginning of a string of parameters, the parameters that follow are Digital private parameters. The device notes this event. When the final character is received, the presence or absence of ? or > contributes to determining the validity and meaning of the parameter.

If ? or > occurs in the control sequence, other than as the first character of the parameter string, the entire sequence is discarded.

The following example shows a valid control sequence using private parameters:

```
CSI ? 6 ; 4 m
```

The following example shows an invalid control sequence:

```
CSI ? 6 ; ? 4 m
```

A string of parameters preceded by ? or > where no preceding character is expected is considered out of range. The device ignores the parameters, but processes any side effects related to the sequence.

Note

The ? and > characters are not interchangeable. They signify different types of private parameters.

2.5.2.3 Selectable Modes

Selectable modes control the way data is transmitted, interpreted, or imaged, instead of causing some action or printing to occur. For example, Line Feed /New Line Mode (LNM) controls how the Line Feed (LF) control character is interpreted: either as a line feed or a new line. The Set Mode (SM) and Reset Mode (RM) control sequences that toggle the state of each selectable mode are listed in Chapter 7.

To use one SM or RM sequence to turn several selectable modes on or off at the same time, send the control sequence introducer, followed by the list of the parameters for each mode, separated by semicolons, followed by the appropriate final character: h (6/8) for set, or l (6/12) for reset. An SM or RM control sequence with multiple selective parameters is treated as multiple SM or RM sequences, each with one parameter.

There are two types of selectable modes: ANSI and Digital private. The ? character (3/15) or > character (3/14) is used to indicate a private parameter string. When you combine multiple selectable modes in a single sequence, all parameters must be of the same type.

Some mode switch parameters set the device to an emulation protocol. Any parameters received after a protocol mode switch parameter are ignored. Parameters received in DEC PPL2 mode before the protocol mode switch parameter are valid. When using a mode switch command to exit an emulation protocol, do not send extra parameters.

2.5.3 Control Strings

Control strings are used to pass variable length data strings. The format of a control string is:

Control string introducer Protocol selector D . . . D ST

The following C1 control characters are the **control string introducers**: Application Program Command (APC), Device Control String (DCS), Operating System Control (OSC), or Privacy Message (PM).

The **protocol selector** specifies the meaning of the data and consists of parameter characters (optional), intermediate characters (optional), and a final character. The protocol selector format is unique for each type of control string.

D . . . D is data to be passed with the control string. This data string must be made up of characters in the range 0/8–0/13 and 2/0–7/14.

ST is the C1 control character String Terminator.

2.5.3.1 Device Control String (DCS) Format

The format of a device control string is:

DCS	P . . . P	I . . . I	F	D . . . D	ST
9/0	3/0–3/15	2/0–2/15	7/0–7/14		9/12
Device Control String	Parameter Characters (0 or more characters)	Intermediate Characters (0 or more characters)	Final Character (1 character)	Data (0 or more characters)	String Terminator
Introducer		Protocol Selector			

The DCS control character is the **Device Control String introducer**. DCS has an 8-bit code of 9/0. This is equivalent to the escape sequence consisting of the ESC (1/11) and P (5/0) characters. Both encodings are recognized as DCS. After DCS is received, all characters received up to and including the String Terminator (ST) are not printed but are stored as part of the control string.

The protocol selector consists of parameter characters (P . . . P), intermediate characters (I . . . I), and the final character. These characters are processed identically to the format of a control sequence (See Section 2.5.2). The intermediate characters, if any, and the final character, specify the meaning of the data. If present, the parameter string can further elaborate the interpretation of the data.

If the protocol selector is parsed but not recognized, all data that follows is ignored until it is either terminated by ST or aborted.

2.5.3.2 Application Program Command, Operating System Command, and Privacy Message Control Strings

The device recognizes the start of Application Program Command (APC), Operating System Command (OSC), and Privacy Message (PM) control strings, but it ignores the protocol selector and data that follows until the control string is either aborted or terminated by ST. See Table 2–2 for further information.

2.5.4 Special Parsing Requirements

When an error occurs during character processing, for example, when invalid parameters are specified or when control characters are embedded in control functions, the device recovers from the condition by performing the appropriate action listed in this section.

- Escape sequences, control sequences, and control strings not recognized by the device are ignored.
- Unless otherwise stated, up to 16 parameters can be received with any control sequence or device control string. Any parameter beyond those specified for the command is ignored, regardless of its value, and the remainder of the command is processed.
- Unless otherwise stated, a selective parameter in a valid position but with an invalid value is ignored. The remaining valid parameters are processed, and any side effects of the control sequence take effect.
- Unless otherwise stated, when a numeric parameter (P_n) exceeds the specified maximum, the maximum allowable value for that parameter is used.
- Unless otherwise stated, when a numeric parameter (P_n) is less than the specified minimum, the minimum allowable value for that parameter is used.
- Unless otherwise stated, if a required parameter is omitted or a semicolon (;) is received without a parameter, a parameter value of zero is assumed.
- Incomplete control strings are generally ignored. There is one exception: in Sixel Graphics mode, any sixels received are processed.
- If a C0 or C1 control character is received after a Single Shift control character (SS2 or SS3), the control character is processed and the single shift flag remains set. If an escape sequence, control sequence, or control string is received after SS2 or SS3, the sequence is processed and the single shift flag remains set.

- If the special characters 2/0 or 7/15 are received after SS2 or SS3, the following occurs:
 - If a 94-character graphic character set resides in the set being accessed, G2 or G3, 2/0 or 7/15 is processed normally and the single shift flag remains set. (Refer to Section 2.4.)
 - If a 96-character graphic character set resides in the set being accessed, G2 or G3, the corresponding graphic character 2/0 or 7/15 is imaged and then the single shift flag is reset.
- If a GR character is received after SS2 or SS3, the eighth bit is ignored. The single shift function is then applied to the remaining seven bits, which define a GL character, and the single shift flag is reset.

Note

Do not use a GR character after SS2 or SS3. This is an error.

- If the special characters 10/0 or 15/15 are received after SS2 or SS3, the following occurs:
 - If a 94-character graphic character set resides in the set being accessed, G2 or G3, 10/0 or 15/15 is processed normally and the single shift flag is reset. (Refer to Section 2.4.)
 - If a 96-character graphic character set resides in the set being accessed, G2 or G3, the corresponding graphic character 10/0 or 15/15 is imaged and then the single shift flag is reset.

Table 2–2 summarizes the special parsing rules for the interaction of control characters and graphic characters with escape sequences, control sequences, and control strings.

Table 2-2 Special Character Parsing

Received Character	Sequences ¹	Control String Data (D . . . D)			Undefined Control String
		Sixel Graphics	DECAUPSS	DECDLD	
ESC	See a.	See a.	See a.	See a.	See a.
CAN	See b.	See b.	See b.	See b.	See b.
SUB	See b.	See g.	See b.	See g.	See b.
Format Effectors ²	See c.	Ignore	Ignore	Ignore	Ignore
Other C0 ³	See c.	See c.	Ignore	Ignore	See c.
2/1-7/14	See d.	See d.	See d.	See d.	Ignore
8/0-9/15	See b.	See b.	See b.	See b.	See b.
10/1-15/14	See e.	See e.	See e.	See e.	See e.
2/0	See f.	Ignore	See f.	See h.	Ignore
10/0	See f.	Ignore	See f.	Ignore	Ignore
7/15	Ignore	Ignore	Ignore	Ignore	Ignore
15/15	Ignore	Ignore	Ignore	Ignore	Ignore

¹Includes escape sequences, control sequences and protocol selectors (See Section 2.5.3).

²Includes Horizontal Tab (HT), Backspace (BS), Line Feed (LF), Vertical Tab (VT), Form Feed (FF), and Carriage Return(CR).

³Includes Bell (BEL), Shift In (SI), and Shift Out (SO).

Action taken:

- a.—Character aborts the command, then introduces a new command.
- b.—Character aborts the command, then the control character is processed.
- c.—Character is processed as if received before the command, then command processing resumes.
- d.—Character is processed as a printable character.
- e.—Eighth bit of character is ignored, then processed as a GL printable character.
- f.—Character processed as 2/0 (Space, SP).
- g.—Character processed as ? (3/15).
- h.—Character ignored unless part of a character set designator.

3

Page Coordinate System

This chapter covers the following topics:

- Coordinate system models, Section 3.1
- Active position, positioning controls, and advance increments, Section 3.2
- Coordinate system bounds, Section 3.3
- Mapping the logical page onto the physical sheet , Section 3.4
- Partial line motion (PLU and PLD), Section 3.5
- Positioning controls and partial line motion, Section 3.6
- Tabs, Section 3.7
- Conditional Form Feed, Section 3.8
- Conditional Sheet Feed, Section 3.9

The **page coordinate system** is a rectangular array of addressable positions specified by a positive X-coordinate and a positive Y-coordinate. The positive X direction is to the right, the positive Y direction is down.

The page coordinate system defines the **logical page**. The **physical sheet** (that is, the sheet of paper) is described by the actual paper size and orientation. These factors also determine certain aspects of the logical page. See Section 3.4 for more details.

3.1 Coordinate System Models

There are two coordinate system models: The **character cell model** and the **point model**.

- In the character cell model, a position covers an entire character. Therefore, the whole character is the smallest addressable unit.
- In the point model, a position is a dimensionless location, and the unit of addressing is not directly related to characters.

3.1.1 Character Cell Model

The character cell model specifies the coordinates of a character cell position as the line and character number, starting with character 1 of line 1. This is a simple model used for monospaced presentation. The character cell model is not used for proportionally spaced characters.

The monospaced character cells of the character cell model are placed on a **grid**, which is defined by the current character and line spacing. Changes in character or line spacing result in changes in the currently selected grid size. Whenever the grid size changes, the device adjusts the coordinates of certain key reference points (such as margins or active position) so that they always fall on even grid boundaries.

The **character box** is the size of the character as stored in the font. In level 2 printers, the software can vary the width of the character box (by changing the width of the current character spacing, which in turn scales the character size), but it cannot vary the height of the character box.

The **character cell** is the distance from one character to another. The host software can vary this distance by changing the height of the current line spacing and the width of the current character spacing.

In level 2 printers, the width of the character cell is always the same as the width of the character box, but the host software can set the height of the character cell larger than, equal to, or smaller than the height of the character box of a font being used.

3.1.2 Point Model

In the point model, the coordinates of a position are specified in units of decipoints (exactly 1/720 in.), centipoints (exactly 1/7200 in.), or device-dependent pixels (the smallest addressable dot on the device).

3.1.3 Conformance to Models

Level 2 devices support only the character cell model. Point addressing is not supported.

3.1.4 Origin and Extent

The page coordinate system origin is at (1,1), not (0,0). All values in the coordinate system are referenced to the origin.

The exact placement of the origin with respect to the physical sheet depends on the imaging capabilities of the printer. For example, the device may place the first line of text lower on single sheets than on fanfold paper. In some devices host software can also partially control the placement of the origin, by using

the Horizontal Page Width Alignment (DECHPWA) command. This allows the user to vary the position of the paper horizontally within the paper-handling mechanism.

3.2 Positioning and Movement

The **active horizontal position** and the **active vertical position** together represent the position on the logical page where the next character is printed. After each character is printed, the active position is updated. In addition, there are several control functions that can change the active position. The control functions are listed in Table 3–1.

3.2.1 Advance Increments

After each character is printed, the active horizontal position is updated according to the current **Horizontal Advance Increment** (HAI). After each line is printed, the active vertical position is updated according to the current **Vertical Advance Increment** (VAI). The values of HAI and VAI can be changed by control functions. In level 2 devices, HAI and VAI are always of fixed width, that is, they do not automatically change based upon the character being printed or the font in use.

3.2.1.1 HAI

Fixed horizontal motion does not vary from character to character or font to font. The HAI is explicitly defined by Set Horizontal Pitch (DECSHORP).

When an HAI is in use that has a different width from the stored character box of the currently selected font, the device modifies the width of the character box to obtain the desired pitch.

3.2.1.2 VAI

Fixed vertical motion does not vary from font to font. The VAI is explicitly defined by Set Vertical Pitch (DECVERP). When a VAI is in use that is shorter than the character box, the device overlaps the character boxes. When a VAI is in use that is taller than the character box, the device adds more white space between lines.

3.2.2 Positioning Control Functions

The control functions that change the active position are listed in Table 3–1.

In general, **Absolute** positioning requires no knowledge of the active position to correctly specify a new position. **Relative** positioning requires knowledge of the active position to execute correctly.

Table 3–1 Positioning Controls and Commands

Control Function	Type	Motion
Autowrap	Relative	Vertical, Horizontal
Backspace (BS)	Relative	Horizontal
Carriage Return (CR)	Absolute	Vertical ¹ , Horizontal
Graphics Carriage Return (DECGCR)	Absolute	Horizontal
Graphics Next Line (DECGNL)	Relative	Vertical, Horizontal
Form Feed (FF)	Absolute	Vertical
Horizontal Position Absolute (HPA)	Absolute	Horizontal
Horizontal Position Relative (HPR)	Relative	Horizontal
Horizontal Tab (HT)	Absolute	Horizontal
Index (IND)	Relative	Vertical
Line Feed (LF)	Relative	Vertical, Horizontal ²
Next Line (NEL)	Relative	Vertical, Horizontal
Partial Line Down (PLD)	Relative	Vertical
Partial Line Up (PLU)	Relative	Vertical
Vertical Position Absolute (VPA)	Absolute	Vertical
Vertical Position Relative (VPR)	Relative	Vertical
Vertical Tab (VT)	Absolute	Vertical

¹Performs vertical motion only if Carriage Return/New Line Mode (DECCRNLM) is set.

²Performs horizontal motion only if Line Feed/New Line Mode (LNM) is set.

Note

Other sequences or actions can set or modify the active position as a side effect.

The units for many control functions are defined as **lines** or **columns**. A line is defined as one VAI. Therefore, VPR with a parameter value of 3 would modify the active vertical position by (3 * VAI). A column is defined as one

HAI. Therefore, HPR with a parameter value of 5 would modify the active horizontal position by $(5 * \text{HAI})$.

3.3 Bounds

Before imaging a character, the device determines if the active position is legal, by testing to see if the character cell to be imaged is within the page coordinate system bounds.

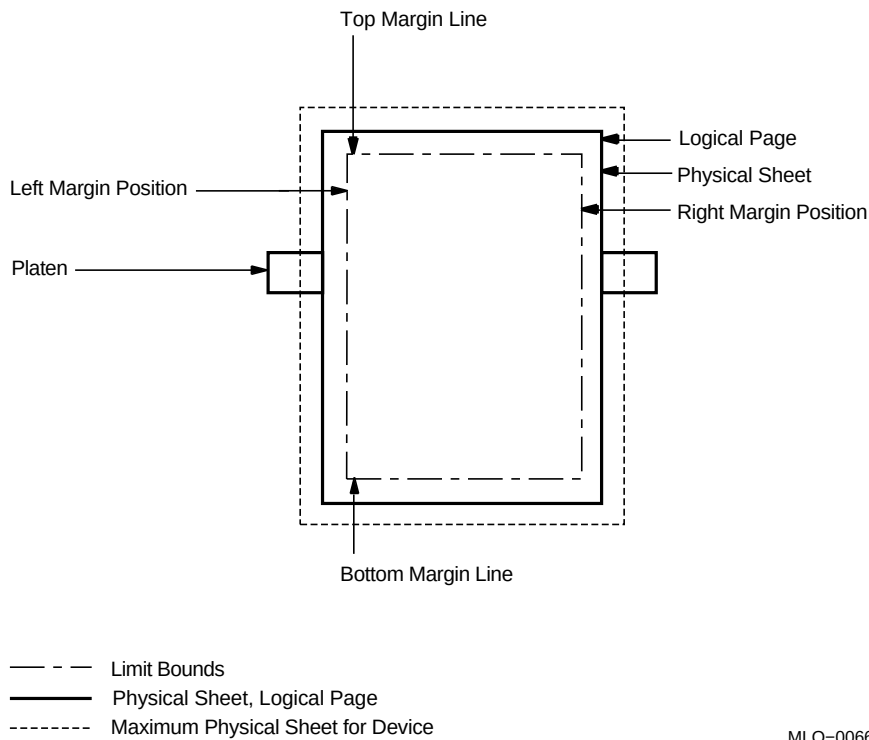
The page coordinate system bounds are also known as **limit bounds** or **margins**.

A limit bound constrains the movement of the active position. The limit bounds are:

- Top Margin Line
- Bottom Margin Line
- Left Margin Position
- Right Margin Position

Figure 3–1 illustrates the relationship of limit bounds to the page coordinate system.

Figure 3–1 Bounds in the Page Coordinate System



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3.3.1 Left Margin Position

The horizontal positioning control functions are constrained to keep the active position to the right of the Left Margin Position. If a control function attempts to move the active horizontal position to the left of the Left Margin Position, or attempts to set the Left Margin Position to the right of the active position, the active horizontal position is set to the Left Margin Position.

3.3.2 Right Margin Position

The horizontal positioning control functions are constrained to allow text to be printed only to the left of the Right Margin Position.

If a right margin violation occurs, the printer enters a state indicated in this document by a flag called the **Right Margin Flag** (RMF).

The Right Margin Flag is set under the following conditions:

- A horizontal positioning control function attempts to exceed the right margin.
- An attempt is made to image a character beyond the right margin.

If text is received when the RMF is set and autowrap is enabled, the RMF is cleared, autowrap occurs, and the text is printed from the Left Margin Position on the next line. If the RMF is set and autowrap is disabled, the device ignores printable data and enters an error state. Use an absolute horizontal positioning command (for example, Carriage Return) to return the active position to a point where characters can be imaged.

If a character is imaged that exactly fills the last position on a line, the device does not set the Right Margin Flag. Instead, the active horizontal position advances to the first value that exceeds the Right Margin Position. The character cell is entirely outside the Right Margin Position (column 81 when the right margin is set at 80).

- If a Backspace (BS) is received, the active position moves backward to allow overstrike of the last character.
- If autowrap is off and more graphic characters or Space (SP) are received, the device ignores the character and sets the Right Margin Flag.
- If autowrap is on and more graphic characters or SP are received, autowrap occurs and the text is printed from the Left Margin Position on the next line.

3.3.3 Top Margin Line

The vertical positioning control functions are constrained to keep the active position below or equal to the Top Margin Line. The only exception is Partial Line Up (PLU).

If a vertical positioning command attempts to move the active vertical position above the Top Margin Line or an attempt is made to set the Top Margin Line below the current active position, the device sets the active vertical position to the Top Margin Line.

PLU can set the active vertical position above the Top Margin Line. This allows superscripts on the first line. See Section 3.5.

Form Feed (FF), whether **explicit** (caused by receipt of an FF control character) or **implicit** (caused by a wrap from the previous page or a conditional FF, for example) sets the active position to the Top Margin Line. Form Feed does not modify the active horizontal position.

3.3.4 Bottom Margin Line

The vertical relative and absolute positioning control functions are constrained to keep the active position above or equal to the Bottom Margin Line.

If a Vertical Position Absolute (VPA) or Vertical Position Relative (VPR) positioning command attempts to move the active position below the Bottom Margin Line, the device sets the active vertical position to the Bottom Margin Line.

If any other vertical positioning command attempts to move the active position below the Bottom Margin Line or an attempt is made to set the Bottom Margin Line above the current active position, the device performs a Form Feed.

Partial Line Down (PLD) can set the active position below the Bottom Margin Line. This allows subscripts on the bottom line. See Section 3.5.

Whenever a character box exceeds the bottom margin, the device executes a Form Feed before it images the character.

If, however, the Top Margin Line and the Bottom Margin Line are less than one character box apart, the device images one line that extends over the bottom margin, then wraps as usual.

3.4 Mapping Logical Page to Physical Sheet

Software can define the logical page length using Set Lines per Physical Page (DECSLPP). The logical page size so defined is the basis for the page coordinate system described in this chapter.

The **physical sheet size** is determined by one or all of the following input mechanisms (depending on the device capabilities and the input mechanism selected):

- Horizontal Page Width Alignment (DECHPWA)
- Page length user setup input
- Page width user setup input — same as width component of DECHPWA
- Initial state values (see the Programming Supplement).

If the paper that you insert into the machine does not match the physical sheet size, the alignment of the physical sheet onto the paper is device dependent. For example, if fanfold paper is installed that does not match the user setup page length selection, the device prints over the perforation. If the paper is narrower than the setup width selection, the device usually prints off the paper onto the platen.

The **logical page length** is determined by Set Lines per Physical Page (DECSLPP). There is no input mechanism for the logical page width, which is therefore always the same as the physical sheet width.

The logical page size is constrained to be less than or equal to the physical sheet size on the device.

3.5 Partial Line Motion (PLU and PLD)

Partial Line Up (PLU) and Partial Line Down (PLD) provide simple superscript and subscript capability by applying a vertical offset of 1/12 in. to the current font. The device counts current outstanding unmatched PLU and PLD sequences to determine the amount of motion for subsequent corresponding PLD and PLU sequences.

The count is maintained for up to 255 unmatched PLU and PLD sequences.

One PLU level is allowed beyond the top margin, and one PLD level is allowed below the bottom margin.

The control functions and activities that reset the PLU/PLD count are listed in Table 3–2.

3.6 Side Effects of Positioning Controls

Table 3–2 summarizes the vertical positioning controls and commands and their effect on the PLU/PLD count.

Table 3–2 Side Effects of Vertical Positioning Controls

Vertical Motion	PLU/PLD Count
Next Line (NEL)	Reset
Line Feed (LF)	Reset
Graphics New Line (DECGNL)	Reset
Form Feed (FF)	Reset
Vertical Position Absolute (VPA)	Reset
Vertical Position Relative (VPR)	Reset
Index (IND)	Reset
Partial Line Down (PLD)	Modified
Partial Line Up (PLU)	Modified

(continued on next page)

Table 3–2 (Cont.) Side Effects of Vertical Positioning Controls

Vertical Motion	PLU/PLD Count
Vertical Tab (VT)	Reset
Autowrap	Reset
Conditional Form Feed	Reset
Set Top and Bottom Margins (DECSTBM)	Reset

For the horizontal components of Next Line (NEL) and Line Feed (LF) when Line Feed New Line Mode (LNM) is set, see Carriage Return (CR) in Table 3–3.

Table 3–3 summarizes the horizontal positioning controls and commands and their effect on the Right Margin Flag (RMF).

Table 3–3 Side Effects of Horizontal Positioning Controls

Horizontal Motion	Right Margin Flag
Backspace (BS)	Unchanged
Carriage Return (CR)	Cleared
Horizontal Position Absolute (HPA)	Cleared ¹
Horizontal Position Relative (HPR)	Unchanged ¹
Horizontal Tab (HT)	Unchanged ¹

¹If the resulting active position is to the right of the right margin, the RMF is then set.

For the vertical component of CR when DECCRNLM is set, see LF in Table 3–2.

3.7 Tabs

Tab stops are stored relative to the origin. If the origin is moved for any reason, for example, with Horizontal Page Width Alignment (DECHPWA), the tabs are moved relative to the paper, but remain unchanged with respect to the page coordinate system. Stored coordinate values remain the same.

A Vertical Tab (VT) control function causes the active position to advance to the next tab stop, even if the motion is less than the current line size. This can occur due to the action of Partial Line Up (PLU) or Partial Line Down (PLD). The only exception occurs when there is a bottom margin violation.

Changes in horizontal pitch can affect print positions set by tab characters. Refer to the description of Set Horizontal Pitch (DECSHORP) in Chapter 7.

3.8 Conditional Form Feed

A number of control functions, such as Soft Terminal Reset (DECSTR), implicitly “complete” a current page in process. This action is referred to as a **conditional Form Feed**. A conditional Form Feed causes a Form Feed (FF) if there has been a marking operation on the current page, or if the current active position is not line 1, column 1. Marking operations consist of printable characters or graphics. A page is considered marked by a printable character even when the graphic character has a blank glyph. In this context Space (SP) acts like a printable character.

3.9 Conditional Sheet Feed

A number of control functions, such as Select Conformance Level (DECSCSCL), implicitly “complete” a current sheet in process. This action is referred to as a **conditional Sheet Feed** and is used to control the output on duplex page printers. On level 2 devices a conditional Sheet Feed is processed as a conditional Form Feed.

4

Fonts

This chapter covers the following topics:

- Character sets, Section 4.1
- Fonts, Section 4.2
- Font repertory, Section 4.3
- Font selection process, Section 4.4

4.1 Character Sets

A **graphic character set** is a set of coded characters in which each character is specified by an abstract name or names that indicate the general appearance of the character, but are independent of the font or type design. Two graphic character sets are considered different sets even if only one character is different. Each character is given a code in the code table for that graphic character set. For example, the ASCII character set consists of 94 graphic characters. In the ASCII character set, the Exclamation Point is specified as 2/1, the Double Quotation Mark as 2/2, the Number Sign is specified as 2/3, and so on. (See Section 4.3.3 and Appendix A for further information on supported character sets.)

4.2 Fonts

A **font** is the visual representation of characters, independent of graphic character sets. The description of a font consists of a single instance of typestyle and density.

For example, the following would comprise a single font:

Courier
Letter quality

This font could be used for imaging the characters of the ASCII, DEC Supplemental, or other graphic character sets. The graphic character set specifies what character is to be imaged, and the font specifies how that character is to be imaged. A font may support many character sets, but has only one density and typestyle.

Level 2 printers apply algorithms as necessary to provide attributes for emphasis, lining, and so on.

4.3 Font Repertory

Each instance of a character set in a given combination of style and density is called a **font file**. It contains 94 or 96 character images, called **glyphs**.

The **font repertory** of the device may include font files from the following sources:

- Built-in fonts
See the Programming Supplement for a list of built-in fonts. These fonts are coded as best suited to the internal design of the device.
- Standard font cartridges available for the device.
See Section 4.3.1 for information on font cartridge font files.
- Font files developed by customers (Download Font — DECDLD)
See DECDLD in Chapter 7 for information on downloading font files.

Note

To determine whether a particular printer supports DECDLD (and thus has downloadable fonts capability), refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement*.

Regardless of the source, all font files are selected by specifying typestyle, density, and character set, as described in Section 4.4.

4.3.1 Font Cartridges

Font cartridges are used to provide alternate typestyles, alternate character sets, or both for built-in fonts.

In order to provide font files for imaging, a font cartridge supports font assignments to Select Graphic Rendition (SGR) font selection parameters. These assignments allow the default font assignments to be redefined to a cartridge-dependent value as part of printer initialization.

4.3.2 Downloaded Fonts

Each downloaded font file contains information identifying its density and character set, as well as an assignment to a Select Graphic Rendition (SGR) font selection parameter. This assignment allows the default font assignment to be redefined to a download-dependent value at the time of the download. See Download Font (DECDLD) in Chapter 7 for more information on the download process.

Note

To determine whether a particular printer supports DECDLD (and thus has downloadable fonts capability), refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement*.

4.3.3 Supported Character Sets

The printer supports font files with any valid character set designator, including 96-character graphic character sets, whether they are built in, downloaded, or provided with a cartridge. Refer to the the Programming Supplement for the character set repertory provided by the built-in fonts.

Each font file includes a field that represents the designating escape sequence for the character set.

Note

This field should represent the actual designating escape sequence. Do not use the User Preference Supplemental Set designator (<) as a downloaded font file character set designator.

See the Select Character Set (SCS) command in Chapter 7 for further information on character set designating escape sequences. See Download Font (DECDLD) in Chapter 7 for further information on downloading.

The printer derives font files to support the National Replacement Character (NRC) sets defined in Section A.6. Font files for NRC sets are derived whenever an ASCII font file exists with either a DEC Supplemental or ISO Latin-1 Supplemental font file. If font files for both DEC Supplemental and ISO Latin-1 Supplemental exist, the ISO Latin-1 Supplemental font file is used. In either case, the font files to be paired must be identical in typestyle and density and must come from the same source. For example, both must be from the same cartridge or both must be built-in fonts.

The process of combining font files is called **pairing**. Pairing of NRC sets does not increase the number of glyphs; rather, the printer selects characters from two separate font files according to the NRC set definition.

4.4 Font Selection Process

A font is selected after a series of evaluations and comparisons of each font file in the **font dictionary** (font file repertory) against a set of font selection criteria called the Current Font Definition.

The font file required for character imaging can change every time any of the font selection criteria change.

4.4.1 Font Dictionary

The printer supports a font dictionary, composed of the available font files from the font repertory, and a system to manage them. The font dictionary provides the list of available font files for selection algorithms to work on.

Font files from the built-in fonts (main board ROM) and cartridge fonts are included in the font dictionary. Downline loaded font files are added to the font dictionary on receipt. The font dictionary can also contain fonts created by combining different font files together to construct a font file for a National Replacement Character (NRC) set.

The font dictionary is initialized at startup for built-in fonts. Font cartridges are also detected at startup. Entries from the cartridges take precedence over built-in fonts. If several slots exist, entries from cartridge slot 1 take precedence over entries from cartridge slot 2, and so on. Downline loaded fonts have precedence over all other sources.

4.4.2 Current Font Definition (CFD)

The collection of font selection criteria is referred to as the **Current Font Definition**, or CFD. The CFD consists of the following components:

- Typestyle
- Character set
- Density

The typestyle component is always defined by the active font selection parameter, Select Graphic Rendition (SGR) 10–19.

The character set component is taken from either the GL or GR character set, based on the character code. In either case, the GL and GR sets map to one of the G-sets (G0 . . . G3). The G-sets are associated to a character set as defined by Select Character Set (SCS) or the initial state. If the current G-set is defined as the User Preference Supplemental set, the character set defined by Assign User Preference Supplemental Set (DECAUPSS) or the initial state is referenced.

Density is defined by Density Selection (DECDEN).

4.4.3 Font Selection and Fallbacks

The device assigns the current font file based on the following order of priority:

1. Character set (highest)
2. Typestyle
3. Density (lowest)

The device compares each font file in the font dictionary to the CFD, noting the files that satisfy the highest priority attribute. Among multiple files that satisfy equal priority levels, the device selects the files satisfying the next highest level, and so on. If the end result is a list of multiple font files, the device selects one font file according to the order of precedence given in Section 4.4.1.

For example, if the DEC Technical character set and a cartridge typestyle are requested, and DEC Technical is not available in that cartridge typestyle, the device uses the built-in Courier DEC Technical. If ASCII Orator Draft is requested and only letter quality is available in the Orator typestyle, the device prints ASCII Orator letter quality (LQ).

Note

For any additional information on the font selection mechanism for a particular device, refer to the *Digital ANSI- Compliant Printing Protocol Level 2 Programming Supplement*.

If a requested character set is not available at all, the device images the error character for each character from the set. This is known as a **character set fault**.

The error character is taken from the ASCII character set. The processing of 2/0 and 7/15 is based on the character set requested, not the fallback character set. For example, if a 96-character graphic character set is requested, 2/0 and 7/15 are imaged as the error character.

5

Sixel Graphics

This chapter describes the Sixel Graphics protocol. You use sixels to transmit and print black and white or color bitmap data to create a graphics image.

