EPSON®

FX SERIES PRINTER

User's Manual

VOLUME 2 REFERENCE

By

David A. Kater

EduKater

FCC COMPLIANCE STATEMENT FOR AMERICAN USERS

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the U.S. Government Printing Office, Washington DC 20402. Stock No. 004-000-00345-4.

P8390097

Preface

The User's Manual for the FX Series Printers consists of two volumes: Tutorial and Reference. This volume is the Reference, which contains the appendixes to Volume 1.

These appendixes are organized as follows:

Appendix A deals with the characters: it gives ASCII codes and displays the dot matrix characters.

Appendixes B through D cover control codes. Appendix B shows the codes in their ASCII numerical order, while C provides a list of the same codes organized by usage groups. Appendix D provides a chart of control codes as they are implemented on three Epson printers, the MX III, the FX, and the RX; a discussion of the differences follows the chart.

Appendixes E through H provide information on other printing needs: E covers defaults and DIP switches, F gives troubleshooting advice, G summarizes how to combine print modes, and H gives ideas for customizing your printer and its programs.

Appendixes I through K concentrate on technical aspects of the hardware: maintenance, specifications, and the parallel interface.

A complete table of contents for this volume begins on the next page.

For your convenience, there is an index at the end of each volume covering the complete two-volume set. You can therefore find all the references to any topic in either one.

FX Series Printer User's Manual
Volume 2 Contents

List of Figures

List of Tables

Appendix A
ASCII Codes and Character Fonts

This appendix provides information about the way the ASCII codes are employed on the FX printers and about the character fonts associated with those codes. The first section summarizes the codes. The second section displays, in ASCII order, the decimal number, the hexadecimal number, a printout, and an enlarged dot matrix for each character in the two fonts that you can access directly:

1. the Roman font for the USA character set (decimal 32-126)
2. the Italic font for the USA character set (decimal X0-254) Also included here is the pair of fonts for the international characters, which you access indirectly:

3. the Roman font for international characters (decimal 0-31)
4. the Italic font for international characters (decimal 128-159)

ASCII Codes and International Characters

To use a character or one of the control codes specified in the third column, you use the BASIC character-string command, CHR$(n), where n represents the decimal number shown in the first column. You cause the code to be sent to a device by using another command; the most common command for sending a code to the printer is LPRINT. For more on this subject, see Chapter 2.

ASCII Code summary

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	none	64	40	@	128	80	none	192	CO	@
1	01	none	65	41	A	129	81	none	193	C1	A
2	02	none	66	42	B	130	82	none	194	C2	B
3	03	none	67	43	C	131	83	none	195	C3	C
4	04	none	68	44	D	132	84	none	196	C4	D
5	05	none	69	45	E	133	85	none	197	C5	E
6	06	none	70	46	F	134	86	none	198	C6	F
7	07	BEL	71	47	G	135	87	BEL	199	C7	G
8	08	BS	72	48	H	136	88	BS	200	C8	H
9	09	HT	73	49	I	137	89	HT	201	C9	I
10	OA	LF	74	4A	J	138	8A	LF	202	CA	J
11	OB	VT	75	4B	K	139	8B	VT	203	CB	k
12	OC	FF	76	4C	L	140	8C	FF	204	CC	L
13	OD	CR	77	4D	M	141	8D	CR	205	CD	M
14	OE	SO	78	4E	N	142	8E	SO	206	CE	N
15	OF	SI	79	4F	O	143	8F	SI	207	CF	O
16	10	none	80	50	P	144	90	none	208	DO	P
17	11	DC1	81	51	Q	145	91	DC1	209	D1	Q
18	12	DC2	82	52	R	146	92	DC2	210	D2	R
19	13	DC3	83	53	S	147	93	DC3	211	D3	S
20	14	DC4	84	54	T	148	94	DC4	212	D4	T
21	15	none	85	55	U	149	95	none	213	D5	U
22	16	none	86	56	V	150	96	none	214	D6	V
23	17	none	87	57	w	151	97	none	215	D7	W
24	18	CAN	88	58	X	152	96	CAN	216	D8	X
25	19	none	89	59	Y	153	99	none	217	D9	Y
26	1A	none	90	5A	Z	154	9A	none	218	DA	Z
27	1B	ESC	91	5B	[	155	9B	ESC	219	DB	[
28	1C	none	92	5C	\	156	9C	none	220	DC	\
29	1D	none	93	5D	]	157	9D	none	221	DD	]
30	1E	none	94	5E	^	158	9E	none	222	DE	^
31	1F	none	95	5F	_	159	9F	none	223	DF	_
32	20	␣	96	60	`	160	A0	␣	224	E0	`
33	21	!	97	61	a	161	A1	!	225	E1	a
34	22	"	98	62	b	162	A2	"	226	E2	b
35	23	#	99	63	c	163	A3	#	227	E3	c
36	24	$	100	64	d	164	A4	$	228	E4	d
37	25	%	101	65	e	165	A5	%	229	E5	e
38	26	&	102	66	f	166	A6	&	230	E6	f
39	27	'	103	67	g	167	A7	'	231	E7	g
40	28	(	104	68	h	168	A8	(	232	E8	h
41	29	)	105	69	i	169	A9	)	233	E9	i
42	2A	*	106	6A	j	170	AA	*	234	EA	j
43	2B	+	107	6B	k	171	AB	+	235	EB	k
44	2C	,	108	6C	l	172	AC	,	236	EC	l
45	2D	-	109	6D	m	173	AD	-	237	ED	m
46	2E	.	110	6E	n	174	AE	.	238	EE	n
47	2F	/	111	6F	o	175	AF	/	239	EF	o
48	30	0	112	70	p	176	B0	0	240	FO	p
49	31	1	113	71	q	177	B1	1	241	F1	q
50	32	2	114	72	r	178	B2	2	242	F2	r
51	33	3	115	73	s	179	B3	3	243	F3	s
52	34	4	116	74	t	180	B4	4	244	F4	t
53	35	5	117	75	u	181	B5	5	245	F5	u
54	36	6	118	76	v	182	B6	6	246	F6	v
55	37	7	119	77	w	183	B7	7	247	F7	w
56	38	8	120	78	x	184	B8	8	248	F8	x
57	39	9	121	79	y	185	B9	9	249	F9	y
58	3A	:	122	7A	z	186	BA		250	FA	z
59	3B	;	123	7B	{	187	BB		251	FB	{
60	3C	<	124	7C	|	188	BC		252	FC	:
61	3D	=	125	7D	}	189	BD		253	FD	}
62	3E	>	126	7E	~	190	BE		254	FE	~
63	3F	?	127	7F	DEL	191	BF		255	FF	DEL

International characters summary

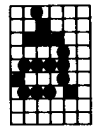
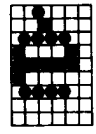
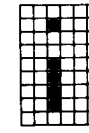
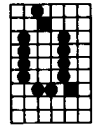
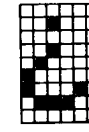
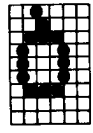
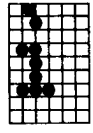
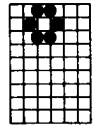
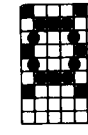
ASCII locations 0 to 31 and 128 to 159 store the international characters that are needed for sets other than the one for the USA. These characters are printable only with the CHR$(27) "6", CHR$(27) "I", or CHR$(27) "R" sequences.

Dec	Hex	CHR	Dec	Hex	CHR
0	00	à	128	80	à
1	01	è	129	81	è
2	02	ù	130	82	ù
3	03	ò	131	83	ò
4	04	ì	132	84	ì
5	05	°	133	85	°
6	06	£	134	86	£
7	07		135	87	/
8	08	¿	136	88	¿
9	09	Ñ	137	89	Ñ
10	0A	ñ	138	8A	ñ
11	0B	Ø	139	8B	Ø
12	0C	Æ	140	8C	Æ
13	0D	Å	141	8D	Å
14	0E	å	142	8E	å
15	0F	ç	143	8F	ç
16	10	§	144	90	§
17	11	ß	145	91	ß
18	12	Æ	146	92	Æ
19	13	æ	147	93	æ
20	14	Ø	148	94	Ø
21	15	ø	149	95	ø
22	16	¨	150	96	¨
23	17	Ä	151	97	Ä
24	18	Ö	152	98	Ö
25	19	Ü	153	99	Ü
26	1A	ä	154	9A	ä
27	1B	ö	155	9B	ö
28	1C	ü	156	9C	ü
29	1D	§	157	9D	É
30	1E	é	158	9E	é
31	1F	¥	159	9F	¥

ASCII Character Matrixes

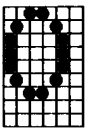
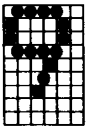
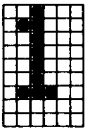
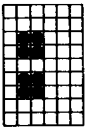
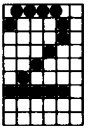
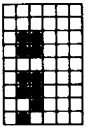
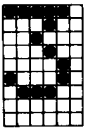
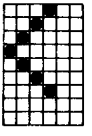
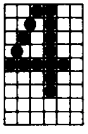
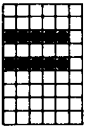
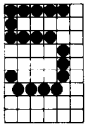
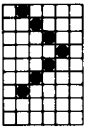
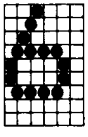
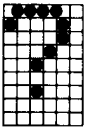
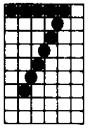
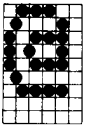
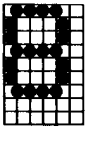
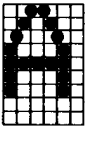
As in the summaries above, this section follows the ASCII code arrangement, but this time we show the codes only as they are associated with characters—0 through 255. The characters for the Roman and Italic USA fonts, which together make up the USA character set, occupy ASCII positions 32 through 126 and 160 through 254, respectively. The international characters use ASCII positions 0 through 31 and 128 through 159. We show enlarged dot matrixes for both pairs of fonts.

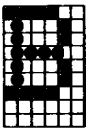
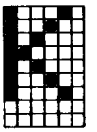
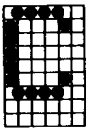
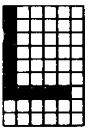
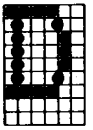
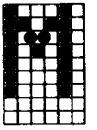
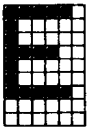
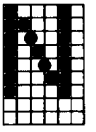
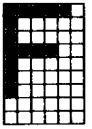
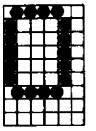
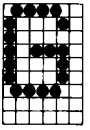
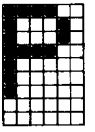
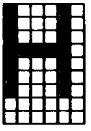
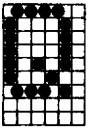
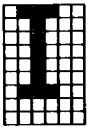
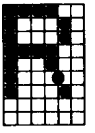
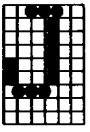
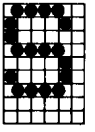
The width column shows the number of units used to print each character in Proportional Mode. A unit is the width of one of the 12 columns in a character matrix (about half a dot).

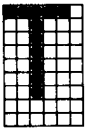
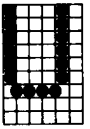
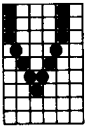
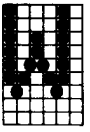
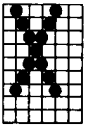
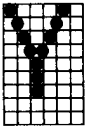
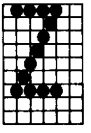
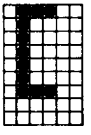
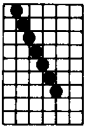
Dec	Hex	Character	Width	Dec	Hex	Character	Width
0	00		12	6	06		12
1	01		12	7	07		5
2	02		11	8	08		12
3	03		10	9	09		12
4	04		6	10	0A		11
5	05		8	11	0B		12

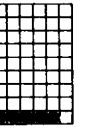
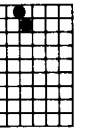
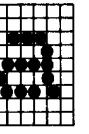
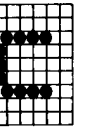
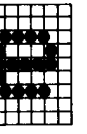
Dec	Hex	Character	Width	Dec	Hex	Character	Width
12	OC	Ã	12	21	15	Ø	12
13	OD	Ä	12	22	16	¨	8
14	OE	à	12	23	17	Ä	12
15	OF	ç	11	24	18	ö	12
16	10	ß	10	25	19	Ü	12
17	11	ß	11	26	1A	ä	12
18	12	Æ	12	27	1B	ö	10
19	13	æ	12	28	1C	ü	11
20	14	Ø	12	29	1D	ß	12

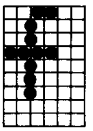
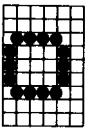
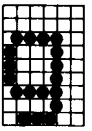
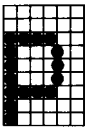
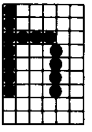
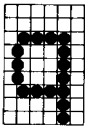
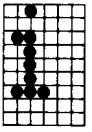
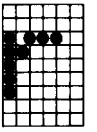
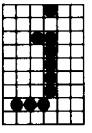
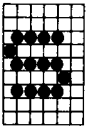
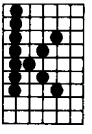
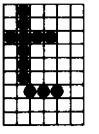
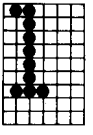
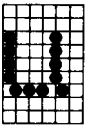
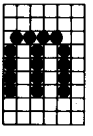
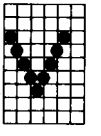
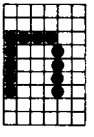
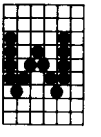
Dec	Hex	Character	Width	Dec	Hex	Character	Width
30	1E		12	39	27	'	5
31	1F		12	40	28	(	6
32	20		12	41	29	)	6
33	21	!	5	42	2A	*	12
34	22	"	8	43	2B	+	12
35	23	#	12	44	2C	,	7
36	24	$	12	45	2D	-	12
37	25	%	12	46	2E	.	6
38	26	&	12	47	2F	/	10

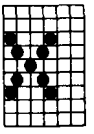
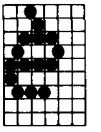
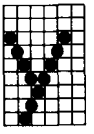
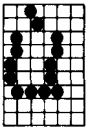
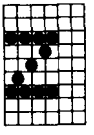
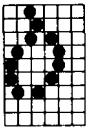
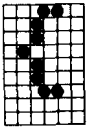
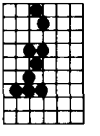
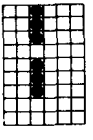
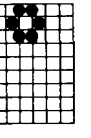
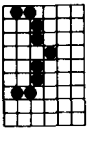
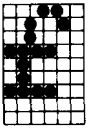
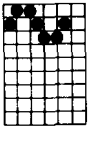
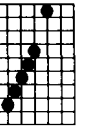
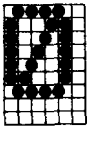
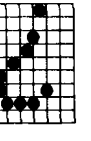
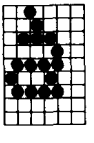
Dec	Hex	Character	Width	Dec	Hex	Character	Width
48	30		12	57	39		12
49	31		8	58	3A		6
50	32	2 	12	59	3B		6
51	33	3 	12	60	3C		10
52	34	4 	12	61	3D		12
53	35	5 	12	62	3E		10
54	36	6 	12	63	3F		12
55	37	7 	12	64	40		
56	38	8 	12	65	41		12

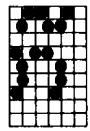
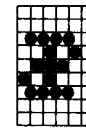
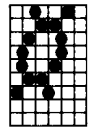
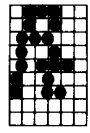
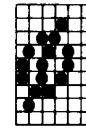
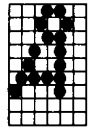
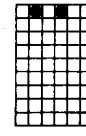
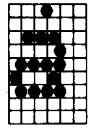
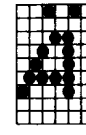
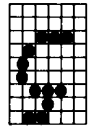
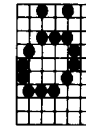
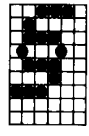
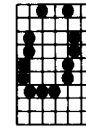
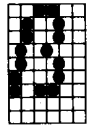
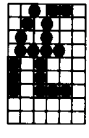
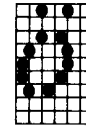
Dec	Hex	Character	Width	Dec	Hex	Character	Width
66	42	B 	12	75	4B	K 	12
67	43	C 	12	76	4C	L 	12
68	44	D 	12	77	4D	M 	12
69	45	E 	12	78	4E	N 	12
70	46	F 	12	79	4F	O 	12
71	47	G 	12	80	50	P 	12
72	48	H 	12	81	51	Q 	12
73	49	I 	8	82	52	R 	12
74	4A	J 	11	83	53	S 	12

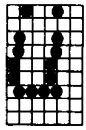
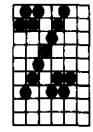
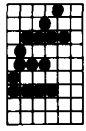
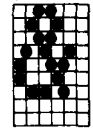
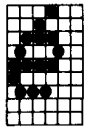
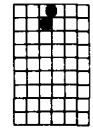
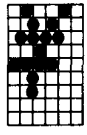
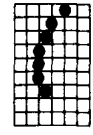
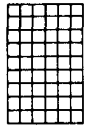
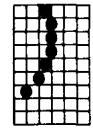
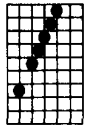
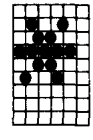
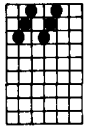
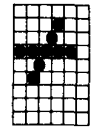
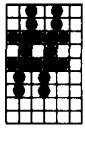
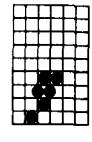
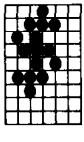
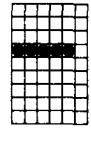
Dec	Hex	Character	Width
84	54	T 	12
85	55	U 	12
86	56	V 	12
87	57	W 	12
88	58	X 	10
89	59	Y 	12
90	5A	Z 	10
91	5B	[	a
92	5C	\ 	10

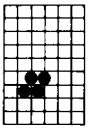
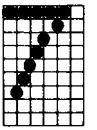
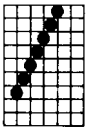
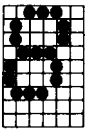
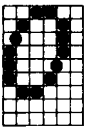
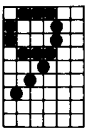
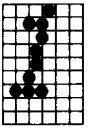
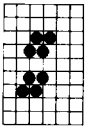
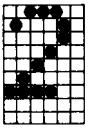
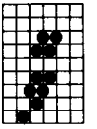
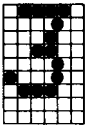
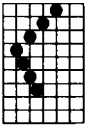
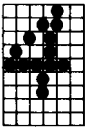
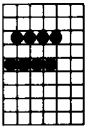
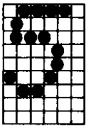
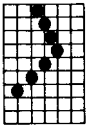
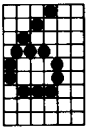
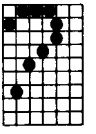
Dec	Hex	Character	Width
93	5D	] 	a
94	5E	^ 	12
95	5F	_ 	12
96	60	` 	5
97	61	a 	12
98	62	b 	11
99	63	c 	11
100	64	d 	11
101	65	e 	12

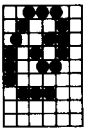
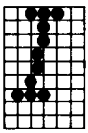
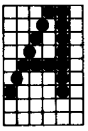
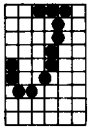
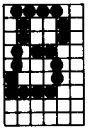
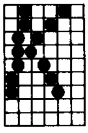
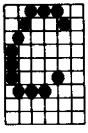
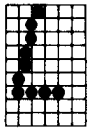
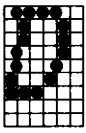
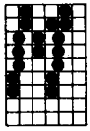
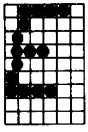
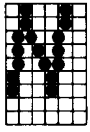
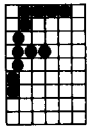
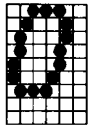
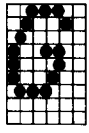
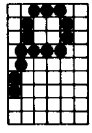
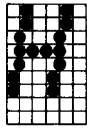
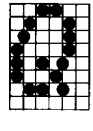
Dec	Hex	Character	Width	Dec	Hex	Character	Width
102	66	f 	10	111	6F	o 	12
103	67	g 	11	112	70	p 	11
104	68	h 	11	113	71	q 	11
105	69	i 	a	114	72	r 	11
106	6A	j 	9	115	73	s 	12
107	6B	k 	10	116	74	t 	11
108	6C	l 	a	117	75	u 	12
109	6D	m 	12	118	76	v 	12
110	6E	n 	11	119	77	w 	12

Dec	Hex	Character	Width	Dec	Hex	Character	Width
120	78	x 	10	129	81	è 	11
121	79	y 	12	130	82	ù 	11
122	7A	z 	10	131	83	ò 	11
123	7B	{ 	9	132	84	ì 	8
124	7C	| 	5	133	85	° 	8
125	7D	} 	9	134	86	£ 	12
126	7E	~ 	12	135	87	/ 	10
127	7F	⌂ 	12	136	88	¿ 	11
128	80	à 	11	137	89	Ñ 	12

Dec	Hex	Character	Width	Dec	Hex	Character	Width
138	8A		12	147	93		12
139	8B		12	148	94		12
140	8C		12	149	95		11
141	8D		12	150	96		9
142	8E		11	151	97		12
143	8F		11	152	98		12
144	90		12	153	99		
145	91		11	154	9A		11
146	92		12	155	9B		11

Dec	Hex	Character	Width	Dec	Hex	Character	Width
156	9C		12	165	A5		12
157	9D		12	166	A6		12
158	9E		11	167	A7		5
159	9F		12	168	A8		a
160	A0		12	169	A9		a
161	Al		10	170	AA		12
162	A2		10	171	AB		12
163	A3		12	172	AC		a
164	A4		11	173	AD		12

Dec	Hex	Character	Width	Dec	Hex	Character	Width
174	AE	. 	7	183	B7	7 	12
175	AF	/ 	10	184	B8	8 	12
176	B0	0 	12	185	B9	9 	11
177	B1	1 	9	186	BA	: 	8
178	B2	2 	12	187	BB	; 	9
179	B3	3 	12	188	BC	< 	10
180	B4	4 	12	189	BD	= 	11
181	B5	5 	12	190	BE	> 	9
182	B6	6 	11	191	BF	? 	11

Dec	Hex	Character	Width	Dec	Hex	Character	Width
192	C0	@ 	12	201	C9	I 	10
193	C1	A 	12	202	CA	J 	12
194	C2	B 	12	203	CB	K 	12
195	C3	C 	12	204	CC	L 	10
196	C4	D 	12	205	CD	M 	12
197	C5	E 	12	206	CE	N 	12
198	C6	F 	12	207	CF	O 	12
199	C7	G 	12	208	D0	P 	12
200	C8	H 	12	209	D1	Q 	12

Dec	Hex	Character	Width
210	D2	R	12
211	D3	S	12
212	D4	T	12
213	D5	U	12
214	D6	V	11
215	D7	W	12
216	D8	X	12
217	D9	Y	12
218	DA	Z	12
219	DB	[	11
220	DC	\	7
221	DD	]	11
222	DE	^	10
223	DF	_	12
224	E0	`	5
225	E1	a	11
226	E2	b	11
227	E3	c	11

Dec	Hex	Character	Width	Dec	Hex	Character	Width
228	E4	d	12	237	ED	m	11
229	E5	e	11	238	EE	n	10
230	E6	f	12	239	EF	o	11
231	E7	g	11	240	F0	p	11
232	E8	h	11	241	F1	q	11
233	E9	i	9	242	F2	r	10
234	EA	j	10	243	F3	s	11
235	EB	k	11	244	F4	t	10
236	EC	l	9	245	F5	u	11

Dec	Hex	Character	Width
246	F6	v	10
247	F7	w	12
248	F8	x	12
249	F9	y	11
250	FA	z	12
251	FB	{	10
252	FC	|	9
253	FD	}	10
254	FE	~	12

Dec	Hex	Character	Width
255	FF		12

Appendix B
Control Codes in Numeric Order

You activate an FX control code by using LPRINT CHR$(n), where n is the number in the decimal column below. When the ESC column contains a dash, you use only CHR$(n) but when ESC is written in this ESC column, you must precede the CHR$(n) with CHR$(27). With this ESCape sequence you may use a shortened form, the ESCape code followed by the character in the symbol column in quotation marks, as shown in the example below, the command that turns Emphasized ON:

LPRINT CHR$(27) “E” .

Abbreviations: cpi = characters per inch
cps = characters per second

ESC	Dec	Hex	Symbol	Function
—	0	00	NUL	Terminates horizontal and vertical tab setting.
—	7	07	BEL	Sounds beeper.
—	**a**	**08**	**BS**	Backspace. Empties the printer buffer, then moves the print head left **1** space in the current pitch.
—	**9**	**09**	**HT**	Horizontal tab. Empties the printer buffer, then moves the print head to the next tab stop.
—	10	0A	LF	Line feed. Empties the printer buffer, performs a line feed at the current line spacing, and resets the buffer character count to 0.

ESC	Dec	Hex	Symbol	Function
-	11	0B	VT	Vertical tab. Empties the printer buffer, then advances the paper to the next vertical tab stop.
-	12	0C	FF	Form feed. Empties the printer buffer, then advances the paper to the next logical top of form.
-	13	0D	CR	Carriage return. Prints the contents of the buffer and resets the buffer character count to 0. Restores the print head to the left margin. You turn the automatic line feed on or off with DIP switch 2-4.
-	14	0E	SO	Shift out. Turns Expanded Mode ON for the length of the line unless cancelled by CHR$(20) or CHR$(27)"WO". Works with Pica, Elite, or Compressed Mode.
-	15	0F	SI	Shift in. Empties the buffer and turns Compressed Mode (17.16 cpi) ON. Cannot work with Emphasized, Elite, Pica, or Proportional Mode. Stays on until cancelled by CHR$(18).
-	17	11	DC1	Device control 1. When 2-1 is OFF places the printer in the active state: printer receives all data sent to it.
-	18	12	DC2	Device control 2. Turns Compressed Mode OFF
-	19	13	DC3	Device control 3. When DIP switch 2-1 is OFF places the printer in the inactive state until a DC1 code is received.
-	20	14	DC4	Device control 4. Turns the Expanded Mode set by CHR$(14) OFF
-	24	18	CAN	Cancels all text in the print buffer.
-	27	1B	ESC	Escape. Prepares the printer to receive control codes.

ESC	Dec	Hex	Symbol	Function
ESC	33	21	!	Master Print Mode Select (Master Select). Selects 16 unique print mode combinations. Format: CHR$(27)" ! "CHR$(n) where n = 0 - 255. See Appendix D.
ESC	35	23	#	Accepts the eighth bit "as is" from the computer.
ESC	37	25	%	Activates a character set. DIP switch 1-4 must be off. Format: CHR$(27)" % "CHR$(0)CHR$(0) selects the ROM set; and CHR$(27)" % "CHR$(1)CHR$(0) selects the RAM set.
ESC	38	26	&	Defines characters in user RAM. Format: CHR$(27)"&"CHR$(0)CHR$($c_1$)CHR$(c_2); CHR$(a)CHR$(d_1) . . . CHR$($d_{11}$); where CHR$(0) is for future use, c_1 is the starting character, and c_2 is the ending character. Each character in the range c_1 - c_2 requires an attribute byte (a) and 11 data bytes (d_1 - d_{11}).
ESC	42	2A	*	Turns Graphics Mode ON. Format: CHR$(27)" * "CHR$(m)CHR$($n_1$)CHR$(n_2); followed by n data numbers, where n = n_1 + 256*n_2, n, = 0 - 255, n_2 = 0 - 255, m selects mode 0 - 6. See Table 1 1-1 for modes.
ESC	45	2D	-	Turns Underline Mode ON. Format: CHR$(27)" - "CHR$(n) where n toggles Underline on and off: 0 turns it OFF 1 turns it ON.

ESC	Dec	Hex	Symbol	Function
ESC	47	2F	/	Selects a vertical tab channel. Format: CHR$(27)"/"CHR$(n) where n = 0 - 7.
ESC	48	30	0	Sets line spacing to 1/8-inch (g-dot).
ESC	49	31	1	Sets line spacing to 7/72-inch (7-dot).
ESC	50	32	2	Returns line spacing to the default of 1/6 inch (12-dot).
ESC	51	33	3	Sets line spacing to n/216-inch (1/216-inch is 1/3 dot). Stays on until changed. Format: CHR$(27)"3"CHR$(n) where n = 0 - 255.
ESC	52	34	4	Turns Italic Mode ON.
ESC	53	35	5	Turns Italic Mode OFF
ESC	54	36	6	Enables the printing of the Italic international characters, which are stored in locations 128 - 159 and 255.
ESC	55	37	7	Turns off CHR$(27)"6". Restores 126 - 159 and 255 to function as control codes.
ESC	56	38	8	Disables the paper-out sensor.
ESC	57	39	9	Enables the paper-out sensor
ESC	58	3A	:	Copies the ROM user-defined character set to RAM. Format: CHR$(27)":"CHR$(n_1)CHR$($n_2$)CHR$(n_3); where n_1, n_2, and n_3 are all 0. (They are included for future expansion.) The RAM character set must be activated with CHR$(27) " % ", and DIP switch 1-4 must be off.
ESC	60	3C	<	Turns 1-line Unidirectional Mode ON. Prints each line from left to right.

ESC	Dec	Hex	Symbol	Function
ESC	61	3D	=	Sets the eighth bit to 0 (limits the range to 0 - 127).
ESC	62	3E	>	Sets the eighth bit to 1 (limits the range to 128 - 255).
ESC	63	3F	?	Redefines one of the 4 alternate graphics codes -- "K","L","Y", or "Z" - as one of the seven graphics density numbers used with the ESCape " * " command. Format: CHR$(27)"?s";CHR$(n); where s is K,L,Y, or Z and n is 0 - 6.
ESC	64	40	@	Reset Code, which resets the printer to its power-up state, including resetting top of form. Clears all text and control codes from the print buffer.
ESC	65	41	A	Sets line spacing to n/72 inch (n-dot). Format: CHR$(27)"A"CHR$(n) where n = 0 - 85.
ESC	66	42	B	Sets up to 16 vertical tabs in the current line spacing. Tab settings are not affected by subsequent changes in line spacing. Format: CHR$(27)"B"CHR$(n_1)CHR$($n_2$). . . **CHR$(n_k)CHR$(0)** where n_k = 1 - 255. Terminate this tab sequence with CHR$(0) or a number less than that of the last tab (n_k).
ESC	67	43	C	Sets the form length to n ***lines*** in the current line spacing. The default is 66 lines. Also resets top of form. Format: CHR$(27)"C"CHR$(n) where n = 1 - 127.
ESC	67	43	C	Sets the form length to n ***inches,*** regardless of the current line spacing. The default is 11 inches. Also resets top of form. Format: CHR$(27)"C"CHR$(0)CHR$(n) where n = 1 - 22.