This chapter covers the following topics:

- Terminology and concepts — Section 5.1
- Converting Sixel Graphics data for transmission — Section 5.2
- Selecting Sixel Graphics mode — Section 5.3
- Protocol structure — Section 5.4
- Character processing in Sixel Graphics mode — Section 5.5
- Graphics and text interactions — Section 5.6
- Programming considerations — Section 5.7
- Sixel control codes — Section 5.8

5.1 Terminology and Concepts

To print a graphics picture in Digital Sixel Graphics protocol, you send the picture to the device in bitmap form. The bitmap data for the picture, known as the **raster**, is divided into horizontal scan lines, each of which is six bitmap elements high. Before sending the data, you can define the horizontal and vertical spacing between elements. Small spacing provides a fine-grained picture. Larger spacing produces a coarse-grained picture, but requires less time to transmit.

The bitmap elements that you send to the device are known as **pixels**. A pixel is the logical rectangular image area defined by each bit of graphics data that you send. Six pixels arranged vertically on the page and grouped together for transmission are known as a **sixel**. Sixels are in turn arranged into horizontal rows known as **scan lines**.

The positions on the page where the device places pixels is known as the **grid**. When you change the grid size using the parameters given in this chapter, you are changing the spacing (horizontally, vertically, or both) between adjacent pixels. The **pixel aspect ratio** is the ratio of the length of the pixel to its width. For example, a square pixel has an aspect ratio of 1 to 1 (or 100 to 100) and a pixel twice as high as wide has an aspect ratio of 2 to 1 (or 200 to 100).

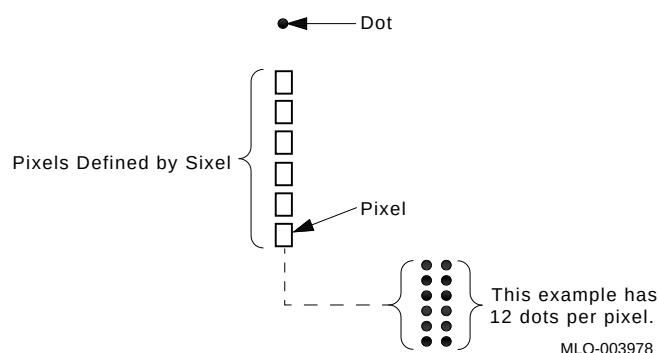
The actual area imaged for each pixel is known as a **pixel-spot**. The shape and size of a pixel-spot is device-dependent and may vary. Pixel-spots are, however, spaced to coincide with the grid size. Therefore, there may be overlap or white space between adjacent pixel-spots. The exact relationship between pixel-spot and grid size varies from device to device and from one set of parameters to the next on the same device.

The smallest unit that can be displayed on a particular device is known as a **dot**. Dots can be round, oval, square, or rectangular, and small or large. A device may use several dots to represent a single pixel as a pixel-spot, and to ensure good coverage of an entire grid position.

The data describing the image, including colors, grid size, pixel aspect ratio, and the encoded raster, is known as the **picture data**. The picture data does not include formatting information, such as position or actual size when printed. Within the picture data are **sixel control codes** that provide additional information beyond the encoded raster, such as line breaking.

Figure 5–1 illustrates the relationship between sixels, pixels, and dots.

Figure 5–1 Sixel Representation



In the Sixel Graphics protocol the software sets the context and attributes for the pixels and then prints the sixels consecutively on adjacent grid positions. The device images sixels from left to right, top to bottom.

The **graphics left margin** marks the left edge of the picture. The **graphics active position** keeps track of the current grid position.

Sixel Graphics mode is selected using the device control string shown in Figure 5-2.

Upon entering Sixel Graphics mode, the device sets the graphics active position and graphics left margin as described in Section 5.6.1.

After each sixel is printed, the graphics active position advances to the next horizontal grid position.

A Graphics Carriage Return (DECGCR) control code or a Graphics Next Line (DECGNL) control code moves the graphics active position to the graphics left margin. In addition, a Graphics Next Line (DECGNL) control code moves the graphics active position down to the next scan line (six vertical grid positions below the current active position). See these control codes in Section 5.8 for further information.

The String Terminator (ST) control character causes the device to exit Sixel Graphics mode and return to text mode. Other control characters may cause an abnormal termination of Sixel Graphics mode. See Table 2-2 for more information.

5.2 Converting Sixel Data

Sixels are coded as 7-bit or 8-bit bytes. Each byte is represented in this document as an ASCII character code. When Sixel Graphics mode is selected, the device interprets the bytes as sixel data. The device processes printable sixel data as bits of information. A bit value of 1 means print the pixel. A bit value of 0 means do not print the pixel (leave a space).

To create a byte of printable sixel data, first determine the sixel you want to print, as described in Section 5.5.1. Then add 3F hexadecimal to form a coded character between 3F and 7E hexadecimal.

5.3 Selecting Sixel Graphics Mode

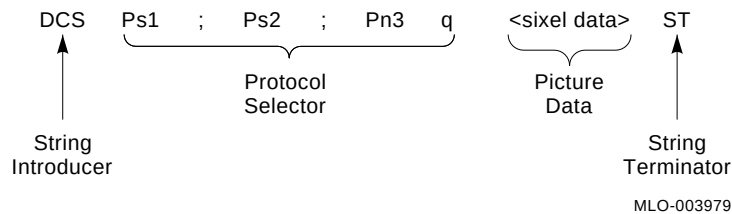
The device control string envelope defined by DEC PPL2 contains the graphics introducer and all graphics data. This envelope is initiated using the Device Control String introducer (DCS) control character and is terminated with the String Terminator (ST) control character. The following components make up the Device Control String for the sixel protocol:

- String introducer
- Protocol selector

- Picture data
- String terminator

Figure 5–2 shows the control string format.

Figure 5–2 Sixel Graphics Device Control String (DCS) Envelope



5.4 Protocol Structure

The structure of the Sixel Graphics protocol supports a layered system approach, whereby several independent processes define or interpret portions of the total data. Thus the size of an image can be described independently of the actual image definition.

The primary data and command fields include:

- **Picture data** — This is the body of the protocol. Software that creates or edits the graphic picture uses the picture data part of the protocol, either with no formatting information or with default formatting information, to describe the graphics image.
- **Formatting information** — The protocol selector provides formatting information only. Page-composition software adds the formatting information to the picture data to define the size of the picture.

5.4.1 Protocol Selector — Formatting Information

The page composition software includes formatting information in the sixel protocol selector. The format of the protocol selector is:

```
Ps1      ;      Ps2      ;      Pn3      q
***      3/11    ***      3/11    ***      7/1
```

5.4.1.1 Ps1

Ps1 is a macro parameter that selects the horizontal grid size and pixel aspect ratio. These implicitly define the vertical grid size.

Table 5–1 lists the Ps1 parameter macro values. These values are compatible with devices that use a native grid size of 1/660 inch. Some devices may use slight variations of these grid sizes to provide high-quality approximations. See the Programming Supplement for the table that relates directly to a particular device.

Table 5–1 Macro Parameter Selections

Ps1	True Horiz. Grid Size (1/660 in.)	Approx. Horiz. Grid Size (Centipoints)	Aspect Ratio	True Vert. Grid Size (Centipoints)
0 (default)	5	50	200:100	100
1	5	50	200:100	100
2	2	22	450:100	100
3	3	33	300:100	100
4	4	40	250:100	100
5	5	54	183:100	100
6	6	66	150:100	100
7	7	77	130:100	100
8	8	89	112:100	100
9	9	100	100:100	100
> 9	5	50	200:100	100

5.4.1.2 Ps2

Ps2 selects a background color. The device ignores this parameter. Software can include Ps2 for compatibility with video devices.

5.4.1.3 Pn3

Pn3 selects the horizontal grid size explicitly, in decipoints (1/720 inch). Any value other than 0 overrides the Ps1 value for horizontal grid size. The maximum horizontal grid size is 99 decipoints.

Together, the Pn3 value and the pixel aspect ratio define the vertical grid size. The vertical grid size equals the horizontal grid size times the pixel aspect ratio. The pixel aspect ratio may be defined by Ps1 (Section 5.4.1.1) or the Set Raster Attributes sixel control code (see Table 5–3). The maximum value for the vertical grid size is 99,000 decipoints.

These are the device-independent maximum values. Level 2 devices have a more limited range. See the Programming Supplement for Sixel Graphics mode fallbacks.

5.4.1.4 *q* — Sixel Graphics Protocol Selector Final

The character *q* identifies this protocol selector as the Sixel Graphics envelope and places the device in Sixel Graphics mode.

5.4.2 Picture Data

Picture data includes sixel printable characters and sixel control codes. These are processed as defined in Section 5.5.

5.4.3 String Terminator

The String Terminator (ST) control character is used to exit Sixel Graphics mode and return to text mode.

5.5 Character Processing in Sixel Graphics Mode

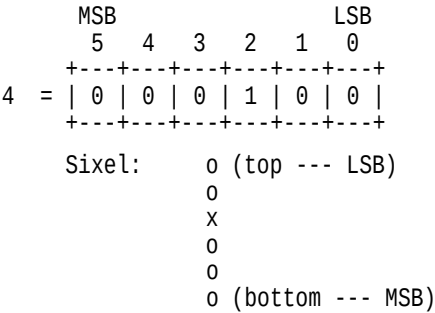
Sixel printable characters and sixel control codes, including the aspect ratio, form the picture data. Sixel printable characters comprise the encoded graphics image raster. Sixel control codes further define how the device images the raster.

5.5.1 Sixel Printable Characters

Characters in the range 3/15–7/14 are interpreted as sixel printable characters. The device subtracts the offset (3F hexadecimal) from the received code, assigning each of the remaining low-order six bits to a grid position. The six pixels are arranged vertically, as follows:

Top pixel	Bit 0 (LSB)
	Bit 1
	Bit 2
	Bit 3
	Bit 4
Bottom pixel	Bit 5 (MSB)

For example, if the device receives the character code 43 hexadecimal (01000011 binary), it subtracts the offset value (3F hexadecimal) from the code value. The resulting value of 4 maps into the scan line, as follows:



The letter “x” indicates a printed pixel-spot, and the letter “o” indicates an unprinted pixel-spot.

Table 5–2 shows the printable dot patterns for a select group of representative character codes.

Table 5–2 Printable Dot Patterns for Sixel Graphics Mode

Character	Hexadecimal Value	Dot Pattern	Action
?	3F	o	Advance by a sixel space
		o	
		o	
		o	
		o	
		o	
		o	
@	40	x	Print only top pixel
		o	
		o	
		o	
		o	
		o	
		o	

(continued on next page)

Table 5–2 (Cont.) Printable Dot Patterns for Sixel Graphics Mode

Character	Hexadecimal Value	Dot Pattern	Action
A	41	o x o o o o	Print second-from-top pixel
y	79	o x o x x x	Print second-from-top pixel and bottom three pixels
~	7E	x x x x x x	Print one full column

See also Section 2.5.4 for error handling.

5.5.2 Sixel Graphics Control Codes

Sixel control codes provide further definition of the encoded graphics image raster, beyond that provided by the protocol selector, as well as line breaks and color information.

Table 5–3 summarizes sixel control codes and functions. Specific sixel control codes (commands) consist of a code in the range 2/1–3/14 (except parameter characters 3/0–3/9 and the parameter separator 3/11), followed by zero or more parameters. Sixel commands are terminated by any non-parameter character. See Section 5.8 for details on each control code.

Table 5–3 Sixel Graphics Control Codes

Name	Abbreviation	Code	Function
Set Raster Attributes	DECGRA	" 2/2	Sets raster attributes.
Graphics Repeat Introducer	DECGRI	! 2/1	Begins repeat sequence.
Graphics Carriage Return	DEGCR	\$ 2/4	Returns active position to graphics left margin.
Graphics Next Line	DECGNL	– 2/13	Returns active position to graphics left margin and increments to next graphics line.
Graphics Color Introducer	DECGCI	# 2/3	Specifies color. Monochrome devices ignore DECGCI. All sixel data is printed in black.
Parameter Characters		0–9 3/0–3/9	Parameters.
Parameter Separator		; 3/11	Separates parameters.

Other codes in the range 2/1–3/14 are reserved for future use.

5.5.3 Parameters

Sixel Graphics control codes are sometimes followed by one or more numeric parameters. Each parameter value is encoded as a decimal number using the characters in the range 0–9 (3/0–3/9). A numeric value is terminated by any non-digit value.

5.5.4 Parameter Separator

The parameter separator (;) is used to separate a series of numeric parameters. If a number does not precede the separator, a value of zero is assumed. If a number does not follow the separator, a value of zero is assumed.

5.5.5 Exiting Sixel Graphics Mode

To exit Sixel Graphics mode, use the String Terminator (ST) control character.

5.6 Sixel Graphics and Text Interactions

Interactions between the Sixel Graphics protocol and text mode occur in the area of the active position and margins.

5.6.1 State upon Entering Sixel Graphics Mode

Upon entering Sixel Graphics mode, the device sets the graphics horizontal active position to the text active horizontal position. The device sets the graphics vertical position so that the top dot of the first sixel falls 700 centipoints above the baseline of adjacent text. The device also sets the graphics left margin to the text active horizontal position.

5.6.2 Interaction with Text Margins

There is no horizontal autowrap in Sixel Graphics mode. Sixels that extend beyond the right margin are ignored. The Graphics Carriage Return (DECGCR) sixel control code brings the horizontal position back to the graphics left margin, not the text left margin.

If the bottom pixel would fall below the bottom margin, the device performs a Form Feed before printing the sixel (Section 3.3.3).

5.6.3 State After Exiting Sixel Graphics Mode

After exiting Sixel Graphics mode, the device returns to text mode with the following conditions:

- The text active horizontal position is the same as just before entering Sixel Graphics mode.
- The text active vertical position is the same as the graphics active vertical position. As a result, the baseline of subsequent text is contiguous with a point 700 centipoints below the top pixel of the last sixel line.
In addition, the first text mode vertical motion command (LF, VT, and so on) causes the device to advance to the next text mode line (get back on grid) before executing the vertical motion command.
- All text attributes, font selections, pitches, margins, and so on are restored to the state that existed before the device entered Sixel Graphics mode.

5.7 Graphics Programming Considerations

Because different devices have different native resolutions (dot sizes), be sure to take issues of compatibility and quality into account when determining the parameters of the protocol selector and the Set Raster Attributes (DECGRA) sixel control code.

5.7.1 Parameter Usage and Interactions

This section uses a generic Sixel Graphics envelope to explain the relationships and interactions between parameters, as follows:

```
DCS Ps1 ; Ps2 ; Pn3 q " Pn4 ; Pn5 ; Pn6 ; Pn7 picture_data ST
```

Ps1

A selective parameter that specifies horizontal grid size and aspect ratio. Ps1 is the only parameter recognized by older impact printers.

Ps2

A selective parameter for background color. Digital printers ignore Ps2. However, software can include Ps2 for compatibility with video terminals.

Pn3

A numeric parameter that specifies the horizontal grid size in centipoints. Pn3 overrides the horizontal grid size in Ps1. It does not override the aspect ratio.

Pn4 and Pn5

Numeric parameters that together specify the aspect ratio. For example, 100;250 gives a 1:2.5 aspect ratio. These parameters override the aspect ratio defined by Ps1. To ensure maximum device-independence of the graphics image, specify the aspect ratio with Pn4 and Pn5 as well as Ps1 .

Pn6 and Pn7

Numeric parameters that together specify the extent (size) of the picture in pixels. The device ignores Pn6 and Pn7. However, page composition software can include these parameters for compatibility with video terminals.

5.7.2 Compatibility

Problems of device compatibility may occur if application programs use an incompatible graphics string for the grid size calculation. This is most likely when software is designed to be used without modification on level 3 devices as well as level 2 devices. See the *Digital ANSI-Compliant Printing Protocol—Level 3 Programming Reference Manual* for suggestions for mixed-level programming.

Level 2 devices do vary in their native resolutions. The fallbacks listed in this chapter allow the devices to maintain a relatively high degree of compatibility. Older level 2 devices, however (for example, the LA100), ignore Ps2–Pn7. When compatibility with older devices is desired, use Ps1 only, or use Ps1 along with equivalent values for Ps2–Pn7.

5.7.3 Quality

Follow these suggestions to ensure highest graphics quality.

- Ensure that the grid size is an integral number of dots. This helps eliminate beat frequencies or undesirable secondary patterns. Such patterns are especially noticeable in grey scale or cross-hatching.
- Use lines at least two dots in thickness. Dots on some devices are irregular in shape. Depending on the orientation of the line, this can result in lines that vary in width. Increasing the thickness of the lines lessens this visual effect.

5.7.4 Compatibility or Quality

There are tradeoffs in choosing between compatibility and quality. Choosing compatibility can force the device to emulate a grid size that is not a multiple of its native dot size, causing problems with print quality. This does, however, allow one figure to have a similar size and shape when printed on two very different devices.

Choosing quality implies either of the following:

- The page composition software calls the creating software with different parameters for different devices to get both the correct size and quality.
- The page composition software adjusts the size of the image to find a match between the natural grid of the printer, the pixel aspect ratio, and the desired size.

The page composition software controls the Sixel Graphics introducer (DCS through *q*). The creating software controls the picture data (the pixel aspect ratio, extent, and the actual sixels).

5.8 Sixel Control Codes

This section describes each sixel control code in detail, organized as follows:

Format
Description
Error Handling

DECGCI (#) — Graphics Color Introducer

DECGCI (#) — Graphics Color Introducer

Assigns a color to a color number or selects a predefined color number.

Format

Pc ; Pu ; Px ; Py ; Pz
2/3 *** 3/11 *** 3/11 *** 3/11 *** 3/11 ***

Description

DECGCI parameters are as follows:

Parameter	Description
Pc	Color number parameter
Pu	Universal coordinate system selector
Px	System color coordinate
Py	System color coordinate
Pz	System color coordinate

Pc indicates the color number (from 0–255) to be used for subsequent sixel data. Pu, Px, Py, and Pz indicate a specific color to be assigned to Pc. Up to 256 different color numbers can be assigned to different colors to make up a color map. Once the assignment has been made, Pc can be specified alone to select a color for printing.

Note

Color numbers remain assigned even after leaving and reentering Sixel Graphics mode. At power-up, Soft Terminal Reset (DECSTR), Select Conformance Level (DECSCL), and Reset to Initial State (RIS), the device assigns all color numbers to black.

Upon entering Sixel Graphics mode, the device selects color 0.

Monochrome devices ignore DECGCI. Any subsequent sixel data is printed in black.

DECGCI (#) — Graphics Color Introducer

Some devices support 64 colors. Others support only 8 colors. Both color systems are given in Table 5–4 and Table 5–5. To support 64 colors, the selected grid size must provide 4 dots per sixel. Otherwise the device chooses from an 8-color palette.

Pu names the universal color coordinate system as follows:

Value	Coordinate System
1	HLS (hue/lightness/saturation)
2	RGB (red/green/blue)
Other	Ignore sequence

Px ; Py ; Pz together select the color coordinates in the specified system, as follows:

	Meaning, Range if HLS Selected	Meaning, Range if RGB Selected
Px	Hue angle, 0–360	Red, 0–100
Py	Lightness, 0–100	Green, 0–100
Pz	Saturation, 0–100	Blue, 0–100

HLS Color Map

Table 5–4 defines the HLS color map.

Table 5–4 HLS Color Map

HLS Range	8-Color Map Designation	64-Color Map Designation
For Saturation 0 and Hue 0–359		
L = 0–24	Black	Black
L = 25–49	Black	Dim grey
L = 50–74	White	Bright grey
L = 75–100	White	White

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–4 (Cont.) HLS Color Map

HLS Range	8-Color Map Designation	64-Color Map Designation
For Saturation 1–100 and Hue 0–359		
L = 0–14	Black	Black
L = 86–100	White	White
For Lightness 15–28 and Saturation 1–100		
H = 330–29	Blue	Medium blue
H = 30–89	Blue	Violet
H = 90–149	Red	Indian red
H = 150–209	Green	Dark olive green
H = 210–269	Green	Dark green
H = 270–329	Cyan	Dark slate grey
For Lightness 29–42 and Saturation 1–49		
H = 300–59	Blue	Cornflower blue
H = 60–179	Magenta	Salmon
H = 180–299	Green	Medium sea green
For Lightness 29–42 and Saturation 50–100		
H = 340–19	Cyan	Navy blue
H = 20–59	Blue	Dark slate blue
H = 60–99	Magenta	Maroon
H = 100–139	Red	Firebrick
H = 140–179	Yellow	Sienna
H = 180–219	Green	Medium forest green
H = 220–259	Green	Forest green
H = 260–299	Green	Sea green
H = 300–339	Cyan	Steel blue

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–4 (Cont.) HLS Color Map

HLS Range	8-Color Map Designation	64-Color Map Designation
For Lightness 43–57 and Saturation 1–33		
H = 360–119	Blue	Violet blue
H = 120–239	Yellow	Khaki
H = 240–359	Cyan	Cadet blue
For Lightness 43–57 and Saturation 34–66		
H = 340–19	Cyan	Medium blue
H = 20–59	Blue	Dark orchid
H = 60–99	Magenta	Violet red
H = 100–139	Red	Orange
H = 140–179	Yellow	Gold
H = 180–219	Green	Yellow green
H = 220–259	Green	Lime green
H = 260–299	Cyan	Medium aquamarine
H = 300–339	Cyan	Sky blue

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–4 (Cont.) HLS Color Map

HLS Range	8-Color Map Designation	64-Color Map Designation
For Lightness 43–57 and Saturation 67–100		
H = 345–14	Blue	Blue
H = 15–44	Blue	Medium slate blue
H = 45–74	Magenta	Magenta
H = 75–104	Magenta	Orange red
H = 105–134	Red	Red
H = 135–164	Red	Coral
H = 165–194	Yellow	Yellow
H = 195–225	Green	Medium spring green
H = 225–254	Green	Green
H = 255–284	Green	Spring green
H = 285–314	Cyan	Cyan
H = 315–344	Cyan	Slate blue
For Lightness 58–71 and Saturation 1–49		
H = 300–59	Cyan	Light steel blue
H = 60–179	Magenta	Pink
H = 180–299	Green	Pale green

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–4 (Cont.) HLS Color Map

HLS Range	8-Color Map Designation	64-Color Map Designation
For Lightness 58–71 and Saturation 50–100		
H = 360–39	Blue	Medium orchid
H = 40–79	Magenta	Orchid
H = 80–119	Magenta	Medium violet red
H = 120–159	Yellow	Tan
H = 160–199	Yellow	Goldenrod
H = 200–239	Green	Green yellow
H = 240–279	Cyan	Aquamarine
H = 280–319	Cyan	Medium turquoise
H = 320–359	Cyan	Dark turquoise
For Lightness 72–85 and Saturation 1–49		
H = 360–119	Magenta	Thistle
H = 120–239	Yellow	Wheat
H = 240–359	Cyan	Light blue
For Lightness 72–85 and Saturation 50–100		
H = 360–119	Magenta	Plum
H = 120–239	Yellow	Medium goldenrod
H = 240–359	Cyan	Turquoise

RGB Color Map

RGB parameters range from 0–100.

Table 5–5 shows the colors available for 8-color and 64-color devices. To transform the offset found in Table 5–5 into its RGB components, apply the following algorithm to the offset:

```

C = Offset
B1 = C mod 4
G1 = (C - B1) mod 16
R1 = (C - B1 - G1) mod 64

```

DECGCI (#) — Graphics Color Introducer

$B = 25 * B1$
 $G = 25 * G1 / 4$
 $R = 25 * R1 / 16$

Example:

C = Color 41 — Khaki

$B1 = 41 \bmod 4 = 1$
 $G1 = 40 \bmod 16 = 8$
 $R1 = 32 \bmod 64 = 32$

$B = 25 * 1 = 25$
 $G = 25 * 8 / 4 = 50$
 $R = 25 * 32 / 16 = 50$

$x \bmod y$ is the remainder when x is divided by y .

Note

If you are writing an 8-color application, use the offsets for red, green, blue, yellow, magenta, and cyan from the 64-color table. Then, if your application is used on a 64-color device, the colors will still be as expected.

Table 5–5 RGB Color Map

Offset	8-Color Device	64-Color Device	Offset	8-Color Device	64-Color Device
00	Black	Black	01	Blue	Medium blue 1
02	Cyan	Navy blue	03	Blue	Blue
04	Green	Dark green	05	Cyan	Dark slate grey
06	Cyan	Steel blue	07	Cyan	Slate blue
08	Green	Forest green	09	Green	Sea green
10	Cyan	Cyan	11	Cyan	Sky blue
12	Green	Green	13	Green	Spring green

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–5 (Cont.) RGB Color Map

Offset	8-Color Device	64-Color Device	Offset	8-Color Device	64-Color Device
14	Cyan	Medium aquamarine	15	Cyan	Medium turquoise
16	Red	Indian red	17	Blue	Violet
18	Blue	Dark slate blue	19	Blue	Medium slate blue
20	Green	Dark olive green	21	Black	Dim grey
22	Blue	Cornflower blue	23	Cyan	Medium blue 2
24	Green	Medium forest green	25	Green	Medium sea green
26	Cyan	Cadet blue	27	Cyan	Dark turquoise
28	Green	Medium spring green	29	Green	Lime green
30	Cyan	Aquamarine	31	Cyan	Turquoise
32	Red	Firebrick	33	Magenta	Maroon
34	Magenta	Magenta	35	Blue	Dark orchid
36	Yellow	Sienna	37	Magenta	Salmon
38	Blue	Violet blue	39	Blue	Medium orchid
40	Yellow	Yellow	41	Yellow	Khaki
42	White	Bright grey	43	Cyan	Light steel blue
44	Green	Yellow green	45	Green	Green yellow
46	Green	Pale green	47	Cyan	Light blue
48	Red	Red	49	Magenta	Orange red
50	Magenta	Violet red	51	Magenta	Orchid
52	Red	Coral	53	Red	Orange
54	Magenta	Medium violet red	55	Magenta	Plum
56	Yellow	Gold	57	Yellow	Tan

(continued on next page)

DECGCI (#) — Graphics Color Introducer

Table 5–5 (Cont.) RGB Color Map

Offset	8-Color Device	64-Color Device	Offset	8-Color Device	64-Color Device
58	Magenta	Pink	59	Magenta	Thistle
60	Yellow	Goldenrod	61	Yellow	Medium goldenrod
62	Yellow	Wheat	63	White	White

Error Handling

If HLS is selected, and hue, lightness, or saturation is omitted, a value of 0 is assumed. If lightness or saturation is greater than 100, the sequence is ignored. If hue is greater than 360, the sequence is ignored.

If RGB is selected, and red, green, or blue is omitted, a value of 0 is assumed. If red, green, or blue is greater than 100, the sequence is ignored.

DECGCR (\$) — Graphics Carriage Return

DECGCR (\$) — Graphics Carriage Return

Moves the graphics active horizontal position to the graphics left margin.

Format

\$
2/4

Description

DECGCR terminates a scan line. In order to optimize for throughput, the device may not print the scan line immediately. Depending on the current vertical grid size, the device may store multiple sixel lines before printing actually occurs.

Carriage Return/New Line Mode (DECCRNLM) has no effect on DECGCR.

DECGNL (-) — Graphics Next Line

Moves the graphics active position to the graphics left margin and down one line of sixels (six actual grid units).

Format

-
2/13

Description

In order to optimize for throughput, the printer may not perform the physical vertical advance immediately. Depending on the current vertical grid size, the device may store multiple sixel lines before printing actually occurs.

See Section 3.3 for the interaction with the page coordinate system bounds.

DECGRA (") — Set Raster Attributes

DECGRA (") — Set Raster Attributes

Defines the pixel aspect ratio, overriding Ps1 of the protocol selector. DECGRA also defines the extent (size) of the raster. DEC PPL2 devices ignore the extent parameters.

Format

" Pn1 ; Pn2 ; Pn3 ; Pn4
2/2 *** 3/11 *** 3/11 *** 3/11 ***

Description

This command must precede all other picture data information. Otherwise, this command is ignored.

Parameter	Description
Pn1	Pixel aspect ratio numerator
Pn2	Pixel aspect ratio denominator
Pn3	Horizontal extent
Pn4	Vertical extent

Pn1 describes the vertical size of a pixel in an arbitrary distance unit. Pn2 describes the horizontal size of a pixel in the same distance unit. For example, to define a pixel to be half as wide as it is tall, send 200 for Pn1 and 100 for Pn2.

The pixel aspect ratio times the horizontal grid size (From Ps1 or Ps3 of the protocol selector) yields the vertical grid size.

Pn3 and Pn4 define the horizontal and vertical extent, respectively, in pixels. Level 2 printers ignore these parameters. Page composition software can include these parameters for compatibility with video terminals.

Error Handling

If Pn1 or Pn2 is greater than 32K, the value 32K is used. If Pn1 or Pn2 is 0 or omitted, the device sets it to 1.

The maximum aspect ratio supported is 1:10 or 10:1 (after reducing the ratio to the lowest possible format).

The maximum parameter implemented for DECGRA is 999 (decimal).

DECGRA (") — Set Raster Attributes

These maximum values may be further limited in some devices by the fallbacks table in the Programming Supplement.

Any additional parameters received are ignored.

If the Set Raster Attributes sequence is received after a sixel printable character, or another sixel control code is received, the command is ignored.

DECGRI (!) — Graphics Repeat Introducer

DECGRI (!) — Graphics Repeat Introducer

Repeats the sixel that follows the repeat introducer a specified number of times.

Format

! Pn
2/1 ***

Description

The device repeats the sixel that follows the repeat introducer Pn times.

The following examples illustrate repeat sequences:

- ! 1 0 ? — repeats 10 graphics spaces
- ! 6 @ — repeats 6 patterns of top dot

Error Handling

If the repeat count is zero or is omitted, it is treated as a repeat count of one. Values that exceed the maximum value are treated as the maximum value.

See the “Sixel Graphics” Column of Table 2–2 for processing of codes 0/0–2/0 received within a DECGRI sequence. “Ignore” indicates that the code is ignored and the repeat sequence is processed as though the code was not received.

If a graphics control code is received within a DECGRI sequence, the repeat sequence is ignored. This includes control codes in the range 2/1–2/15, 3/10, and 3/12–3/14.

If multiple parameters are received (separated by 3/11), the device uses the first parameter and ignores the rest.

6

Control Characters

This chapter discusses the following topics:

- Control characters, Section 6.1
- C0 control characters, Section 6.2
- C1 control characters, Section 6.3

6.1 Control Characters

Control characters generally are not printed but instead perform a control function or action. An exception is when Control Representation Mode (CRM) is set. See the description of CRM in Chapter 7.

The three types of control characters are:

- C0 control characters (0/0–1/15)
- C1 control characters (8/0–9/15, or 7-bit equivalents)
- Special characters (2/0, 7/15, 10/0, 15/15)

See Section 2.4 for more information about processing special characters. See Table 2–2 for the interaction of all these control characters with escape sequences, control sequences, and control strings.

6.2 C0 Control Characters

With the exception of Escape (ESC), Cancel (CAN), and Substitute (SUB), C0 control characters do not affect escape sequences, control sequences, or control strings. See Table 2–2 for further information.

ACK (0/6)

Acknowledge (ACK) is ignored. The use of ACK for communications flow control in serial devices is not part of DEC PPL2.

BEL (0/7)

Bell (BEL) causes the device to sound a bell or buzzer. See the Programming Supplement to determine the availability of BEL in a particular device.

BS (0/8)

Backspace (BS) moves the active horizontal position back one Horizontal Advance Increment (see Section 3.2.1). However, if the Right Margin Flag is set (the right margin has been exceeded), BS is ignored. See Section 3.3.1, Section 3.3.2, and Table 3–3 for the interaction of BS with other margins.

CAN (1/8)

Cancel (CAN) is ignored unless received in an escape sequence, control sequence, or control string, where it aborts the sequence or string in progress. See also Table 2–2.

CR (0/13)

Carriage Return (CR) sets the active horizontal position to the Left Margin Position. If Carriage Return/New Line Mode (DECCRNLM) is set, the device also moves down one Vertical Advance Increment (VAI). See Section 3.2.1. See Section 3.3 for the interaction with the coordinate system bounds.

CR clears the Right Margin Flag. See Section 3.3.2 for further information.

DC1 (1/1) (XON)

Device Control 1 (DC1) is ignored. The use of DC1 for communications flow control in serial devices is not part of DEC PPL2.

DC2 (1/2)

Device Control 2 (DC2) is ignored.

DC3 (1/3) (XOFF)

Device Control 3 (DC3) is ignored. The use of DC3 for communications flow control in serial devices is not part of DEC PPL2.

DC4 (1/4)

Device Control 4 (DC4) is ignored.

DLE (1/0)

Data Link Escape (DLE) is ignored.

EM (1/9)

End of Medium (EM) is ignored.

ENQ (0/5)

Enquiry (ENQ) is ignored. The use of ENQ at the communications level in serial devices is not part of DEC PPL2.

EOT (0/4)

End of Transmission (EOT) is ignored. The use of EOT at the communications level in serial devices is not part of DEC PPL2.

ESC (1/11)

Escape (ESC) introduces an escape sequence. An ESC control character received in an escape sequence, control sequence, or control string aborts that sequence and begins a new escape sequence. See also Table 2–2.

ETB (1/7)

End of Transmission Block (ETB) is ignored.

ETX (0/3)

End of Text (ETX) is ignored. The use of ETX for communications flow control in serial devices is not part of DEC PPL2.

FF (0/12)

Form Feed (FF) indicates the end of the current page and beginning of the new page. Subsequent output is printed on the new page. The FF sets the active vertical position to the Top Margin Line. FF does not modify the active horizontal position. FF resets the PLU/PLD count. See Section 3.3 for the interaction with the coordinate system bounds.

FS (1/12)

File Separator (FS) is ignored.

GS (1/13)

Group Separator (GS) is ignored.

HT (0/9)

Horizontal Tab (HT) moves the active position to the next horizontal tab stop on the same line. If no tab stop exists to the right of the active horizontal position and within the right margin, HT moves to the right margin and sets the Right Margin Flag. See Section 3.3.2 for further information.

LF (0/10)

Line Feed (LF) moves the active vertical position down one Vertical Advance Increment (VAI). See Section 3.2.1. If Line Feed/New Line Mode (LNM) is set, the active horizontal position moves to the Left Margin Position. LF resets the

PLU/PLD count. See Section 3.3 for the interaction with the coordinate system bounds.

NAK (1/5)

Negative Acknowledge (NAK) is ignored.

NUL (0/0)

Null (NUL) is ignored. The use of NUL for communications flow control in serial devices is not part of DEC PPL2.

RS (1/14)

Record Separator (RS) is ignored.

SI (0/15)

Shift In (SI), also named **Locking Shift Zero** (LS0), invokes character set G0 as the GL character set.

SO (0/14)

Shift Out (SO), also named **Locking Shift One** (LS1), invokes character set G1 as the GL character set.

SOH (0/1)

Start of Header (SOH) is ignored.

STX (0/2)

Start of Text (STX) is ignored.

SUB (1/10)

Substitute (SUB) in an escape or control sequence aborts the sequence in progress. SUB in a control string generally aborts the string in progress. See Table 2–2 for exceptions.

SUB in printable text causes the error character (a reverse question mark) to be printed.

SYN (1/6)

Synchronous Idle (SYN) is ignored.

US (1/15)

Unit Separator (US) is ignored.

VT (0/11)

Vertical Tab (VT) moves the active position to the next vertical tab stop on the current page. If no tab exists between the active position and the bottom

margin, VT moves to the bottom margin. VT resets the PLU/PLD count. See Section 3.3 for the interaction with the coordinate system bounds.

6.3 C1 Control Characters

All C1 control characters abort any escape sequence, control sequence, or control string in progress. Refer to Table 2–2 for more information.

C1 control characters can be represented by a 7-bit equivalent escape sequence. Refer to Table 2–1.

APC (9/15)

Application Program Command (APC) introduces an application program command control string. APC control strings are ignored. See Section 2.5.3.2.

BPH (8/2)

Break Permitted Here (BPH) aborts any escape sequence, control sequence, or control string in progress. BPH is otherwise ignored.

CCH (9/4)

Cancel Character (CCH) aborts any escape sequence, control sequence, or control string in progress. CCH is otherwise ignored.

CSI (9/11)

Control Sequence Introducer (CSI) introduces a control sequence. A CSI control character received in an escape sequence, control sequence, or control string aborts that sequence and begins a new control sequence.

DCS (9/0)

Device Control String (DCS) introduces a device control string. A DCS control character received in an escape sequence, control sequence, or control string aborts that sequence and begins a new device control string.

EPA (9/7)

End of Protected Area (EPA) aborts any escape sequence, control sequence, or control string in progress. EPA is otherwise ignored.

ESA (8/7)

End of Selected Area (ESA) aborts any escape sequence, control sequence, or control string in progress. ESA is otherwise ignored.

HTJ (8/9)

Horizontal Tab with Justification (HTJ) aborts any escape sequence, control sequence, or control string in progress. HTJ is otherwise ignored.

HTS (8/8)

Horizontal Tab Set (HTS) sets a horizontal tab stop at the active horizontal position. No change occurs if that position is already a tab stop. If the number of stored horizontal tabs is already at a maximum, the printer discards the highest tab stop (farthest to the right). If the new tab stop is the farthest to the right, it is discarded.

IND (8/4)

Index (IND) moves the active vertical position down one Vertical Advance Increment. See Section 3.2.1. IND resets the PLU/PLD count. See Section 3.3 for the interaction with the coordinate system bounds.

MW (9/5)

Message Waiting (MW) aborts any escape sequence, control sequence, or control string in progress. MW is otherwise ignored.

NBH (8/3)

No Break Here (NBH) aborts any escape sequence, control sequence, or control string in progress. NBH is otherwise ignored.

NEL (8/5)

Next Line (NEL) sets the active horizontal position to the Line Home Position and moves the active vertical position down one Vertical Advance Increment (VAI). See Section 3.2.1. NEL clears the Right Margin Flag and resets the PLU/PLD count. See Section 3.3 for the interaction with the coordinate system bounds.

OSC (9/13)

Operating System Command (OSC) introduces an Operating System Command control string. OSC control strings are ignored. See Section 2.5.3.2.

PLD (8/11)

Partial Line Down (PLD) moves the active vertical position downward by 1/12 inch. See Section 3.5 for further information.

PLU (8/12)

Partial Line Up (PLU) moves the active vertical position upward by 1/12 inch. See Section 3.5 for further information.

PM (9/14)

Privacy Message (PM) introduces a privacy message control string. PM control strings are ignored. See Section 2.5.3.2 for further information.

PU1 (9/1)

Private Use 1 (PU1) aborts any escape sequence, control sequence, or control string in progress. PU1 is otherwise ignored.

PU2 (9/2)

Private Use 2 (PU2) aborts any escape sequence, control sequence, or control string in progress. PU2 is otherwise ignored.

RI (8/13)

Reverse Index (RI) aborts any escape sequence, control sequence, or control string in progress. RI is otherwise ignored.

SCI (8/3)

Single Character Introducer (SCI) aborts any escape sequence, control sequence, or control string in progress. SCI is otherwise ignored.

SOS (8/3)

Start of String (SOS) aborts any escape sequence, control sequence, or control string in progress. SOS is otherwise ignored.

SPA (9/6)

Start of Protected Area (SPA) aborts any escape sequence, control sequence, or control string in progress. SPA is otherwise ignored.

SS2 (8/14)

Single Shift 2 (SS2) temporarily invokes character set G2 into GL to print one character. See also Section 2.5.4.

SS3 (8/15)

Single Shift 3 (SS3) temporarily invokes character set G3 into GL to print one character. See also Section 2.5.4.

SSA (8/6)

Start of Selected Area (SSA) aborts any escape sequence, control sequence, or control string in progress. SSA is otherwise ignored.

ST (9/12)

String Terminator (ST) indicates the end of a control string. See Section 2.5.3 for further information.

STS (9/3)

Set Transmit State (STS) aborts any escape sequence, control sequence, or control string in progress. STS is otherwise ignored.

VTB (8/10)

Vertical Tab Set (VTB) sets a vertical tab stop at the active vertical position. No change occurs if that position is already a vertical tab stop.

If the number of stored vertical tabs is already at a maximum, the printer discards the highest tab stop (farthest down on the page). If the new tab stop is the farthest down, it is discarded.

8/0, 8/1, and 9/9

These positions in the 8-bit code table are reserved for future use. They abort any escape sequence, control sequence, or any control string in progress. They are otherwise ignored.

Command Dictionary

This chapter describes each command in detail, organized as follows:

- Format
- Description
- Side Effects
- Error Handling
- Notes to Software

If no side effects, error handling, or software information exists for a command, no special side effects or error handling need to be considered.

The command dictionary also includes information on where commands should be generated (**Source**) and for which type of device they are intended (**Destination**).

- Command sources include Symbiont and Application. See Section 1.3 for more information on Symbiont and Application sources.
- Command destinations include levels 1, 2, and 3. Level 3 commands can be used only on a level 3 device. Level 1 or 2 commands can also be used on a level 3 device.
- Certain commands are referred to as **deprecated**. These commands are included only for backwards compatibility and are not recommended for new software.
- Commands that are labeled **Extension** are considered extensions to the protocol and may not be available on every device.
- Commands labeled **Exception** have a special use. For example, they may be used in debugging programs or they may be device-specific.

See Chapter 1 for more information on printer levels.

Some sequences are sent from the device to the host. In this case, the device is the source and the application or symbiont is the destination.

Notes
See the Programming Supplement to determine which extensions and exceptions are supported by a particular device.
Information on side effects and error handling is included here for completeness and clarification. However, error handling may vary from device to device. Do not depend on side effects or error handling conditions.
Most devices have a user setup feature, often performed using keyswitches on the front panel, which allows the user to customize the device. In some cases the setup values interact in various ways with the commands in this chapter. See the Programming Supplement for more information.

The following command summaries are provided for your convenience:

- Table 7–1, Commands Listed by Function
- Table 7–9, ESC Sequences Sorted by Final Character
- Table 7–10, Control Sequences Sorted by Final Character
- Table 7–11, DCS Strings Sorted by Final Character

Table 7–1 provides a short summary of commands, grouped by function.

Table 7–1 Commands Listed by Function

Sheet Size and Margins	
DECHPWA	Set Page Width Alignment
DECSLPP	Set Lines per Physical Page
DECSLRM	Set Left and Right Margins
DECSTBM	Set Top and Bottom Margins

(continued on next page)

Table 7–1 (Cont.) Commands Listed by Function

Explicit Cursor Movement

HPA	Horizontal Position Absolute
HPR	Horizontal Position Relative
VPA	Vertical Position Absolute
VPR	Vertical Position Relative

Type Size and Spacing, Managing Implicit Cursor Motion

DECAWM	Autowrap Mode
DECCRNLM	Carriage Return/New Line Mode
DECSHORP	Set Horizontal Pitch
DECVERP	Set Vertical Pitch
LNLM	Line Feed/New Line Mode

Font Management and Attribute Selection

SGR	Select Graphic Rendition - <i>Selecting Fonts</i>
SGR	Select Graphic Rendition - <i>Selecting Attributes</i>
DECDDL	Download Font

Tabs

DECCAHT	Clear All Horizontal Tabs
DECCAVT	Clear All Vertical Tabs
DECHTS	Horizontal Tab Set
DECSHTS	Set Horizontal Tab Stops
DECSVTS	Set Vertical Tab Stops
DECVTS	Vertical Tab Set
TBC	Tab Clear

(continued on next page)

Table 7–1 (Cont.) Commands Listed by Function

Character Set Selection

ASCEF	Announce Subset of Code Extension Facilities
DECAUPSS	Assign User Preference Supplemental Set
LS*/LS*R/SS*	Locking and Single Shifts
SCS	Select Character Set

Reports

DA	Device Attributes
DAR	Device Attributes Report
DA2	Secondary Device Attributes
DA2R	Secondary Device Attributes Report
DECFSR	Font Status Report
DECRFS	Request Font Status
DSR	Device Status Request
DSR	Device Status Report

Explicit Resets

DECSCL	Select Conformance Level
DECSTR	Soft Terminal Reset
RIS	Reset to Initial State

Emulations

DECIPEM	IBM Proprinter Emulation Mode
ROCS	Return from Other Coding System
SOCS	Select Other Coding System

(continued on next page)

Table 7–1 (Cont.) Commands Listed by Function

Miscellaneous

CRM	Control Representation Mode
DECASFC	Automatic Sheet Feeder Control
DECSBCA	Select Bar Code Attributes
DECBAR	Start or Stop Bar Codes
DEC DEN	Density Selection
DECAC1	Accept C1 Control Codes
DECTC1	Truncate C1 Control Codes
DECUPM	Unidirectional Print Mode

ASCEF — Announce Subset of Code Extension Facilities

ASCEF — Announce Subset of Code Extension Facilities

Indicates which subset of code extension facilities or what level of ISO 4873 is used for subsequent exchanges of information. These three control functions are macros that incorporate the effects of Select Character Set (SCS) and Locking Shift (LS) commands.

Source: Application **Destination:** Levels 1, 2, 3

Format

ESC	SP	L	ISO 4873, level 1.
1/11	2/0	4/12	
ESC	SP	M	ISO 4873, level 2.
1/11	2/0	4/13	
ESC	SP	N	ISO 4873, level 3.
1/11	2/0	4/14	

Description

Level 1 and level 2 result in the following settings:

- ASCII designated into G0 and invoked into GL
- ISO Latin-1 Supplemental designated into G1 and invoked into GR

Level 3 results in the following settings:

- ASCII designated into G0 and invoked into GL

Refer to Section 2.2.1 for more information on invoking and designating character sets.

Note

The levels referred to here are ISO 4873 standard levels. They have no relationship to the Digital ANSI-Compliant Printing Protocol levels described in Section 1.1.

CRM — Control Representation Mode

CRM — Control Representation Mode

Enters or exits a mode in which the device prints a graphic token for each byte. In this mode, the device does not act upon most control characters.

Source: Application, Symbiont **Destination:** Exception — use at any level for debugging software

Format

CSI	3	h	Set Control Representation mode.
9/11	3/3	6/8	
CSI	3	l	Reset Control Representation mode.
9/11	3/3	6/12	

Description

Note

For any details on the CRM output for a particular device, refer to the *Digital ANSI- Compliant Printing Protocol Level 2 Programming Supplement*.

When Control Representation mode is set, the device does not act on control or special characters, with the following exceptions:

- Line Feed (LF) is printed as **<LF>**, then executes a Carriage Return/Line Feed.
- Form Feed (FF) is printed as **<FF>**, then executes a Form Feed.
- The Control Representation Mode reset command is printed as **<CSI> 3 l**, then executes an exit from CRM.

Autowrap mode is in effect while CRM is set. On exiting CRM, Autowrap mode is restored to its previous state.

All Select Graphic Rendition (SGR) attributes are turned off while CRM is set. On exiting CRM, SGR attributes are restored to their previous state.

Control Representation mode does not affect imaging of printable characters. They are imaged from GL/GR as is normal, using the current character set selections.

CRM — Control Representation Mode

Control and special characters are imaged in bold, using the appropriate two- or three-letter acronym from Chapter 6, in angle brackets. For example, **<FF>**.

Those characters that have no acronym are printed in hexadecimal. For example, 8/0 is imaged as **<X80>**. Some control characters may be intercepted by the communication interface and may not be available for CRM. See the Programming Supplement for the interaction with setup or the front panel, if any.

Notes to Software

Use CRM only when debugging software. CRM in some devices may reset states or variables other than those mentioned above.

CRM may be set by alternate methods at the physical device. In such cases, the CRM reset command does not disable CRM. Also, the manually invoked CRM may cause a power-up reset of the device.

DA — Device Attributes

Requests the device product identification.

Source: Symbiont

Destination: Levels 1, 2, 3

Format

CSI Ps c
9/11 *** 6/3

Ps (if present) must equal 0.

Description

The device responds to the DA command by sending a Device Attributes Report (DAR).

There are two types of Device Attributes Reports: **generic** and **alias**. The generic DAR reports the protocol level of the device. The alias DAR is used to mimic an older printer for compatibility.

See also DAR in this chapter. See the Programming Supplement for a list of alias responses (if any) and for configuration information.

Error Handling

If Ps is present and has a value other than 0, the device ignores the command.

Notes to Software

Use DA (generic response) for normal symbiont inquiries and forward compatibility. Use DA (alias response) for backwards compatibility with older devices.

It is recommended that you send this command with no parameter. Although the DEC PPL2 parsing rules allow a parameter in any control sequence, this command is traditionally sent without one.

DAR (generic response) — Device Attributes Report

DAR (generic response) — Device Attributes Report

Response to a symbiont request for a Device Attributes (DA) report.

Source: Device Destination: Symbiont

Format

ESC [? Ps1 ; Ps2 ; . . . ; Psn c
1/11 5/11 3/15 *** 3/11 *** 3/11 . . . 3/11 *** 6/3

Description

The device sends this command when set to the generic response. The device may be set to use the alias response. See DAR (alias response) in this chapter. See the Programming Supplement for configuration information.

Ps1 = 72

Ps2–Psn describe the implemented extensions to DEC PPL2. See Chapter 1 for an explanation of extensions.

Table 7–2 contains a list of possible extensions. See the Programming Supplement for the extensions supported by a particular device.

Table 7–2 Extension Parameters for Generic Primary DA Response

Parameter	Minimum Level		Protocol Extension
3/1	1	1	Color
3/4	4	1	Sixel Graphics
3/5	5	1	Katakana character set
3/6	6	1	Sheet feeder
3/7	7	2	Dynamically redefinable character sets (Downloaded fonts, DECDLD)

(continued on next page)

DAR (generic response) — Device Attributes Report

Table 7–2 (Cont.) Extension Parameters for Generic Primary DA Response

Parameter	Minimum Level	Protocol Extension
3/1 3/2	12	1
3/2 3/3	23	2
3/2 3/4	24	2
3/2 3/5	25	2
3/2 3/6	26	2

The response depends on the configuration.

The reply to the DA request is sent to the host only after all preceding data (except DSR) has been processed. This provides host software with a mechanism for synchronization.

Notes to Software

Ps1 indicates the highest conformance level supported by the device.

Level 3 devices support level 2 control functions, so software written for level 2 devices should accept the level 3 response (Ps1 = 73). For forward compatibility, all software should accept all higher Ps1 responses, even those above level 3, up to and including 79.

It is recommended that all new software use the device set to generic response.

When values are not returned, they are left out of the response entirely (that is, there are not any blanks indicated by semicolons). However, software should always accept blank parameters.

The device sends parameters in ascending order. However, software should accept the parameters in any order.

DAR (alias response) — Device Attributes Report

DAR (alias response) — Device Attributes Report

Response to a symbiont request for a Device Attributes (DA) Report.

See the Programming Supplement for the list of alias responses supported by the device.

Source: Device

Destination: Symbiont

Format

ESC [? Ps1 ; Ps2 ; . . . ; Psn c
1/11 5/11 3/15 *** 3/11 *** 3/11 . . . 3/11 *** 6/3

Description

The device sends this sequence when set to the alias response. The device may be set to use the generic response. See the Programming Supplement for configuration information and for the alias responses supported by the device.

The reply to the DA request is sent to the host only after all preceding data (except DSR) has been processed. This provides host software with a mechanism for synchronization.

DA2 — Secondary Device Attributes

DA2 — Secondary Device Attributes

Requests a Secondary Device Attributes Report (DA2R). DA2R contains device- and version-specific product information.

Source: Symbiont

Destination: Levels 1, 2, 3

Format

CSI > Ps c Ps (if present) must equal 0.
9/11 3/14 *** 6/3

Description

The device responds to the DA2 request by sending a Secondary Device Attributes Report (DA2R).

Error Handling

If Ps is present and has a value other than 0, the device ignores the command.

Notes to Software

This command should be used only by diagnostic programs or specialized symbionts.

Use DA (generic response) for normal symbiont inquiries and forward compatibility. Use DA (alias response) for backwards compatibility with older devices.

DA2R — Secondary Device Attributes Report

Source: Device

Destination: Symbiont

ESC [> Ps1 ; Ps2 c
1/11 5/11 3/14 *** 3/11 *** 6/3

The selective parameters are as follows:

Ps	Meaning
Ps1	A device-specific value indicating the model of the device. See the Programming Supplement.
Ps2	Firmware revision level times 10. V1.0 would be encoded as 10, and V1.1 would be encoded as 11.

7-14 Command Dictionary

DECAC1 — Accept C1 Control Characters

DECAC1 — Accept C1 Control Characters

Instructs the device to accept 8-bit C1 control characters.

Source: Symbiont

Destination: Level 2, 3

Format

ESC SP 7
1/11 2/0 3/7

Description

For all subsequent characters, the device processes 2-character sequences as shown in the “7-Bit Equivalent Sequence” column and 8-Bit C1 control characters as shown in the “8-Bit Column/Row” column of Table 2–1.

This sequence is processed in sequence with all other data. Therefore, it is recommended that software send this sequence before all other commands to prevent confusion.

If the device is set to 7 data bits through a setup feature or the front panel, this sequence is ignored.

See also Truncate C1 Control Characters (DECTC1) in this chapter.

DECASFC — Automatic Sheet Feeder Control

DECASFC — Automatic Sheet Feeder Control

Selects the specified paper tray position and performs a conditional Sheet Feed on a multiple-tray printer. On devices with only one input tray, DECASFC performs a conditional Sheet Feed.

Source: Symbiont **Destination:** Levels 1, 2, 3 Extension

Format

CSI Ps ! v
9/11 *** 2/1 7/6

Description

Selective parameters for DECASFC are as follows:

Ps	Action
0	No tray position change.
1	Tray position 1.
2	Tray position 2.
3	Tray position 3.
<i>n</i>	Tray position <i>n</i> .
99	Manual feed.

This command causes a conditional Sheet Feed, even when the tray requested is already selected. The device feeds subsequent sheets from the indicated tray position. See the Programming Supplement for further information on input trays.

Side Effects

The device performs a conditional Sheet Feed for any valid Ps, whether or not the device recognizes it.

Error Handling

If an unsupported parameter is received, it is treated as Ps = 0.
See the Programming Supplement for error handling when the physical sheet size does not match the logical page size.

DECAUPSS — Assign User Preference Supplemental Set

DECAUPSS — Assign User Preference Supplemental Set

Assigns a particular character set to the User Preference Supplemental set. This becomes the character set designated by the final character of the User Preference Supplemental character set when used in a Select Character Set (SCS) sequence.

Source: Symbiont **Destination:** Levels 1, 2, 3

Format

DCS Ps ! u D . . . D ST
9/0 *** 2/1 7/5 * . . . * 9/12

Description

Ps indicates whether the User Preference Supplemental set is a 94-character or a 96-character set:

Ps	Meaning
0	94-character set.
1	96-character set.

D . . . D is a string containing the intermediate and final characters of the designating sequence used explicitly to select the User Preference Supplemental character set. See SCS in this chapter for a list of intermediate and final characters.

To assign DEC Supplemental as the User Preference Supplemental character set, use the following DECAUPSS command:

DCS 0 ! u %5 ST

To assign ISO Latin-1 Supplemental as the User Preference Supplemental set, use the following DECAUPSS command:

DCS 1 ! u A ST

To use the User Preference Supplemental set, see User Preference under SCS.

DECAUPSS — Assign User Preference Supplemental Set

The supported character sets are shown in Table 7–3:

Table 7–3 User Preference Supplemental Character Sets

Character Set	Ps
DEC Supplemental	0
ISO Latin-1 Supplemental	1
DEC 8-Bit Hebrew Supplemental	0
ISO Latin-Hebrew Supplemental	1
DEC Technical	0
ISO Latin-Greek Supplemental	1
DEC Greek Supplemental	0

Error Handling

If Ps is an unsupported value, the command is ignored.

If Ps does not match the available character sets for a particular device, refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement* for any additional information.

If the character set is not available when an imaging function is attempted, the device follows the action taken on a character set fault. See Section 4.4.3 for more information on character set faults.

DECAWM — Autowrap Mode

Instructs the device whether to execute an automatic Carriage Return/Line Feed when the active position exceeds the right margin.

Source: Application

Destination: Level 2

Format

CSI	?	7	h	Set Autowrap mode.
9/11	3/15	3/7	6/8	
CSI	?	7	l	Reset Autowrap mode.
9/11	3/15	3/7	6/12	

Description

When DECAWM is set and the active position is beyond the right margin, printable characters that follow are printed on the next line beginning at the left margin. When DECAWM is reset, all printable characters received beyond the right margin are ignored (truncated). See Section 3.3.2 for more details about actions at the right margin.

The device always autowraps when Control Representation mode is set.

Side Effects

Setting Autowrap mode may cause the device to generate extra line feeds which may, in turn, cause a wrap to the next page.

DECBAR — Start or Stop Bar Codes

DECBAR — Start or Stop Bar Codes

Enables and disables bar code printing defined by the last Select Bar Code Attributes (DECSBCA) sequence.

Some devices do not support bar codes. See the Programming Supplement.

Source: Application **Destination:** Level 2, 3 Exception

Format

ESC	%	SP	0	Start bar code.
1/11	2/5	2/0	3/0	
ESC	%	@		Stop bar code.
1/11	2/5	4/0		

Description

Bar code attributes are defined by the last Select Bar Code Attributes (DECSBCA) sequence, which is used to select the bar code encoding system (bar code style). For the list of bar code styles provided by a particular printer, refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement*.

If human-readable characters are selected, the Start code, the Stop code, and the Center code (if any) as well as all bar code characters have human-readable characters printed beneath the bar code. See the Programming Supplement for details on human-readable character attributes.

While bar code imaging is enabled, any printable character not considered part of the selected bar code system is ignored. All control characters are also ignored, except the following:

- Escape (ESC) — abort bar code sequence, enter regular text mode, and process the ESC
- Cancel (CAN) — abort bar code sequence, enter regular text mode, and process the CAN
- Substitute (SUB) — abort bar code sequence, enter regular text mode, and process the SUB

For any details on how a particular device processes control codes while bar code imaging is enabled, refer to the Programming Supplement.

DECBAR — Start or Stop Bar Codes

Only 7-bit characters are processed. If an 8-bit character is received, the printer strips the eighth bit and processes the character as a 7-bit character.

The Start Bar Code command is coded similar to the Select Other Coding System (SOCS) command. The Stop Bar Code command is coded the same as the Return from Other Coding System (ROCS) command. However, the bar code commands function as described here, not as described under SOCS and ROCS.

Error Handling

Bar codes that extend beyond the margins are truncated, regardless of the setting of Autowrap mode.

Notes to Software

To print a bar code of an arbitrary height, repeat the bar code start, data, and stop on consecutive lines, as follows:

```
ESC # SP 0 barcode_data ESC # @  
ESC # SP 0 barcode_data ESC # @  
ESC # SP 0 barcode_data ESC # @  
ESC # SP 0 barcode_data ESC # @  
ESC # SP 0 barcode_data ESC # @
```

For any information on a particular device's capability for using the DECSBCA command to set bar code height, refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement*.

To print human-readable characters, send a new DECSBCA command before the last line of bar codes.

DECCAHT — Clear All Horizontal Tabs

DECCAHT — Clear All Horizontal Tabs

Clears horizontal tab stops.

Source: Application
(deprecated command)

Destination: Level 2

Format

ESC 2
1/11 3/2

Description

See Tab Clear (TBC) with Ps = 2.

Notes to Software

This command is included for backwards compatibility with older devices.
Conforming software should not use this command.

DECCA VT — Clear All Vertical Tabs

DECCA VT — Clear All Vertical Tabs

Clears vertical tab stops.

Source: Application
(deprecated command)

Destination: Level 2

Format

ESC 4
1/11 3/4

Description

See Tab Clear (TBC) with Ps = 4.

Notes to Software

This command is included for backwards compatibility with older devices.
Conforming software should not use this command.

DECCRNLM — Carriage Return /New Line Mode

DECCRNLM — Carriage Return /New Line Mode

Instructs the device whether to perform a Line Feed (LF) upon receipt of a Carriage Return (CR).

Source: Symbiont **Destination:** Levels 2, 3

Format

CSI	?	4	0	h	Set — CR acts as New Line.
9/11	3/15	3/4	3/0	6/8	
CSI	?	4	0	l	Reset — CR acts as Carriage Return.
9/11	3/15	3/4	3/0	6/12	

Description

If DECCRNLM is set and a CR is received, the active position advances to the left margin of the next line. If DECCRNLM is reset and a CR is received, the active position returns to the left margin of the current line.

See Section 2.5.2.3 for information about parsing this command with multiple parameters.

Notes to Software

Symbionts developed by Digital handle record terminators without using Carriage Return/New Line Mode. This command is available for third-party symbionts.

DECDEN — Density Selection

Selects print density.

Source: Application

Destination: Level 2

Format

CSI	Ps	"	z
9/11	***	2/2	7/10

Description

The selective parameters for DECDEN are as follows:

Ps	Selection
0	Selects draft print density (highest speed).
1	Selects draft print density (highest speed).
2	Selects letter-quality print density (highest quality).
3	Selects memo print density.
4	Selects near letter-quality print density.

Not all densities may be present in all devices. See the Programming Supplement for the densities available in a particular device, fallbacks for those that are not available, and interaction with front panel or setup, if any.

Error Handling

All other parameter values are ignored.

DECDLD — Download Font

DECDLD — Download Font

Loads a font file description into the device, which can be subsequently designated and invoked as a resident character set or typestyle. Some devices do not support downloaded fonts. See the Programming Supplement.