ESC	Dec	Hex	Symbol	Function
ESC	68	44	D	Resets the current tabs and sets up to 32 horizontal tabs in the current pitch. Tabs may range up to the maximum width for the character and printer size. For example, the maximum tab for Pica characters on an 8-inch line is 79. Tab settings are not affected by subsequent changes in pitch. Format: CHR$(27)"D"CHR$(n_1)CHR$($n_2$). . . **CHR$(n_k)CHR$(0)** Terminate a tab sequence with CHR$(0) or a number less than that of the last tab (n_k).
ESC	69	45	E	Turns Emphasized Mode ON. Cannot mix with Elite or Compressed Modes.
ESC	70	46	F	Turns Emphasized Mode OFF
ESC	71	47	G	Turns Double-Strike Mode ON.
ESC	72	48	H	Turns Double-Strike Mode OFF
ESC	73	49	I	Enables printing of the characters stored in the ASCII locations 0 - 31 that are not reserved for control codes. Symbols stored in control-code locations must be printed with CHR$(27)"R". Format: CHR$(27)"I"CHR$(n) where n toggles the codes; 1 prints characters, 0 prints control codes.
ESC	74	4A	J	Forces an immediate line feed of n/21 6 inches without changing the current line spacing. Prints the contents of the buffer without a carriage return. Format: CHR$(27)"J"CHR$(n) where n = 0 - 255.

ESC	Dec	Hex	Symbol	Function
ESC	75	4B	K	Turns Single-Density Graphics Mode ON. Prints 480 dots per 8-inch line. Format: CHR$(27)"K"CHR$(n_1)CHR$($n_2$); followed by n data numbers, where $n = n_1 + 256*n_2$, n_1 = 0 - 255, n_2 = 0 - 255. For example, to print 480 dots, n_1 = 224, n_2 = 1.
ESC	76	4C	L	Turns Low-Speed Double-Density Graphics Mode ON. Prints 960 dots per 8-inch line. Format: CHR$(27)"L"CHR$(n_1)CHR$($n_2$) followed by n data numbers, where $n = n_1 + 256*n_2$, n_1 = 0- 255, n_2 = 0 - 255. For example, to print 960 dots, n_1 = 192, n_2 = 3.
ESC	77	4D	M	Turns Elite Mode (12 cpi) ON. Cannot mix with Pica, Proportional, Emphasized, or Compressed Mode.
ESC	78	4E	N	Sets skip-over-perforation to n lines. Format: CHR$(27)"N"CHR$(n) where n = 1 - 127.
ESC	79	4F	O	Turns skip-over-perforation OFF
ESC	80	50	P	Turns Elite Mode OFF Returns to Pica unless Compressed Mode is active.

ESC	Dec	Hex	Symbol	Function
ESC	81	51	Q	Sets the right margin. Also cancels all text that is in the print buffer. Format: CHR$(27)"Q"CHR$(n) where n = 1 - maximum number of characters per line in the current pitch: FX-80 FX-100 2-80 2-136 in Pica 3-96 3-163 in Elite 4-137 4-233 in Compressed
ESC	82	52	R	Selects an international character set by its country's number. See Tables 6-2 and 6-3. Format: CHR$(27)"R"CHR$(n) where n = 0 - 8.
ESC	83	53	S	Turns Script Mode ON. Either type of Script is printed in Double-Strike; neither can mix with Proportional Mode. Format: CHR$(27)"S"CHR$(n) where n = 0 produces Superscript, and 1 produces Subscript.
ESC	84	54	T	Turns Script Mode OFF
ESC	85	55	U	Turns Unidirectional Mode ON. Prints each line from left to right. Format: CHR$(27)"U"CHR$(n) where n toggles the mode on and off: 0 turns it OFF 1 turns it ON.
ESC	87	57	W	Turns Expanded Mode ON; stays ON until turned OFF Cannot be turned off with CHR$(20). Format: CHR$(27)"W"CHR$(n) where n toggles the mode on and off: 0 turns it OFF 1 turns it ON.

ESC	Dec	Hex	Symbol	Function
ESC	89	59	Y	Turns High-Speed Double-Density Graphics Mode ON; gives the same density as CHR$(27)" L", but cannot print two adjacent dots in the same row.
ESC	90	5A	Z	Turns Quadruple-Density Graphics Mode ON. Prints 1920 dots per 8-inch line. Format: CHR$(27)"Z"CHR$(n_1)CHR$($n_2$) followed by n data numbers, where $n = n, + 256*n_2$, n_1 = 0 - 255, n_2 = 0 - 255. For example, to print 1920 dots on the FX-80 n_1 = 128, n_2 = 7. On the FX-100, to print 3264 dots, n_1 = 192, n_2 = 12.
ESC	94	5E	^	Turns Nine-Pin Graphics ON. Format: CHR$(27)"^"CHR$(d)CHR$($n_1$)CHR$(n_2); followed by 2 times n data numbers where $n = n_1 + 255* n_2$ n_1 = 0 - 255. n_2 = 0 - 255. The printer expects 2 data numbers for each column of print. The d selects the density, where 0 produces Single-Density and 1 produces Double-Density
ESC	98	62	b	Sets the vertical tab for channel n. Format: CHR$(27)"b"CHR$(n); where n = 0 - 7, and n = 0 is the same as CHR$(27)"B".
ESC	105	69	i	On the FX-80 only, turns Immediate Mode ON. Prints each character immediately as it is received by the printer. Format: CHR$(27)"i"CHR$(n) where n toggles Immediate on and off: 0 turns it OFF; and 1 turns it ON.

ESC	Dec	Hex	Symbol	Function
ESC	106	6A	j	On the FX-80 only, causes an immediate reverse line feed in an increment of 1/216-inch without a carriage return. Similar to CHR$(27)"J". Format: CHR$(27)"j"CHR$(n) where n = 0 - 255.
ESC	108	6C	l	Sets the left margin. Format: CHR$(27)"l"CHR$(n) where n ranges from: FX-80 FX-100 0 - 78 0-134 in Pica 0 - 93 0-160 in Elite 0-133 0-229 in Compressed
ESC	112	70	p	Turns Proportional Mode ON. Cannot mix with Elite, Emphasized, Compressed, Script, or Double-Strike Mode. Format: CHR$(27)"p"CHR$(n) where n toggles Proportional on and off: 0 turns it OFF and 1 turns it ON.
ESC	115	73	s	Selects the print speed. Half-Speed Mode can be employed to reduce noise. Format: CHR$(27)"s"CHR$(n) where n toggles Half-Speed on and off, so that 1 produces 80 cps, while 0 produces 160 cps.
-	127	7F	DEL	Deletes the last text character in the print buffer.

The printer's high-order control codes from 128 to 155 and 255 mirror their low-order counterparts (0 - 27 and 127). For ready reference, both sets are listed here:

Low Dec	High Dec	High Hex	Symbol	Function
0	128	80	NUL	Terminates horizontal and vertical tab setting.
7	135	87	BEL	Sounds beeper.
8	136	88	BS	Backspace.
9	137	89	HT	Horizontal tab.
10	138	8A	LF	Line feed.
11	139	8B	VT	Vertical tab.
12	140	8C	FF	Form feed.
13	141	8D	CR	Carriage return.
14	142	8E	SO	Shift out; turns Expanded Mode ON.
15	143	8F	SI	Shift in; turns Compressed Mode ON.
17	145	91	DC1	Device control 1; activates printer.
18	146	92	DC2	Device control 2; turns Compressed Mode OFF:
19	147	93	DC3	Device control 3; deactivates printer.
20	148	93	DC4	Device control 4; turns the Expanded Mode set by (CHR$(14) OFF:
24	152	97	CAN	Cancels all text in the print buffer.
27	155	9B	ESC	Escape code.
127	255	FF	DEL	Deletes the last text character in the print buffer.

Appendix C
Control Codes by Function

This Appendix shows the same control codes as Appendix B, but this time arranged by categories before ASCII order. If your computer cannot generate lowercase letters, use the equivalent decimal ASCII values. See Appendix B or refer to the pages suggested by the Index for usage instructions.

Character Width (Pitch)

CHR$(27)“M”	Turns Elite Mode ON.
CHR$(27) "P"	Turns Elite Mode OFF.
CHR$(15)	Turns Compressed Mode ON.
CHR$(18)	Turns Compressed Mode OFF.
CHR$(14)	Turns one-Line Expanded Mode ON.
CHR$(20)	Turns one-Line Expanded Mode OFF.
CHR$(27)“W0”	Turns Expanded Mode OFF.
CHR$(27)“W1”	Turns continuous Expanded Mode ON.
CHR$(27)“p0”	Turns Proportional Mode OFF.
CHR$(27)“p1”	Turns Proportional Mode ON.

Character Weight

CHR$(27)“E”	Turns Emphasized Mode ON.
CHR$(27) “F”	Turns Emphasized Mode OFF.
CHR$(27)“G”	Turns Double-Strike Mode ON.
CHR$(27)“H”	Turns Double-Strike Mode OFF.

Print Enhancement

CHR$(27)"S0"	Turns Superscript Mode ON.
CHR$(27)"S1"	Turns Subscript Mode ON.
CHR$(27)"T"	Turns either Script Mode OFF.
CHR$(27)"-0"	Turns Underline Mode OFF.
CHR$(27)"-1"	Turns Underline Mode ON.

Mode and Character-Set Selection

CHR$(27)"!"CHR$(n)
Master Select.

CHR$(27)"%"CHR$(n_1)CHR$($n_2$)
Selects a character set by source: ROM (factory) or RAM (user-defined).

CHR$(27)"&"CHR$(n)CHR$($c_1$)CHR$(c_2)CHR$(A)CHR$(d_1)... CHR$($d_{11}$)
Defines characters c_1 to c_2 in RAM area; n is 0. Each character requires an attribute byte (A), followed by 11 data numbers (d_1 to d_{11}).

CHR$(27)"4"	Turns Italic Mode ON.
CHR$(27)"5"	Turns Italic Mode OFF.
CHR$(27)"6"	Enables printing of characters stored at ASCII 128 - 159.
CHR$(27)"7"	Causes codes 128 - 159 to print as control codes.

CHR$(27)":"CHR$(n_1)CHR$($n_2$)CHR$(n_3)
Copies ROM characters to the user RAM area.

CHR$(27)"@"	Reset Code.
CHR$(27)"I0"	Causes codes 0 - 31 to print as control codes.
CHR$(27)"I1"	Enables printing of characters stored at ASCII 0 - 31 that are not used as control codes.

CHR$(27)"R" CHR$(n)
Selects an international character set.

Special Printer Features

CHR$(7)	Sounds the beeper.
CHR$(8)	Backspaces.
CHR$(17)	Enables the printer to receive data.
CHR$(19)	Disables the printer from receiving data.
CHR$(24)	Cancels the text in the print buffer.
CHR$(27)"#"	Accepts the high-order bit "as is" from the computer.

CHR$(27)" < "	Turns One-Line Unidirectional Mode ON.
CHR$(27)" = "	Sets the high-order bit OFF.
CHR$(27)" > "	Sets the high-order bit ON.
CHR$(27)" U0 "	Turns Continuous Unidirectional Mode OFF.
CHR$(27)"Ul"	Turns Continuous Unidirectional Mode ON.
CHRS(27)"i0"	Turns Immediate Mode OFF.
CHR$(27) "il"	Turns Immediate Mode ON.
CHR$(27)"s0"	Returns to normal speed.
CHR$(27)"sl"	Turns Half-Speed Mode ON.
CHR$(127)	Deletes the most recent text character in the print buffer.

Line Spacing

CHR$(10)	Produces a line feed.
CHR$(27)"0"	Sets line spacing to 1/8-inch.
CHR$(27)"1"	Sets line spacing to 7/72-inch.
CHR$(27)"2"	Sets line spacing to 1/6-inch (default).
CHR$(27)"A"CHR$(n)	Sets line spacing to n/72-inch.
CHR$(27)"3"CHR$(n)	Sets line spacing to n/216-inch.
CHR$(27)"J"CHR$(n)	Produces an immediate one-time line feed of n/216-inch without a carriage return.
CHRS(27)" j "CHR$(n)	Produces an immediate one-time reverse feed of n/216-inch without a carriage return.

Forms Control

CHR$(27)"8"	Turns the paper-out sensor OFF.
CHR$(27)"9"	Turns the paper-out sensor ON.
CHR$(12)	Produces a form feed.
CHR$(13)	Produces a carriage return.
CHR$(27)"C"CHR$(0)CHR$(n)	Sets the form length in inches.
CHR$(27)"C"CHR$(n)	Sets the form length in lines.
CHR$(27)"N"CHR$(n)	Turns a variable skip-over-perforation ON.
CHR$(27) "O"	Turns skip-over-perforation OFF.

Page Format

CHR$(9) or CHR$(137)
Activates a horizontal tab.

CHR$(1l) Activates a vertical tab.

CHR$(27)" / " CHR$(n)
Selects a vertical tab channel.

CHR$(27)"B"CHR$(n_1) . . . CHR$($n_k$)CHR$(0)
Sets vertical tab stops.

CHR$(27)"D"CHR$(n_1) . . . CHR$($n_k$)CHR$(0)
Sets horizontal tab stops.

CHR$(27)"Q"CHR$(n)
Sets the right margin.

CHR$(27)"b"CHR$(n)CHR$($n_2$)CHR$(n_2) . . . CHR$($n_k$)CHR$(0)
Stores vertical tab stops in a channel.

CHR$(27)"1"CHR$(n)
Sets the left margin.

Dot Graphics

CHR$(2^X) When sent as graphics data fires pin X, where x = 0 - 7 .

CHR$(27)"*"CHR$(n)CHR$($n_1$)CHR$(n_2);
Selects one of six graphics densities.

CHR$(27)"?s"CHR$(n)
Reassigns a code letter s to a graphics density n, where s = K, L, Y, or Z and n = 0 - 6.

CHR$(27)"K"CHR$(n_1)CHR$($n_2$);
Turns Single-Density Graphics Mode ON.

CHR$(27)"L"CHR$(n_1)CHR$($n_2$);
Turns Double-Density Graphics Mode ON.

CHR$(27)"Y"CHR$(n_1)CHR$($n_2$);
Turns High-Speed Double-Density Graphics Mode ON.

CHR$(27)"Z"CHR$(n_1)CHR$($n_2$);
Turns Quadruple-Density Graphics Mode

CHR$(27)"^"CHR$(0)CHR$(n1)CHR$(n2);
Turns Single-Density Nine-Pin Graphics Mode

CHR$(27)"^"CHR$(l)CHR$($n_1$)CHRS($n_2$);
Turns Double-Density Nine-Pin Graphics Mode ON.

Appendix D
Control Code Comparison

The first part of this appendix consists of a chart of the commands used on Epson printers. It shows similarities and differences between the MX III, the FX, and the RX. Unless otherwise specified, the FX column applies to both the FX-80 and the FX-100, and the RX column applies to both the RX-80 and the RX-100.