Source: Application

Destination: Level 2 Extension

Format

DCS Pfn ; Pcn ; Pe ; Pcmw ; PSS ; Pu ; Pcmh ; PCSS ; Psgr { D . . . D ST
9/0 Parameter String . . . 7/11 * . . . * 9/12

Description

Use DECDLD to download font buffers from the host. The DECDLD command contains a sequence of binary data in sixel format which defines the glyphs of the font file. Using the DECDLD control string, you can downline load one or more characters of a specified 94-character or 96-character font file with a specified dot pattern.

D . . . D also contains the designating intermediate and final characters for the character set being downloaded. These are in the form $I_2 I_3 F$, identical to the format used by Select Character Set (SCS).

Once the font file has been loaded, you may designate it to any of the four G-sets (G0, G1, G2, or G3) and invoke it into either GL or GR using the sequences for designating and invoking character sets listed in this chapter. See also SCS, Locking and Single Shifts (LS*/LS*R/SS*), and Assign User Preference Supplemental Set (DECAUPSS) in this chapter.

Every downloaded font must be assigned a Select Graphic Rendition (SGR) number. The device uses the SGR number to identify the typestyle of the downloaded font. You may include an SGR number in the download sequence or allow the device to use the default typestyle, which is the same as the built-in fonts.

Once the font is downloaded and has an assigned typestyle (SGR number) and a character set designator, the device enters it into the Font Dictionary. See Section 4.4.1 for more information. Font selection occurs according to the character set, typestyle, and density currently in use.

DECDLD — Download Font

The device deletes downline loaded fonts whenever there is a change in protocol or when the device is powered down.

Note

Different devices have different inherent dot sizes and print densities. Because DECDLD addresses individual dots of the device, it is considered device dependent. Level 3 devices do not support DECDLD. It is available only on certain level 2 devices.

Parameters

The DECDLD command is a device control string consisting of a protocol selector followed by string data. The protocol selector is terminated by the final character ({}).

The selective parameters within the protocol selector control the operation of the font load function.

The selective parameters for DECDEN are shown in Table 7–4:

Table 7–4 DECDLD Selective Parameters

	Parameter	Description
Pfn	Font Number	Specifies the particular font buffer to be loaded. The device supports up to three, numbered 1–3. See the Programming Supplement for the exact number supported.
Pcn	First Character in Set to Load	Selects the first character in the font buffer to be loaded. This parameter interacts with Character Set Size (PCSS). See Pcss in this table for more information.

(continued on next page)

DECDLD — Download Font

Table 7–4 (Cont.) DECDLD Selective Parameters

Parameter		Description
Pe	Erase Control	Controls which characters are erased before loading takes place: 0 — Erase all characters in the specified font buffer. 1 — Erase only the characters that are loaded. 2 — Erase all characters in all font buffers. A parameter value of 1 permits the changing of one or more characters in the specified font without affecting remaining characters of that font. Characters that have been erased from the buffer and not redefined are represented by the error character (reverse question mark) when printed.
Pcmw ¹	Character Cell Matrix Width	Defines the limit of the character cell matrix width, in dots, of the font being loaded. Legal values for this parameter depend on the Font Usage parameter (Pu). See the Programming Supplement for supported parameter values.
Pss	Font Set Size	Density of downloaded font file. 0 — default to draft density 1 — draft density 2 — near letter quality density 3 — letter quality See the Programming Supplement for supported parameters.

¹The device associates this parameter with the selected download buffer number. Subsequent downloads into the same buffer with a different value for this parameter result in the erasure of the entire buffer before the download.

(continued on next page)

DECDLD — Download Font

Table 7–4 (Cont.) DECDLD Selective Parameters

	Parameter	Description
Pu ¹	Font Usage	Defines the loaded font as either a text font or a full cell font. Full cell fonts can individually address all dots in a cell; text fonts may not be able to address all dots individually. In general, standard text character boxes are designed to be printed in one pass of the printhead, and are big enough for 10-point Roman text characters with accents and descenders. Full text character cells are designed to connect vertically when printed at 6 lines/inch. Supported values of this parameter are: 1 — Text 2 — Full Cell
Pcmh ¹	Character Cell Matrix Height	Defines the limit of the character cell matrix height in dots of the font being loaded. Supported values of this parameter are given in the Programming Supplement.

¹The device associates this parameter with the selected download buffer number. Subsequent downloads into the same buffer with a different value for this parameter result in the erasure of the entire buffer before the download.

(continued on next page)

DECDLD — Download Font

Table 7–4 (Cont.) DECDLD Selective Parameters

	Parameter	Description																					
Pcss ¹	Character Set Size	Controls the size of the associated character set and modifies the interpretation of the Pcn parameter. The value of the parameter indicates the size of the character set associated with the downloaded font:																					
		0 — 94-character set																					
		1 — 96-character set																					
		A parameter value of 1 permits the loading of the 2/0 and 7/15 characters in the font, and requires that the 96-character designating escape sequences be used to designate the font (see Select Character Size—SCS).																					
		Interaction between Pcn and Pcss:																					
		<table><tr><th>Pcn</th><th>Pcss</th><th>Start Loading at:</th></tr><tr><td>0</td><td>0 (94)</td><td>2/1</td></tr><tr><td>1</td><td>0 (94)</td><td>2/1</td></tr><tr><td>2–94</td><td>0 (94)</td><td>2/2–7/14</td></tr><tr><td>>94</td><td>0 (94)</td><td>Ignore sequence</td></tr><tr><td>0–95</td><td>1 (96)</td><td>2/0–7/15</td></tr><tr><td>>95</td><td>1 (96)</td><td>Ignore sequence</td></tr></table>	Pcn	Pcss	Start Loading at:	0	0 (94)	2/1	1	0 (94)	2/1	2–94	0 (94)	2/2–7/14	>94	0 (94)	Ignore sequence	0–95	1 (96)	2/0–7/15	>95	1 (96)	Ignore sequence
Pcn	Pcss	Start Loading at:																					
0	0 (94)	2/1																					
1	0 (94)	2/1																					
2–94	0 (94)	2/2–7/14																					
>94	0 (94)	Ignore sequence																					
0–95	1 (96)	2/0–7/15																					
>95	1 (96)	Ignore sequence																					
Psg ¹	Select Graphic Rendition (SGR) Number	Assigns an SGR number to the downloaded font file. This allows you to associate a typestyle with the downloaded font. If the SGR number assigned is 10, the downloaded font overrides the built-in font. See Section 4.4.1 for a complete explanation of precedence rules. For maximum flexibility, use SGR numbers 11, 12, and 13 for download buffers 1, 2, and 3 respectively. This minimizes conflicts with built-in and cartridge fonts.																					

¹The device associates this parameter with the selected download buffer number. Subsequent downloads into the same buffer with a different value for this parameter result in the erasure of the entire buffer before the download.

D . . . D

The data string (D . . . D) represents the actual font load data. The syntax of D . . . D is as follows:

Dscs glyph_data_1 ; glyph_data_2 ; . . . ; glyph_data_n ST

Dscs — Character Set Designator

Dscs defines the intermediate and final characters of the Select Character Set (SCS) sequence used to designate the loaded font as an active character set.

Dscs is a set of zero, one, or two intermediate characters, followed by a final character ($D_{scs} = I_2 I_3 F$). See Select Character Set (SCS) in this chapter for a description of the designating command. See Table 7–7 for a list of character set designators.

The designating sequence may be either a replacement for a built-in set, such as the ASCII character set, or the downloaded character set designator from Table 7–7.

For example:

- If Dscs = B, the loaded font is defined as the ASCII character set.
- If Dscs = SP @, the loaded font is defined as the downloaded character set. This is the recommended value for user-defined character sets.

Font_data_n — Sixel Bit Patterns

There is one *font_data* bit pattern string for each downloaded character. Strings are separated by the semicolon character ; (3/11). Each individual sixel bit pattern string consists of a sequence of sixel characters that defines one horizontal scan of a character pattern and is terminated by a slash character / (2/15).

Character codes 0/8—0/13 may be included in the data strings. These codes are ignored and do not affect the interpretation of the data.

The binary data is encoded in sixels. The application software adds an offset of 3FH to the binary data to form a printable character between ? (3/15) and ~ (7/15).

The bits are represented as a vertical, 1x6 dot matrix, with the least significant bit at the top. A set bit (one) specifies a printed dot.

DECDLD — Download Font

Note

The DECDLD data string uses the sixel data format, but not the control functions, defined in Chapter 5.

To load the dot pattern for an individual character in a font (one *font_data_n* pattern), send a sequence of sixel characters, with each sixel specifying one vertical column of six dots. After loading each sixel character, the font pattern scan advances horizontally by one dot.

Terminate each horizontal scan (except for the last horizontal scan of the bit pattern) with a scan terminator / (2/15). Terminate the last horizontal scan of the bit pattern with a bit pattern terminator ; (3/11).

The scan terminator character / (2/15) advances the font pattern scan to the next lower row of six vertical dots. If the height of a loaded character (as defined in Pcmh) is not a multiple of six, the device ignores the high-order bits of the sixel values on the last row of the *font_data_n* pattern.

Any dots of a loaded character that are not specified are set to zero.

Example of *font_data_n*

The following illustration shows the mapping of sixels onto an 8x10 dot character cell. The character represented is a backslash, extending from the top left-hand portion of the cell to the lower right-hand corner. The right-hand side of the illustration shows the hexadecimal representation of the bitmap data before and after adjusting for the sixel protocol, as well as the resulting ASCII representation.

The rows of numbers on the top and bottom relate to the order in which sixel values are sent to the device.

DECDLD — Download Font

									Bitmap data: +3F = Bytes to send:								
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8
b0	0	0	0	0	0	0	0	0		6	C	18	30	20	0	0	0
b1	1	0	0	0	0	0	0	0		+3F	+3F	+3F	+3F	+3F	+3F	+3F	+3F
b2	1	1	0	0	0	0	0	0		---	---	---	---	---	---	---	---
b3	0	1	1	0	0	0	0	0		45	4B	57	6F	5F	3F	3F	3F
b4	0	0	1	1	0	0	0	0		E	K	W	0	_	?	?	?
b5	0	0	0	1	1	0	0	0	2F /								
b0	0	0	0	0	1	1	0	0		0	0	0	0	1	3	6	C
b1	0	0	0	0	0	1	1	0		+3F	+3F	+3F	+3F	+3F	+3F	+3F	+3F
b2	0	0	0	0	0	0	1	1		---	---	---	---	---	---	---	---
b3	0	0	0	0	0	0	0	1		3F	3F	3F	3F	40	42	45	4B
										?	?	?	?	@	B	E	K
	9	10	11	12	13	14	15	16		9	10	11	12	13	14	15	16

DCS 1 ; 92 ; 0 ; 8 ; 0 ; 2 ; 10 ; 0 ; 10 { EKWo_???/???@BEK ; ST

Note

This example is for illustrative purposes only. Use the character matrix size given in the Programming Supplement.

ST — String Terminator

The data string (D . . . D) is terminated by ST (9/12).

Error Handling

If Pfn or Pu is zero or is omitted, the device assumes a value of 1. If Psgr is zero or is omitted, the device assumes a value of 10. If Pcsc or Pe is omitted, the device assumes a value of 0.

The following conditions cause the device to ignore the entire download sequence:

- Pfn (font number) greater than 3
- Pe (erase) greater than 2
- Pcn (first character in set) greater than 95
- Pcmw (character matrix width) unrecognized (see the Programming Supplement for recognized values)
- Pcmh (character matrix height) unrecognized (see the Programming Supplement for recognized values)

DECDLD — Download Font

- Pcss (character set size) greater than 1
- Pu (font usage) greater than 2
- Psgr—Select Graphic Rendition (SGR) assignment greater than 0 and less than 10
- Psgr—Select Graphic Rendition (SGR) assignment greater than 19
- Dscs—Select Character Set (SCS) designator = > (User Preference designator)

Any change to Pcmw, Pu, Pcmh, Pcss, Psgr, or Dscs for a particular buffer since the last DECDLD sequence for that buffer results in the erasure of the entire set and causes a new font load to begin.

If the input buffer becomes full because of memory restrictions, the device deletes the partially loaded font and discards the rest of the download sequence.

DECFSR — Font Status Report

Reports the status of the installed cartridge fonts. Response to Request Font Status (DECRFS) command.

Source: Device

Destination: Symbiont

Format

```
ESC P 3 " { D . . . D ESC \
1/11 5/0 3/3 2/2 7/11 * . . . * 1/11 5/12
```

Description

Ps = 3 indicates that *D . . . D* contains a brief status report of the cartridge fonts. The device always sends one report with Ps = 3.

D . . . D is formatted as follows:

```
typestyle (   intended horiz. pitch ;   SGR parameter )   ;   CR   LF . . .
****      2/8   ****                3/11   ****                2/9 3/11 0/13 0/10
```

This information is stored in the cartridge font file.

Example

```
ESC P 3 " { COURIER(12;17); CR LF
GOTHIC(12;18); CR LF
ORATOR(10;19)CR LF
ESC \
```

All cartridge fonts may be printed at any of the horizontal pitch selections. Therefore, the intended pitch information within the font status report only identifies the pitch that is recommended by the font designer.

If no cartridge is installed, the device returns a null report, as follows:

```
ESC P 3 " { ESC \
```

Software should ignore any data that the device sends between the right parenthesis and the semicolon (;). This convention allows for future expansion of the reporting mechanism.

DECHPWA — Set Page Width Alignment

DECHPWA — Set Page Width Alignment

Sets the origin and the width of the physical sheet beginning with the current line. This command is intended to provide alignment of the physical sheet to the device mechanism.

Source: Symbiont **Destination:** Level 2 Exception

Format

CSI Pn1 ; Pn2 " s
9/11 *** 3/11 *** 2/2 7/3

Description

The numeric parameters are as follows:

Pn	Meaning
Pn1	Position of the origin (left edge of paper) measured in 1/12 in. increments from the leftmost printable position for the device. Beginning with the current line, Pn1 changes the horizontal origin of the entire coordinate system.
Pn2	Width of paper in 1/12 in. increments. The device never allows printing beyond this point. This parameter is relative to Pn1. For example, if Pn1 = 12 and Pn2 = 102, the device assumes the left edge of the paper is 1 in. in from the left edge of the printable area, the paper is 8 ½ in. wide, and the right edge of the paper is 9 ½ in. from the left edge of the printable area.

The maximum sheet size is the width of the printable area. The minimum sheet size that can be specified by this command is ½ in. For any other minimum sheet size value for a particular device, refer to the Programming Supplement.

DECHPWA — Set Page Width Alignment

Side Effects

The device sets the left margin to the new origin described by Pn1, and sets the right margin to the new right edge of the physical sheet, rounded down to the next even multiple of the current Horizontal Advance Increment (HAI).

The device moves the active position so that its position relative to the left reference does not change. If the new active position is greater than the new right margin, the device sets the Right Margin Flag. See Section 3.3.2.

Error Handling

If Pn1 is omitted, Pn1 is set to 0. If Pn2 is omitted, Pn2 is set to the width of the printable area.

If Pn1 is greater than printable area width minus $\frac{1}{2}$ in., the device sets Pn1 to the printable area width minus $\frac{1}{2}$ in.

If Pn1 plus Pn2 are greater than the printable area width, the device sets Pn2 to the printable area width minus Pn1.

If Pn2 is less than $\frac{1}{2}$ in., the device sets Pn2 to $\frac{1}{2}$ in.

Notes to Software

DECHPWA should only be used on a new page, and the parameters should match the size and location of the paper. This command is intended to align the paper relative to the platen. It should not be used for arbitrary origin placement. Send Set Left and Right Margins (DECSLRM) to position the logical page image within the physical sheet size and location defined by DECHPWA.

DECHTS — Horizontal Tab Set

DECHTS — Horizontal Tab Set

Executes Horizontal Tab Set (HTS).

Source: Application
(deprecated command)

Destination: Level 2

Format

ESC 1
1/11 3/1

Description

See HTS in Chapter 6.

Notes to Software

This command is included for backwards compatibility with older devices.
Conforming software should not use this command.

DECIPEM — Enter IBM Proprinter Emulation Mode

DECIPEM — Enter IBM Proprinter Emulation Mode

Executes Select Other Coding System (SOCS), enabling IBM Proprinter Emulation mode.

Source: Symbiont
(deprecated command)

Destination: Levels 2, 3 Exception

Format

```
CSI ? 5 8 h
9/11 3/15 3/5 3/8 6/8
```

Description

See SOCS with final character = (3/13).

Some devices do not support IBM Proprinter Emulation mode. See the Programming Supplement for a list of protocols supported in a particular device.

Notes to Software

This command is provided for backwards compatibility with older devices. Conforming software should use SOCS instead.

DECIPEM — Return from IBM Proprinter Emulation Mode

DECIPEM — Return from IBM Proprinter Emulation Mode

If received during IBM Proprinter Emulation mode, executes Return from Other Coding System (ROCS), returning to DEC mode and disabling all IBM Proprinter Emulation mode escape sequences.

Source: Symbiont
(deprecated command)

Destination: Levels 2, 3 Exception

Format

ESC [? 5 8 l
1/11 5/11 3/15 3/5 3/8 6/12

Description

See ROCS. This command always executes ROCS when received during IBM Proprinter Emulation mode, regardless of the command used to enter IBM Proprinter Emulation mode.

This command must be coded exactly as delineated above.

Some devices do not support IBM Proprinter Emulation mode. See the Programming Supplement for a list of protocols supported in a particular device.

This command returns to DEC mode only if sent during IBM Proprinter Emulation mode.

Notes to Software

This command is provided for backwards compatibility with older devices. Conforming software should use ROCS instead.

DECRFS — Request Font Status

DECRFS — Request Font Status

Requests a font cartridge report. Response is Font Status Report (DECFSR).

Source: Symbiont

Destination: Levels 2, 3

Format

```
CSI  Ps  "  {  
9/11 *** 2/2 7/11
```

Description

The selective parameters for DECRFS are as follows:

Ps	Meaning
0	Requests a default report (same as 3).
3	Requests a brief status report of all cartridge typestyles in the device.

The host sends this command to request a status report of the cartridge fonts available for printing.

Error Handling

If Ps is any value other than 0 or 3, the device ignores this command.

DECSBCA — Select Bar Code Attributes

Selects the bar code encoding system (bar code style) size, pitch, and other attributes for subsequent bar code characters, and selects or deselects human-readable characters. Some devices do not support bar codes. See the Programming Supplement.

Source: Application **Destination:** Level 2, 3 Exception

Format

CSI Ps1 $\dot{}$ Pn2 $\dot{}$: $\dot{}$ Ps9 ' q
9/11 *** 3/11 *** 3/11 : 3/11 *** 2/7 7/1

Description

Ps1 selects the type of bar code encoding:

Ps1	Bar Code Encoding
0	Code 3 of 9 (default value).
2	Code 3 of 9.
n	Other encoding system (bar code style). For the list of bar code styles and selective parameters for a particular device, refer to the Programming Supplement.

Pn2 sets the width of the narrow bars and spaces in units of decipoints. Some devices accept only specific values for Pn2. See the Programming Supplement for supported values. If 0 is selected for Pn2, the default for the device is selected. This value may vary among devices.

Pn3 sets the width of the quiet zone in decipoints. Some devices ignore this parameter and use a fixed-width quiet zone. See the Programming Supplement. However, you should always include Pn3 to ensure that your software will be accepted on future devices.

Pn4 sets the width of the wide bars and wide spaces in decipoints. Most devices accept only specific values for Pn4. See the Programming Supplement for supported values. If 0 is selected for Pn4, the default for the device is selected. This value may vary among devices.

DECSBCA — Select Bar Code Attributes

Pn5 sets the inter-character gap in decipoints. Most devices accept only specific values for Pn5. See the Programming Supplement for supported values. If 0 is selected for Pn5, the default for the device is selected. This value may vary among devices.

Pn6 sets the height of the bars in decipoints. Some devices ignore this parameter and use a fixed-height bar. See the Programming Supplement. However, you should always include Pn6 to ensure that your software will be accepted on future devices.

Pn7 defines the control character encoding character. If the device does not support control characters, Pn7 is ignored. See the Programming Supplement. If you do not need control character support, send a zero (0) for Ps7.

Ps8 sets the orientation for the bar codes. In some devices, the printed bar code cannot be rotated. See the Programming Supplement.

Ps8	Orientation
0	Default for the device.
1	Horizontal (portrait).
2	Vertical (landscape).

Ps9 sets the human-readable character option.

Ps9	Human Readable Characters
0, 1	None.
2	Current font.

Error Handling

Unsupported values for Ps1, Pn2, Pn4, and Pn5 cause the entire sequence to be ignored.

Unsupported values for Pn3, Pn6, Pn7, and Ps8 are ignored. They cause no change to the current value.

Unsupported values for Ps9 are treated as 1.

DECSCL — Select Conformance Level

DECSCL — Select Conformance Level

Performs a reset to protocol defaults and a conditional Sheet Feed. The name “Select Conformance Level” exists for historical reasons.

Source: Symbiont **Destination:** Levels 1, 2, 3

Format

CSI Ps " p
9/11 *** 2/2 7/0

Description

The selective parameters for DECSCL are as follows:

Ps	Meaning
0	Treated as 72.
71	Reset to DEC PPL1 defaults.
72	Reset to DEC PPL2 defaults.

The device resets all variables listed in the Initial State Values table in the Programming Supplement to the factory defaults. This is a different reset than Soft Terminal Reset (DECSTR) or Reset to Initial State (RIS).

At present, all DEC defaults are the same, regardless of level. Therefore, all recognized Ps values have the same effect. Future devices may implement different default lists. Therefore, software should use the appropriate level of reset.

Side Effects

The device performs a conditional Sheet Feed regardless of the value of Ps.

Error Handling

If Ps is an unsupported value, the device ignores the command, except for the side effect mentioned above.

DECSHORP — Set Horizontal Pitch

Selects character spacing for monospaced fonts.

Source: Application

Destination: Levels 1, 2, 3

Format

```
CSI  Ps  W
9/11 *** 7/7
```

Description

The DECSHORP command determines the number of characters/inch (pitch) that the device uses. This establishes the Horizontal Advance Increment (HAI).

The selective parameters for DECSHORP are as follows:

Ps	HAI	Pitch
0	720 centipoints	10 characters/inch
1	720 centipoints	10 characters/inch
2	600 centipoints	12 characters/inch
3	545 centipoints	13.2 characters/inch
4	436 centipoints	16.5 characters/inch
5	1440 centipoints	5 characters/inch
6	1200 centipoints	6 characters/inch
7	1090 centipoints	6.6 characters/inch
8	872 centipoints	8.25 characters/inch
9	480 centipoints	15 characters/inch
11	420 centipoints	Approximately 17.1 characters/inch or, more accurately, 14/240 in.
12	840 centipoints	Approximately 8.55 characters/inch or, more accurately, 28/240 in.
13	400 centipoints	18 characters/inch
14	800 centipoints	9 characters/inch
15	720 centipoints	10 characters/inch

DECSHORP — Set Horizontal Pitch

There may be device limitations on pitch based on resolution restrictions. If fallbacks are used, however, the resulting characters are the same size or smaller than those requested. See the discussion of horizontal resolution in the Programming Supplement for the actual supported pitches.

Side Effects

Execution of DECSHORP produces the following side effects:

- Sets the Left and Right Margin Positions to the edges of the physical sheet. See Section 3.4.
- Clears the Right Margin Flag.
- Adjusts horizontal tab stops (multiplies each tab location by the ratio of the new Horizontal Advance Increment over the old HAI). For example, if a horizontal tab stop is set at column 12 with a horizontal pitch of 12 characters/inch, the tab stop stored is 1 inch from the origin. But if a DECSHORP command changes the pitch to 6 characters/inch, the tab stop moves to 2 inches from the origin in order to retain 12 characters between the origin and the tab stop.
- If the active horizontal position is not a multiple of the new HAI, it is adjusted rightward to the next multiple of HAI.

Error Handling

All other parameter values cause this command to be ignored except for the bounds and Right Margin Flag resets described under Side Effects. A parameter that is valid but unsupported in a particular device results in a fallback. See the discussion of horizontal resolution in the Programming Supplement for a list of supported pitches.

DECSHTS — Set Horizontal Tab Stops

Adds one or more tab stops to the horizontal tab table.

Source: Application

Destination: Level 2

Format

```
CSI  Pn  ;    . . . ;    Pn  u
9/11 *** 3/11 . . . 3/11 *** 7/5
```

Description

Pn is the column number on which to set the tab stop.

Each Pn parameter is a selected horizontal tab stop. A maximum of 16 tab stops can be selected in one command. The device can receive Pn values in any order; it sorts them and places them into the tab table.

The device sets tab stops relative to the origin and not to the left margin. Changing the left margin does not change the position of tab stops. Changing the pitch with the Set Horizontal Pitch (DECSHORP) command modifies tab positions to keep the number of columns between tab stops constant.

The device allows at least one tab per eight columns along the widest paper supported at the smallest built-in monospaced pitch. See the Programming Supplement for the exact number.

Tab stops can be set outside the current margins; however, the device does not use tabs outside the margins.

Error Handling

If the device receives more than 16 tab stops in one sequence, it sets the first 16 and ignores the rest. If the same tab stop is sent more than once, the device sets the tab stop once. The device ignores a sequence sent without tab stop parameters.

When the number of new tab settings exceeds the maximum, the device discards the tab stops with the highest values.

DECSLPP — Set Lines per Physical Page

DECSLPP — Set Lines per Physical Page

Defines the logical page length. See Section 3.4 for more information.

Source: Application **Destination:** Levels 1, 2

Format

CSI Pn t
9/11 *** 7/4

Description

This command sets the page length to the physical distance that corresponds to Pn units (lines at the current vertical pitch). Once page length is set, changing the size of the units does not change the page length.

If Pn = 0, the device enters **no forms mode**. This mode emulates the use of roll paper (paper with no perforations). In no forms mode there is no top margin. The device is therefore required to change the processing of certain commands and activities that are normally based on the top margin.

No forms mode has the following effects:

- Form Feed (FF), Vertical Position Absolute (VPA), and Vertical Tab (VT) commands are processed as Line Feed (LF) characters.
- Vertical Position Relative (VPR) is processed up to 255 lines.
- Top and bottom margins are ignored.
- The FF button on the front panel (if any) is processed as a Line Feed (if fanfold paper is in use) or as an Eject (if single sheets are in use).
- No vertical active position adjustment occurs on the receipt of Select Vertical Pitch (DECVERP).

Table 7–5 lists the parameter values for a small selection of page lengths as a function of vertical pitch.

DECSLPP — Set Lines per Physical Page

Table 7–5 Page Length Parameters

Length in Inches	Lines per Inch					
	2	3	4	6	8	12
	Lines per Page					
11.0/3	N/A	11	N/A	22	N/A	44
8.5/2	N/A	N/A	17	N/A	34	51
8.5	17	N/A	34	51	68	102
11.0	22	33	44	66	88	132
14.0	28	42	56	84	112	168
21.0	42	63	84	126	168	252

Where N/A is indicated, the length is not selectable while the indicated vertical pitch is in effect. If it is selected using another vertical pitch and a subsequent pitch change occurs, page lengths of a nonintegral number of lines may result. Page wrap occurs after the last whole line.

The page length limits the range of possible settings for the Set Top and Bottom Margins (DECSTBM) command.

Side Effects

The device resets the top margin to 1 and the bottom margin to the page length.

See also the discussion of no forms mode, above.

Error Handling

If the Pn parameter is greater than the physical sheet length, the device sets the logical page length to the physical sheet length. See also Section 3.4.

Notes to Software

Use DECSLPP only at the top of a new page.

DECSLRM — Set Left and Right Margins

DECSLRM — Set Left and Right Margins

Sets the horizontal margins.

Source: Application **Destination:** Levels 2, 3

Format

CSI Pn1 ; Pn2 s
9/11 *** 3/11 *** 7/3

Description

Pn1 is a decimal value that specifies the left margin position.

Pn1	Meaning
0	Leave margin unchanged.
<i>n</i>	Set left margin to <i>n</i> columns.

Pn2 is a decimal value that specifies the right margin position.

Pn2	Meaning
0	Leave margin unchanged.
<i>n</i>	Set right margin to <i>n</i> columns.

The left margin is an imaginary line running down the left-hand side of the leftmost column. The right margin is an imaginary line running down the right-hand side of the rightmost column. Since the active position is an imaginary line running down the *left* of the character cell, it is possible to set the left margin and the right margin on the same column. The result is one column per line.

The device sets the margins relative to the page origin, as set by Horizontal Page Width Alignment (DECHPWA). Changing the page origin causes the margins to be reset.

Changing right and left margins does not affect horizontal tab stops. The active position is affected only if it is outside the new margins. See Error Handling.

DECSLRM — Set Left and Right Margins

Select Horizontal Pitch (DECSHOP) affects margin settings. See DECSHOP. DECHPWA affects the positions of the left and right margins in relation to the paper edge. See DECHPWA.

Error Handling

If the active position is less than the new left margin, the device sets the active position to the new left margin.

If the active position is greater than the new right margin, the device sets the Right Margin Flag. See Section 3.3.2.

If Pn2 is to the right of the right edge of the physical sheet, the device sets Pn2 to the right edge of the physical sheet. See also Section 3.4.

If Pn1 is greater than Pn2, or Pn1 is to the right of the right edge of the physical sheet, the device ignores the command.

For any additional information on any minimum distance between vertical margins for a particular device, refer to the *Digital ANSI-Compliant Printing Protocol Level 2 Programming Supplement*.

Notes to Software

Margins can be changed or reset as a side effect of other actions.

DECSLRM should be used only on a new page.

DECSTBM — Set Top and Bottom Margins

DECSTBM — Set Top and Bottom Margins

Sets the vertical margins.

Source: Application **Destination:** Levels 2, 3

Format

CSI Pn1 ; Pn2 r
9/11 *** 3/11 *** 7/2

Description

Pn1 is a decimal value that specifies the top margin position.

Pn1	Meaning
0	Leave margin unchanged.
<i>n</i>	Set top margin to <i>n</i> lines.

Pn2 is a decimal value that specifies the bottom margin position.

Pn2	Meaning
0	Leave margin unchanged.
<i>n</i>	Set bottom margin to <i>n</i> lines.

The device images only within the top and bottom margins, with the following exceptions:

- Partial Line Down (PLD) may print part of a character below the bottom margin.
- Partial Line Up (PLU) may print part of a character above the top margin.
- If the margins are less than one character height apart, text may exceed the bottom margin.

Changing the top and bottom margins does not affect vertical tab stops. The active position is affected only if it is outside the new margins. See Error Handling.

Set Lines per Physical Page (DECSLPP) affects margin settings.

DECSTBM — Set Top and Bottom Margins

After the top and bottom margins are set, if the vertical pitch is changed (Set Vertical Pitch—DECVERP), the physical positions of the top and bottom margins are not cleared but may change by a small amount so that they are still on grid. See DECVERP.

See Section 3.5 for a description of the interactions between PLU and PLD and the top and bottom margins.

Error Handling

If the active position is above the new top margin, the device sets the active position to the new top margin.

If the active position is below the new bottom margin, the device performs a Form Feed (FF).

If Pn2 is greater than the logical page length, the device sets the bottom margin to the bottom of the logical page.