In the second part of this chapter, we summarize the differences in software and then cover variations in hardware features. The commands, both in the chart and in the prose summary, are arranged in ASCII order.

Control Code Chart

ASCII Dec	ASCII symbol	Function	MXIII	FX	RX
7	BEL	Sounds beeper	*	*	*
8	BS	Backspace	*	*	*
9	HT	Horizontal Tabulation	*	*	*
10	LF	Line Feed	*	*	*
11	VT	Vertical Tabulation	*	*	*
12	F F	Form Feed	*	*	*
13	CR	Carriage Return	*	*	*
14	SO	Shift Out; Expanded (1-line) on	*	*	*
15	SI	Shift In; Compressed on	*	*	*
17	DC1	Activates the printer		*	
18	DC2	Compressed Mode off	*	*	*
19	DC3	Deactivates the printer		*	
20	DC4	Expanded Mode (1 -line) off	*	*	*
24	CAN	CANcels text in print buffer		*	RX-100
27	ESC	Escape code	*	*	*
33	ESC !	Selects mode combinations		*	
35	ESC #	Cancels MSB function	*	*	

ASCII Dec	ASCII symbol	Function	MX III	FX	RX
37	ESC %	Selects active character set (internal ROM or user RAM)		*	
38	ESC &	Defines user characters		*	
42	ESC *	Selects dot Graphics Modes		*	*
45	ESC -	Underline Mode	*	*	*
47	ESC /	Selects active vertical tab channel		*	RX-100
48	ESC 0	1/8″ line spacing	*	*	*
49	ESC 1	7/72″ line spacing	*	*	*
50	ESC 2	1/6″ line spacing	*	*	*
51	ESC 3	n/216″ line spacing	*	*	*
52	ESC 4	Italic Mode on	*	*	*
53	ESC 5	Italic Mode off	*	*	*
54	ESC 6	Deactivates high-order control codes		*	
55	ESC 7	Restores high-order control codes		*	
56	ESC 8	Paper-end detector off	*	*	*
57	ESC 9	Paper-end detector on	*	*	*
58	ESC :	Copies from ROM to user RAM		*	
60	ESC <	One-line Unidirectional Mode	*	*	*
61	ESC =	Resets MSB Function	*	*	
62	ESC >	Sets MSB Function	*	*	
63	ESC ?	Reassigns alternate graphics codes		*	RX-100
64	ESC @	Reset Code	*	*	*
65	ESC A	n/72″ line spacing	*	*	*
66	ESC B	Vertical tab setting		*	RX-100
67	ESC C	Page length	*	*	*
68	ESC D	Horizontal tab setting	*	*	RX-100
69	ESC E	Emphasized Mode on	*	*	*
70	ESC F	Emphasized Mode off	*	*	*
71	ESC G	Double-Strike Mode on	*	*	*
72	ESC H	Double-Strike Mode off	*	*	*
73	ESC I	Control code select		*	
74	ESC J	Immediate temporary line feed	*	*	*
75	ESC K	Single-Density Graphics Mode	*	*	*
76	ESC L	Double-Density Graphics Mode	*	*	*
77	ESC M	Elite Mode on		*	*
78	ESC N	Skip-over-perforation on	*	*	*
79	ESC O	Skip-over-perforation off	*	*	*
80	ESC P	Elite Mode off		*	*
81	ESC Q	Sets right margin	*	*	*
82	ESC R	International characters		*	*
83	ESC S	Super/Subscript Mode on	*	*	*

ASCII Dec	ASCII symbol	Function	MX III	FX	RX
84	ESC T	Super/Subscript Mode off	*	*	*
85	ESC U	Unidirectional printing on/off	*	*	*
87	ESC W	Expanded Mode (continuous) on/off	*	*	*
89	ESC Y	High-Speed Double-Density Graphics Mode		*	*
90	ESC Z	Quadruple-Density Graphics Mode		*	*
94	ESC ^	Nine-Pin Graphics Mode		*	RX-100
98	ESC b	Sets vertical tab channel		*	RX-100
101	ESC e	Sets horizontal/vertical tab increments			RX-80
102	ESC f	Sets horizontal/vertical position			RX-80
105	ESC i	Immediate print (typewriter mode)		FX-80	
106	ESC j	Immediate temporary reverse paper feed		FX-80	
108	ESC l	Sets left margin		*	*
109	ESC m	Selects graphics character set			*
112	ESC p	Proportional Mode on/off		*	
115	ESC s	Half-Speed on/off		*	*
127	DEL	Delete last text character in print buffer	*	*	*

Epson Model Differences

In this discussion of software and hardware differences between the MX III, the FX and the RX, the command name (backspace, vertical tab, etc.) is that of the most recent model which carries it.

CHR$(8) - Backspacing

On the MX III in Expanded Mode, moves the print head to the left one Pica position.

On the FX and RX in all six pitches, moves the print head to the left one position in the current pitch.

CHR$(9) or CHR$(137) - Default horizontal tabbing

See CHR$(27)"D" and CHR$(27)"e".

CHR$(11) - Vertical tabbing

On the MX III, prints a line feed.

On the FX and RX, activates a vertical tab. See also ESCape "e".

CHR$(15) - Compressed Mode selection

On the MX III, prints 132 characters per 8-inch line.

On the FX-80 and RX-80, prints 132 characters per 8-inch line, but can print 137 characters if the right margin is changed. On the FX-100 and RX-100 prints 233 characters per 13.6-inch line.

CHR$(17) and CHR$(19) - Printer selection

On the FX only and only with DIP switch 2-1 off, turns printing on and off. When CHR$(19) is in effect, the printer ignores all output.

CHR$(24) - Cancelling text

On the FX and RX-100 only erases all text from the buffer; does not erase control codes from the buffer.

ESCape " ! " - Master Print Mode selection

On the FX only, selects one of 16 print mode combinations. Any one of these may also be combined with other print modes.

Escape"#" , " > " and " = " - MSB control

On the MX III and the FX, these three codes allow 7-bit system users to print high-order control codes by manipulating the most significant bit.

ESCape " % " , " : ', and " &" - Custom character definition

On the FX only, lets you design your own characters and store them in RAM. You can use them alone or in combination with the standard FX characters.

Escape "*" - Special Graphics Mode selection

On all three models, ESCape"K" and "L" provide two Graphics Modes.

On both the FX and the RX, Escape"*" adds four more graphics densities: 80, 90, 120, and 140 dots per inch.

On the FX only, adds a fifth, 72 dots per inch.

ESCape " - " - Underlining

On all three models, the underline character is five dots wide.

On the MX-III, this code dumps the buffer and, when a space is placed at the beginning or end of a line, the printer ignores it.

On the FX, the underline code does not empty the buffer and spaces can occur (and thus be underlined) at the beginning or end of a line.

On the RX, the underline code does dump the buffer and spaces can occur (and thus be underlined) at the beginning or end of a line.

Escape"/" , "B", and "b" - Vertical tabbing

On the FX and RX-100 only lets you set up to 16 vertical tabs and store up to eight vertical tab channels in memory.

ESCape "3" - Special line spacing

On all three models, you can set and reset the line feed function by changing hardware (DIP switch and/or cable wiring).

On the FX and RX, this code provides n/216-inch line spacing and incidentally controls the automatic line feed function.

ESCape"4" - Italic Mode selection

On all three models, prints in the Italic version of the current pitch.

On the FX only, also empties the buffer.

ESCape "6" and "7" - Special character selection

On the FX only, lets you print the characters that are stored behind control codes 128 to 159 and 255.

Escape"?" - Graphics code reassignment.

On the FX reassigns alternate graphics codes to one of seven density settings.

On the RX-100 only, reassigns alternate graphics codes to one of six density settings.

ESCape"A" - Special line spacing

On all three models, you can set and reset the line feed function by changing hardware (DIP switch and/or cable wiring).

On the FX and RX, this code provides n/72-inch line spacing and incidentally controls the automatic line feed function.

ESCape"B" - Vertical tabbing. See Escape"/" .

ESCape"D" - Horizontal tabbing

On the MX III, you set horizontal tabs in the current pitch when that is Pica, Elite, or Compressed (Emphasized does not affect the settings). The positions of horizontal tabs change with subsequent changes in pitch, and zero is the terminator character.

On the FX and RX-100 only, you set horizontal tabs in the current pitch. Horizontal tab stops remain located at the positions that you set regardless of any subsequent changes in pitch, and you can terminate them with any value less than or equal to that of the last tab stop. Default tab settings do change when Expanded Mode is in effect.

For the RX-80, see ESCape"e".

Escape " G" - Double-Strike Mode selection

On the MX III, FX-100, and RX, moving in and out of Double-Strike Mode on one line produces a descent of one-third dot per change.

ESCape "H" - Double-Strike Mode selection

On the MX III, this code also cancels Script Mode.

ESCape " I " - Special character selection

On the FX only, you can use this code as a toggle (with 0 and 1) which allows you to print the characters stored behind control codes 0 to 31. ESCape"I" will not work on those codes needed by the printer.

ESCape "K"- Graphics Mode selection with the format ESCape"K"CHR$($n_1$)CHR$(n_2)

On the MX III, this code is invalid when the high-order bit is set, and n_2 works modulo 8.

On the FX, users of 7-bit systems can use this code with the high-order bit set, but n_2 will not work modulo 8.

On the RX, this code works with the high-order bit set, and n_2 does work modulo 8.

ESCape "M" and "P" - Elite Mode selection

On the FX and RX, prints in Elite (12 characters per inch), which matches the pitch used on many typewriters. ESCape"M" selects Elite and "P" returns the printer to the default mode.

ESCape "R" - International character set selection

On the RX, lets you select from 11 international character sets.

On the FX only, lets you select from 9 international character sets: also prints the contents of the buffer.

Escape "S" and "T" - Script Mode selection

On the MX III, Script characters cannot be printed in Expanded or Emphasized Mode; ESCape"H" cancels not only Double-Strike Mode but also both Script Modes; and ESCape"T" returns the printer to Double-Strike.

On the FX and RX, Script characters can be printed in Expanded or Emphasized; Escape"H" cancels only Double-Strike; and ESCape"T" returns the printer to the previous mode, whether it was Single- or Double-Strike.

See also ESCape "G".

ESCape "Y" - High-Speed Double-Density Graphics Mode selection

On the FX and RX, prints ESCape"L" graphics at twice the usual speed. There is one limitation: it will not print adjacent dots in the same row.

ESCape "Z" - Quadruple-Density Graphics Mode selection

On the FX and RX, prints 1920 dots per B-inch line; on the FX-100 and RX-100, prints 3264 dots per 13.6-inch line.

Escape "^" - Nine-pin Graphics Mode selection

On the FX and RX-100 only, speeds up screen dumps.

ESCape "b" - Vertical tabbing. See Escape "/" .

ESCape "e" - Horizontal and vertical tabbing

On the RX-80 only, lets you set an increment to be used by CHR$(9), CHR$(137), or CHR$(11). Regardless of the current pitch, you set horizontal tabs in Pica pitch. After a tab is set, subsequent changes in line spacing or pitch do not affect its position.

Escape "f" - Special horizontal and vertical spacing

On the RX-80 only, lets you print up to 127 horizontal spaces or vertical line feeds.

ESCape "i" - Immediate printing

On the FX-80 only, causes character-by-character printing, as on a typewriter.

Escape "j" - Reverse line-feed selection

On the FX-80 only, causes a reverse line feed of n/216-inch in the current column.

ESCape "1" - Left margin selection

On the FX-80 and RX-80, lets you set the left margin for an B-inch line at 0 to 78 in Pica, 0 to 93 in Elite, and 0 to 133 in Compressed. On the RX-100 and FX-100, lets you set the left margin for a 13.6-inch line at 0 to 134 in Pica, 0 to 160 in Elite, and 0 to 229 in Compressed.

ESCape "m" - Graphics character selection

On the RX only, lets you print the graphics characters which are stored behind control codes 128 to 159.

ESCape "p" - Proportional Mode selection

On the FX only, prints characters proportionally, without excess space, in Emphasized Mode.

ESCape"s" - Half-speed printing

On the FX, prints at half the normal speed, which results in 80 characters per second.

On the RX, prints at half the normal speed, which results in 50 characters per second.

Dumping programs in hexadecimal

On the FX and RX, you can use the hex dumping facility to aid you in debugging. All codes sent to the printer are dumped onto the paper in their hex format, which lets you see exactly what the printer is receiving from the computer.

You turn this facility on as you turn the printer on. As you turn on the FX, hold down the FF button. As you turn on the RX, hold down both the FF and LF buttons. For either model, you stop dumping in hex by turning off the printer.

The FX-80 prints the hex dump at 20 numbers per line; this leaves 2 spaces between each pair of numbers. The FX-100 prints the hex dump at 34 numbers per line; this leaves 2 spaces between each pair of numbers.

The RX-80 prints the hex dump at 26 numbers per line; this leaves 1 space between each number.

Alarms

The FX and RX have different alarms for the various error conditions. See Appendix F.

Typestyles

On the FX and RX, you can print in 128 typestyles.

DIP switches

Each model has its own arrangement of DIP switches. See Appendix E.

Pin feeder

Only the FX-80 has a built-in pin feeder.

Appendix E
Defaults and DIP Switches

In this Appendix we list the default settings for your printer, showing which settings you can change and the way you can change them. Some of the defaults can be changed by using DIP switches; the second section illustrates and discusses those defaults.

Default Settings

When your FX comes from the factory, it is set to the following defaults. An asterisk (*) means that you can change the default for this setting by changing a DIP switch, while a bullet (•) means that you can change this setting in a program, by using an ESCape code.

* • Printer activated
  • Roman character font
* • Pica pitch
  • Margins set at maximums: left margin at 0, and, since the default is Pica, the right margin at 80 on the FX-80 and at 136 on the FX-100
  • 12-dot line spacing
  • 66 lines (11 inches of default line spacing)
  • Vertical tabs set at every two lines
  • Vertical tab channel 0 selected
  • Horizontal tabs set at every eight spaces
* • USA character set

* 2K buffer available for user-defined characters

* • Paper-out sensor on

* Non-slashed zero (although there's no code for "turning on" slashed zero, you can slash one zero at a time with backspace)

* Carriage return issued at the end of a line without an automatic line feed

• Bidirectional movement of the print head

* • Skip-over-perforation feature off

* Beeper on (turning off the paper-out sensor deactivates the beeper for this function but not for others)

Top of form occurs at the position of the print head when you reset the printer-by turning power on or by issuing an ESCape "@"-or when you change the form length with either format of ESCape "C".

DIP Switches

The FX printers have two sets of internal switches which are used by the printer to determine the default mode on power-up. The switches are under the upper right vent. As outlined in Chapter 1, the vent screw must be removed with a Phillips-head screwdriver in order to take the cover off.

Since switch settings are only checked by the printer on power-up, all switch setting should be done with the power off. The printer will not recognize changes made in switch settings when the power is on until the printer is turned off and then on again.

The factory sets and numbers the switches in the following way:

Table E-1. DIP switch function

Switch 1

No.	ON	Function	OFF
1-8	ON	International character	OFF
1-7	ON	International character	OFF
1-6	ON	International character	OFF
1-5	Emphasized	Print weight	Single-strike
1-4	2K buffer	RAM memory	User-defined characters
1-3	Inactive	Paper-out sensor	Active
1-2	Ø (slashed)	Zero character	0
1-1	Compressed	Print pitch	Pica

Switch 2

No.	ON	Function	OFF
2-4	CR + LF	Automatic line feed	CR only
2-3	ON	Skip-over-perforation feature	OFF
2-2	Sounds	Beeper	Mute
2-1	Active	Printer select	Inactive

Note: The shaded boxes show the factory settings.

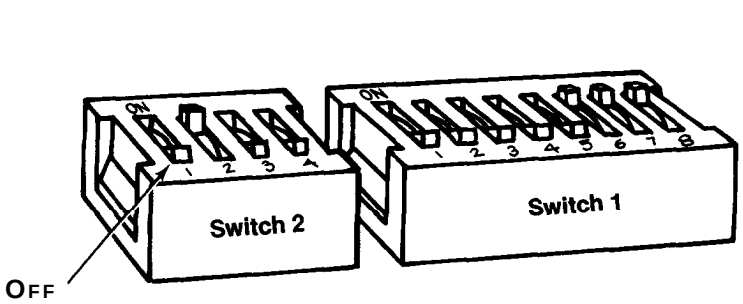


Figure E-Z. Factory setting of the DIP switches

Examining the Switches

Switches **1-6, 1-7,** and **1-8** determine the active international character set as shown on the next page:

Table E-2. *International DIP switch settings*

Country	Switch 1-6	Switch 1-7	Switch 1-8
USA	On	On	On
France	On	On	Off
Germany	On	Off	On
United Kingdom	On	Off	Off
Denmark	Off	On	On
Sweden	Off	On	Off
Italy	Off	Off	On
Spain	Off	Off	Off

See Chapter 6 for a discussion of the international sets.

Switch 1-5: selects a default print weight. When it is ON, Emphasized is the default. When it is OFF, Single-Strike is the default.

Switch 7-4: controls the RAM memory. When it is ON, makes a 2K buffer available. When it is OFF, that memory can be used for user-defined characters.

Switch 1-3: controls the paper-out sensor. When it is ON, the sensor is deactivated, and printing will continue even when paper is out (printer stays on-line). When it is OFF, printing stops when the printer runs out of paper. The printer goes off-line (and the beeper sounds if switch 2-2 is on).

Switch 1-2: controls the printing of zeroes. When it is ON, the FX prints a slashed zero (0). When it is OFF, a normal zero is printed.

Switch 1-1: selects a default pitch. When it is ON Compressed Mode becomes the default. When it is OFF, Pica is the default. If both switch 1-5 and switch 1-1 are ON, Emphasized Mode takes priority over Compressed.

Switch 2-4: controls the line feed. When it is ON, the printer produces an automatic line feed with every carriage return. When it is OFF no line feed is added (line feed must be provided by computer).

Switch 2-3: controls the skip-over perforation feature. When it is ON, a form feed is produced one inch from the bottom of every form. Note that the top of form is set when the printer is turned ON. This switch is used primarily to skip automatically over the paper perforation of fanfold paper. When it is OFF, no skip is made. See chapter 8 for details.

Switch 2-2: controls the beeper. When it is ON, the beeper sounds when it receives a CHR$(7) or to indicate the paper has run out. When it is OFF, CHR$(7) or paper-out doesn't sound beeper.

For printer detected error other than paper-out sensing (for which switch 1-3 must also be set), the beeper will sound regardless of the setting of switch 2-2.

Switch 2-1: selects the printer. When it is ON, it activates the $\overline{\text{SLCT IN}}$ signal and the printer actively processes commands sent from the computer; it cannot be deactivated with software codes. When it is OFF, the printer can be activated and deactivated by external software codes. CHR$(17) (DCl) activates or turns on printing, and CHR$(19) (DC3) deactivates or turns off printing. While the printer is inactive, all input data is ignored (until the printer is reactivated by CHR$(17)).

Appendix F
Troubleshooting

This appendix approaches troubleshooting from several directions. The first section uses a columnar format to match solutions with problems. Other sections cover beeper error warnings, hexadecimal code dumping, coding and seven-bit solutions, and specific solutions for several popular personal computer systems.

Problem/Solution Summary

The left column below will help you in identifying the source of your problem and start you on the way to finding a solution.

Problem	Solution
Setting print styles	
Can't get Compressed print.	Cancel Emphasized, Elite and/or Proportional Modes. They have priority over Compressed. Be sure that DIP switch 1-5 is not set for Emphasized.
Doesn't go back to Pica print when Proportional Mode is cancelled.	Proportional print masks other modes. When it is cancelled, the printer returns to the mode that it was in prior to Proportional. To get back to Pica, cancel all other modes.

Changing form measurements

The ESCape"C" command is not working properly.	Don't set, form lengths of 0 or 128.
The ESCape"N" skip-over-perforation doesn't work.	Don't set the skip larger than the form length.

Tabbing

Vertical tabs don't work correctly.	Can't set vertical tabs greater than the form length. Each tab sequence must be terminated by a CHR$(0) or a number less than the last tab value.
Horizontal tabs don't work correctly.	Each tab sequence must be terminated by a CHR$(0) or a number less than the last tab value.
Horizontal tabs are incorrect when changing pitch.	Tabs are set according to current print pitch. Changes in pitch do not affect the position of the tabs on the page.

Graphics

Strange things print.	Some systems require a WIDTH statement. See your system documentation. Many computers have problems sending one or more of the codes 0 and 8 - 13. Avoid any that affect your system if possible. Alternatively, you can substitute the high-order versions, or you can POKE the problem codes directly to the printer. Seven-bit computers cannot use the eighth pin (128). If you have a 7-bit computer and your pin sequence is larger than 127, change it.

Printer "freezes" in Graphics Mode.	The printer expects a certain number of pin patterns, determined by n_1 and n_2. It will wait patiently until the quota is full. Note that 9-Pin Graphics Mode requires two bytes for each column of graphics.
Can't get a full page in width.	Some systems require a WIDTH statement. See your system documentation. Seven-bit computers are limited **to widths of 0 - 127, 256 - 383, 512 - 639,** etc. See below.
Having trouble getting into Graphics Mode.	Make sure the high-order bit is OFF. For 7-bit computers, that means sending the code: ESCape " = "

User-Defined Characters

The last character is swallowed by the printer . . . nothing gets printed.	Make sure the attribute byte is sent before the 11-pin patterns for EACH character.
Characters are one dot too high or low.	Use the correct setting for the attribute byte. An attribute byte less than 128 makes the bottom 8 pins active (good for descenders). An attribute byte of 128 or greater activates the top 8 (matching ROM characters without descenders).
Characters are running too close **together.**	You must reserve space between characters within the character design. Typically, the last 2 columns are defined as 0. See the matrixes for ROM characters in Appendix A.
Some of the dots are being ignored by the printer.	Two dots in the same row cannot be printed in adjacent columns.

Loading paper

Paper goes crooked as it rolls down.	It may be running against the ribbon guide. Move the printhead to the middle of its path.
Paper crunches up.	The paper guides are set incorrectly. Move them to fit this paper. If your paper is thin, doubling the first page may give enough rigidity to ease it through the guides. For subsequent loading, tape the first page of a new batch of paper to the last page of an old batch, thus avoiding reloading.
Top edge of paper sticks under the roller.	There may be bits of paper caught under the roller. Stop inserting paper; turn the roller and extract any paper bits with fingers or tweezers.

Paper-out sensor

Can't deactivate paper-out sensor with DIP switch 1-3 or ESCape "8".	Computer systems that monitor printer cable pin 12 will ignore both ESCape "8" and the setting of switch 1-3. These systems will stop the printing when no paper is in contact with the paper-out sensor (a reed switch located on the paper guide). Certain printer cables are designed to overcome this problem, or you can tape a business card over the switch.

Beeper Error Warnings

The FX will warn you of certain error conditions by sounding the internal beeper. Each of the four error conditions has a unique sound. Listen closely . . .

1. A short circuit between the collector and the emitter of a head transistor along with a shorted dot driver winding produces:
   PI, PI, PI . . . PI, PI, PI
   on power-up or self-test, and
   PI, PI, PI, PI
   when on-line and printing.

2. Detection of high voltage produces:
   PI, PI, PI, PEE

3. Errors detected by slave CPU (restricted printhead motion or PTS sensor failure) produce:
   PI, PI, PI . . . PI, PI, PI

4. The paper running out produces:
   PI, PI, PI, PI (repeated five times)

Note: Except for paper-out sensing, the beeper will sound regardless of switch setting.

Hex Diagnosis

Some computer systems change one or more codes when sending them from BASIC to the printer. The FX's ability to dump in hexadecimal lets you determine which codes are creating problems for your system.

The hex dump facility prints each code that is being received by the FX onto the paper as a string of hexadecimal values. You turn the hex dump on by holding down the FF button while you turn the printer on.

A hex printout of a program shows you exactly what the printer is receiving, regardless of what the computer is sending. The following program lets you check to see what codes, if any, make problems for your computer system.

```
10 FOR X=0 TO 255
20 LPRINT CHR$(X);
30 NEXT X
```

Put the printer in hex dump status and then RUN the program.

If your system passes the codes directly to the printer without changing them, your output looks like Figure F-1 (take your printer off-line to make it print the final line).

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13
14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27
28 29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B
3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F
50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62 63
64 65 66 67 68 69 6A 6B 6C 6D 6E 6F 70 71 72 73 74 75 76 77
78 79 7A 7B 7C 7D 7E 7F 80 81 82 83 84 85 86 87 88 89 8A 8B
8C 8D 8E 8F 90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF B0 B1 B2 B3
B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF C0 C1 C2 C3 C4 C5 C6 C7
C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB
DC DD DE DF E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF 0D
```

Figure F-1. Best-case hex dump

Most BASICs, however, are not quite that straightforward. For example, the TRS-80 Model III prints Figure F-2:

```
00 01 02 03 04 05 06 07 08 09 0D 0B 0A 0A 0A 0A 0A 0A 0A 0A
0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A
0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A
0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0A 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23
24 25 26 27 28 29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37
38 39 3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49 4A 4B
4C 4D 4E 4F 50 51 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F 70 71 72 73
74 75 76 77 78 79 7A 7B 7C 7D 7E 7F 80 81 82 83 84 85 86 87
88 89 8A 8B 8C 8D 8E 8F 90 91 92 93 94 95 96 97 98 99 9A 9B
9C 9D 9E 9F A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF
B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF C0 C1 C2 C3
C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5 D6 D7
D8 D9 DA DB DC DD DE DF E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB
EC ED EE EF F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
0D
```

Figure F-2. TRS-80 Model III hex dump

Notice that the FX is receiving decimal code 10 as hex 0D, which is decimal 13. In addition, decimal code 12 (hex 0C) is coming across as a series of line feeds, hex 0A (decimal 10).

The hex mode prints 20 numbers per line on the FX-80 and 34 numbers per line on the FX-100. If it receives fewer than it expects in a line, it sits in a holding pattern, awaiting more data. Take the printer offline to dump the characters to the paper.

To debug a program quickly, just use the hex dumping capability. Appendix A will help you translate the hex codes to ASCII equivalents.

Coding Solutions

Once you've determined that a code creates problems for your

printing, either by trial and error or by using the hex dumping capability of the FX, you can start overcoming them.

Because each computer system deals with ASCII codes differently, it is impossible to provide solutions for all potential problems in one appendix. We can, however, point out generic problems and suggest ways to handle them.

There are four common approaches. First, you may be able to buy an alternative printer interface card for your system. This is the best solution for 7-bit system problems. See your computer dealer for advice about this.

The second approach is to use commercially available software that is specifically designed to overcome these coding problems. Consult your computer dealer or computer publications to see if a program for your computer system is available.

The third approach consists of avoiding the software that is changing the codes. On most computers you can send each code directly to the printer. This bypasses the BASIC interpreter and avoids the interface.

Unfortunately, this process is also different for each computer system. We'll give the procedure for a couple of systems here; if your system is not either of them, use the procedure as a model. Consult your computer's manual to determine if you can do the same on your system.

A fourth approach is to change the printer driver program in your system. This requires a knowledge of machine language and of the way your computer works. If you don't have this knowledge, your computer dealer may be able to help you or suggest someone who can.

We show a sample printer driver below (following the examples of POKEing codes). The idea is to pass the codes as issued by a BASIC program directly to the FX.

POKEing codes

The TRS-80 Model I version of the CHR$ function does not correctly pass on the values of 0, 10, 11, and 12. Zero is a particular problem as it is very important to the ESCape codes of the FX printers.

These codes can be sent directly to the printer by POKEing them to a special memory location where they are immediately forwarded to the printer. The format is:

```
POKE 14312, N
```

where N is the decimal value of the code you wish to send to the printer. This works fine as long as the printer is ready to receive the data when you are ready to send it. On the Model I, the printer's readiness is assured if location 14312 contains a decimal 63.

It is best to first test to see if the printer is ready with:

```
100 IF PEEK(14312)<>63 THEN 100
```

This puts the program into a continuous loop until the printer is ready to receive data. If data is sent while the printer is "out to lunch," it will be lost.

To show how similar these commands can be from system to system, here is the same concept implemented on the Apple II Plus:

```
100 IF PEEK(49601)>127 THEN 100
200 POKE 49296,N
```

The printer's status is stored in location 49601 and the outgoing values are sent to 49296.

Special printer drivers

An even better (but more difficult) way to overcome these problems is to modify the printer driver so that the codes are passed correctly to the printer without any PEEKs or POKEs. If you do not want to write such a driver yourself, your computer dealer may be able to help you. Or you may find aid in the pages of a trade journal.

The following printer driver, for instance, was written for the TRS-80 Model I by Bob Boothe and reprinted with the kind permission of 80 *Micro* (Wayne Green Publishers). The program POKEs a machine-language printer driver program (stored in line 10) into memory, then tells the system where its new driver is located. Once you RUN the program, all codes sent by any BASIC program are sent directly to the printer-including 0s, 10s, and 12s.