If Pn1 is greater than Pn2, or Pn1 is greater than the logical page length, the device ignores the command.

For additional information on any minimum distance between vertical margins for a particular device, refer to the Programming Supplement.

Notes to Software

Margins can be changed or reset as a side effect of other actions.

DECSTBM should be used only on a new page.

DECSTR — Soft Terminal Reset

DECSTR — Soft Terminal Reset

Resets the device to the initial state values. Also returns to DEC PPL2 regardless of the power-up protocol selected.

Source: Application, Symbiont **Destination:** Levels 1, 2, 3

Format

```
CSI  !  p
9/11 2/1 7/0
```

Description

The device sets all the initial state values listed in the Programming Supplement to the conditions in the “DECSTR” column of the Initial State Values table.

The device does not run self-test, change the current communication settings, or clear the input buffer.

Side Effects

The device performs a conditional Form Feed. See Section 3.8.

See Select Other Coding System (SOCS) when an alternate protocol is in use.

DECSVTS — Set Vertical Tab Stops

DECSVTS — Set Vertical Tab Stops

Adds one or more tab stops to the vertical tab table.

Source: Application

Destination: Level 2

Format

```
CSI  Pn  ;    . . . ;    Pn  v
9/11 *** 3/11 . . . 3/11 *** 7/6
```

Description

Pn is the line number on which to set the tab stop. Each Pn parameter is a selected vertical tab stop. A maximum of 16 tab stops can be selected in one command. The device can receive Pn parameters in any order; it sorts them and places them into the tab table.

The device sets tab stops relative to the page origin, not to the top margin. Changing the top margin does not change the position of tab stops. Changing the pitch with Set Vertical Pitch (DECVERP) modifies tab positions to keep the number of lines between tab stops constant.

The device allows at least one tab per line along the longest paper supported at the smallest line spacing. See the Programming Supplement for maximum values.

Tab stops can be set outside the current margins; however, the device does not use tab stops beyond the bottom margin.

Error Handling

If the device receives more than 16 tab stops, it sets the first 16 and ignores the rest. If the same tab stop is sent more than once, the device sets the tab stop once. The device ignores a command sent without tab stop parameters.

DECTC1 — Truncate C1 Control Characters

DECTC1 — Truncate C1 Control Characters

Instructs the device to truncate the high-order bit of 8-bit C1 control characters.

Source: Symbiont

Destination: Level 2, 3

Format

ESC SP 6
1/11 2/0 3/6

Description

For all subsequent characters, the device processes received 2-character sequences as shown in the “7-Bit Equivalent Sequence” column of Table 2–1. If 8-bit C1 control characters are received, it drops the eighth bit and processes the character as a C0 character.

This sequence is processed in sequence with all other data. Therefore, it is recommended that software send this sequence before all other commands to prevent confusion.

See also Accept C1 Control Characters (DECAC1) in this chapter.

DECUPM — Unidirectional Print Mode

DECUPM — Unidirectional Print Mode

Designates the direction of printhead motion.

Source: Application

Destination: Levels 1, 2

Format

CSI ? 4 1 h Set: selects unidirectional printing.
9/11 3/15 3/4 3/1 6/8

CSI ? 4 1 l Reset: selects bidirectional printing.
9/11 3/15 3/4 3/1 6/12

Description

Either unidirectional printing or bidirectional printing can be selected.

With DECUPM set, printing occurs only when the printhead is moving from left to right. This provides more accurate horizontal positioning on some devices. With DECUPM reset, the device prints from right to left as well as from left to right. This optimizes printing speed.

The device always prints sixel graphics and some text attributes in unidirectional print mode, regardless of the setting of DECUPM.

See Section 2.5.2.3 for details about parsing this command with multiple parameters.

DECVERP — Set Vertical Pitch

DECVERP — Set Vertical Pitch

Selects line spacing.

Source: Application **Destination:** Levels 1, 2¹

¹Metric line spacing parameters are an extension to the protocol.

Format

CSI Ps z
9/11 *** 7/10

Description

The DECVERP command determines the number of lines/inch (pitch) that the device uses. This establishes the Vertical Advance Increment (VAI). Changing the vertical pitch changes the white space between lines, not the size of the character. If the number of lines/inch is increased, the amount of white space between the lines is decreased.

The selective parameter values for DECVERP are as follows:

Ps	VAI	Pitch
0	1200 centipoints	6 lines/inch
1	1200 centipoints	6 lines/inch
2	900 centipoints	8 lines/inch
3	600 centipoints	12 lines/inch
4	3600 centipoints	2 lines/inch
5	2400 centipoints	3 lines/inch
6	1800 centipoints	4 lines/inch
10	Same as Ps = 1	
11	Same as Ps = 1	
12	Same as Ps = 2	

DECVERP — Set Vertical Pitch

Ps	VAI	Pitch
13	Same as Ps = 3	
14	Same as Ps = 4	
15	Same as Ps = 5	
16	Same as Ps = 6	
21 ¹		4 lines/centimeter
22 ¹		2 lines/centimeter
23 ¹		1 line/centimeter
31 ¹	Same as Ps = 21	
32 ¹	Same as Ps = 22	
33 ¹	Same as Ps = 23	

¹Metric line spacing parameters are an extension to the protocol and may not be supported in all devices. See the Programming Supplement.

There may be device limitations on pitch based on resolution restrictions. These usually affect only the metric line spacing parameters. See the discussion of resolution in the Programming Supplement for supported pitches.

The exact vertical pitch produced for parameters 11–16 is device dependent. The result is defined as lines/page on the printable area defined for portrait printing on A-sized paper for that device. Although this is always defined as a given vertical pitch on level 2 devices, it can vary on certain level 3 devices.

Side Effects

DECVERP does not change the active position. However, before processing the next vertical motion command, the active line advances a minimum amount to be on the new line grid.

Unlike the action of Set Horizontal Pitch (DECSHORP) on the horizontal margins, top and bottom margins are not cleared, but are advanced to be on grid using the same algorithm described for the active position.

Note

Application software should not depend on this functionality.
Application software should always select new top and bottom margins after changing the vertical pitch.

DECVERP — Set Vertical Pitch

Vertical tab stops are adjusted in order to retain a constant number of lines between vertical tabs. For example, if a vertical tab stop is set at 12 lines with a vertical pitch of 6 lines/inch, the tab stop stored is 2 inches from the origin. But if a DECVERP command changes the pitch to 12 lines/inch, the tab stop moves to 1 inch from the origin in order to retain 12 lines between the origin and the tab stop.

The DECVERP command does not change the page length.

Error Handling

If the vertical pitch is set greater than the page length, the device images one line/page. See Section 3.3.4.

If Ps is invalid, the command is ignored.

DECVTS — Vertical Tab Set

Executes Vertical Tab Set (VTS).

Source: Application
(deprecated command)

Destination: Level 2

Format

ESC 3
1/11 3/3

Description

See VTS in Chapter 6.

Notes to Software

This command is included for backwards compatibility with older devices.
Conforming software should not use this command.

DSR — Device Status Request

DSR — Device Status Request

Requests error status.

Source: Symbiont **Destination:** Levels 1, 2, 3

Format

CSI Ps n
9/11 *** 6/14

Description

In response to a DSR command, the device sends a single brief or extended status report. If you enable unsolicited reports, the device sends additional reports whenever any reportable status condition changes state or an error event occurs.

The device processes the DSR request immediately upon receipt, asynchronously to the rest of the data stream. This allows the device to respond to the request when an error has halted the printing process and the input buffer is full.

The selective parameters for the Device Status Request command are as follows:

Ps	Selection
0 or 5	Sends an extended status report.
?1	Disables all unsolicited status reports.
?2	Enables brief unsolicited status reports, sends extended status report.
?3	Enables extended unsolicited status reports, sends extended status report.

The host sends the Device Status Request command to request a status report of detected errors. There are two types of reports: extended and brief. The brief report sends a simple “error” or “no error” indication. The extended report sends this indication as well as a list of more specific error codes.

The number of DSR requests the device can process is limited only by the transmission time of each report.

DSR — Device Status Request

Error Handling

If Ps has a value other than those shown, the device ignores the entire command. is not necessary to parse multiple parameters. If multiple parameters are received, it is acceptable for the device not to recognize the command.

Notes to Software

Do not use multiple parameters when sending DSR.

DSR — Device Status Report

DSR — Device Status Report

Reports error status. The device sends this report:

- In response to certain error conditions (if unsolicited reports are enabled)
- In response to a Device Status Request (DSR) with Ps = 0, 5, ?2, or ?3

Source: Device

Destination: Symbiont

Brief Report Format

ESC	[	Ps	n
1/11	5/11	***	6/14

Extended Report Format

Brief report followed by:

$$\text{ESC} \quad \left[\begin{array}{ccccccc} \text{Pn1} & & \text{Pn2} & & \dots & & \text{Pnn} \\ \text{1/11} & \text{5/11} & \text{**} & \text{3/11} & \text{**} & \text{3/11} & \text{**} & \text{n/14} \end{array} \right]$$

Brief Report Description

The brief report parameters are as follows:

Ps	Meaning
0	No errors.
3	Error.

Extended Report Description

Each Pn value is an error code of up to three digits. The error codes are listed in the Programming Supplement.

Each error code is classified as a **state** (the error is cleared internally when the error condition is corrected) or an **event** (the error is cleared internally when the error condition is reported). These classifications are listed in the Programming Supplement.

DSR — Device Status Report

Notes

If unsolicited reports are enabled, errors are reported as they occur.

If no errors occurred, the device returns a generic “no error” code. The extended “no error” indication varies depending on the configuration, for example, the presence or absence of a sheet feeder.

If an **event error** occurs when unsolicited reports are disabled, the event is stored, then is reported and cleared on the next request. If a **state error** occurs when unsolicited reports are disabled, an error report is generated on the next request only if the error condition still exists — for example, the cover is open or the device is off line.

If unsolicited reports are enabled and an event occurs that normally causes the device to go off line, the device transmits a report before going off line.

The device sends parameters in ascending order, except for the “First Report Since Initialization” parameter (if any), which is always sent first. However, software should accept the parameters in any order.

HPA — Horizontal Position Absolute

HPA — Horizontal Position Absolute

Moves to a new active horizontal position. Motion occurs either to the right or to the left.

Source: Application **Destination:** Levels 2, 3

Format

CSI Pn `
 9/11 *** 6/0

Description

Select Pn as follows:

Pn	Meaning
0	Interpreted as 1.
<i>n</i>	Position to move to.

The device sets the active horizontal position to column Pn.

See Section 3.3 for interactions with the coordinate system bounds.

When lining attributes are invoked by Select Graphic Rendition (SGR), HPA underlines, double underlines, overlines, or strikes through from the current position to the target position.

Side Effects

The device clears the Right Margin Flag if the HPA command causes the active position to move to the left of the right margin.

Error Handling

If Pn is to the left of the Left Margin Position, the device sets the horizontal position to the Left Margin Position.

If Pn is to the right of the Right Margin Position, the device sets the horizontal position equal to the Right Margin Position and sets the Right Margin Flag. See Section 3.3.2 for more information.

HPR — Horizontal Position Relative

HPR — Horizontal Position Relative

Moves the active position to the right a specified number of columns.

Source: Application

Destination: Levels 2, 3

Format

```
CSI   Pn   a
9/11  ***  6/1
```

Description

Select Pn as follows:

Pn	Meaning
0	Interpreted as 1.
<i>n</i>	Number of characters.

When lining attributes are invoked by Select Graphic Rendition (SGR), HPR underlines, double underlines, overlines, or strikes through text from the current position to the target position.

Error Handling

If the resulting position would be to the right of the Right Margin Position, the device sets the horizontal position equal to the Right Margin Position and sets the Right Margin Flag. See Section 3.3.2 for more information.

When the Right Margin Flag is set, the command is ignored.

LNM — Line Feed/New Line Mode

LNM — Line Feed/New Line Mode

Instructs the device whether to perform a Carriage Return (CR) upon receipt of a Line Feed (LF).

Source: Symbiont

Destination: Levels 2, 3

Format

CSI 2 0 h
9/11 3/2 3/0 6/8

Set — LF acts as New Line.

CSI 2 0 l
9/11 3/2 3/0 6/12

Reset — LF acts as Line Feed.

Description

If LNM is set and a Line Feed is received, the active position advances to the left margin of the next line. If LNM is reset and a Line Feed is received, the active position advances to the same horizontal position on the next line.

See Section 2.5.2.3 for details about parsing this command with multiple parameters.

LS*/LS*R/SS* — Locking and Single Shifts

LS*/LS*R/SS* — Locking and Single Shifts

These sequences invoke the G0–G3 character sets into GL or GR.

Source: Application

Destination: Levels 1, 2, 3

Format

The locking shift and single shift sequences are as follows:

Name	Mnemonic	Sequence	Function
Single Shift 2	SS2	ESC N 1/11 4/14	Temporarily invokes character set G2 into GL to print one character.
Single Shift 3	SS3	ESC O 1/11 4/15	Temporarily invokes character set G3 into GL to print one character.
Shift Out	SO	SO 0/14	See Locking Shift 1.
Shift In	SI	SI 0/15	See Locking Shift 0.
Locking Shift 0	LS0	SI 0/15	G0 becomes the active GL character set.
Locking Shift 1	LS1	SO 0/14	G1 becomes the active GL character set.
Locking Shift 2	LS2	ESC n 1/11 6/14	G2 becomes the active GL character set.
Locking Shift 3	LS3	ESC o 1/11 6/15	G3 becomes the active GL character set.
Locking Shift 1 Right	LS1R	ESC ~ 1/11 7/14	G1 becomes the active GR character set.
Locking Shift 2 Right	LS2R	ESC } 1/11 7/13	G2 becomes the active GR character set.
Locking Shift 3 Right	LS3R	ESC 1/11 7/12	G3 becomes the active GR character set.

There is no LS0R.

LS*/LS*R/SS* — Locking and Single Shifts

Description

See Section 2.2.1 for more information on designating and invoking character sets.

The effect of a single shift (SS2 or SS3) continues only for the first printable GL character that follows the single shift sequence. See Section 2.5.4 for special processing of intervening characters.

The effect of a locking shift (LS0, LS1, LS2, LS3, LS1R, LS2R, or LS3R) continues indefinitely; that is, until another locking shift changes the effect, or until reset or power down.

RIS — Reset to Initial State

Executes Soft Terminal Reset (DECSTR).

Source: Symbiont

Destination: Levels 1, 2, 3

Format

ESC c
1/11 6/3

Description

See DECSTR.

Notes to Software

This command is included for backwards compatibility with older devices.
Conforming software should not use this command.

ESC c is reserved for other uses in some emulation modes.

ROCS — Return from Other Coding System

ROCS — Return from Other Coding System

Returns to DEC PPL2 from an alternate protocol emulation mode.

Source: Symbiont

Destination: Levels 2, 3 Exception

Format

ESC	%	@
1/11	2/5	4/0

Description

This command causes the device to return to DEC PPL2. If switching protocols, the device also returns to power-up defaults. See the Initial State Values table in the Programming Supplement. Defaults are not applied if this command is received while already in DEC PPL2.

Restrictions

If received during an emulation binary transmission mode, the command is processed as binary data and does not return the device to DEC PPL2.

Immediately after receiving the exit command, the device may still be in an emulation mode processing buffered data. Asynchronous processing (such as Device Status Report—DSR) may not function properly. In order to compensate for this restriction, send a Device Attributes (DA) request command after sending the ROCS command. The reply to the DA indicates that the device has entered DEC mode and is ready to accept DEC PPL2 commands.

While in an emulation mode, ROCS must be coded exactly as delineated above.

Some devices do not support emulation modes. See the Programming Supplement for a list of supported protocols.

Notes to Software

Since ROCS does not reset the device unless received in an emulation protocol, symbionts wishing to return the device to a known state between jobs should follow ROCS with Select Conformance Level (DECSCL).

SCS — Select Character Set

Designates a graphic character set into G0, G1, G2, or G3.

Source: Application

Destination: Levels 1, 2, 3

Format

ESC I₁ I₂ . . . I_n F
1/11 (See Description)

Description

I₁ is an intermediate character selected from Table 7–6.

Table 7–6 SCS Intermediate Characters

I ₁ Character	Code	Invoke into Gset
94-Character Sets		
(Left parenthesis	2/8	G0
) Right parenthesis	2/9	G1
* Asterisk	2/10	G2
+ Plus sign	2/11	G3
96-Character Sets		
– Minus sign	2/13	G1
. Period	2/14	G2
/ Slash	2/15	G3

Table 7–7 lists the character set designating characters. See Appendix A for a description of the character sets. These character sets are selected using the identifier as F or I₂ F in the SCS sequence. If the font file is a downline loaded font or cartridge font, use the designator provided with the font file.

SCS — Select Character Set

Table 7-7 SCS Intermediate (I₂) and Final Characters

Character Set	I ₂ F Designator Characters	Code
94-Character Sets		
British	A	4/1
ASCII	B	4/2
DEC Dutch	4	3/4
DEC Finnish	5	3/5
French	R	5/2
DEC French-Canadian	9	3/9
German	K	4/11
DEC Hebrew Supplemental	"4	2/2, 3/4
DEC 7-Bit Hebrew	%=	2/5, 3/13
ISO Italian	Y	5/9
Legal	%4	2/5, 3/4
JIS Katakana	I	4/9
JIS Roman	J	4/10
DEC Norwegian/Danish	6	3/6
ISO Spanish	Z	5/10
DEC Swedish	7	3/7
DEC Swiss	=	3/13
Norwegian/Danish	`	6/0
DEC Supplemental	%5	2/5, 3/5
DEC Technical	>	3/14
DEC Special Graphics	0	3/0
DEC Portuguese	%6	2/5, 3/6
DEC 7-Bit Turkish	%2	2/5, 3/2
DEC 8-Bit Turkish Supplemental	%0	2/5, 3/0
DEC Greek Supplemental	"?	2/2, 3/15
User Preference Supplemental	< ¹	3/12

¹For compatibility with older devices, set the User Preference Supplemental character set to the DEC Supplemental character set. This is a 94-character set.

(continued on next page)

SCS — Select Character Set

Table 7–7 (Cont.) SCS Intermediate (I₂) and Final Characters

Character Set	I ₂ F Designator Characters	Code
Downloaded character set	SP @ ²	2/0, 4/0
96-Character Sets		
ISO Latin-1 Supplemental	A	4/1
ISO Latin-2 Supplemental	B	4/2
ISO Latin-Greek Supplemental	F	4/6
ISO Latin-Hebrew Supplemental	H	4/8
ISO Latin-Cyrillic Supplemental	L	4/12
ISO Latin-5 Supplemental	M	4/13
User Preference Supplemental	< ¹	3/12
Downloaded character set	SP @ ²	2/0, 4/0

¹For compatibility with older devices, set the User Preference Supplemental character set to the DEC Supplemental character set. This is a 94-character set.

²This designator is recommended for use with downloaded character sets that are not described by any of the above designators, or by any international standard. Whether you use this or any other designator to select a downloaded font, it must match the designator assigned to the downloaded font file by the Select Character Set (Dscs) parameter of the Download Font (DECDLD) control string. See DECDLD.

The SCS sequences in Table 7–8 select Digital character sets as fallbacks, if the requested set is not present. Since Digital reserves the right to redefine these sequences in the future to conform to ISO standards, it is recommended that conforming software not use these sequences but instead use the Digital escape sequences in Table 7–7 to select these sets.

Table 7–8 SCS Final Characters for Fallback Character Sets

Character Set	F Designator Character	Code
Fall back to DEC Finnish	C	4/3
Fall back to DEC French Canadian	Q	8/1
Fall back to DEC Norwegian/Danish	E	4/5
Fall back to DEC Swedish	H	4/8

SCS — Select Character Set

Error Handling

Do not invoke a 96-character set into GL. This is considered an error condition.

A 94-character downloaded character set can only be selected using 94-character set selection sequences. If a 96-character set selection sequence is used, it selects the corresponding 96-character set. If no 96-character set with that designator is available, a character set fault results. The converse is also true. See Section 4.4.3 for more information.

SGR — Select Graphic Rendition - *Selecting Attributes*

SGR — Select Graphic Rendition - *Selecting Attributes*

Selects printing attributes, including lining functions, superscript and subscript functions, and emphasis functions. Also selects text color.

Source: Application

Destination: Levels 1, 2, 3¹

¹Color parameters are an extension to the protocol.

Format

CSI Ps ; . . . ; Ps m Selects standard attributes.
9/11 *** 3/11 . . . 3/11 *** 6/13

Description

Select an attribute using standard SGR parameters as follows:

Ps	Action
0	Turn off all attributes, standard and private.
1	Turn on bold.
3	Turn on slant.
4	Turn on underline, turn off double underline.
9	Turn on strike-through.
21	Turn on double underline, turn off underline.
22	Turn off bold.
23	Turn off slant.
24	Turn off underline and double underline.
29	Turn off strike-through.
30 ¹	Print text in black.
31 ¹	Print text in red.
32 ¹	Print text in green.
33 ¹	Print text in yellow.
34 ¹	Print text in blue.

¹Color text parameters are an extension to the protocol and may not be supported in all devices. See the Programming Supplement.

SGR — Select Graphic Rendition - *Selecting Attributes*

Ps	Action
35 ¹	Print text in magenta.
36 ¹	Print text in cyan.
37 ¹	Print text in “white” (transparent, no printing).
39 ¹	Print text in default color (black).
53	Turn on overline.
55	Turn off overline.

¹Color text parameters are an extension to the protocol and may not be supported in all devices. See the Programming Supplement.

Select an attribute using Digital private SGR parameters as follows:

Ps	Action
?0	Turn off all private attributes (deprecated parameter).
?4	Turn on superscript, turn off subscript.
?5	Turn on subscript, turn off superscript.
?6	Turn on overline (deprecated parameter).
?24	Turn off superscript and subscript.
?26	Turn off overline (deprecated parameter).

Notes to Software

The parameter ?0 is provided for backwards compatibility with older devices. Conforming software should not use this parameter. Use parameter 0 instead.

The parameters ?6 and ?26 are provided for backwards compatibility with older devices. Conforming software should not use these parameters. Use parameters 53 and 55 instead.

Using SGR to Select Character Attributes

You can send more than one parameter at a time, separated with semicolons. Do not mix standard and private parameters in one command. See Section 2.5.2.2 for more information.

The device uses the selected attribute across line and page boundaries.

SGR — Select Graphic Rendition - *Selecting Attributes*

Lining Attributes

Underline, double underline, overline, and strike-through attributes affect all printable characters in the data stream, as well as:

- Space (SP)
- Horizontal Position Relative (HPR)
- Horizontal Position Absolute (HPA)

Tabs are not affected.

Legal documents often use the strike-through attribute to indicate words deleted from a previous version of the document. The device draws a line through the marked characters, in the same manner as underline.

All lining attributes are contiguous relative to the baseline of the entire line, even when used on superscript or subscript text. This applies to SGR superscript and subscript only, not to Partial Line Up (PLU) or Partial Line Down (PLD). Do not use lining attributes with PLU and PLD. The result may differ depending on the device.

Some devices do not perform lining attributes on **full cell** characters. A full cell character is one that is too large to be printed in one pass of the printhead.

Superscript and Subscript Attributes

If superscript or subscript is requested, the device generates half-height characters algorithmically. The device aligns the top of the superscript character with the top of the normal character cell and the bottom of the subscript character with the bottom of the normal (not full) character cell.

Line feed distance and active position are not affected by superscript or subscript.

Superscripts and subscripts cannot be nested.

Emphasis Attributes

If bold printing is selected, the device uses an algorithm to produce darker characters. Lining attributes that are selected in conjunction with bold are printed at the normal weight — only the characters are emphasized.

When slant printing is selected, the characters are algorithmically slanted. See the Programming Supplement for more information about built-in algorithmic transformations and the slant algorithm.

SGR — Select Graphic Rendition - *Selecting Attributes*

Wrapping algorithms apply to the unmodified character. Characters that have only the modified part extending outside the margins do not wrap.

Some devices do not slant full cell characters.

SGR — Select Graphic Rendition - *Selecting Fonts*

Selects a typestyle for printing.

Source: Application

Destination: Level 2, 3

Format

```
CSI  Ps  m
9/11 *** 6/13
```

Description

Select a typestyle using SGR parameters as follows:

Ps	Selection
10–19	Select typestyle as predefined, using precedence order given in Section 4.4.1.

Each cartridge typestyle and downloaded font file has a preassigned SGR number. See the Programming Supplement for the initial state values of SGR parameters.

The select font command can be used anywhere in the data stream. The selected typestyle remains in effect until either of the following occurs:

- The device receives another select font command (SGR 10–19).
- The device is reset or powered down.

A change in character set may result in a temporary change in font. See Section 4.4.3 for more information on character set faults.

SOCS — Select Other Coding System

SOCS — Select Other Coding System

Selects an alternate protocol.

Source: Symbiont **Destination:** Levels 2, 3 Exception

Format

ESC % = Select IBM Proprinter Emulation mode.
1/11 2/5 3/13

Description

Subsequent data is coded according to the selected protocol.
When in an alternate coding system, the device ignores all DEC PPL2 sequences except the following:

Coding	Sequence
ESC % @	Return from Other Coding System (ROCS)
ESC [! p	Soft Terminal Reset (DECSTR)
ESC [? 5 8 1	IBM Proprinter Emulation Mode (DECIPEM) reset only if in IBM Proprinter Emulation mode (deprecated function)

These commands must be coded exactly as delineated above. DEC PPL2 rules regarding extra parameters may not apply. Do not use the 8-bit form of Control Sequence Introducer (CSI) in place of ESC [.

This command causes a reset of the selected emulation mode to its initial conditions. See the emulation mode specification for a list of the initial conditions.

When in emulation mode, the device does not save DSR events for later reporting after returning to DEC mode.

Some devices do not support any emulation modes. See the Programming Supplement for a list of supported protocols.

TBC — Tab Clear

Clears one or all horizontal or vertical tab stops.

Source: Application

Destination: Levels 1, 2

Format

```
CSI  Ps  ;   . . . ;   Ps  g
9/11 *** 3/11 . . . 3/11 *** 6/7
```

Description

Select Ps as follows:

Ps	Action
0	Clears one horizontal tab at active column.
1	Clears one vertical tab at active line.
2	Clears all horizontal tabs.
3	Clears all horizontal tabs.
4	Clears all vertical tabs.

See also Horizontal Tab (HT) and Vertical Tab (VT) in Chapter 6.

Error Handling

Unrecognized parameters are ignored.

If the absolute position is not on an even line grid, this command with a parameter of 1 clears a tab stop on the next even line grid in the forward direction.

VPA — Vertical Position Absolute

VPA — Vertical Position Absolute

Moves to a new active vertical position. The horizontal position is unchanged. The new position must be below the current position.

Source: Application **Destination:** Levels 2, 3

Format

CSI Pn d
9/11 *** 6/4

Description

Select Pn as follows:

Pn	Meaning
0	Interpreted as 1.
<i>n</i>	Position to move to.

Set the active vertical position to line Pn.
In no forms mode, VPA acts like a Line Feed, regardless of the value of Pn. See Set Lines per Physical Page (DECSLPP).

Side Effects

VPA resets the PLU/PLD flag.

Error Handling

See Section 3.3 for interactions with the coordinate system bounds.

VPR — Vertical Position Relative

VPR — Vertical Position Relative

Moves the active vertical position down by the specified number of lines. The horizontal position does not change.

Source: Application

Destination: Levels 2, 3

Format

```
CSI Pn e
9/11 *** 6/5
```

Description

Select the VPR parameter as follows:

Pn	Meaning
0	Interpreted as 1.
<i>n</i>	Number of lines.

Side Effects

In no forms mode, VPR is limited to 255 lines. See Set Lines per Physical Page (DECSLPP).

VPR resets the PLU/PLD count.

Error Handling

See Section 3.3 for interactions with the coordinate system bounds.

Command Summary

Command Summary

This section contains commands grouped alphabetically by their final characters.

- Table 7–9 lists ESC sequences.
- Table 7–10 lists control sequences.
- Table 7–11 lists DCS strings.

Table 7–9 ESC Sequences Sorted by Final Character

Coding	Mnemonic	Name
ESC I ₁ A	SCS	Select British or ISO Latin-1 Supplemental character set
ESC I ₁ B	SCS	Select ASCII character set
ESC I ₁ B	SCS	Select ISO Latin-2 Supplemental character set
ESC c	RIS	Reset to Initial State
ESC I ₁ C	SCS	Fall back to DEC Finnish character set
ESC I ₁ E	SCS	Fall back to DEC Norwegian/Danish character set
ESC I ₁ F	SCS	Select ISO Latin-Greek Supplemental character set
ESC SP F	S7C1T	Transmit C1 characters as ESC Fe This sequence is ignored in all digital printers, and is not documented in this manual.
ESC SP G	S8C1T	Transmit C1 characters as C1 This sequence is ignored in all digital printers, and is not documented in this manual.
ESC I ₁ H	SCS	Select ISO Latin-Hebrew Supplemental or fall back to DEC Swedish character set
ESC I ₁ I	SCS	Select JIS Katakana character set
ESC I ₁ J	SCS	Select JIS Roman character set
ESC I ₁ K	SCS	Select German character set
ESC I ₁ L	SCS	Select ISO Latin-Cyrillic Supplemental character set
ESC SP L	ASCEF	Announce ISO 4873 level 1 Subset of Code Extension Facilities
ESC I ₁ M	SCS	Select ISO Latin-5 Supplemental character set
ESC SP M	ASCEF	Announce ISO 4873 level 2 Subset of Code Extension Facilities

(continued on next page)

Command Summary

Table 7–9 (Cont.) ESC Sequences Sorted by Final Character

Coding	Mnemonic	Name
ESC n	LS2 (Listed under LS* /LS*R/SS*)	Locking Shift 2
ESC SP N	ASCEF	Announce ISO 4873 level 3 Subset of Code Extension Facilities
ESC o	LS3 (Listed under LS* /LS*R/SS*)	Locking Shift 3
ESC O	SS3 (Listed under LS* /LS*R/SS*)	Single Shift 3
ESC I ₁ Q	SCS	Fall back to DEC French-Canadian character set
ESC I ₁ R	SCS	Select French character set
ESC I ₁ Y	SCS	Select ISO Italian character set
ESC I ₁ Z	SCS	Select ISO Spanish character set
ESC I ₁ 0	SCS	Select DEC Special Graphics character set
ESC I ₁ % 0	SCS	Select DEC 8-Bit Turkish Supplemental character set
ESC % SP 0	DECBAR	Start Bar Codes
ESC 1	DECHTS	Horizontal Tab Set
ESC 2	DECCAHT	Clear All Horizontal Tabs
ESC I ₁ % 2	SCS	Select DEC 7-Bit Turkish character set
ESC 3	DECVTS	Vertical Tab Set
ESC 4	DECCAVT	Clear All Vertical Tabs
ESC I ₁ 4	SCS	Select DEC Dutch character set
ESC I ₁ " 4	SCS	Select DEC Hebrew Supplemental character set
ESC I ₁ % 4	SCS	Select Legal character set
ESC I ₁ 5	SCS	Select DEC Finnish character set
ESC I ₁ % 5	SCS	Select DEC Supplemental character set
ESC SP 6	DECTC1	Process C1 as C0
ESC I ₁ 6	SCS	Select DEC Norwegian/Danish character set
ESC I ₁ % 6	SCS	Select DEC Portuguese character set
ESC SP 7	DECAC1	Process C1 as C1

(continued on next page)

Command Summary

Table 7–9 (Cont.) ESC Sequences Sorted by Final Character

Coding	Mnemonic	Name
ESC I ₁ 7	SCS	Select DEC Swedish character set
ESC I ₁ 9	SCS	Select DEC French-Canadian character set
ESC I ₁ <	SCS	Select User Preference Supplemental character set
ESC % =	SOCS	Select IBM Proprinter Emulation mode.
ESC I ₁ =	SCS	Select DEC Swiss character set
ESC I ₁ % =	SCS	Select DEC 7-Bit Hebrew character set
ESC I ₁ >	SCS	Select DEC Technical character set
ESC I ₁ " ?	SCS	Select DEC Greek Supplemental character set
ESC % @	ROCS	Return from Other Coding System
ESC % @	DECBAR	Stop Bar Codes
ESC I ₁ `	SCS	Select Norwegian/Danish character set
ESC	LS3R (Listed under LS* /LS*R/SS*)	Locking Shift 3 Right
ESC }	LS2R (Listed under LS* /LS*R/SS*)	Locking Shift 2 Right
ESC ~	LS1R (Listed under LS* /LS*R/SS*)	Locking Shift 1 Right

Table 7–10 Control Sequences Sorted by Final Character

Coding	Mnemonic	Name
CSI Ps c	DA	Device Attributes
ESC [? Ps1 ; Ps2 ; . . . ; Psn c	DAR	Device Attributes Report
CSI > Ps c	DA2	Secondary Device Attributes
ESC [> Ps1 ; Ps2 c	DA2R	Secondary Device Attributes Report
CSI Pn d	VPA	Vertical Position Absolute
CSI Pn e	VPR	Vertical Position Relative
CSI Ps ; . . . ; Ps g	TBC	Tab Clear

(continued on next page)

Command Summary

Table 7–10 (Cont.) Control Sequences Sorted by Final Character

Coding	Mnemonic	Name
CSI 3 h	CRM	Control Representation Mode (set)
CSI 20 h	LNLM	Line Feed/New Line Mode (set)
CSI ? 7 h	DECAWM	Autowrap Mode (set)
CSI ? 40 h	DECCRNLM	Carriage Return/New Line Mode (set)
CSI ? 41 h	DECUPM	Unidirectional Print Mode (set)
CSI ? 58 h	DECIPEM	IBM Proprinter Emulation Mode (set)
CSI 3 l	CRM	Control Representation Mode (reset)
CSI 20 l	LNLM	Line Feed/New Line Mode (reset)
CSI ? 7 l	DECAWM	Autowrap mode (reset)
CSI ? 40 l	DECCRNLM	Carriage Return /New Line Mode (reset)
CSI ? 41 l	DECUPM	Unidirectional Print Mode (reset)
ESC [? 58 l	DECIPEM	IBM Proprinter Emulation Mode (reset)
CSI Ps ; . . . ; Ps m	SGR	Select Graphic Rendition
CSI Ps n	DSR	Device Status Request
ESC [Ps n	DSR	Device Status Report
CSI Ps1 " p	DECSCL	Select Conformance Level
CSI Pn ! p	DECSTR	Soft Terminal Reset
CSI Ps1 ; Pn2 ; . . . ; Ps9 ' q	DECSBCA	Select Bar Code Attributes
CSI Pn1 ; Pn2 r	DECSTBM	Set Top and Bottom Margins
CSI Pn1 ; Pn2 " s	DECHPWA	Set Page Width Alignment
CSI Pn1 ; Pn2 s	DECSLRM	Set Left and Right Margins
CSI Pn t	DECSLPP	Set Lines per Physical Page
CSI Pn ; . . . ; Pn u	DECSHTS	Set Horizontal Tab Stops
CSI Pn ; . . . ; Pn v	DECSVTS	Set Vertical Tab Stops
CSI Ps ! v	DECASFC	Automatic Sheet Feeder Control
CSI Ps w	DECSHORP	Set Horizontal Pitch
CSI Ps " z	DECDEN	Density Selection
CSI Ps z	DECVERP	Set Vertical Pitch
CSI Pn `	HPA	Horizontal Position Absolute

(continued on next page)

Table 7–10 (Cont.) Control Sequences Sorted by Final Character

Coding	Mnemonic	Name
CSI Ps " {	DECRFS	Request Font Status

Table 7–11 DCS Strings Sorted by Final Character

Coding	Mnemonic	Name
DCS Ps ! u D . . . D ST	DECAUPSS	Assign User Preference Supplemental set
DCS Pfn ; Pcn ; Pe ; Pcmw ; Pss ; Pu ; Pcmh ; Pess ; Psgr { D . . . D ST	DECDDL	Download font
ESC P 3 " { D . . . D ST	DECFSR	Cartridge Font Status Report

A

Character Sets

This appendix contains the code tables of the following character sets:

- ASCII Character Set, Figure A-1
- DEC Supplemental Character Set, Figure A-2
- DEC Special Graphics Character Set, Figure A-3
- DEC Technical Character Set, Figure A-4
- ISO Latin Alphabet No. 1 Supplemental Character Set, Figure A-5
- National Replacement Character (NRC) sets:
 - British Character Set, Figure A-6
 - DEC Finnish Character Set, Figure A-7
 - French Character Set, Figure A-8
 - DEC French-Canadian Character Set, Figure A-9
 - German Character Set, Figure A-10
 - ISO Italian Character Set, Figure A-11
 - JIS Roman Character Set, Figure A-12
 - DEC Norwegian/Danish Character Set, Figure A-13
 - ISO Spanish Character Set, Figure A-14
 - DEC Swedish Character Set, Figure A-15
 - Norwegian/Danish Character Set, Figure A-16
 - DEC Dutch Character Set, Figure A-17
 - DEC Swiss Character Set, Figure A-18
 - DEC Portuguese Character Set, Figure A-19
- Legal Character Set, Figure A-20

- Hebrew Character Sets:
 - DEC 7-Bit Hebrew Character Set, Figure A–21
 - DEC Hebrew Supplemental Character Set, Figure A–22
 - ISO Latin-Hebrew Supplemental Character Set, Figure A–23
- Greek Character Sets:
 - DEC Greek Supplemental Character Set, Figure A–24
 - ISO Latin-Greek Supplemental Character Set, Figure A–25
- Turkish Character Sets:
 - DEC 7-Bit Turkish Character Set, Figure A–26
 - DEC 8-Bit Turkish Supplemental Character Set, Figure A–27
 - ISO Latin Alphabet No. 5 Supplemental Character Set, Figure A–28
- Eastern European Character Sets:
 - ISO Latin Alphabet No. 2 Supplemental Character Set, Figure A–29
 - ISO Latin-Cyrillic Supplemental Character Set, Figure A–30
- JIS Katakana Character Set, Figure A–31

A.1 ASCII Character Set

The ASCII character set is specified by ANSI X3.4-1986. Figure A–1 illustrates the ASCII character set.

A.2 DEC Supplemental Character Set

The DEC Supplemental character set, shown in Figure A–2, consists of alphabetic characters and symbols not included in the ASCII character set. There are 81 characters defined in this set. The remaining character positions are considered “reserved for future use.” These positions are indicated by shaded boxes in the figure. The error character is printed when one of these reserved characters is received by the device.

Figure A-1 ASCII Character Set

ASCII Character Set

Row	GL GR		Column	GL GR		Column	GL GR		Column	GL GR		Column	GL GR		Column	GL GR		Column	Row
	2	10		3	11		4	12		5	13		6	14		7	15		
0				0	60 48 30 B0		@	100 64 40 C0		P	120 80 50 D0		`	140 96 60 E0		p	160 112 70 F0		0
1	!	41 33 21 A1		1	61 49 31 B1		A	101 65 41 C1		Q	121 81 51 D1		a	141 97 61 E1		q	161 113 71 F1		1
2	"	42 34 22 A2		2	62 50 32 B2		B	102 66 42 C2		R	122 82 52 D2		b	142 98 62 E2		r	162 114 72 F2		2
3	#	43 35 23 A3		3	63 51 33 B3		C	103 67 43 C3		S	123 83 53 D3		c	143 99 63 E3		s	163 115 73 F3		3
4	\$	44 36 24 A4		4	64 52 34 B4		D	104 68 44 C4		T	124 84 54 D4		d	144 100 64 E4		t	164 116 74 F4		4
5	%	45 37 25 A5		5	65 53 35 B5		E	105 69 45 C5		U	125 85 55 D5		e	145 101 65 E5		u	165 117 75 F5		5
6	&	46 38 26 A6		6	66 54 36 B6		F	106 70 46 C6		V	126 86 56 D6		f	146 102 66 E6		v	166 118 76 F6		6
7	'	47 39 27 A7		7	67 55 37 B7		G	107 71 47 C7		W	127 87 57 D7		g	147 103 67 E7		w	167 119 77 F7		7
8	(	50 40 28 A8		8	70 56 38 B8		H	110 72 48 C8		X	130 88 58 D8		h	150 104 68 E8		x	170 120 78 F8		8
9	)	51 41 29 A9		9	71 57 39 B9		I	111 73 49 C9		Y	131 89 59 D9		i	151 105 69 E9		y	171 121 79 F9		9
10	*	52 42 2A AA		:	72 58 3A BA		J	112 74 4A CA		Z	132 90 5A DA		j	152 106 6A EA		z	172 122 7A FA		10
11	+	53 43 2B AB		;	73 59 3B BB		K	113 75 4B CB		[	133 91 5B DB		k	153 107 6B EB		{	173 123 7B FB		11
12	,	54 44 2C AC		<	74 60 3C BC		L	114 76 4C CC		\	134 92 5C DC		l	154 108 6C EC			174 124 7C FC		12
13	-	55 45 2D AD		=	75 61 3D BD		M	115 77 4D CD		]	135 93 5D DD		m	155 109 6D ED		}	175 125 7D FD		13
14	.	56 46 2E AE		>	76 62 3E BE		N	116 78 4E CE		^	136 94 5E DE		n	156 110 6E EE		~	176 126 7E FE		14
15	/	57 47 2F AF		?	77 63 3F BF		O	117 79 4F CF		_	137 95 5F DF		o	157 111 6F EF					15

LEGEND

A	GL GR		Column/Row
	4/1	12/1	
	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Figure A-2 DEC Supplemental Character Set

DEC Supplemental Character Set															
Column		GL	GR			GL	GR			GL	GR			GL	GR
		2	10			3	11			4	12			5	13
Row	0					60 48 30	260 176 B0			100 64 40	300 192 C0			120 80 50	320 208 D0
				°		61 49 31	261 177 B1			101 65 41	301 193 C1			121 81 51	321 209 D1
1	i	41 33 21	241 161 A1	±		62 50 32	262 178 B2			102 66 42	302 194 C2			122 82 52	322 210 D2
2	¢	42 34 22	242 162 A2	2		63 51 33	263 179 B3			103 67 43	303 195 C3			123 83 53	323 211 D3
3	£	43 35 23	243 163 A3	3		64 52 34	264 180 B4			104 68 44	304 196 C4			124 84 54	324 212 D4
4		44 36 24	244 164 A4			65 53 35	265 181 B5			105 69 45	305 197 C5			125 85 55	325 213 D5
5	¥	45 37 25	245 165 A5	μ		66 54 36	266 182 B6			106 70 46	306 198 C6			126 86 56	326 214 D6
6		46 38 26	246 166 A6	¶		67 55 37	267 183 B7			107 71 47	307 199 C7			127 87 57	327 215 D7
7	§	47 39 27	247 167 A7	•		68 56 38	268 184 B8			108 72 48	308 200 C8			128 88 58	328 216 D8
8	✕	48 40 28	248 168 A8			69 57 39	269 185 B9			109 73 49	309 201 C9			129 89 59	329 217 D9
9	©	49 41 29	249 169 A9	1		70 58 40	270 186 BA			110 74 50	310 202 CA			130 90 60	330 218 DA
10	ª	50 42 30	250 170 AA	º		71 59 41	271 187 BB			111 75 51	311 203 CB			131 91 61	331 219 DB
11	«	51 43 31	251 171 AB	»		72 60 42	272 188 BC			112 76 52	312 204 CC			132 92 62	332 220 DC
12		52 44 32	252 172 AC	¼		73 61 43	273 189 BD			113 77 53	313 205 CD			133 93 63	333 221 DD
13		53 45 33	253 173 AD	½		74 62 44	274 190 BE			114 78 54	314 206 CE			134 94 64	334 222 DE
14		54 46 34	254 174 AE			75 63 45	275 191 BF			115 79 55	315 207 CF			135 95 65	335 223 DF
15		55 47 35	255 175 AF	¿		76 64 46	276 192 BG			116 80 56	316 208 DG			136 96 66	336 224 EG

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
/	101	301	Octal
A	65	193	Decimal
	41	C1	Hex

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A.3 DEC Special Graphics Character Set

The DEC Special Graphics character set contains 62 characters from the ASCII character set and 32 special graphics symbols.

These characters also connect with similar characters in the DEC Technical character set.

Figure A-3 DEC Special Graphics Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15		8	16		9	17		10	18		11	19	
Row 0				0	60 48 30	260 176 B0	@	100 64 C0	300 192 C0	P	120 80 D0	320 208 D0	◆	140 96 E0	340 224 E0	— SCAN 3	160 112 F0	360 240 F0	Row 0												
1	!	41 33 A1	241 161 A1	1	61 49 B1	261 177 B1	A	101 65 C1	301 193 C1	Q	121 81 D1	321 209 D1	■	141 97 E1	341 225 E1	— SCAN 5	161 113 F1	361 241 F1	1												
2	"	42 34 A2	242 162 A2	2	62 50 B2	262 178 B2	B	102 66 C2	302 194 C2	R	122 82 D2	322 210 D2	H T	142 98 E2	342 226 E2	— SCAN 7	162 114 F2	362 242 F2	2												
3	#	43 35 A3	243 163 A3	3	63 51 B3	263 179 B3	C	103 67 C3	303 195 C3	S	123 83 D3	323 211 D3	F F	143 99 E3	343 227 E3	— SCAN 9	163 115 F3	363 243 F3	3												
4	\$	44 36 A4	244 164 A4	4	64 52 B4	264 180 B4	D	104 68 C4	304 196 C4	T	124 84 D4	324 212 D4	C R	144 100 E4	344 228 E4	┌ SCAN 11	164 116 F4	364 244 F4	4												
5	%	45 37 A5	245 165 A5	5	65 53 B5	265 181 B5	E	105 69 C5	305 197 C5	U	125 85 D5	325 213 D5	L F	145 101 E5	345 229 E5	└ SCAN 13	165 117 F5	365 245 F5	5												
6	&	46 38 A6	246 166 A6	6	66 54 B6	266 182 B6	F	106 70 C6	306 198 C6	V	126 86 D6	326 214 D6	o	146 102 E6	346 230 E6	⊥ SCAN 15	166 118 F6	366 246 F6	6												
7	'	47 39 A7	247 167 A7	7	67 55 B7	267 183 B7	G	107 71 C7	307 199 C7	W	127 87 D7	327 215 D7	±	147 103 E7	347 231 E7	⊢ SCAN 17	167 119 F7	367 247 F7	7												
8	(	50 28 A8	250 168 A8	8	70 56 B8	270 184 B8	H	110 72 C8	310 200 C8	X	130 88 D8	330 216 D8	N L	150 104 E8	350 232 E8	 SCAN 19	170 120 F8	370 248 F8	8												
9	)	51 29 A9	251 169 A9	9	71 57 B9	271 185 B9	I	111 73 C9	311 201 C9	Y	131 89 D9	331 217 D9	V T	151 105 E9	351 233 E9	≡ SCAN 21	171 121 F9	371 249 F9	9												
10	*	52 2A AA	252 170 AA	:	72 58 BA	272 186 BA	J	112 74 CA	312 202 CA	Z	132 90 DA	332 218 DA	┘	152 106 EA	352 234 EA	≠ SCAN 23	172 122 FA	372 250 FA	10												
11	+	53 2B AB	253 171 AB	;	73 59 BB	273 187 BB	K	113 75 CB	313 203 CB	[	133 91 EB	333 219 EB	┐	153 107 EB	353 235 EB	π SCAN 25	173 123 FB	373 251 FB	11												
12	,	54 2C AC	254 172 AC	<	74 60 BC	274 188 BC	L	114 76 CC	314 204 CC	\	134 92 EC	334 220 EC	└	154 108 EC	3																

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

Character Sets **A-5**

A.4 DEC Technical Character Set

The DEC Technical character set, shown in Figure A–4, contains 85 characters including Greek letters, mathematical symbols, and logical symbols. The remaining character positions are considered “reserved for future use.” These positions are indicated by shaded boxes in the figure. The error character is printed when one of these reserved characters is received by the device.

The DEC Technical character set also contains component characters used for constructing larger mathematical symbols, such as large integral and summation signs on character cell devices.

The characters listed in Table A–1 are designed to span an appropriate distance horizontally and vertically so that these characters connect when printed at any supported horizontal pitch, and at 6 lines/inch vertical pitch to form large characters that may occupy several vertically adjacent or horizontally adjacent character positions. Diagonal characters may not connect well at horizontal pitches other than 1/10 in.

Figure A-4 DEC Technical Character Set

DEC Technical Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				}	60 176 30	260 176 B0	∴	100 300 40	340 192 C0	Π	120 320 50	320 208 D0	¬	140 340 60	340 224 E0	π	160 112 70	360 240 F0	Row 0
1	√	41 33 21	241 161 A1	⋖	61 49 31	261 177 B1	α	101 301 45	341 193 C1	Ψ	121 321 51	321 209 D1	α	141 341 61	341 225 E1	ψ	161 113 71	361 241 F1	1
2	⌊	42 34 22	242 162 A2	⋖	62 50 32	262 178 B2	∞	102 302 42	342 194 C2	▨	122 322 52	322 210 D2	β	142 342 62	342 226 E2	ρ	162 114 72	362 242 F2	2
3	—	43 35 23	243 163 A3	⋖	63 51 33	263 179 B3	÷	103 303 43	343 195 C3	Σ	123 323 53	323 211 D3	χ	143 343 63	343 227 E3	σ	163 115 73	363 243 F3	3
4	⌈	44 36 24	244 164 A4	⋖	64 52 34	264 180 B4	Δ	104 304 44	344 196 C4	▨	124 324 54	324 212 D4	δ	144 344 64	344 228 E4	τ	164 116 74	364 244 F4	4
5	⌋	45 37 25	245 165 A5	⋖	65 53 35	265 181 B5	∇	105 305 45	345 197 C5	▨	125 325 55	325 213 D5	ε	145 345 65	345 229 E5	▨	165 117 75	365 245 F5	5
6	⌊	46 38 26	246 166 A6	⋖	66 54 36	266 182 B6	Φ	106 306 46	346 198 C6	√	126 326 56	326 214 D6	φ	146 346 66	346 230 E6	f	166 118 76	366 246 F6	6
7	⌈	47 39 27	247 167 A7	⋖	67 55 37	267 183 B7	Γ	107 307 47	347 199 C7	Ω	127 327 57	327 215 D7	γ	147 347 67	347 231 E7	ω	167 119 77	367 247 F7	7
8	⌋	50 28 A8	250 168 A8	▨	70 58 38	270 184 B8	~	110 310 48	350 200 C8	Ξ	130 330 58	330 216 D8	η	150 350 68	350 232 E8	ξ	170 120 78	370 248 F8	8
9	⌈	51 29 A9	251 169 A9	▨	71 59 39	271 185 B9	≈	111 311 49	351 201 C9	T	131 331 59	331 217 D9	ι	151 351 69	351 233 E9	υ	171 121 79	371 249 F9	9
10	⌋	52 2A AA	252 170 AA	▨	72 58 3A	272 186 BA	Θ	112 312 4A	352 202 CA	⊂	132 332 5A	332 218 DA	θ	152 352 6A	352 234 EA	ζ	172 122 7A	372 250 FA	10
11	⌈	53 2B AB	253 171 AB	▨	73 59 3B	273 187 BB	×	113 313 4B	353 203 CB	⊃	133 333 5B	333 219 DB	κ	153 353 6B	353 235 EB	←	173 123 7B	373 251 FB	11
12	⌋	54 2C AC	254 172 AC	⊆	74 5C 3C	274 188 BC	Λ	114 314 4C	354 204 CC	∩	134 334 5C	334 220 DC	λ	154 354 6C	354 236 EC	↑	174 124 7C	374 252 FC	12
13	⌈	55 2D AD	255 173 AD	≠	75 5D 3D	275 189 BD	↔	115 315 4D	355 205 CD	∪	135 335 5D	335 221 DD	▨	155 355 6D	355 237 ED	→	175 125 7D	375 253 FD	13
14	⌋	56 2E AE	256 174 AE	⊇	76 5E 3E	276 190 BE	⇒	116 316 4E	356 206 CE	∧	136 336 5E	336 222 DE	ν	156 356 6E	356 238 EE	↓	176 126 7E	376 254 FE	14
15	{	57 2F AF	257 175 AF	⌋	77 5F 3F	277 191 BF	≡	117 317 4F	357 207 CF	∨	137 337 5F	337 223 DF	∂	157 357 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
α	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Table A–1 DEC Technical Character Set Component Characters

Code	Radical Sign	Integral Sign	Square Brackets	Curly Braces	Parentheses	Summation Sign
2/1	•					
2/2	•					
2/3	•					•
2/4		•				
2/5		•				
2/6	•	•	•	•	•	
2/7			•			
2/8			•			
2/9			•			
2/10			•			
2/11				•	•	
2/12				•	•	
2/13				•	•	
2/14				•	•	
2/15				•		
3/0				•		
3/1						•
3/2						•
3/3						•
3/4						•
3/5						•
3/6						•
3/7						•

A.5 ISO Latin Alphabet No. 1 Supplemental Character Set

The majority of the characters used in the ISO Latin Alphabet No. 1 Supplemental character set are the same as in the DEC Supplemental character set. This character set is specified by ISO 8859-1. The ISO Latin-1 Supplemental character set is a 96-character graphic character set. Figure A–5 illustrates the ISO Latin-1 Supplemental character set.

Figure A-5 ISO Latin Alphabet No. 1 Supplemental Character Set

ISO Latin-1 Supplemental Character Set

	GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0	NBSP	240 160 A0	°	260 176 B0	À	300 192 C0	Ð	320 208 D0	à	340 224 E0	ð	360 240 F0						
1	í	241 161 A1	±	261 177 B1	Á	301 193 C1	Ñ	321 209 D1	á	341 225 E1	ñ	361 241 F1						
2	¢	242 162 A2	²	262 178 B2	Â	302 194 C2	Ò	322 210 D2	â	342 226 E2	ò	362 242 F2						
3	£	243 163 A3	³	263 179 B3	Ã	303 195 C3	Ó	323 211 D3	ã	343 227 E3	ó	363 243 F3						
4	¤	244 164 A4	´	264 180 B4	Ä	304 196 C4	Ô	324 212 D4	ä	344 228 E4	ô	364 244 F4						
5	¥	245 165 A5	µ	265 181 B5	Å	305 197 C5	Õ	325 213 D5	å	345 229 E5	õ	365 245 F5						
6	¦	246 166 A6	¶	266 182 B6	Æ	306 198 C6	Ö	326 214 D6	æ	346 230 E6	ö	366 246 F6						
7	§	247 167 A7	·	267 183 B7	Ç	307 199 C7	×	327 215 D7	ç	347 231 E7	÷	367 247 F7						
8	¨	250 168 A8	¸	270 184 B8	È	310 200 C8	Ø	330 216 D8	è	350 232 E8	ø	370 248 F8						
9	©	251 169 A9	¹	271 185 B9	É	311 201 C9	Ù	331 217 D9	é	351 233 E9	ù	371 249 F9						
10	ª	252 170 AA	º	272 186 BA	Ê	312 202 CA	Ú	332 218 DA	ê	352 234 EA	ú	372 250 FA						
11	«	253 171 AB	»	273 187 BB	Ë	313 203 CB	Û	333 219 DB	ë	353 235 EB	û	373 251 FB						
12	¬	254 172 AC	¼	274 188 BC	Ì	314 204 CC	Ü	334 220 DC	ì	354 236 EC	ü	374 252 FC						
13	-	255 173 AD	½	275 189 BD	Í	315 205 CD	Ý	335 221 DD	í	355 237 ED	ý	375 253 FD						
14	®	256 174 AE	¾	276 190 BE	Î	316 206 CE	Þ	336 222 DE	î	356 238 EE	þ	376 254 FE						
15	¯	257 175 AF	¿	277 191 BF	Ï	317 207 CF	ß	337 223 DF	ï	357 239 EF	ÿ	377 255 FF						

LEGEND

	GR	
12/1	Column/Row	
301	Octal	
193	Decimal	
C1	Hex	

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A.6 National Replacement Character (NRC) Sets

Each National Replacement Character (NRC) set contains 94 characters. Characters in the NRC sets differ from the ASCII set in up to 12 locations, as specified in ISO 646. Different characters are selected in each NRC set to satisfy local language requirements in 7-bit environments. This section contains the code tables for the following NRCs:

- British Character Set, Figure A–6
- DEC Finnish Character Set, Figure A–7
- French Character Set, Figure A–8
- DEC French-Canadian Character Set, Figure A–9
- German Character Set, Figure A–10
- ISO Italian Character Set, Figure A–11
- JIS Roman Character Set, Figure A–12
- DEC Norwegian/Danish Character Set, Figure A–13
- ISO Spanish Character Set, Figure A–14
- DEC Swedish Character Set, Figure A–15
- Norwegian/Danish Character Set, Figure A–16
- DEC Dutch Character Set, Figure A–17
- DEC Swiss Character Set, Figure A–18
- DEC Portuguese Character Set, Figure A–19

NRC sets are often constructed by the device using ASCII and either ISO Latin-1 Supplemental or DEC Supplemental, as described in Section 4.3.3. If both are available, the device uses ISO Latin-1. The process of combining compatible fonts to create a third font is called **pairing**.

Since ISO Latin-1 Supplemental and DEC Supplemental differ in a few positions, the exact supplemental character positions used for NRC character sets sometimes differ, depending on which supplemental set is used to do the pairing. A few characters are not available in DEC Supplemental.

Table A–2 contains pairing information for all NRC pairing instances in which the output differs depending on the supplemental set used. All other instances produce identical output, whether the DEC Supplemental or the ISO Latin-1 Supplemental character set is used.

Positions from 2/1–7/14 are from the ASCII character set. Positions from 10/0–15/15 are from the supplemental character set.