```
10  DATA  2lE837CB7E20FC211100397E32E837C9
20 READ B$: A=16571
30 FOR P=1 TO LEN (B$) STEP 2
40 B=ASC(MID$(B$,P,l))  -  48
```

```
50 IF B>9 THEN B=B - 7
60 T=ASC(MID$(B$,P + 1, l)) - 48
70 IF T>9 THEN T=T-7
80 POKE A,B*l6 + T
90 A=A+1
100 NEXT P
110 POKE 16422, 187
120 POKE 16423, 64
```

This driver will also work on the TRS-80 Model III-with one change in line 10: change 32E837 to D3FB. That's all there is to it. If you use this program, you can kiss problems with radical codes goodbye.

Solutions for Seven-Bit Systems

The BASIC language on some computers can only send seven bits to the printer at one time, even though the machine language may be able to send eight. (The Apple II Plus is a case in point.) On such computers, the CHR$ function cannot send the entire range of ASCII codes (0 - 255) to the printer; it can send only the lower half (0 - 127).

To find out whether your system is an 8-bit system, capable of generating all 256 ASCII codes, enter this simple test:

```
10 FOR X=160 TO 254
20 LPRINT CHR$(X);
30 NEXT X
```

If you get Italic characters when you RUN this, you are using an 8-bit system.

If you have a 7-bit system, you need to understand what happens to the control codes you send. The FX automatically interprets these codes the way your system sends them-as the lower half of the range. There is something you can do when you want to send the upper half (128 - 255): have your program convert all codes outside of the active range to their equivalent in the upper half by adding 128 to them.

The problems that are associated with 7-bit systems include:

Tabs can't be set in both code ranges (to avoid problem codes).
Limitations on width in Graphics Mode.
Inability to use the top pin for Graphics Mode.

User-defined characters can't be printed with the top 8 pins (the standard position for most characters). Eight pins can't be used in defining characters. Here we suggest some ways to work around these types of problems.

High-order bit control

If you own a seven-bit system, the FX can help you. It gives you three instructions to let you control the high-order (eighth) bit:

- ESCape ">" turns the high-order control and the high-order bit ON
- ESCape "=" turns the high-order bit OFF
- ESCape "#" returns the system to normal by turning the high-order control OFF

Note that the eighth bit does not change state automatically-it remains in the state that you have set until you change it with one of the other two bit-control codes.

The FX also helps you 7-bit system users by letting you leave the eighth bit turned on through changes in the ESCape codes. In other words, adding 128 to any ESCape code will not change its effect. This means that the low-order sequence for Emphasized print:

```
CHR$(27)CHR$(69)
```

and the high-order sequence:

```
CHR$(27)CHR$">"CHR$(27)CHR$(69)
```

produce the same result even though for the high-order sequence, 128 is added to each of the second pair of character-string codes. This means that when you turn the high-order bit on to handle numbers between 128 and 255, you do not have to worry about changing any ESCape code sequences.

Here's an example of how you can use the three codes:

```
NEW
10 LPRINT CHR$(27)" 'Sets eighth bit
20 FOR X=65 TO 90: LPRINT CHR$(X);: NEXT X
30 LPRINT CHR$(27)"="   'Supresses eighth bit
40 FOR X=193 TO 218: LPRINT CHR$(X);: NEXT X
50 LPRINT CHR$(27)"#"  ' Returns eighth bit to normal
```

ABCDEFGHIJKLMNOPQRSTUVWXYZ
ABCDEFGHIJKLMNOPQRSTUVWXYZ

Setting the eighth bit on in line `10` adds `128` to each of the number in line 20; thus it prints Italic characters. The ESCape "=" in line 30 effectively subtracts `128` from each of the numbers in line 40, so the second line prints as the characters from 65 throught 90. Line 50 returns your system to its usual state.

Seven-bit graphics

The 7-bit limitation affects graphics in two ways. First, 7-bit computer programs are limited in the widths they can specify for graphics. When you enter a Graphics Mode from a 7-bit system, the first number (n_1) you send can only range as high as 127. Even by changing n_2 from 0 to 1, 2, 3, etc., you can only set specific figure widths: 0 to `127, 256` to 383, 512 to 639, etc.

Let's look at an example. The usual way you reserve the entire width of an 8-inch page for graphics is:

```
LPRINT  CHR$(27)"K"CHR$(224)CHR$(ll);
```

This gives 224 dots plus 1 times 256 dots, or 480 total. But a 7-bit system cannot send the 224; the largest number it can send is 127. So the maximum number attainable with $n_2 = l$ is 127 + 1 x 256 = 383, which is still less than Single-Density's page width. If you change n_1 to a 0 and n_2 to a 2 you get 0 + 2 x 256 = 512. Now it's too high.

So, what can you 7-bit users do? First, do not get discouraged. You can do a lot in 383 columns of dots and where you really need more than 383 columns graphics, there is a solution. Just enter Single-Density Graphics Mode twice on the same line, first for 383 columns and then for 97 columns.

```
10 LPRINT CHR$(27)"K"CHR$(127)CHR$(1):
20 FOR X=1 TO 383: LPRINT CHR$(l);: NEXT X
30 LPRINT CHR$(27)"K"CHR$(97)CHR$(0);
40 FOR X=1 TO 97: LPRINT CHR$(l);: NEXT X
50 LPRINT
```

This gives coverage of the full 480 columns. It's not elegant, but it gets the job done.

Solutions for Specific Systems

The next four sections illustrate dealing with interface puzzles on four types of computers: the Apple II, the TRS-80, the IBM-PC, and the QX-10.

Apple II solutions

There are two types of problems that you who own Apple II computers will need to address. The first is that the Apple II is an 8-bit computer, but its printer interface only handles seven bits. The second is that there is one problem code number: nine.

The printer interface card furnished with the Apple II computer only passes seven bits to the FX, which means that you have a 7-bit system. Should you need an 8-bit system, the simplest solution is to purchase a new printer interface card from your computer dealer. Such a card is available for the Apple II.

Or you can use software to solve any problems that arise from the limitation to seven bits. You can POKE codes to memory as discussed above, you can write your own printer driver, or you can avoid the types of programs that require eight bits.

A routine to POKE codes to the memory of an Apple II Plus is given above.

The Apple II uses CHR$(9) to "initialize" the printer. This code and the following character or characters are intercepted by the printer interface card and used to change modes (in somewhat the same way that the printer uses ESCape codes). You can divert all output to the printer instead of to the screen by sending the following line to the printer interface card:

```
PR#l
PRINT CHR$(9)"80N"
```

Then type anything, followed by RETURN.

The CHR$(9)"80N" code directs all subsequent output to the printer, up to 80 characters per row. You can cancel this by typing:

```
PRINT CHR$(9)"1" or   PR#0
```

The problem is that the FX uses CHR$(9) to activate horizontal tabulation and can also use it in graphics programs. When you send this code, however, your system will interpret it as a printer initialization

code and the program will not work properly. The programs in this manual do not use CHR$(9), but some do use its high-order version - CHR$(137) - which your system will change to CHR$(9). In these **cases** use the following method to change your printer initialization code to a number that is not used in the program. For example, you can change your initialization code to one by typing:

```
PR#l
PRINT CHR$(9); CHR$(l)
```

TRS-80 solutions

A routine to POKE codes to the memory of a Model I is given above. A special printer driver for either the Model I or the Model III is also shown above. One of those methods should solve any problems with the programs in this manual.

IBM-PC solutions

There are two problems in using the IBM Personal Computer BASIC to drive a printer. First, the IBM-PC BASIC inserts a carriage-return/line-feed (CR-LF) after each 80 characters you send it. Second, it adds an LF to each CR in an LPRINT statement.

Here is the way to adjust the width when it is the only problem. Tell the computer that the print line is wider than 80 characters with this WIDTH statement:

```
WIDTH "LPTl:", 255
```

The 255 is a special number that prevents the computer system from inserting a CR-LF into the line. Unless, of course, there's one in your program.

The extra line feed-CHR$(10)-that accompanies each carriage return-CHR$(13) - is no problem except when you need to use CHR$(13) in a graphics program. Getting rid of the extra CHR$(10) is rather complicated. First you open the printer as a random file:

```
OPEN "LPTl:" AS #l
```

Although this allows you to send any code to the printer, you can no longer use the LPRINT command. Instead, you must use a PRINT #l command:

```
PRINT #l, "Now I can print anything"
```

This does allow you to print anything, but it ignores any previous WIDTH statements.

If you want to print more than 80 characters per line in a graphics program, you must therefore change your opening statement to include the appropriate WIDTH statement:

```
OPEN "LPTl:" AS #l : WIDTH #l, 255
```

And for the programs in this manual, don't forget to use PRINT #l wherever we use LPRINT.

This won't work for those of you who have the original release of the Disk Operating System (DOS 1.0). It can't run a printer like a file. Last year, however, IBM issued a free update (DOS 1.05); take a disk to your dealer to get your copy.

Another printer problem with DOS 1.0 is that it doesn't send CHR$(7) to the printer; it just rings the computer's bell. This has also been corrected in subsequent versions.

For Programmer's Easy Lesson make the following modifications in the program. In line 10 change the 29 to 28 and the 137 to 9; in line 20 change the 26 to 25; in lines 110 and 250 change the 25s to 24s; in line 330 change the 11s to 9s; add one line:

```
7 WIDTH "LPTl:", 255
```

QX-10 solutions

There are two types of computer-printer interface problems that you owners of Epson QX-10s may need to address. The first is making a width statement when a line is to be more than 80 characters wide. The second is changing any occurrence of the number nine to some other number.

Any time you want to print more than 80 characters (which is the same as 480 dots) on one line, you need to reserve the extra room by putting the WIDTH statement:

```
WIDTH LPRINT 255
```

in one of the first lines of the program.

The only problem code for the QX-10 is 9. One way to get around this is to use the ASCII high-order equivalent (137) whenever you would normally use 9.

Sometimes it may be easier to use another low-order value. For example:

```
FOR X=1 TO 10
IF X=9 THEN X=10
```

When DATA numbers include `9,` you can sometimes simply double each of them or change each 9 to 8 or `11.` The best number to substitute for 9 in pin patterns is usually `11.`

Appendix G
Mixing Print Modes

One of the most pleasing aspects of your FX printer is its wide variety of print modes. By mixing modes as shown in Table G-1, you can print characters in 128 different type styles. The details are in Chapter 5; a short summary is provided here.

Table G-1, Arriving at **128** *type styles.*

4 type modes	**2 strike modes**	**3 combining modes**	**2 script modes** (Double-Strike only)
Elite or Emphasized Pica or Compressed or Pica	Single-Strike or Double-Strike	Expanded (E) and/or Italics (I) and/or Underline (U)	Superscript or Subscript
4 pitches = 4	x 2 strikes = 8	x 8 combinations E,I,U,EI,EU,IU, EIU (all) or none = 64	+ 2 Script Modes x 32 Double-Strike combinations = 64 64 + 64 = 128

Methods for Mixing

The Master Select code can be used to select 16 popular print modes. The format is

```
CHR$(27)"!"CHR$(n)
```

where n ranges from 0 to 255.

By using the character form of some of the numbers, you can shorten the command string. Table G-2 shows some convenient characters to be used for the various combinations. You can find the Master Select code for any valid combination of pitch and weight by reading across in the row for the pitch you have selected and down in the column for the weight you want. Where the two intersect you will find the ASCII symbol to use in the simplified format. For example, to combine Compressed with Double-Strike, use LPRINT CHR$(27) "!T". N/A indicates that the two modes cannot be combined.

Table G-2. Master Select quick reference chart

	WEIGHT			
PITCH	Single Strike	Emphasized	Double Strike	Double Strike Emphasized
Pica	@	H	P	X
Elite	A	N/A	Q	N/A
Compressed	D	N/A	T	N/A
Expanded Pica	ⅆ	*	0	8
Expanded		N/A	1	N/A
Expanded **Compressed**	$	N/A	4	N/A

The rest of the 128 unique mode combinations can be achieved by using one of the selections from Table G-2 with the code for one or more of the following modes:

Superscript	Italic
Subscript	Underline

Only two constraints must be observed when combining these four modes with the others: 1) the two script modes cannot be used at the same time; 2) the script modes are always printed in Double-Strike. Other than that, anything goes. The upshot is that 128 unique modes are available on your FX printer. The print sample at the end of Chapter 5 shows the full array.

Mode Conflicts and Priorities

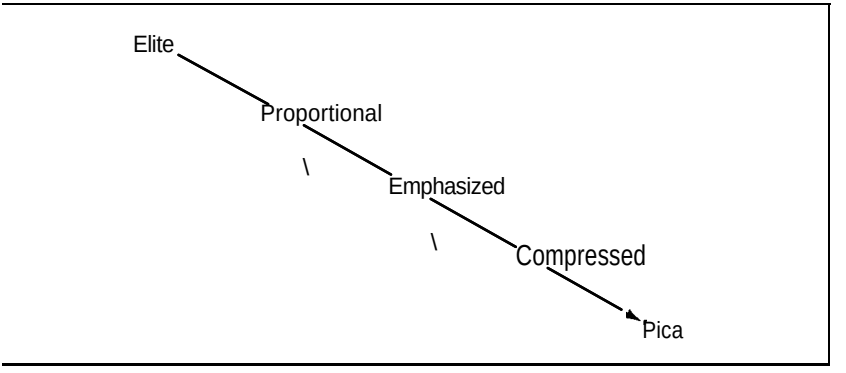
To better understand the way the FX print modes work, consider that each mode except Pica (Pica is the default) has a separate switch that can be turned on and off via software. Once the switch is on,

it stays on until turned off. When two modes that conflict are turned on at the same time, the printer must choose which one to use.

For example, suppose you turn on both Elite and Compressed Pitches. Since the printer can only print one pitch at a time, it must make a choice; in this case, the printer chooses Elite. The Compressed switch, however, is still on even though it doesn't show on your printout. When the Elite switch is turned off, the Compressed switch will take charge-unless some other mode that has priority over Compressed Mode is active.

Table G-3 shows the internal priority list maintained by the printer.

Table G-3. Mode *priorities*



Summary Notes:

(1) Pica is the default pitch when Elite and Compressed are turned off.

(2) When two modes conflict, the one of lesser priority is masked (not cancelled). For example, Compressed and Emphasized cannot be printed at the same time. The chart shows that when both are active, printing is in Emphasized. When Emphasized is cancelled, printing is in Compressed.

(3) Italic, Underline, and Expanded Modes combine with all the above print modes.

(4) Proportional characters are always printed in Emphasized.

(5) Script characters are always printed in Double-Strike.

Appendix H
Customizing the FX

You can adapt your FX to fit a variety of needs. You can alter the print capability both by hardware switches that change default conditions and by software codes that activate or deactivate different print modes. In this Appendix we show you a few typical applications and a few adjustments that you may want to make to your printer.

Spread-Sheet Programs

Three changes in the standard configuration of the printer may be of some use to those who make heavy use of spread-sheet programs. Changing switch 1-2 to ON will print all zeros with slashes, making it easy to distinguish between zeros and ohs. Switch 1-4 ON makes the 2K buffer available so that you can work with the computer while the sheet finishes printing. Also, Switch 1-1 ON changes the power-up pitch to Compressed so that you can squeeze more characters into a line.

For software that allows you to insert printer codes during the set-up or operation of the program, see the Quick Reference card for the appropriate codes.

Word Processing

If your FX is used primarily for word processing, you will need to do little more than install the printer according to the instructions for your word processing program. Since most of these programs have their own page formatting controls, leave switch 2-3 (automatic skip-over-perforation) OFF.

If you want to use Emphasized Mode (See Chapter **4)** to enhance your printing all the time, you can activate it with DIP switch **1-5.**

Keep in mind that this puts extra wear on your ribbon and slows your printing speed.

A few word processing programs support the FX's Proportional Mode. Since there is no DIP switch for this mode, consult your program's manual for instructions on activating Proportional printing. If you wish to use right-justification with Proportional, be sure that your program can do so.

Another option-for those who use foreign characters in their correspondence-is to select the appropriate country with switches **1-6,** 1-7, and **1-8.** Eight of the 9 countries can be selected (all except Japan) according to the chart in Appendix E. This will work as long as your word processor can send out the required codes. See Chapter 6.

For software that allows you to insert printer codes during **the set-**up or operation of the program, see the Quick Reference card for **the** appropriate codes.

BASIC Program Listings

Set switch 1-2 ON to print all zeros with slashes. Set switch 2-3 ON or use CHR$(27)"N"CHR$(n) to activate the skip-over-perforation feature.

Quiet Printing

The protective lid dampens the noise output. The Half-Speed Mode, activated with CHR$(27)"s1", also cuts down on the noise level. And for those late night sessions, you may **want to** turn the beeper off by turning switch 2-2 OFF.

Graphics and User-Defined Characters

Set switch 1-4 OFF to enable you to define characters.

Appendix I
Printer Maintenance

Always

Always keep your printer in a safe and clean location. Keep it away from:

Dust and grease

Heaters and furnaces. Safe temperature range is 5°C (41°F) to 35°C(95°F)

Base unit for cordless telephone systems

Large electrical machines

Crowded areas (the paper needs room to flow freely)

Leaky ceilings

Rambunctious children or pets.

Now and Then

Clean particles and dust from the printer every so often with a soft cloth or brush. Use a mild cleanser for the outside framework and, after removing the ribbon cartridge, denatured alcohol for the inside.

The ribbon cartridge prints about 3 million characters. See your Epson dealer for replacements.

Rarely

Once in a great while your printer should be lubricated. Epson recommends two lubricants: O-2 (Epson Part No. B710200001) and G-2 (Epson Part No. B70020001). Every 6 months or one million lines, use

O-2 lubricant on the shafts and platen bearings, wiping off excess with cloth. Use G-2 sparingly on ribbon feed, line feed, and carriage return drive gears, every five million lines.

Changing the Print Head

The expected life of an FX print head is about 100,000,000 characters (assuming an average of 14 dots per character). See your Epson dealer for FX print head replacements.

To remove the old print head:

If you have been printing, turn the printer OFF for about 15 minutes to allow the print head to cool. Next, remove the protective lid and ribbon cartridge. Flip the head lock lever shown in Figure I-1 toward the back of the printer.

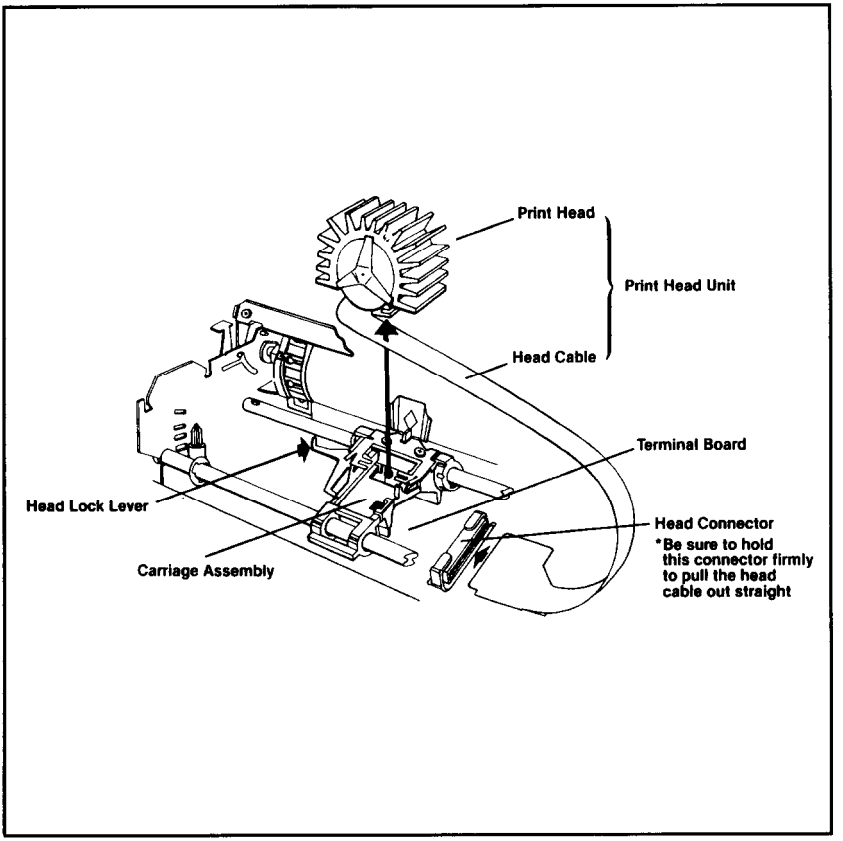


Figure I-1. Print head replacement

Now pull the cable from the connector block. Hold the block firmly because it has to stay put. Pull the print head straight up and off.

To install the new print head:

Place the new print head onto the head mount and flip the locking lever back toward the front of the printer. Connect the cable to the block. That's all there is to it!

Appendix J
Technical Specifications

Printing

Printing method ..... Impact dot matrix
Printing speed ..... **160** characters per second
Paper feed speed ..... Approximately 150 ms/line (at 1/6 inch/line)
Printing direction ..... Bidirectional, logic seeking
Unidirectional (left to right) in Graphics Mode

Character set ..... 96 Roman characters
96 Italic characters
32 special international characters
(8 international character sets)

Character sizes:

Mode	Width (mm)	Height (mm)
Pica	2.1	3.1
Pica Emphasized	2.1	3.1
Pica Expanded	4.2	3.1
Elite	1.4	3.1
Elite Expanded	2.8	3.1
Compressed Pica	1.05	3.1
Compressed Expanded	2.1	3.1
Super/Subscript		1.6

Line spacing ..... Default is 1/6 inch. Programmable in increments of 1/72 inch and 1/216 inch

Column width:

	Maximum characters per line	
	FX-80	FX-100
Pica	80	136
Pica Expanded	40	68
Elite	96	163
Elite Expanded	48	81
Compressed	132*	233
Compressed Expanded	68	116

*137 if right margin is changed (See Chapter 9).

Paper

FX-80

	Paper width	
Pin-feed	9.5" to 10"	Adjustable sprocket pin-feed
	4" to 9"	Tractor feed with optional tractor unit
Cut Sheet	7.25" to 8.5"	Friction Feed
Roll Paper	8.5"	Friction Feed with optional roll paper holder

FX-100

	Paper width	
Pin-feed Paper	4" to 16"	Tractor feed
Cut Sheet	7.25" to 8.5"	Friction feed
Number of copies	One original plus two carbon copies (total thickness not to exceed 0.3 mm (0.012")	

Printer

Ribbon ..... Cartridge ribbon, black
Ribbon life expectancy.... 3,000,000 characters
MTBF..... 5,000,000 lines (excluding print-head life)
Print head life ..... 100,000,000 characters

Dimensions and weight

	FX-80	FX-100
Height	100 mm	150 mm
Width (without paper feed knob)	420 mm	594 mm
Depth	347 mm	354 mm
Weight	7.5 kg	10.5 kg

Power ..... 120 AC ± 10%
Power capacity ..... 70 volt-amperes maximum
Frequency ..... 49.5 to 60.5 Hz

Environment

Temperature ..... Operating 5°C to 35°C (41°F to 95°F)
Storage — 30°C to 70°C (— 22°F to 158°F)

Humidity ..... Operating 10% to 80% (no condensation)
Storage 5% to 85% (no condensation)

Shock ..... Operating 1 G (less than 1 millisecond)
Storage 2 G (less than 1 millisecond)

Vibration ..... Operating 0.25 G, 55Hz (maximum)
Storage 0.50 G, 55Hz (maximum)

Insulation resistance ..... 10 megaohms between AC power line and chassis

Dielectric strength ..... No trouble when 1 kilovolt (R.M.S.) 50 or 60 Hz is applied for more than 1 minute between AC power line and chassis

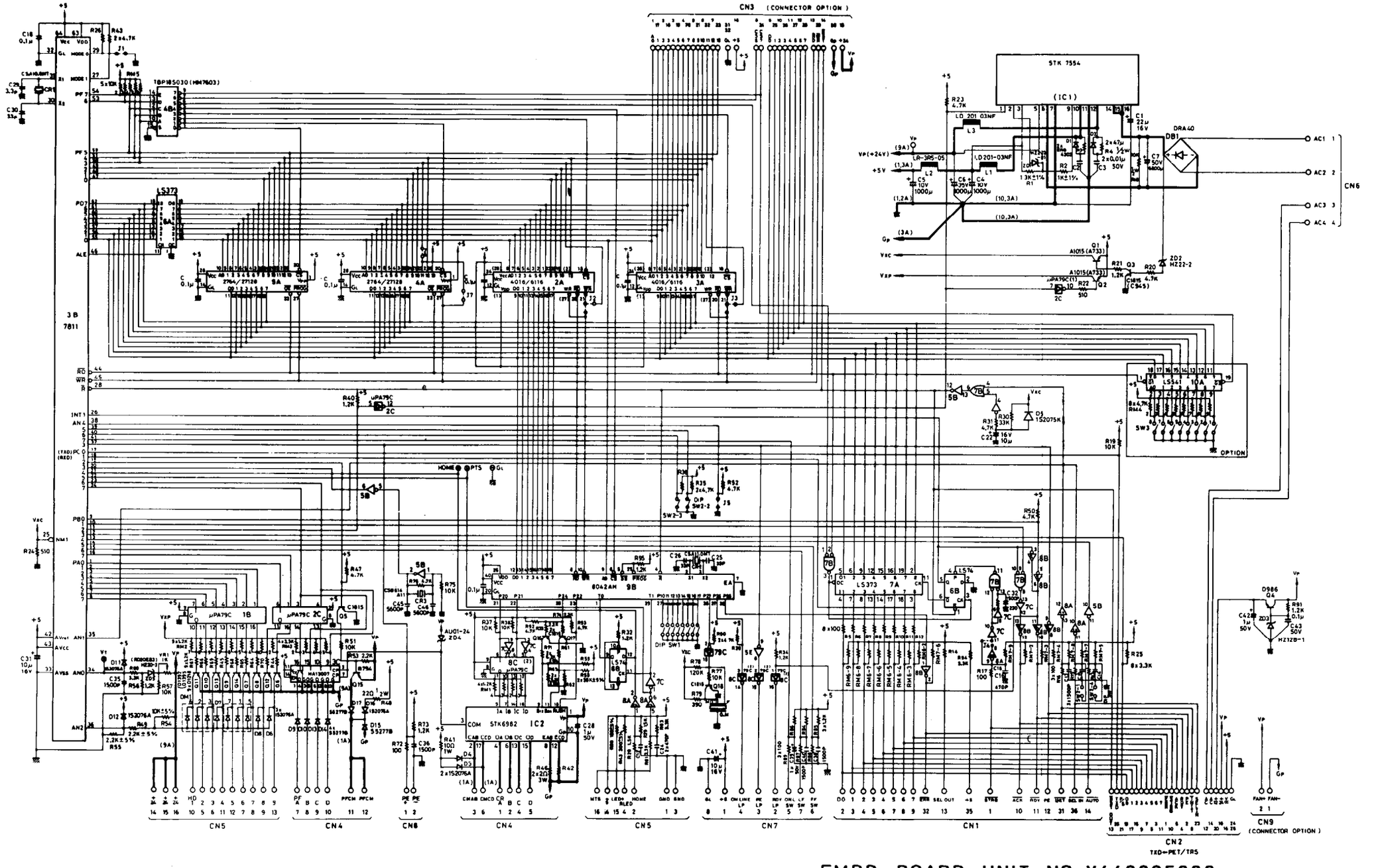
Interface

Interface ..... Centronics® compatible, 8-bit parallel (compatible with Epson MX series)

Synchronization ..... By externally supplied $\overline{\text{STROBE}}$ pulses

Handshaking ..... By $\overline{\text{ACKNLG}}$ or BUSY signals

Logic level ..... Input data and all interface control signals are compatible with the TTL level


CN3 (CONNECTOR OPTION)
STK 7554
(IC1)
CN6
AC1 1
AC2 2
AC3 3
AC4 4
OPTION
CN5
CN4
CN8
CN4
CN5
CN7
CN1
CN2
TXD←PET/TRS
CN9
(CONNECTOR OPTION)
EPSON FX 2839 2-3
FMBD BOARD UNIT NO. Y440205000

Appendix K
The Parallel Interface

The FX printer uses a parallel interface to communicate with the computer; this appendix describes it.

Connector pin assignments and a description of respective interface signals are shown in Table K-1.

Table K-1. Pins and signals

Signal Pin	Return Pin	Signal	Direction	Description
1	19	$\overline{\text{STROBE}}$	IN	$\overline{\text{STROBE}}$ pulse to read data in. Pulse width must be more than 0.5 microseconds at the receiving terminal.
2	20	DATA 1	IN	These signals represent information of the 1st to 8th bits of parallel data, respectively Each signal is at HIGH level when data is logical 1 and LOW when it is logical 0.
3	21	DATA 2	IN	
4	22	DATA 3	IN	
5	23	DATA 4	IN	
6	24	DATA 5	IN	
7	25	DATA 6	IN	
8	26	DATA 7	IN	
9	27	DATA 8	IN	
10	28	ACKNLG	OUT	Approximately, 12-microsecond pulse. LOW indicates that data has been received and that the printer is ready to accept more data.
11	29	BUSY	OUT	A HIGH signal indicates that the printer cannot receive data. The signal goes HIGH in the following cases: 1) During data entry 2) During printing. 3) When Off-Line. 4) During printer-error state.