Table A–2 National Replacement Character Set Pairing Fallbacks

Character Set	Character	NRC Pairing Fallback	
		DEC Supp.	ISO Latin-1 Supp.
DEC Dutch, French	Dieresis (¨)	02/02 (")	10/08 (¨)
DEC Dutch	Acute accent (´)	02/07 (´)	11/04 (´)
DEC Dutch	Fraction three-quarters ($\frac{3}{4}$)	11/03 (³)	11/14 ($\frac{3}{4}$)
DEC Dutch	Small ij ligature (ij)	15/13 (ÿ)	15/15 (ÿ)
JIS Roman	Macron	7/14 (~)	10/15

Figure A-6 British Character Set

British NRCS

		GL GR			GL GR			GL GR			GL GR			GL GR			GL GR		
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 48 30	260 176 80	@	100 64 40	300 192 C0	P	120 320 208 50	320 208 D0	`	140 340 96 60 E0	240 220 p	160 112 70	360 240 F0	Row 0	
1	!	41 33 21 A1	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 341 97 61 E1	241 225 E1	161 113 71	361 241 F1	1	
2	"	42 34 22 A2	242 162 A2	2	62 50 32 B2	262 178 B2	B	102 66 42 C2	302 194 C2	R	122 322 52 D2	322 210 D2	b	142 342 98 62 E2	242 226 E2	162 114 72 F2	362 242 F2	2	
3	£	43 35 23 A3	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43 C3	303 195 C3	S	123 323 53 D3	323 211 D3	c	143 343 99 63 E3	243 227 E3	163 115 73 F3	363 243 F3	3	
4	\$	44 36 24 A4	244 164 A4	4	64 52 34 B4	264 180 B4	D	104 68 44 C4	304 196 C4	T	124 324 54 D4	324 212 D4	d	144 344 100 64 E4	244 228 E4	164 116 74 F4	364 244 F4	4	
5	%	45 37 25 A5	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45 C5	305 197 C5	U	125 325 55 D5	325 213 D5	e	145 345 101 65 E5	245 229 E5	165 117 75 F5	365 245 F5	5	
6	&	46 38 26 A6	246 166 A6	6	66 54 36 B6	266 182 B6	F	106 70 46 C6	306 198 C6	V	126 326 56 D6	326 214 D6	f	146 346 102 66 E6	246 230 E6	166 118 76 F6	366 246 F6	6	
7	'	47 39 27 A7	247 167 A7	7	67 55 37 B7	267 183 B7	G	107 71 47 C7	307 199 C7	W	127 327 57 D7	327 215 D7	g	147 347 103 67 E7	247 231 E7	167 119 77 F7	367 247 F7	7	
8	(	50 42 28 A8	250 168 A8	8	70 56 38 B8	270 184 B8	H	110 72 48 C8	310 200 C8	X	130 330 58 D8	330 216 D8	h	150 350 104 68 E8	250 232 E8	170 120 78 F8	370 248 F8	8	
9	)	51 41 29 A9	251 169 A9	9	71 57 39 B9	271 185 B9	I	111 73 49 C9	311 201 C9	Y	131 331 59 D9	331 217 D9	i	151 351 105 69 E9	251 233 E9	171 121 79 F9	371 249 F9	9	
10	*	52 42 2A AA	252 170 AA	:	72 58 3A BA	272 186 BA	J	112 74 4A CA	312 202 CA	Z	132 332 5A DA	332 218 DA	j	152 352 106 6A EA	252 234 EA	172 122 7A FA	372 250 FA	10	
11	+	53 43 2B AB	253 171 AB	;	73 59 3B BB	273 187 BB	K	113 75 4B CB	313 203 CB	[	133 333 5B DB	333 219 DB	k	153 353 107 6B EB	253 235 EB	173 123 7B FB	373 251 FB	11	
12	,	54 44 2C AC	254 172 AC	<	74 60 3C BC	274 188 BC	L	114 76 4C CC	314 204 CC	\	134 334 5C DC	334 220 DC	l	154 354 108 6C EC	254 236 EC	174 124 7C FC	374 252 FC	12	
13	-	55 45 2D AD	255 173 AD	=	75 61 3D BD	275 189 BD	M	115 77 4D CD	315 205 CD	]	135 335 5D DD	335 221 DD	m	155 355 109 6D ED	255 237 ED	175 125 7D FD	375 253 FD	13	
14	.	56 46 2E AE	256 174 AE	>	76 62 3E BE	276 190 BE	N	116 78 4E CE	316 206 CE	^	136 336 5E DE	336 222 DE	n	156 356 110 6E EE	256 238 EE	176 126 7E FE	376 254 FE	14	
15	/	57 47 2F AF	257 175 AF	?	77 63 3F BF	277 191 BF	O	117 79 4F CF	317 207 CF	—	137 337 5F DF	337 223 DF	o	157 357 111 6F EF	257 239 EF			15	

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Figure A-7 DEC Finnish Character Set

DEC Finnish NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 176 30	260 176 B0	@	100 64 40	300 192 C0	P	120 320 50	320 208 D0	é	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 322 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 323 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 324 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 325 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 326 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 327 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 28 21	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 330 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 29 22	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 331 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 22 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 332 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 23 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Ä	133 333 5B	333 219 DB	k	153 107 6B	353 235 EB	ä	173 123 7B	373 251 FB	11
12	,	54 24 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ö	134 334 5C	334 220 DC	l	154 108 6C	354 236 EC	ö	174 124 7C	374 252 FC	12
13	-	55 25 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Å	135 335 5D	335 221 DD	m	155 109 6D	355 237 ED	å	175 125 7D	375 253 FD	13
14	.	56 26 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	Ü	136 336 5E	336 222 DE	n	156 110 6E	356 238 EE	ü	176 126 7E	376 254 FE	14
15	/	57 27 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 337 5F	337 223 DF	o	157 111 6F	357 239 EF				15</

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Figure A-8 French Character Set

French NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0																			Row 0
				0	60 48 30	260 176 80	à	100 64 40	300 192 C0	P	120 320 50	320 208 D0	`	140 96 60	340 224 E0	p	160 112 70	360 240 F0	
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 322 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	£	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 323 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 324 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 325 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 326 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 327 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 42 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 330 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 43 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 331 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 44 30	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 332 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 45 31	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	o	133 333 5B	333 219 DB	k	153 107 6B	353 235 EB	/	173 123 7B	373 251 FB	11
12	,	54 46 32	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	ç	134 334 5C	334 220 DC	l	154 108 6C	354 236 EC	`	174 124 7C	374 252 FC	12
13	-	55 47 33	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	§	135 335 5D	335 221 DD	m	155 109 6D	355 237 ED	è	175 125 7D	375 253 FD	13
14	.	56 48 34	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 336 5E	336 222 DE	n	156 110 6E	356 238 EE	..	176 126 7E	376 254 FE	14
15	/	57 49 35	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 337 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Figure A-9 DEC French-Canadian Character Set

DEC French-Canadian NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 48 30	260 176 B0	à	100 64 40	300 192 C0	P	120 80 50	320 208 D0	ô	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 40 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	â	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	/	173 123 7B	373 251 FB	11
12	,	54 44 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	ç	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ù	174 124 7C	374 252 FC	12
13	-	55 45 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	ê	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	è	175 125 7D	375 253 FD	13
14	.	56 46 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	î	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	û	176 126 7E	376 254 FE	14
15	/	57 47 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR
	4/1	12/1
	101	301
	65	193
A	41	C1

Column/Row
Octal
Decimal
Hex

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Figure A-10 German Character Set

German NRCS

		GL GR			GL GR			GL GR			GL GR			GL GR			GL GR			
	Column	2	10		3	11		4	12		5	13		6	14		7	15		
Row 0				0	60 48 30	260 176 80	§	100 64 40	300 192 C0	P	120 320 50	320 208 D0	`	140 340 60	240 220 E0	p	160 112 70	360 240 F0		Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	61 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 341 61	241 225 E1	q	161 113 71	361 241 F1		1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 322 52	322 210 D2	b	142 342 62	242 226 E2	r	162 114 72	362 242 F2		2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 323 53	323 211 D3	c	143 343 63	243 227 E3	s	163 115 73	363 243 F3		3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 324 54	324 212 D4	d	144 344 64	244 228 E4	t	164 116 74	364 244 F4		4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 325 55	325 213 D5	e	145 345 65	245 229 E5	u	165 117 75	365 245 F5		5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 326 56	326 214 D6	f	146 346 66	246 230 E6	v	166 118 76	366 246 F6		6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 327 57	327 215 D7	g	147 347 67	247 231 E7	w	167 119 77	367 247 F7		7
8	(	50 42 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 330 58	330 216 D8	h	150 350 68	250 232 E8	x	170 120 78	370 248 F8		8
9	)	51 43 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 331 59	331 217 D9	i	151 351 69	251 233 E9	y	171 121 79	371 249 F9		9
10	*	52 44 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 332 5A	332 218 DA	j	152 352 6A	252 234 EA	z	172 122 7A	372 250 FA		10
11	+	53 45 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Ä	133 333 5B	333 219 DB	k	153 353 6B	253 235 EB	ä	173 123 7B	373 251 FB		11
12	,	54 46 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ö	134 334 5C	334 220 DC	l	154 354 6C	254 236 EC	ö	174 124 7C	374 252 FC		12
13	-	55 47 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Ü	135 335 5D	335 221 DD	m	155 355 6D	255 237 ED	ü	175 125 7D	375 253 FD		13
14	.	56 48 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 336 5E	336 222 DE	n	156 356 6E	256 238 EE	ß	176 126 7E	376 254 FE		14
15	/	57 49 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 337 5F	337 223 DF	o	157 357 6F	257 239 EF					15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003990

Figure A-11 ISO Italian Character Set

ISO Italian NRCS

Row	Column	GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	Row
		2	10		3	11		4	12		5	13		6	14		7	15	
0				0	48 B0	260 176 B0	§	64 40	100 300 C0	P	120 80 50	320 208 D0	ù	140 96 60	340 224 E0	p	160 112 70	360 240 F0	0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	65 41	101 301 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	66 42	102 302 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	£	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	67 43	103 303 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	68 44	104 304 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	69 45	105 305 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	70 46	106 306 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	71 47	107 307 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	48 40 28	248 168 A8	8	70 56 38	270 184 B8	H	72 48	110 310 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	73 49	111 311 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 30	252 170 AA	:	72 58 3A	272 186 BA	J	74 4A	112 312 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 31	253 171 AB	;	73 59 3B	273 187 BB	K	75 4B	113 313 CB	o	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	à	173 123 7B	373 251 FB	11
12	,	54 44 32	254 172 AC	<	74 60 3C	274 188 BC	L	76 4C	114 314 CC	ç	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ò	174 124 7C	374 252 FC	12
13	-	55 45 33	255 173 AD	=	75 61 3D	275 189 BD	M	77 4D	115 315 CD	é	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	è	175 125 7D	375 253 FD	13
14	.	56 46 34	256 174 AE	>	76 62 3E	276 190 BE	N	78 4E	116 316 CE	^	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	ì	176 126 7E	376 254 FE	14
15	/	57 47 35	257 175 AF	?	77 63 3F	277 191 BF	O	79 4F	117 317 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003991

Figure A-12 JIS Roman Character Set

JIS Roman NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0																			Row 0
				0	60 48 30	260 176 80	@	100 64 40	300 192 C0	P	120 320 50	320 208 D0	`	140 96 60	340 224 E0	p	160 112 70	360 240 F0	
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 322 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 323 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 324 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 325 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 326 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 327 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 40 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 330 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 331 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 30	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 332 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 31	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	[	133 333 5B	333 219 DB	k	153 107 6B	353 235 EB	{	173 123 7B	373 251 FB	11
12	,	54 44 32	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	¥	134 334 5C	334 220 DC	l	154 108 6C	354 236 EC		174 124 7C	374 252 FC	12
13	-	55 45 33	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	]	135 335 5D	335 221 DD	m	155 109 6D	355 237 ED	}	175 125 7D	375 253 FD	13
14	.	56 46 34	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 336 5E	336 222 DE	n	156 110 6E	356 238 EE	—	176 126 7E	376 254 FE	14
15	/	57 47 35	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 337 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003992

Figure A-13 DEC Norwegian/Danish Character Set

DEC Norwegian/Danish NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column		2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	48 B0	260 176 B0	Ä	100 64 40	300 192 C0	P	120 80 50	320 208 D0	ä	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	48 40 28	248 168 A8	8	68 56 38	268 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 30	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 31	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Æ	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	æ	173 123 7B	373 251 FB	11
12	,	54 44 32	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ø	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ø	174 124 7C	374 252 FC	12
13	-	55 45 33	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Å	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	å	175 125 7D	375 253 FD	13
14	.	56 46 34	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	Ü	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	ü	176 126 7E	376 254 FE	14
15	/	57 47 35	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR
	4/1	12/1
	Column/Row	
A	101	301
	65	193
	41	C1
	Octal Decimal Hex	

MLO-003993

Figure A-14 ISO Spanish Character Set

ISO Spanish NRCS

		GL GR			GL GR			GL GR			GL GR			GL GR			GL GR		
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0																			Row 0
1	!	41 33 21 A1	241 161 A1	0	68 40 30	260 176 80	§	100 64 40	300 192 C0	P	120 320 50 D0	320 208 D0	`	140 96 60 E0	340 224 E0	p	160 112 70	360 240 F0	1
2	"	42 34 22 A2	242 162 A2	2	62 50 32 B2	262 178 B2	B	102 66 42 C2	302 192 C2	R	122 322 52 D2	322 210 D2	b	142 98 62 E2	342 226 E2	r	162 114 72 F2	362 242 F2	2
3	£	43 35 23 A3	243 163 A3	3	63 51 33 B3	263 179 B3	C	103 67 43 C3	303 195 C3	S	123 323 53 D3	323 211 D3	c	143 99 63 E3	343 227 E3	s	163 115 73 F3	363 243 F3	3
4	\$	44 36 24 A4	244 164 A4	4	64 52 34 B4	264 180 B4	D	104 68 44 C4	304 196 C4	T	124 324 54 D4	324 212 D4	d	144 100 64 E4	344 228 E4	t	164 116 74 F4	364 244 F4	4
5	%	45 37 25 A5	245 165 A5	5	65 53 35 B5	265 181 B5	E	105 69 45 C5	305 197 C5	U	125 325 55 D5	325 213 D5	e	145 101 65 E5	345 229 E5	u	165 117 75 F5	365 245 F5	5
6	&	46 38 26 A6	246 166 A6	6	66 54 36 B6	266 182 B6	F	106 70 46 C6	306 198 C6	V	126 326 56 D6	326 214 D6	f	146 102 66 E6	346 230 E6	v	166 118 76 F6	366 246 F6	6
7	'	47 39 27 A7	247 167 A7	7	67 55 37 B7	267 183 B7	G	107 71 47 C7	307 199 C7	W	127 327 57 D7	327 215 D7	g	147 103 67 E7	347 231 E7	w	167 119 77 F7	367 247 F7	7
8	(	50 42 28 A8	250 168 A8	8	70 56 38 B8	270 184 B8	H	110 72 48 C8	310 200 C8	X	130 330 58 D8	330 216 D8	h	150 104 68 E8	350 232 E8	x	170 120 78 F8	370 248 F8	8
9	)	51 43 29 A9	251 169 A9	9	71 57 39 B9	271 185 B9	I	111 73 49 C9	311 201 C9	Y	131 331 59 D9	331 217 D9	i	151 105 69 E9	351 233 E9	y	171 121 79 F9	371 249 F9	9
10	*	52 44 2A AA	252 170 AA	:	72 58 3A BA	272 186 BA	J	112 74 4A CA	312 202 CA	Z	132 332 5A DA	332 218 DA	j	152 106 6A EA	352 234 EA	z	172 122 7A FA	372 250 FA	10
11	+	53 45 2B AB	253 171 AB	;	73 59 3B BB	273 187 BB	K	113 75 4B CB	313 203 CB	i	133 333 5B DB	333 219 DB	k	153 107 6B EB	353 235 EB	o	173 123 7B FB	373 251 FB	11
12	,	54 46 2C AC	254 172 AC	<	74 60 3C BC	274 188 BC	L	114 76 4C CC	314 204 CC	~ N	134 334 5C DC	334 220 DC	l	154 108 6C EC	354 236 EC	~ n	174 124 7C FC	374 252 FC	12
13	-	55 47 2D AD	255 173 AD	=	75 61 3D BD	275 189 BD	M	115 77 4D CD	315 205 CD	¿	135 335 5D DD	335 221 DD	m	155 109 6D ED	355 237 ED	ç	175 125 7D FD	375 253 FD	13
14	.	56 48 2E AE	256 174 AE	>	76 62 3E BE	276 190 BE	N	116 78 4E CE	316 206 CE	^	136 336 5E DE	336 222 DE	n	156 110 6E EE	356 238 EE	˘	176 126 7E FE	376 254 FE	14
15	/	57 49 2F AF	257 175 AF	?	77 63 3F BF	277 191 BF	O	117 79 4F CF	317 207 CF	—	137 337 5F DF	337 223 DF	o	157 111 6F EF	357 239 EF		357 255 FF	</	15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003994

Figure A-15 DEC Swedish Character Set

DEC Swedish NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 176 30	260 176 B0	É	100 64 C0	300 192 C0	P	120 320 50	320 208 D0	é	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 177	261 177 B1	A	101 65 41	301 193 C1	Q	121 321 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 322 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 323 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 324 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 325 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 326 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 327 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 28 21	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 330 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 29 22	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 331 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 22 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 332 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 23 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Ä	133 333 5B	333 219 DB	k	153 107 6B	353 235 EB	ä	173 123 7B	373 251 FB	11
12	,	54 2C 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ö	134 334 5C	334 220 DC	l	154 108 6C	354 236 EC	ö	174 124 7C	374 252 FC	12
13	-	55 2D 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Å	135 335 5D	335 221 DD	m	155 109 6D	355 237 ED	å	175 125 7D	375 253 FD	13
14	.	56 2E 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	Ü	136 336 5E	336 222 DE	n	156 110 6E	356 238 EE	ü	176 126 7E	376 254 FE	14
15	/	57 2F 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 337 5F	337 223 DF	o	157 111 6F	357 239 EF				1

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003995

Figure A-16 Norwegian/Danish Character Set

Norwegian/Danish NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 48 30	260 176 B0	@	100 64 40	300 192 C0	P	120 80 50	320 208 D0	`	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 42 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Æ	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	æ	173 123 7B	373 251 FB	11
12	,	54 44 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ø	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ø	174 124 7C	374 252 FC	12
13	-	55 45 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Å	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	å	175 125 7D	375 253 FD	13
14	.	56 46 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	~	176 126 7E	376 254 FE	14
15	/	57 47 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

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Figure A-17 DEC Dutch Character Set

DEC Dutch NRCS

		GL GR			GL GR			GL GR			GL GR			GL GR			GL GR		
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0																			Row 0
				0	60 176 30 B0	260 176 B0	¾	100 64 192 C0	P	120 320 208 D0	`	140 96 60 E0	p	160 224 70 F0	360 240 F0		160 240 F0		
1	!	41 33 21 A1	241 161 A1	1	61 49 177 B1	261 177 B1	A	101 65 193 C1	Q	121 81 209 D1	a	141 97 225 E1	q	161 241 71 F1	361 241 F1		161 241 F1		1
2	"	42 34 22 A2	242 162 A2	2	62 50 178 B2	262 178 B2	B	102 66 194 C2	R	122 82 210 D2	b	142 98 62 E2	r	162 242 72 F2	362 242 F2		162 242 F2		2
3	£	43 35 23 A3	243 163 A3	3	63 51 179 B3	263 179 B3	C	103 67 195 C3	S	123 83 211 D3	c	143 99 227 E3	s	163 243 73 F3	363 243 F3		163 243 F3		3
4	\$	44 36 24 A4	244 164 A4	4	64 52 180 B4	264 180 B4	D	104 68 196 C4	T	124 84 212 D4	d	144 100 64 E4	t	164 244 74 F4	364 244 F4		164 244 F4		4
5	%	45 37 25 A5	245 165 A5	5	65 53 181 B5	265 181 B5	E	105 69 197 C5	U	125 85 213 D5	e	145 101 65 E5	u	165 245 75 F5	365 245 F5		165 245 F5		5
6	&	46 38 26 A6	246 166 A6	6	66 54 182 B6	266 182 B6	F	106 70 198 C6	V	126 86 214 D6	f	146 102 66 E6	v	166 246 76 F6	366 246 F6		166 246 F6		6
7	'	47 39 27 A7	247 167 A7	7	67 55 183 B7	267 183 B7	G	107 71 199 C7	W	127 87 215 D7	g	147 103 67 E7	w	167 247 77 F7	367 247 F7		167 247 F7		7
8	(	50 42 28 A8	250 168 A8	8	70 56 184 B8	270 184 B8	H	110 72 200 C8	X	130 88 216 D8	h	150 104 68 E8	x	170 248 78 F8	370 248 F8		170 248 F8		8
9	)	51 43 29 A9	251 169 A9	9	71 57 185 B9	271 185 B9	I	111 73 201 C9	Y	131 89 217 D9	i	151 105 69 E9	y	171 249 79 F9	371 249 F9		171 249 F9		9
10	*	52 44 2A AA	252 170 AA	:	72 58 186 BA	272 186 BA	J	112 74 202 CA	Z	132 90 218 DA	j	152 106 6A EA	z	172 250 7A FA	372 250 FA		172 250 FA		10
11	+	53 45 2B AB	253 171 AB	;	73 59 187 BB	273 187 BB	K	113 75 203 CB	ij	133 91 219 DB	k	153 107 6B EA	..	173 251 7B FA	373 251 FB		173 251 FB		11
12	,	54 46 2C AC	254 172 AC	<	74 60 188 BC	274 188 BC	L	114 76 204 CC	½	134 92 220 DC	l	154 108 6C EA	f	174 252 7C FA	374 252 FC		174 252 FC		12
13	-	55 47 2D AD	255 173 AD	=	75 61 189 BD	275 189 BD	M	115 77 205 CD		135 93 221 DD	m	155 109 6D EA	¼	175 253 7D FA	375 253 FD		175 253 FD		13
14	.	56 48 2E AE	256 174 AE	>	76 62 190 BE	276 190 BE	N	116 78 206 CE	^	136 94 222 DE	n	156 110 6E EA	,	176 254 7E FA	376 254 FE		176 254 FE		14
15	/	57 49 2F AF	257 175 AF	?	77 63 191 BF	277 191 BF	O	117 79 207 CF	—	137 95 223 DE	o	157 111 6F EA		177 255 7F FA	377 255 FE		177 255 FE		15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

NOTE: The following table indicates the approximations that are used to represent the Dutch characters that are not available in the DEC MCS or ISO Latin-1 character sets. The character position in the chart is listed by Column/Row.

Column/Row	Character Set Name (Symbol)	Approximation Name (Symbol)
5/11	Lowercase ij Ligature (ij)	Lowercase y with Diaeresis (ÿ)
7/12	Florin Sign (ƒ)	Lowercase f (f)

Figure A-18 DEC Swiss Character Set

DEC Swiss NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 48 30	260 176 B0	à	100 64 40	300 192 C0	P	120 80 50	320 208 D0	ô	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	ù	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 40 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 30	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 31	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	é	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	ä	173 123 7B	373 251 FB	11
12	,	54 44 32	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	ç	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ö	174 124 7C	374 252 FC	12
13	-	55 45 33	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	ê	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	ü	175 125 7D	375 253 FD	13
14	.	56 46 34	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	î	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	û	176 126 7E	376 254 FE	14
15	/	57 47 35	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	è	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

NOTE: At Column/Row 5/15 lowercase e with grave accent replaces underline (_), which is used in ASCII and all other NRC sets.

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Figure A-19 DEC Portuguese Character Set

DEC Portuguese NRCS

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column		2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	48 176 30	260 B0	@	64 192 40	300 C0	P	120 80 50	320 208 D0	`	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	48 40 28	248 168 A8	8	68 56 38	268 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 30	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 31	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Ã	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	ã	173 123 7B	373 251 FB	11
12	,	54 44 32	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ç	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ç	174 124 7C	374 252 FC	12
13	-	55 45 33	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Õ	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	õ	175 125 7D	375 253 FD	13
14	.	56 46 34	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	~	176 126 7E	376 254 FE	14
15	/	57 47 35	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003999

A.7 Legal Character Set

The Legal character set contains 88 characters from the ASCII character set and 6 special graphic symbols often found in legal documents.

Figure A-20 illustrates the Legal character set.

Figure A-20 Legal Character Set

Legal																			
		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column		2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	60 48 30	260 176 B0	@	100 64 40	300 192 C0	P	120 80 50	320 208 D0	=	140 96 60	340 224 E0	p	160 112 70	360 240 F0	Row 0
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1	1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2	2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3	3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4	4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5	5
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6	6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7	7
8	(	50 40 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8	8
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9	9
10	*	52 42 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA	10
11	+	53 43 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	[	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	§	173 123 7B	373 251 FB	11
12	,	54 44 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	®	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	¶	174 124 7C	374 252 FC	12
13	-	55 45 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	]	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	†	175 125 7D	375 253 FD	13
14	.	56 46 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	©	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE	™	176 126 7E	376 254 FE	14
15	/	57 47 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	Column/Row
	4/1	12/1	
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-003982

A.8 Hebrew Character Sets

Three Hebrew character sets are supported:

- DEC 7-Bit Hebrew Character Set, Figure A–21
- DEC Hebrew Supplemental Character Set, Figure A–22
- ISO Latin-Hebrew Supplemental Character Set, Figure A–23

In the DEC Hebrew Supplemental and ISO Latin-Hebrew Supplemental character sets, some character positions are considered “reserved for future use.” These positions are indicated by shaded boxes in the figure. The error character is printed when one of these reserved characters is received by the device.

DEC 7-Bit Hebrew and DEC Hebrew Supplemental are 94-character graphic character sets and ISO Latin-Hebrew Supplemental is a 96-character graphic character set. The ISO Latin-Hebrew Supplemental character set is specified by ISO 8859-8.

Figure A-21 DEC 7-Bit Hebrew Character Set

DEC 7-Bit Hebrew Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0				0	48 60 30	260 176 61	@	100 300 40	300 192 C0	P	120 80 50	320 208 D0	ℵ	140 96 60	340 224 E0	160 112 70	360 240 F0	Row 0	
1	!	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	⋈	141 97 61	341 225 E1	161 113 71	361 241 F1	1	
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	λ	142 98 62	342 226 E2	162 114 72	362 242 F2	2	
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	⌈	143 99 63	343 227 E3	163 115 73	363 243 F3	3	
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	⌋	144 100 64	344 228 E4	164 116 74	364 244 F4	4	
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	⌋	145 101 65	345 229 E5	165 117 75	365 245 F5	5	
6	&	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	⌋	146 102 66	346 230 E6	166 118 76	366 246 F6	6	
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	⌋	147 103 67	347 231 E7	167 119 77	367 247 F7	7	
8	(	50 42 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	⌋	150 104 68	350 232 E8	170 120 78	370 248 F8	8	
9	)	51 41 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	⌋	151 105 69	351 233 E9	171 121 79	371 249 F9	9	
10	*	52 42 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	⌋	152 106 6A	352 234 EA	172 122 7A	372 250 FA	10	
11	+	53 43 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	[	133 91 5B	333 219 DB	⌋	153 107 6B	353 235 EB	173 123 7B	373 251 FB	11	
12	,	54 44 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	\	134 92 5C	334 220 DC	⌋	154 108 6C	354 236 EC	174 124 7C	374 252 FC	12	
13	-	55 45 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	]	135 93 5D	335 221 DD	⌋	155 109 6D	355 237 ED	175 125 7D	375 253 FD	13	
14	.	56 46 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	^	136 94 5E	336 222 DE	⌋	156 110 6E	356 238 EE	176 126 7E	376 254 FE	14	
15	/	57 47 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	⌋	157 111 6F	357 239 EF			15	

LEGEND

	GL	GR
	4/1	12/1
A	101 65 41	301 193 C1

Column/Row
Octal
Decimal
Hex

MLO-004001

Figure A-22 DEC Hebrew Supplemental Character Set

DEC Hebrew Supplemental Character Set

[illegible]

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-004002

Figure A-23 ISO Latin-Hebrew Supplemental Character Set

ISO Latin-Hebrew Supplemental Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row																			
0	NBSP	240 160 A0	°		260 176 B0			300 192 C0			320 208 D0	ℵ		340 224 E0	⋈		360 240 F0		Row 0
1		241 161 A1	±		261 177 B1			301 193 C1			321 209 D1	⋈		341 225 E1	⋈		361 241 F1		1
2	¢	242 162 A2	2		262 178 B2			302 194 C2			322 210 D2	λ		342 226 E2	ℵ		362 242 F2		2
3	£	243 163 A3	3		263 179 B3			303 195 C3			323 211 D3	⋈		343 227 E3	⋈		363 243 F3		3
4	¤	244 164 A4	,		264 180 B4			304 196 C4			324 212 D4	⋈		344 228 E4	⋈		364 244 F4		4
5	¥	245 165 A5	μ		265 181 B5			305 197 C5			325 213 D5	⋈		345 229 E5	⋈		365 245 F5		5
6	¦	246 166 A6	¶		266 182 B6			306 198 C6			326 214 D6	⋈		346 230 E6	⋈		366 246 F6		6
7	§	247 167 A7	•		267 183 B7			307 199 C7			327 215 D7	⋈		347 231 E7	⋈		367 247 F7		7
8	¨	250 168 A8	ˆ		270 184 B8			310 200 C8			330 216 D8	⋈		350 232 E8	⋈		370 248 F8		8
9	©	251 169 A9	1		271 185 B9			311 201 C9			331 217 D9	⋈		351 233 E9	⋈		371 249 F9		9
10	×	252 170 AA	÷		272 186 BA			312 202 CA			332 218 DA	⋈		352 234 EA	⋈		372 250 FA		10
11	«	253 171 AB	»		273 187 BB			313 203 CB			333 219 DB	⋈		353 235 EB			373 251 FB		11
12	⌈	254 172 AC	¼		274 188 BC			314 204 CC			334 220 DC	⋈		354 236 EC			374 252 FC		12
13	-	255 173 AD	½		275 189 BD			315 205 CD			335 221 DD	⋈		355 237 ED			375 253 FD		13
14	®	256 174 AE	¾		276 190 BE			316 206 CE			336 222 DE	⋈		356 238 EE			376 254 FE		14
15	-	257 175 AF			277 191 BF			317 207 CF			337 223 DF	⋈		357 239 EF			377 255 FF		15

LEGEND

	GR	
	12/1	Column/Row
	301	Octal
	193	Decimal
	C1	Hex

MLO-004003

A.9 Greek Character Sets

Two Greek character sets are supported:

- DEC Greek Supplemental Character Set, Figure A-24
- ISO Latin-Greek Supplemental Character Set, Figure A-25

In the DEC Greek Supplemental and ISO Latin-Greek Supplemental character sets, some character positions are considered “reserved for future use.” These positions are indicated by shaded boxes in the figure. The error character is printed when one of these reserved characters is received by the device.

DEC Greek Supplemental is a 94-character graphic character set. ISO Latin-Greek Supplemental is a 96-character graphic character set. The ISO Latin-Greek Supplemental character set is specified by ISO 8859-7.