12	30	PE	OUT	A HIGH signal indicates that the printer is out of paper.

Table K-1, continued

Signal	Return	Signal	Direc-tion	Description
13	—	—	–	Pulled up to + 5 volts through 3.3K ohm resistance.
14	–	AUTO FEED XT	IN	When this signal is LOW, the paper is automatically fed 1 line after printing. (The signal level can be fixed to this by setting DIP switch 2-4 to ON.)
15	–	N C	—	Unused.
16	—	OV	—	Logic ground level.
17	–	CHASSIS GND	—	Printer's chassis ground, which is isolated from the logic ground.
18	—	N C	—	Unused.
19 - 30	–	GND	—	Twisted-pair return signal ground level.
31	—	INIT	IN	When this level becomes LOW, the printer controller is reset to its power-up state and the print buffer is cleared. This level is usually High; its pulse width must be more than 50 microseconds at the receiving terminal.
32	—	ERROR	OUT	This level becomes LOW when the printer is in: 1) Paper-end state. 2) Off-line. 3) Error state.
33	—	GND	—	Same as for Pins 19 - 30.
34	–	NC	—	Unused.
35	—	—	—	Pulled up to + 5V through 3.3K ohm resistance.
36	—	SLCT IN	IN	Data entry to the printer is possible only when this level is LOW; DIP switch 2-1 is set for this at the factory

Notes:

1. The column heading “Direction” refers to the direction of signal flow as viewed from the printer.
2. “Return” denotes the twisted-pair return, to be connected at signal ground level. For the interface wiring, be sure to use a twisted-pair cable for each signal and to complete the connection on the return side. To prevent noise, these cables should be shielded and connected to the chassis of the host computer or the printer.
3. All interface conditions are based on TTL level. Both the rise and the fall times of each signal must be less than 0.2 microseconds.

4. Data transfer must be carried out by observing the ACKNLG or BUSY signal. (Data transfer to this printer can be carried out only after receipt of the ACKNLG signal or when the level of the BUSY signal is LOW.)
5. Under normal conditions, printer cable pins 11, 12, and 32 are activated when the paper-out condition is detected. The ESCape"8" code disables pins 11 and 32, but not pin 12. Those computers that monitor pin 12 halt printing when the paper is out, making ESCape"8" ineffective.

Data Transfer Sequence

Interface timing

Figure K-1 shows the timing for the parallel interface.

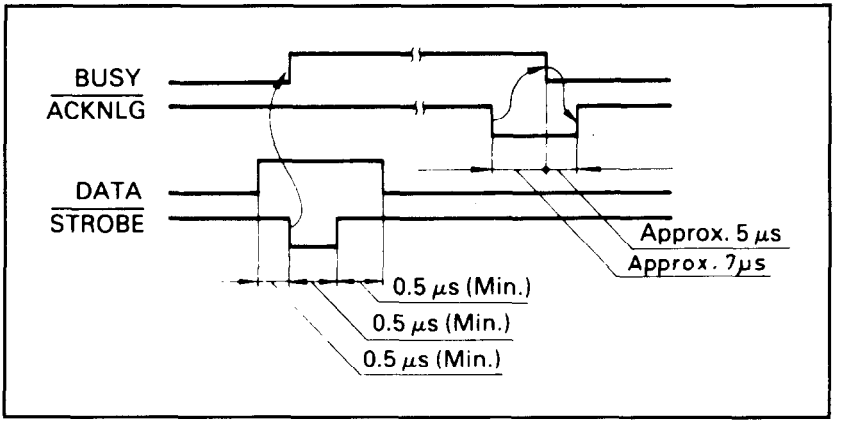


Figure K-1. Parallel interface timing

Signal relationships

Table K-2 shows the way data entry is handled in the On-Line and Off-Line states by showing the relationships between seven signal sets.

Table K-2. Signal interrelations

On-Line	$\overline{\text{SLCT IN}}$	DC1/DC3	$\overline{\text{ERROR}}$	BUSY	$\overline{\text{ACKNLG}}$	DATA ENTRY
OFF	HIGH/LOW	DC1/DC3	LOW	HIGH	Not generated	Disabled
ON	HIGH	DC1	HIGH	LOW/HIGH	Generated after data entry	Enabled (normal entry)
ON		DC3	HIGH	same	same	Enabled*
ON	LOW	DC1//DC3	HIGH	same	same	Enabled (normal entry)

*Data entry will be acknowledged, but the input data will be lost until DC1is input.

Note: $\overline{\text{ERROR}}$ status is assumed to result only in Off-Line state, and the $\overline{\text{ERROR}}$ status does not always mean $\overline{\text{SLCT IN}}$.

INDEX

Note: Refer to Table of Contents and List of Figures for specific programs. Also, the chapter summaries are not indexed.

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z

Print Width Commands

CHR$(27)"M"	Turns Elite Mode ON.
CHR$(27)"P"	Turns Elite Mode OFF.
CHR$(15) [^O]	Turns Compressed Mode ON.
CHR$(18) [^R]	Turns Compressed Mode OFF.
CHR$(14) [^N]	Turns One-Line Expanded Mode ON.
CHR$(20) [^T]	Turns One-Line Expanded Mode OFF.
CHR$(27)"W1"	Turns Continuous Expanded Mode ON.
CHR$(27)"W0"	Turns Expanded Mode OFF.

Print Quality Commands

CHR$(27)"E"	Turns Emphasized Mode ON.
CHR$(27)"F"	Turns Emphasized Mode OFF.
CHR$(27)"G"	Turns Double-Strike Mode ON.
CHR$(27)"H"	Turns Double-Strike Mode OFF.
CHR$(27)"S0"	Turns Superscript Mode ON.
CHR$(27)"S1"	Turns Subscript Mode ON.
CHR$(27)"T"	Turns either Script Mode OFF.
CHR$(27)"p1"	Turns Proportional Mode ON. *
CHR$(27)"p0"	Turns Proportional Mode OFF. *
CHR$(27)"-1"	Turns Underline Mode ON.
CHR$(27)"-0"	Turns Underline Mode OFF.
CHR$(27)"4"	Turns italic character set ON.
CHR$(27)"5"	Turns italic character set OFF.

Selecting Print Modes

CHR$(27)"!" CHR$(n)	Master Print Mode Select (Master Select): n = 0 to 255.
CHR$(27)"@"	Reset Code.

Special Printer Features

CHR$(7) [^G]	Sounds beeper.
CHR$(8) [^H]	Backspaces.
CHR$(17)	Enables the printer to receive data (default).
CHR$(19)	Disables the printer from receiving data.
CHR$(24)	Cancels the text in the print buffer.
CHR$(127)	Deletes the most recent text character in the print buffer.
CHR$(27)">"	Sets the high-order bit ON.
CHR$(27)"="	Sets the high-order bit OFF.
CHR$(27)"#"	Accepts the 8th bit "as is" from the computer.
CHR$(27)"R" CHR$(n)	Selects the international character set n, where n = 0 - 8.
CHR$(27)"i1"	Turns Immediate Mode ON. *
CHR$(27)"i0"	Turns Immediate Mode OFF. *
CHR$(27)"s1"	Turns Half-Speed Mode ON.*
CHR$(27)"s0"	Returns to normal speed.*

Paper Feed Commands

CHR$(10) [^J]	Produces a line feed.
CHR$(27)"0"	Sets line spacing to 1/8 inch.
CHR$(27)"1"	Sets line spacing to 7/72 inch.
CHR$(27)"2"	Sets line spacing to 1/6 inch (default).
CHR$(27)"A"CHR$(n)	Sets line spacing to n/72 inch.
CHR$(27)"3"CHR$(n)	Sets line spacing to n/216 inch.
CHR$(27)"J"CHR$(n)	Produces an immediate one-time line feed of n/216 inch without a carriage return.
CHR$(27)"j"CHR$(n)	Produces an immediate one-time reverse feed of n/216 inch without a carriage return.*

Forms Control Commands

CHR$(12) ["L] Produces a form feed.
CHR$(13) Produces a carriage return.
CHR$(27)"8" Turns the paper-out **sensor** OFF.
CHR$(27)"9" Turns the paper-out sensor ON.
CHR$(27)"C"CHR$(n) Sets the form length in lines: n = 0 - 127.
CHR$(27)"C"CHR$(0)CHR$(n)
Sets the form length in inches: n = 0 - 22.
CHR$(27)"N"CHR$(n) Produces a variable skip-over-perforation. n = 0 - form length or 127.
CHR$(27)"0" Turns skip-over-perforation OFF.

Formatting Commands

CHR$(27)"D"CHR$(n_1) ... CHR$($n_k$)CHR$(0)
Sets the horizontal tab stops at n_1, n_2, ..., n_k, where $k <= 32$, $0 < n_k <$ margin length.
CHR$(9) or CHR$(137) Activates a horizontal tab.
CHR$(27)"B"CHR$(n_1)....CHR$($n_k$)CHB$(0)
Sets the vertical tab stops at n_1 - n_k, where $k <= 16$; n_k = 1 to form **length.**
CHR$(27)"b"CHR$(n)CHR$($n_1$)CHB$(n_2) ... CHR$($n_k$)CHR$(0)
Stores vertical tab stops in channel n, where n = 0 - 7. Channel 0 is the same as CHR$(27)"B".*
CHR$(27)"/"CHR$(n) Selects channel n.
CHR$(1l) Activates a vertical tab.
CHR$(27)"Q"CHR$(n) Sets the right margin at n, where n ranges
from 2 - 80 in Pica,
3 - 96 in Elite, and
4 - 137 in Compressed.
CHR$(27)"l"CHR$(n) Sets the left margin at n, where n ranges
from 0 - 78 in Pica,
0 - 93 in Elite, and
0 - 133 in Compressed.*
CHR$(27)"U1" Turns Continuous Unidirectional Mode ON.
CHR$(27)"U0" Turns Continuous Unidirectional Mode OFF.
CHR$(27)"<" Turns One-Line Unidirectional Mode ON.

Graphics Modes

CHR$(2^X) Fires pin X when sent as graphics data, where X = 0 -7.
CHR$(27)"K"CHR$(n_1)CHR$($n_2$);
Turns Single-Density Graphics Mode ON; width = $n_1 + 256*n_2$
CHR$(27)"L"CHR$(n_1)CHR$($n_2$);
Turns Double-Density Graphics Mode ON.
CHR$(27)"Y"CHR$(n_1)CHR$($n_2$);
Turns High-Speed Double-Density Graphics ON.
CHR$(27)"Z"CHR$(n_1)CHR$($n_2$);
Turns Quadruple-Density Graphics Mode ON.
CHR$(27)"*"CHR$(n)CHR$($n_1$)CHR$(n_2);
Selects Graphics Density n, where:
0 = 480 dots per line 4 = 640 dpl
1 = 960 dpl (same as CHR$(27)"L") 5 = 576 dpl (1-to-1 ratio)
2 = 960 dpl (same as CHR$(27)"Y") 6 = 720 dpl
3 = 1920 dpl (same as CHR$(27)"Z")
CHR$(27)"^"CHR$(0)CHR$($n_1$)CHR$(n_2);
Turns Single-Density Nine-Pin Graphics Mode ON.
CHR$(27)"^"CHR$(l)CHR$($n_1$)CHR$(n_2);
Turns Double-Density Nine-Pin Graphics Mode ON

CHR$(27)"%"CHR$(n_1)CHR$($n_2$)
Selects a character set: n_1 selects ROM (0) or RAM (1); n_2 is 0.

CHR$(27)"&"CHR$(n)CHR$($c_1$)CHR$(c_2)CHR$(A)CHR$(d_1) ... CHR$($d_{11}$)...
Defines characters c_1 to c_2 in RAM area: n is 0. Each character requires an attribute byte (A), followed by 11 data numbers (d_1 to d_{11}).

CHR$(27)":"CHR$(n_1)CHR$($n_2$)CHR$(n_3)
Copies ROM characters to the user RAM area. All numbers must be 0.

CHR$(27)"I1" Enables printing of the symbols that are stored in locations 0 - 31 and that are not used as control codes.

CHR$(27)"I0" Disables printing of codes 0 - 31 as characters.

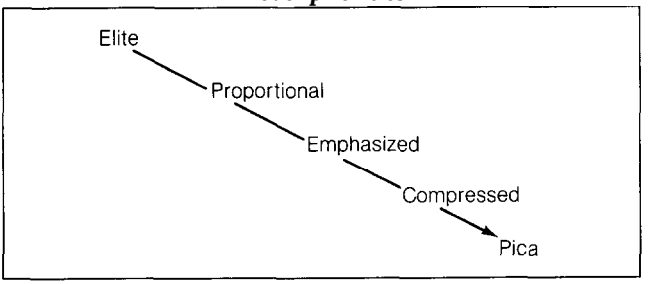
CHR$(27)"6" Enables printing of characters stored in locations 128 - 159.

CHR$(27)"7" Causes codes 128 - 159 to print as control codes.

*If your computer cannot generate lower-case letters, use the equivalent decimal values.

Note: For software that allows you to insert printer codes during the set-up or operation of the program, you will usually use the ESCape key Instead of CHR$(27) and omit the quotation marks. If the code does not include CHR$(27), you will find an alternate version in brackets. This alternate version uses the CONTROL key (indicated by a ^) with a letter. For example, to produce Elite, press ESCape then M; to produce Compressed, press CONTROL and O at the same time.

Mode priorities



Note: Each mode takes precedence over the modes beneath it

Master Select Quick Reference Chart

PITCH	WEIGHT			
	Single Strike	Emphasized	D o u b l e	Double Strike Emphasized
Pica	@	H	P	X
Elite	A	N/A	Q	N/A
Compressed	D	N/A	T	N/A
Expanded Pica	⌀	*	0	8
Expanded Elite	!	N/A	1	N/A
Expanded Compressed	$	N/A	4	N/A

Dec	Hex	Character or Function
0	00	none
1	01	none
2	02	none
3	03	none
4	04	none
5	05	none
6	06	none
7	07	BEL
8	08	BS
9	09	HT
10	OA	LF
11	OB	VT
12	OC	FF
13	OD	CR
14	0E	SO
15	OF	SI
16	10	none
17	11	DC1
18	12	DC2
19	13	DC3
20	14	DC4
21	15	none
22	16	none
23	17	none
24	18	CAN
25	19	none
26	1A	none
27	1B	ESC
28	1C	none
29	1D	none
30	1E	none
31	1F	none
32	20	(space)
33	21	!
34	22	"
35	23	#
36	24	$
37	25	%
38	26	&
39	27	'
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	_
96	60	`
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	:
125	7D	}
126	7E	~
127	7F	DEL
128	80	none
129	81	none
130	82	none
131	83	none
132	84	none
133	85	none
134	86	none
135	87	BEL
136	88	BS
137	89	HT
138	8A	LF
139	8B	VT
140	8C	FF
141	8D	CR
142	8E	s o
143	8F	SI
144	90	none
145	91	DC1
146	92	DC2
147	93	DC3
148	94	DC4
149	95	none
150	96	none
151	97	none
152	98	CAN
153	99	none
154	9A	none
155	9B	ESC
156	9C	none
157	9D	none
158	9E	none
159	9F	none
160	A0	(space)
161	A1	!
162	A2	"
163	A3	#
164	A4	$
165	A5	%
166	A6	&
167	A7	'
168	A8	(
169	A9	)
170	AA	*
171	AB	+
172	AC	,
173	AD	-

Dec	Hex	Character or Function	Dec	Hex	Character or Function	Dec	Hex	Character or Function
174	AE	,	202	CA	J	230	E6	f
175	AF	/	203	CB	K	231	E7	g
176	BO	0	204	CC	L	232	E8	h
177	B1	1	205	CD	M	233	E9	i
178	B2	2	206	CE	N	234	EA	j
179	B3	3	207	CF	O	235	EB	k
180	B4	4	208	D0	P	236	EC	l
181	B5	5	209	D1	Q	237	ED	m
182	B6	6	210	D2	R	238	EE	n
183	87	7	211	D3	S	239	EF	o
184	B8	8	212	D4	T	240	F0	p
185	B9	9	213	D5	U	241	F1	q
186	BA	:	214	D6	V	242	F2	r
187	BB	;	215	D7	W	243	F3	s
188	BC	<	216	D8	X	244	F4	t
189	BD	=	217	D9	Y	245	F5	u
190	BE	>	218	DA	Z	246	F6	v
191	BF	?	219	DB	[	247	F7	w
192	CO	@	220	DC	\	248	F8	x
193	C1	A	221	DD	]	249	F9	y
194	C2	B	222	DE	^	250	FA	z
195	C3	C	223	DF	_	251	FB	{
196	C4	D	224	E0	`	252	FC	/
197	C5	E	225	E1	a	253	FD	}
198	C6	F	226	E2	b	254	FE	~
199	C7	G	227	E3	c	255	FF	DEL
200	C8	H	228	E4	d			
201	C9	I	229	E5	e			

The DIP Switches

Switch 1

No.	ON	Function	OFF
1-8	ON	International character	OFF
1-7	ON	International character	OFF
1-6	ON	International character	OFF
1-5	Emphasized	Print weight	Single-strike
1-4	2K buffer	RAM memory	User-defined characters
1-3	Inactive	Paper-out sensor	Active
1-2	0 (slashed	Zero character	0
1-1	Compressed	Print pitch	Pica

Switch 2

No.	O N	Function	OFF
2-4	CR + LF	Line feed	CR only
2-3	O N	Skip-over-perforation feature	O F F
2-2	Sounds	Beeper	Mute
2-1	Active	Printer select	Inactive

Note: The shaded boxes show the factory settings.