Figure A-24 DEC Greek Supplemental Character Set

DEC Greek Supplemental Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row				°	60 48 30	260 176 B0	°	100 64 C0	300 192 C0		120 80 50	320 208 D0	°	140 96 60	340 224 E0		160 112 70	360 240 F0	Row
0				°	60 48 30	260 176 B0	°	100 64 C0	300 192 C0		120 80 50	320 208 D0	°	140 96 60	340 224 E0		160 112 70	360 240 F0	
1	i	41 33 21	241 161 A1	±	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Π	121 81 51	321 209 D1	α	141 97 61	341 225 E1	π	161 113 71	361 241 F1	1
2	¢	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	P	122 82 52	322 210 D2	β	142 98 62	342 226 E2	ρ	162 114 72	362 242 F2	2
3	£	43 35 23	243 163 A3	3	63 51 33	263 179 B3	Γ	103 67 43	303 195 C3	Σ	123 83 53	323 211 D3	γ	143 99 63	343 227 E3	σ	163 115 73	363 243 F3	3
4		44 36 24	244 164 A4		64 52 34	264 180 B4	Δ	104 68 44	304 196 C4	T	124 84 54	324 212 D4	δ	144 100 64	344 228 E4	τ	164 116 74	364 244 F4	4
5	¥	45 37 25	245 165 A5	μ	65 53 35	265 181 B5	E	105 69 45	305 197 C5	Υ	125 85 55	325 213 D5	ε	145 101 65	345 229 E5	υ	165 117 75	365 245 F5	5
6		46 38 26	246 166 A6	¶	66 54 36	266 182 B6	Z	106 70 46	306 198 C6	Φ	126 86 56	326 214 D6	ζ	146 102 66	346 230 E6	φ	166 118 76	366 246 F6	6
7	§	47 39 27	247 167 A7	•	67 55 37	267 183 B7	H	107 71 47	307 199 C7	X	127 87 57	327 215 D7	η	147 103 67	347 231 E7	χ	167 119 77	367 247 F7	7
8	✂	50 28 21	250 168 A8		70 58 38	270 184 B8	Θ	110 72 48	310 200 C8	Ψ	130 88 58	330 216 D8	θ	150 104 68	350 232 E8	ψ	170 120 78	370 248 F8	8
9	©	51 29 22	251 169 A9	1	71 59 39	271 185 B9	I	111 73 49	311 201 C9	Ω	131 89 59	331 217 D9	ι	151 105 69	351 233 E9	ω	171 121 79	371 249 F9	9
10	à	52 2A 2A	252 170 AA	²	72 60 3A	272 186 BA	K	112 74 4A	312 202 CA	α	132 90 5A	332 218 DA	κ	152 106 6A	352 234 EA	ς	172 122 7A	372 250 FA	10
11	«	53 2B 2B	253 171 AB	»	73 61 3B	273 187 BB	Λ	113 75 4B	313 203 CB	ε	133 91 5B	333 219 DB	λ	153 107 6B	353 235 EB	ι	173 123 7B	373 251 FB	11
12		54 2C 2C	254 172 AC	¼	74 60 3C	274 188 BC	M	114 76 4C	314 204 CC	η	134 92 5C	334 220 DC	μ	154 108 6C	354 236 EC	ι	174 124 7C	374 252 FC	12
13		55 2D 2D	255 173 AD	½	75 61 3D	275 189 BD	N	115 77 4D	315 205 CD	ι	135 93 5D	335 221 DD	ν	155 109 6D	355 237 ED	ι	175 125 7D	375 253 FD	13
14		56 2E 2E	256 174 AE		76 62 3E	276 190 BE	Ξ	116 78 4E	316 206 CE		136 94 5E	336 222 DE	ξ	156 110 6E	356 238 EE		176 126 7E	376 254 FE	14
15		57 2F 2F	257 175 AF	¾	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	ο	137 95 5F	337 223 DF	ο	157 111 6F	357 239 EF				15

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-006607

Figure A-25 ISO Latin-Greek Supplemental Character Set

ISO Latin-Greek Supplemental Character Set

	GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
Column	2	10		3	11		4	12		5	13		6	14		7	15
Row 0	NBSP	40 240 32 160 20 A0	°	60 260 48 176 30 B0	ı	100 300 64 40 192 C0	Π	120 320 80 208 50 D0	ˆ	140 340 96 224 60 E0	π	160 360 112 240 70 F0					
1	`	41 241 33 161 21 A1	±	61 261 49 177 31 B1	Α	101 301 65 41 193 C1	Ρ	121 321 81 209 51 D1	α	141 341 97 225 61 E1	ρ	161 361 113 241 71 F1					
2	´	42 242 34 162 22 A2	²	62 262 50 178 32 B2	Β	102 302 66 42 194 C2		122 322 82 210 52 D2	β	142 342 98 226 62 E2	ς	162 362 114 242 72 F2					
3	£	43 243 35 163 23 A3	³	63 263 51 179 33 B3	Γ	103 303 67 43 195 C3	Σ	123 323 83 211 53 D3	γ	143 343 99 227 63 E3	σ	163 363 115 243 73 F3					
4		44 244 36 164 24 A4	´	64 264 52 180 34 B4	Δ	104 304 68 44 196 C4	Τ	124 324 84 212 54 D4	δ	144 344 100 228 64 E4	τ	164 364 116 244 74 F4					
5		45 245 37 165 25 A5	¨	65 265 53 181 35 B5	Ε	105 305 69 45 197 C5	Υ	125 325 85 213 55 D5	ε	145 345 101 229 65 E5	υ	165 365 117 245 75 F5					
6	ı	46 246 38 166 26 A6	ˆ	66 266 54 182 36 B6	Ζ	106 306 70 46 198 C6	Φ	126 326 86 214 56 D6	ζ	146 346 102 230 66 E6	φ	166 366 118 246 76 F6					
7	§	47 247 39 167 27 A7	•	67 267 55 183 37 B7	Η	107 307 71 47 199 C7	Χ	127 327 87 215 57 D7	η	147 347 103 231 67 E7	χ	167 367 119 247 77 F7					
8	¨	50 250 40 168 28 A8	ˆ	68 268 56 184 38 B8	Θ	110 310 72 48 200 C8	Ψ	130 330 88 216 58 D8	θ	150 350 104 232 68 E8	ψ	170 370 120 248 78 F8					
9	©	51 251 41 169 29 A9	ˆ	69 269 57 185 39 B9	Ι	111 311 73 49 201 C9	Ω	131 331 89 217 59 D9	ι	151 351 105 233 69 E9	ω	171 371 121 249 79 F9					
10		52 252 42 170 2A AA	ˆ	70 270 58 186 3A BA	Κ	112 312 74 50 202 CA	İ	132 332 90 218 5A DA	κ	152 352 106 234 6A EA	ı	172 372 122 250 7A FA					
11	<<	53 253 43 171 2B AB	>>	73 273 59 187 3B BB	Λ	113 313 75 50 203 CB	Ț	133 333 91 219 5B DB	λ	153 353 107 235 6B EB	ü	173 373 123 251 7B FB					
12	¬	54 254 44 172 2C AC	ˆ	74 274 60 188 3C BC	Μ	114 314 76 52 204 CC	ˆ	134 334 92 220 5C DC	μ	154 354 108 236 6C EC	ˆ	174 374 124 252 7C FC					
13	-	55 255 45 173 2D AD	½	75 275 61 189 3D BD	Ν	115 315 77 53 205 CD	ˆ	135 335 93 221 5D DD	ν	155 355 109 237 6D ED	ˆ	175 375 125 253 7D FD					
14		56 256 46 174 2E AE	ˆ	76 276 62 190 3E BE	Ξ	116 316 78 54 206 CE	ˆ	136 336 94 222 5E DE	ξ	156 356 110 238 6E EE	ˆ	176 376 126 254 7E FE					
15	—	57 257 47 175 2F AF	ˆ	77 277 63 191 3F BF	Ο	117 317 79 55 207 CF	ˆ	137 337 95 223 5F DF	ο	157 357 111 239 6F EF		177 377 127 255 7F FF					

LEGEND

	GL	GR
	4/1	12/1
	101	301
A	65	193
	41	C1

Column/Row
Octal
Decimal
Hex

MLO-006610

A.10 Turkish Character Sets

Three Turkish character sets are supported:

- DEC 7-Bit Turkish Character Set, Figure A–26
- DEC 8-Bit Turkish Supplemental Character Set, Figure A–27
- ISO Latin Alphabet No. 5 Supplemental Character Set, Figure A–28

DEC 8-Bit Turkish Supplemental and DEC 7-Bit Turkish are 94-character graphic character sets. ISO Latin-5 Supplemental is a 96-character graphic character set. The ISO Latin-5 Supplemental character set is specified by ISO 8859-9.

Figure A-26 DEC 7-Bit Turkish Character Set

DEC 7-Bit Turkish Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
	Column	2	10		3	11		4	12		5	13		6	14		7	15
Row																		
0				0	60 48 30	260 176 B0	ı	100 64 40	300 192 C0	P	120 80 50	320 208 D0	ç	140 96 60	340 224 E0	p	160 112 70	360 240 F0
1	ı	41 33 21	241 161 A1	1	61 49 31	261 177 B1	A	101 65 41	301 193 C1	Q	121 81 51	321 209 D1	a	141 97 61	341 225 E1	q	161 113 71	361 241 F1
2	"	42 34 22	242 162 A2	2	62 50 32	262 178 B2	B	102 66 42	302 194 C2	R	122 82 52	322 210 D2	b	142 98 62	342 226 E2	r	162 114 72	362 242 F2
3	#	43 35 23	243 163 A3	3	63 51 33	263 179 B3	C	103 67 43	303 195 C3	S	123 83 53	323 211 D3	c	143 99 63	343 227 E3	s	163 115 73	363 243 F3
4	\$	44 36 24	244 164 A4	4	64 52 34	264 180 B4	D	104 68 44	304 196 C4	T	124 84 54	324 212 D4	d	144 100 64	344 228 E4	t	164 116 74	364 244 F4
5	%	45 37 25	245 165 A5	5	65 53 35	265 181 B5	E	105 69 45	305 197 C5	U	125 85 55	325 213 D5	e	145 101 65	345 229 E5	u	165 117 75	365 245 F5
6	ğ	46 38 26	246 166 A6	6	66 54 36	266 182 B6	F	106 70 46	306 198 C6	V	126 86 56	326 214 D6	f	146 102 66	346 230 E6	v	166 118 76	366 246 F6
7	'	47 39 27	247 167 A7	7	67 55 37	267 183 B7	G	107 71 47	307 199 C7	W	127 87 57	327 215 D7	g	147 103 67	347 231 E7	w	167 119 77	367 247 F7
8	(	50 42 28	250 168 A8	8	70 56 38	270 184 B8	H	110 72 48	310 200 C8	X	130 88 58	330 216 D8	h	150 104 68	350 232 E8	x	170 120 78	370 248 F8
9	)	51 43 29	251 169 A9	9	71 57 39	271 185 B9	I	111 73 49	311 201 C9	Y	131 89 59	331 217 D9	i	151 105 69	351 233 E9	y	171 121 79	371 249 F9
10	*	52 44 2A	252 170 AA	:	72 58 3A	272 186 BA	J	112 74 4A	312 202 CA	Z	132 90 5A	332 218 DA	j	152 106 6A	352 234 EA	z	172 122 7A	372 250 FA
11	+	53 45 2B	253 171 AB	;	73 59 3B	273 187 BB	K	113 75 4B	313 203 CB	Ş	133 91 5B	333 219 DB	k	153 107 6B	353 235 EB	ş	173 123 7B	373 251 FB
12	,	54 46 2C	254 172 AC	<	74 60 3C	274 188 BC	L	114 76 4C	314 204 CC	Ö	134 92 5C	334 220 DC	l	154 108 6C	354 236 EC	ö	174 124 7C	374 252 FC
13	-	55 47 2D	255 173 AD	=	75 61 3D	275 189 BD	M	115 77 4D	315 205 CD	Ç	135 93 5D	335 221 DD	m	155 109 6D	355 237 ED	ç	175 125 7D	375 253 FD
14	.	56 48 2E	256 174 AE	>	76 62 3E	276 190 BE	N	116 78 4E	316 206 CE	Ü	136 94 5E	336 222 DE	n	156 110 6E	356 238 EE		176 126 7E	376 254 FE
15	/	57 49 2F	257 175 AF	?	77 63 3F	277 191 BF	O	117 79 4F	317 207 CF	—	137 95 5F	337 223 DF	o	157 111 6F	357 239 EF			

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
A	101	301	Octal
	65	193	Decimal
	41	C1	Hex

MLO-006605

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
	Column	2	10		3	11		4	12		5	13		6	14		7	15												
Row 0				°	60 48 170	260 176 B0	` Å	100 64 40	300 192 C0	˘ Ğ	120 80 50	320 208 D0	à â	140 96 60	340 224 E0	ğ ğ	160 112 70	360 240 F0												
1	i	41 33 21	241 161 A1	±	61 49 31	261 177 B1	´ Á	101 65 41	301 193 C1	˙ Ñ	121 81 51	321 209 D1	á ä	141 97 61	341 225 E1	ñ ñ	161 113 71	361 241 F1												
2	İ	42 34 22	242 162 A2	2	62 50 32	262 178 B2	Â Ä	102 66 42	302 194 C2	˚ Ö	122 82 52	322 210 D2	â å	142 98 62	342 226 E2	ö ö	162 114 72	362 242 F2												
3	£	43 35 23	243 163 A3	3	63 51 33	263 179 B3	Ã Å	103 67 43	303 195 C3	ó Ó	123 83 53	323 211 D3	ã ä	143 99 63	343 227 E3	ó ó	163 115 73	363 243 F3												
4		44 36 24	244 164 A4		64 52 34	264 180 B4	Ä Å	104 68 44	304 196 C4	ô Ô	124 84 54	324 212 D4	ä å	144 100 64	344 228 E4	ô ô	164 116 74	364 244 F4												
5	¥	45 37 25	245 165 A5	µ	65 53 35	265 181 B5	Å Æ	105 69 45	305 197 C5	õ Ö	125 85 55	325 213 D5	å æ	145 101 65	345 229 E5	õ ö	165 117 75	365 245 F5												
6		46 38 26	246 166 A6	¶	66 54 36	266 182 B6	Æ Ç	106 70 46	306 198 C6	ö Ö	126 86 56	326 214 D6	æ ç	146 102 66	346 230 E6	ö ç	166 118 76	366 246 F6												
7	§	47 39 27	247 167 A7	•	67 55 37	267 183 B7	Ç D	107 71 47	307 199 C7	œ E	127 87 57	327 215 D7	ç d	147 103 67	347 231 E7	œ e	167 119 77	367 247 F7												
8	¤	50 42 28	250 168 A8		70 56 38	270 184 B8	È É	110 72 48	310 200 C8	ø E	130 88 58	330 216 D8	è é	150 104 68	350 232 E8	ø e	170 120 78	370 248 F8												
9	©	51 41 29	251 169 A9	1	71 57 39	271 185 B9	É Ê	111 73 49	311 201 C9	ù U	131 89 59	331 217 D9	é f	151 105 69	351 233 E9	ù f	171 121 79	371 249 F9												
10	à	52 42 30	252 170 A0	à	72 58 3A	272 186 BA	Ê Ë	112 74 50	312 202 CA	ú U	132 90 5A	332 218 DA	ê g	152 106 6A	352 234 EA	ú g	172 122 7A	372 250 FA												
11	«	53 43 31	253 171 AB	»	73 59 3B	273 187 BB	Ë Ì	113 75 4B	313 203 CB	û U	133 91 5B	333 219 DB	ë h	153 107 6B	353 235 EB	û h	173 123 7B	373 251 FB												
12		54 44 32	254 172 AC	¼	74 60 3C	274 188 BC	Ì Í	114 76 4C	314 204 CC	ü U																				

	GL	GR	
	4/1	12/1	Column/Row
/	101	301	Octal
A	65	193	Decimal
	41	C1	Hex

Character Sets **A-37**

Figure A-28 ISO Latin-5 Supplemental Character Set

ISO Latin-5 Supplemental Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
	Column	2	10		3	11		4	12		5	13		6	14		7	15													
Row 0	NBSP	40 32 20 A0	240 160 A0	°	60 48 30 B0	260 176 80	À	100 64 40 C0	300 192 C0	Ġ	120 80 D0	320 208 D0	à	140 96 60 E0	340 224 E0	ġ	160 112 70 F0	360 240 F0													
1	ı	41 33 21 A1	241 161 A1	±	61 49 31 B1	261 177 81	Á	101 65 41 C1	301 193 C1	Ñ	121 81 D1	321 209 D1	á	141 97 61 E1	341 225 E1	ñ	161 113 71 F1	361 241 F1													
2	¢	42 34 22 A2	242 162 A2	2	62 50 32 B2	262 178 82	Â	102 66 42 C2	302 194 C2	Ò	122 82 D2	322 210 D2	â	142 98 62 E2	342 226 E2	ò	162 114 72 F2	362 242 F2													
3	£	43 35 23 A3	243 163 A3	3	63 51 33 B3	263 179 83	Ã	103 67 43 C3	303 195 C3	Ó	123 83 D3	323 211 D3	ã	143 99 63 E3	343 227 E3	ó	163 115 73 F3	363 243 F3													
4	¤	44 36 24 A4	244 164 A4	,	64 52 34 B4	264 180 84	Ä	104 68 44 C4	304 196 C4	Ô	124 84 D4	324 212 D4	ä	144 100 64 E4	344 228 E4	ô	164 116 74 F4	364 244 F4													
5	¥	45 37 25 A5	245 165 A5	μ	65 53 35 B5	265 181 85	Å	105 69 45 C5	305 197 C5	Õ	125 85 D5	325 213 D5	å	145 101 65 E5	345 229 E5	õ	165 117 75 F5	365 245 F5													
6	ı	46 38 26 A6	246 166 A6	¶	66 54 36 B6	266 182 86	Æ	106 70 46 C6	306 198 C6	Ö	126 86 D6	326 214 D6	æ	146 102 66 E6	346 230 E6	ö	166 118 76 F6	366 246 F6													
7	§	47 39 27 A7	247 167 A7	•	67 55 37 B7	267 183 87	Ç	107 71 47 C7	307 199 C7	×	127 87 D7	327 215 D7	ç	147 103 67 E7	347 231 E7	÷	167 119 77 F7	367 247 F7													
8	¨	50 42 28 A8	250 168 A8	ˆ	70 58 38 B8	270 184 88	È	110 72 48 C8	310 200 C8	Ø	130 88 D8	330 216 D8	è	150 104 68 E8	350 232 E8	ø	170 120 78 F8	370 248 F8													
9	©	51 43 29 A9	251 169 A9	1	71 57 39 B9	271 185 89	É	111 73 49 C9	311 201 C9	Ù	131 89 D9	331 217 D9	é	151 105 69 E9	351 233 E9	ù	171 121 79 F9	371 249 F9													
10	à	52 44 2A AA	252 170 AA	º	72 58 3A BA	272 186 8A	Ê	112 74 4A CA	312 202 CA	Ú	132 90 5A DA	332 218 DA	ê	152 106 6A EA	352 234 EA	ú	172 122 7A FA	372 250 FA													
11	«	53 45 2B AB	253 171 AB	»	73 59 3B BB	273 187 8B	Ë	113 75 4B CB	313 203 CB	Û	133 91 5B DB	333 219 DB	ë	153 107 6B EB	353 235 EB	û	173 123 7B FB	373 251 FB													
12	┐	54 46 2C AC	254 172 AC	¼	74 60 3C BC	274 188 8C	Ì	114 76 4C CC	314 204 CC	Ü	134 92 5C DC	334 220 DC	ì	154 108 6C EC	354 236 EC	ü	174 124 7C FC	374 252 FC													
13	-	55 47 2D AD	255 173 AD	½	75 61 3D BD	275 189 8D	Í	115 77 4D CD	315 205 CD	İ	135 93 5D DD	335 221 DD	í	155 109 6D ED	355 237 ED	ı	175 125 7D FD	375 253 FD													
14	®	56 48 2E AE	256 174 AE	¾	76 62 3E BE	276 190 8E	Î	116 78 4E CE	316 206 CE	Ş	136 94 5E DE	336 222 DE	î	156 110 6E EE	356 238 EE	ş	176 126 7E FE	376 254 FE													
15	-	57 49 2F AF	257 175 AF	ı	77 63 3F BF	277 191 8F	Ï	117 79 4F CF	317 207 CF	ß	137 95 5F DF	337 223 DF	ï	157 111 6F EF	357 239 EF	ÿ	177 127 7F FF	377 255 FF													

LEGEND

	GR	
	12/1	Column/Row
/	301	Octal
A	193	Decimal
	C1	Hex

MLO-006611

A.11 Eastern European Character Sets

Two Eastern European character sets are supported:

- ISO Latin Alphabet No. 2 Supplemental Character Set, Figure A–29
- ISO Latin-Cyrillic Supplemental Character Set, Figure A–30

Both character sets are 96-character graphic character sets. ISO Latin-2 Supplemental is specified by ISO 8859-2. ISO Latin-Cyrillic Supplemental is specified by ISO 8859-5.

Figure A-29 ISO Latin-2 Supplemental Character Set

ISO Latin-2 Supplemental Character Set

	GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column	2	10		3	11		4	12		5	13		6	14		7	15	
Row 0	NBSP	40 32 20 160 A0	°	60 48 30 176 B0	°	80 64 40 192 C0	°	120 80 50 208 D0	°	140 96 60 224 E0	°	160 112 70 240 F0	°	180 144 100 300 120	°	200 160 120 280 140	°	220 180 140 300 120
1	À	41 33 21 161 A1	á	61 49 31 177 B1	â	81 65 41 193 C1	ã	101 81 51 209 D1	ä	121 97 61 225 E1	å	141 113 71 241 F1	æ	161 125 81 281 141	°	181 145 105 301 121	°	201 165 125 281 141
2	Á	42 34 22 162 A2	ä	62 50 32 178 B2	Å	82 66 42 194 C2	Ä	102 82 52 210 D2	Å	122 98 62 226 E2	Ä	142 114 72 242 F2	Å	162 126 82 282 142	°	182 146 106 302 122	°	202 166 126 282 142
3	Â	43 35 23 163 A3	å	63 51 33 179 B3	Ä	83 67 43 195 C3	Å	103 83 53 211 D3	Ä	123 99 63 227 E3	Å	143 115 73 243 F3	Å	163 127 83 283 143	°	183 147 107 303 123	°	203 167 127 283 143
4	Ã	44 36 24 164 A4	ä	64 52 34 180 B4	Å	84 68 44 196 C4	Ä	104 84 54 212 D4	Å	124 100 64 228 E4	Ä	144 116 74 244 F4	Å	164 128 84 284 144	°	184 148 108 304 124	°	204 168 128 284 144
5	Ä	45 37 25 165 A5	ä	65 53 35 181 B5	Å	85 69 45 197 C5	Ä	105 85 55 213 D5	Å	125 101 65 229 E5	Ä	145 117 75 245 F5	Å	165 129 85 285 145	°	185 149 109 305 125	°	205 169 129 285 145
6	Å	46 38 26 166 A6	ä	66 54 36 182 B6	Å	86 70 46 198 C6	Ä	106 86 56 214 D6	Å	126 102 66 230 E6	Ä	146 118 76 246 F6	Å	166 130 86 286 146	°	186 150 110 306 126	°	206 170 130 286 146
7	Ä	47 39 27 167 A7	ä	67 55 37 183 B7	Å	87 71 47 199 C7	Ä	107 87 57 215 D7	Å	127 103 67 231 E7	Ä	147 119 77 247 F7	Å	167 131 87 287 147	°	187 151 111 307 127	°	207 171 131 287 147
8	Å	48 40 28 168 A8	ä	68 56 38 184 B8	Å	88 72 48 200 C8	Ä	108 88 58 216 D8	Å	128 104 68 232 E8	Ä	148 120 78 248 F8	Å	168 132 88 288 148	°	188 152 112 308 128	°	208 172 132 288 148
9	Ä	49 41 29 169 A9	ä	69 57 39 185 B9	Å	89 73 49 201 C9	Ä	109 89 59 217 D9	Å	129 105 69 233 E9	Ä	149 121 79 249 F9	Å	169 133 89 289 149	°	189 153 113 309 129	°	209 173 133 289 149
10	Ä	50 42 30 170 AA	ä	70 58 3A 186 BA	Å	90 74 4A 202 CA	Ä	110 90 5A 218 DA	Å	130 106 6A 234 EA	Ä	150 122 7A 250 FA	Å	170 124 7C 252 FC	°	190 126 7E 254 FE	°	210 128 7F 256 FF
11	Ä	51 43 2B 171 AB	ä	71 59 3B 187 BB	Å	91 75 4B 203 CB	Ä	111 91 5B 219 DB	Å	131 107 6B 235 EB	Ä	151 123 7B 251 FB	Å	171 125 7D 253 FD	°	191 127 7F 255 FF	°	211 129 81 257 129
12	Ä	52 44 2C 172 AC	ä	72 60 3C 188 BC	Å	92 76 4C 204 CC	Ä	112 92 5C 220 DC	Å	132 108 6C 236 EC	Ä	152 125 7E 254 FE	Å	172 126 7F 255 FF	°	192 128 80 256 128	°	212 130 82 258 130
13	Ä	53 45 2D 173 AD	ä	73 61 3D 189 BD	Å	93 77 4D 205 CD	Ä	113 93 5D 221 DD	Å	133 109 6D 237 ED	Ä	153 126 7F 255 FF	Å	173 127 80 256 128	°	193 129 81 257 129	°	213 131 83 259 131
14	Ä	54 46 2E 174 AE	ä	74 62 3E 190 BE	Å	94 78 4E 206 CE	Ä	114 94 5E 222 DE	Å	134 110 6E 238 EE	Ä	154 127 81 257 129	Å	174 128 82 258 130	°	194 130 84 260 132	°	214 132 86 262 134
15	Ä	55 47 2F 175 AF	ä	75 63 3F 191 BF	Å	95 79 4F 207 CF	Ä	115 95 5F 223 DF	Å	135 111 6F 239 EF	Ä	155 128 82 258 130	Å	175 129 83 259 131	°	195 131 85 261 134	°	215 133 87 263 136

LEGEND

	GL	GR
4/1	12/1	Column/Row
101	301	Octal
65	193	Decimal
41	C1	Hex

MLO-006608

Figure A-30 ISO Latin-Cyrillic Supplemental Character Set

ISO Latin-Cyrillic Supplemental Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR	
Column		2	10		3	11		4	12		5	13		6	14		7	15	
Row	0	NBSP	40 32 20 A0	240 160 80 C0	A	60 48 30 B0	P	100 64 40 C0	300 192 120 D0	a	120 80 50 D0	ρ	140 96 60 E0	N°	160 112 70 F0	Row	0		
1		·E	41 33 21 A1	241 161 81 C1	Б	61 49 31 B1	C	101 65 41 C1	301 193 121 D1	δ	121 81 51 D1	с	141 97 61 E1	ë	161 113 71 F1	1			
2		Ѣ	42 34 22 A2	242 162 82 C2	В	62 50 32 B2	Т	102 66 42 C2	302 194 122 D2	В	122 82 52 D2	т	142 98 62 E2	ћ	162 114 72 F2	2			
3		/Г	43 35 23 A3	243 163 83 C3	Г	63 51 33 B3	У	103 67 43 C3	303 195 123 D3	Г	123 83 53 D3	у	143 99 63 E3	/г	163 115 73 F3	3			
4		Є	44 36 24 A4	244 164 84 C4	Д	64 52 34 B4	Ф	104 68 44 C4	304 196 124 D4	Д	124 84 54 D4	ф	144 100 64 E4	є	164 116 74 F4	4			
5		Ѕ	45 37 25 A5	245 165 85 C5	Е	65 53 35 B5	Х	105 69 45 C5	305 197 125 D5	е	125 85 55 D5	х	145 101 65 E5	ѕ	165 117 75 F5	5			
6		І	46 38 26 A6	246 166 86 C6	Ж	66 54 36 B6	Ц	106 70 46 C6	306 198 126 D6	ж	126 86 56 D6	ц	146 102 66 E6	і	166 118 76 F6	6			
7		·І	47 39 27 A7	247 167 87 C7	З	67 55 37 B7	Ч	107 71 47 C7	307 199 127 D7	з	127 87 57 D7	ч	147 103 67 E7	·і	167 119 77 F7	7			
8		Ј	50 42 30 A8	250 168 88 C8	И	70 56 38 B8	Ш	110 72 48 C8	310 200 130 D8	и	130 88 58 D8	ш	150 104 68 E8	ј	170 120 78 F8	8			
9		Љ	51 41 29 A9	251 169 89 C9	Й	71 57 39 B9	Щ	111 73 49 C9	311 201 131 D9	й	131 89 59 D9	щ	151 105 69 E9	љ	171 121 79 F9	9			
10		Њ	52 42 30 AA	252 170 80 CA	К	72 58 3A BA	Ъ	112 74 4A CA	312 202 132 DA	к	132 90 5A DA	ъ	152 106 6A EA	њ	172 122 7A FA	10			
11		Ѣ	53 43 31 AB	253 171 81 CB	Л	73 59 3B BB	Ы	113 75 4B CB	313 203 133 DB	л	133 91 5B DB	ы	153 107 6B EB	ћ	173 123 7B FB	11			
12		/К	54 44 32 AC	254 172 82 CC	М	74 60 3C BC	Ь	114 76 4C CC	314 204 134 DC	м	134 92 5C DC	ь	154 108 6C EC	/к	174 124 7C FC	12			
13		-	55 45 33 AD	255 173 83 DD	Н	75 61 3D BD	Э	115 77 4D CD	315 205 135 DD	н	135 93 5D DD	э	155 109 6D ED	-	175 125 7D FD	13			
14		·у	56 46 34 AE	256 174 84 CE	О	76 62 3E BE	Ю	116 78 4E CE	316 206 136 DE	о	136 94 5E DE	ю	156 110 6E EE	·у	176 126 7E FE	14			
15		Џ	57 47 35 AF	257 175 85 CF	П	77 63 3F BF	Я	117 79 4F CF	317 207 137 DF	п	137 95 5F DF	я	157 111 6F EF	Џ	177 127 7F FF	15			

LEGEND

	GL	GR	
	4/1	12/1	Column/Row
	101	301	Octal
	65	193	Decimal
C	41	C1	Hex

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A.12 JIS Katakana Character Set

This graphic character set consists of the Katakana characters, which are Japanese phonetic characters. This character set is specified by JIS X 0201-1976.

There are 63 characters defined in this character set. The remaining character positions are considered “reserved for future use.” These positions are indicated by shaded boxes in figure Figure A–31. The error character is printed when one of these reserved characters is received by the device.

Figure A–31 illustrates the JIS Katakana character set.

Figure A-31 JIS Katakana Character Set

JIS Katakana Character Set

		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
	Column	2	10		3	11		4	12		5	13		6	14		7	15		8	16
Row 0				ー	60 48 30	260 176 B0		タ	100 64 40	300 192 C0		ニ	120 80 50	320 208 D0		140 96 60	340 224 E0		160 112 70	360 240 F0	Row 0
1	・	41 33 21	241 161 A1	ア	61 49 31	261 177 B1		チ	101 65 41	301 193 C1		ム	121 81 51	321 209 D1		141 97 61	341 225 E1		161 113 71	361 241 F1	1
2	ㄱ	42 34 22	242 162 A2	イ	62 50 32	262 178 B2		ツ	102 66 42	302 194 C2		メ	122 82 52	322 210 D2		142 98 62	342 226 E2		162 114 72	362 242 F2	2
3	ㄴ	43 35 23	243 163 A3	ウ	63 51 33	263 179 B3		テ	103 67 43	303 195 C3		モ	123 83 53	323 211 D3		143 99 63	343 227 E3		163 115 73	363 243 F3	3
4	、	44 36 24	244 164 A4	エ	64 52 34	264 180 B4		ト	104 68 44	304 196 C4		ヤ	124 84 54	324 212 D4		144 100 64	344 228 E4		164 116 74	364 244 F4	4
5	・	45 37 25	245 165 A5	オ	65 53 35	265 181 B5		ナ	105 69 45	305 197 C5		ル	125 85 55	325 213 D5		145 101 65	345 229 E5		165 117 75	365 245 F5	5
6	ヲ	46 38 26	246 166 A6	カ	66 54 36	266 182 B6		ニ	106 70 46	306 198 C6		ヨ	126 86 56	326 214 D6		146 102 66	346 230 E6		166 118 76	366 246 F6	6
7	ㄷ	47 39 27	247 167 A7	キ	67 55 37	267 183 B7		ヌ	107 71 47	307 199 C7		ウ	127 87 57	327 215 D7		147 103 67	347 231 E7		167 119 77	367 247 F7	7
8	イ	50 42 28	250 168 A8	ク	70 56 38	270 184 B8		ネ	110 72 48	310 200 C8		リ	130 88 58	330 216 D8		150 104 68	350 232 E8		170 120 78	370 248 F8	8
9	ウ	51 41 29	251 169 A9	ケ	71 57 39	271 185 B9		ノ	111 73 49	311 201 C9		ル	131 89 59	331 217 D9		151 105 69	351 233 E9		171 121 79	371 249 F9	9
10	エ	52 42 2A	252 170 AA	コ	72 58 3A	272 186 BA		ハ	112 74 4A	312 202 CA		レ	132 90 5A	332 218 DA		152 106 6A	352 234 EA		172 122 7A	372 250 FA	10
11	オ	53 43 2B	253 171 AB	サ	73 59 3B	273 187 BB		ヒ	113 75 4B	313 203 CB		ロ	133 91 5B	333 219 DB		153 107 6B	353 235 EB		173 123 7B	373 251 FB	11
12	ヤ	54 44 2C	254 172 AC	シ	74 60 3C	274 188 BC		フ	114 76 4C	314 204 CC		ワ	134 92 5C	334 220 DC		154 108 6C	354 236 EC		174 124 7C	374 252 FC	12
13	ヅ	55 45 2D	255 173 AD	ス	75 61 3D	275 189 BD		ハ	115 77 4D	315 205 CD		ン	135 93 5D	335 221 DD		155 109 6D	355 237 ED		175 125 7D	375 253 FD	13
14	ヨ	56 46 2E	256 174 AE	セ	76 62 3E	276 190 BE		ホ	116 78 4E	316 206 CE		ハ	136 94 5E	336 222 DE		156 110 6E	356 238 EE		176 126 7E	376 254 FE	14
15	ツ	57 47 2F	257 175 AF	ソ	77 63 3F	277 191 BF		マ	117 79 4F	317 207 CF		オ	137 95 5F	337 223 DF		157 111 6F	357 239 EF				15

LEGEND

	GL	GR
	4/1	12/1
チ	101 65 41	301 193 C1

Column/Row
Octal
Decimal
Hex

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