Barcodes
Code 128

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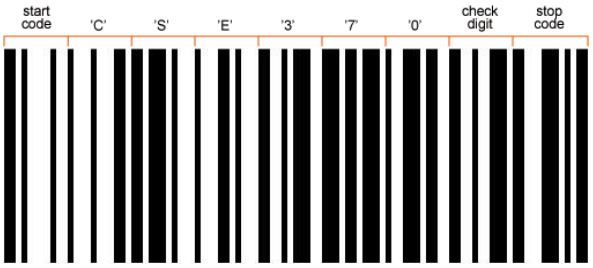
Code 128

- Very effective, high-density symbology
- Permits encoding of alphanumeric data
  - Can encode all 128 ASCII characters
- Includes verification protection via a checksum digit
- Widely implemented in many applications
  (particularly, where a relatively large amount of data must be encoded in a relatively small amount of space)
- Its specific structure allows numeric data to be encoded at, effectively, double-density.

Parts of a Code 128

- A leading "quiet zone“
- A start code (there are 3 start codes possible)
- The data (any number of characters)
- A check character
- A stop code
- A trailing “quiet zone”



Start Code

- Code 128 has three “character sets” (A, B and C)
- The start code defines which character set to use
  - Start-A, Start-B, Start-C
    (The character set may be changed in the middle of the barcode)
- Start Code A allows encoding all the standard alphanumeric characters plus control characters and special characters
- Start Code B includes all standard alphanumeric characters plus lower case alpha and special characters
- Start Code C includes a set of 100 digit pairs from 00 to 99 and can be used to double the density of encoding numeric-only data

Changing character set in the middle of a symbol

- Use the special character CODE
  - Applies to all subsequent characters
- Use the special character SHIFT
  - Changes the next character and only changes between Code Set A and Code Set B or the reverse

Encoding

- Each symbol is made up of 11 black or white modules

  Stop code, however, is made up of 13 modules
- The 11 modules correspond to 3 bars and 3 spaces
- Bars and spaces can vary between 1 and 4 modules wide

Encoding

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
0	SP	SP	00	2 1 2 2 2 2	SP (ASCII 32)
1	!	!	01	2 2 2 1 2 2	! (ASCII 33)
2	"	"	02	2 2 2 2 2 1	" (ASCII 34)
3	#	#	03	1 2 1 2 2 3	# (ASCII 35)
4	$	$	04	1 2 1 3 2 2	$ (ASCII 36)
5	%	%	05	1 3 1 2 2 2	% (ASCII 37)
6	&	&	06	1 2 2 2 1 3	& (ASCII 38)
7	'	'	07	1 2 2 3 1 2	' (ASCII 39)
8	(	(	08	1 3 2 2 1 2	((ASCII 40)
9	)	)	09	2 2 1 2 1 3	) (ASCII 41)

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
10	*	*	10	2 2 1 3 1 2	* (ASCII 42)
11	+	+	11	2 3 1 2 1 2	+ (ASCII 43)
12	,	,	12	1 1 2 2 3 2	, (ASCII 44)
13	-	-	13	1 2 2 1 3 2	- (ASCII 45)
14	.	.	14	1 2 2 2 3 1	. (ASCII 46)
15	/	/	15	1 1 3 2 2 2	/ (ASCII 47)
16	0	0	16	1 2 3 1 2 2	0 (ASCII 48)
17	1	1	17	1 2 3 2 2 1	1(ASCII 49)
18	2	2	18	2 2 3 2 1 1	2 (ASCII 50)
19	3	3	19	2 2 1 1 3 2	3 (ASCII 51)

Encoding

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
20	4	4	20	2 2 1 2 3 1	4 (ASCII 52)
21	5	5	21	2 1 3 2 1 2	5 (ASCII 53)
22	6	6	22	2 2 3 1 1 2	6 (ASCII 54)
23	7	7	23	3 1 2 1 3 1	7 (ASCII 55)
24	8	8	24	3 1 1 2 2 2	8 (ASCII 56)
25	9	9	25	3 2 1 1 2 2	9 (ASCII 57)
26	:	:	26	3 2 1 2 2 1	: (ASCII 58)
27	;	;	27	3 1 2 2 1 2	; (ASCII 59)
28	<	<	28	3 2 2 1 1 2	< (ASCII 60)
29	=	=	29	3 2 2 2 1 1	= (ASCII 61)

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
30	>	>	30	2 1 2 1 2 3	> (ASCII 62)
31	?	?	31	2 1 2 3 2 1	? (ASCII 63)
32	@	@	32	2 3 2 1 2 1	@ (ASCII 64)
33	A	A	33	1 1 1 3 2 3	A (ASCII 65)
34	B	B	34	1 3 1 1 2 3	B (ASCII 66)
35	C	C	35	1 3 1 3 2 1	C (ASCII 67)
36	D	D	36	1 1 2 3 1 3	D (ASCII 68)
37	E	E	37	1 3 2 1 1 3	E (ASCII 69)
38	F	F	38	1 3 2 3 1 1	F (ASCII 70)
39	G	G	39	2 1 1 3 1 3	G (ASCII 71)

Encoding

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
40	H	H	40	2 3 1 1 1 3	H (ASCII 72)
41	I	I	41	2 3 1 3 1 1	I (ASCII 73)
42	J	J	42	1 1 2 1 3 3	J (ASCII 74)
43	K	K	43	1 1 2 3 3 1	K (ASCII 75)
44	L	L	44	1 3 2 1 3 1	L (ASCII 76)
45	M	M	45	1 1 3 1 2 3	M (ASCII 77)
46	N	N	46	1 1 3 3 2 1	N (ASCII 78)
47	O	O	47	1 3 3 1 2 1	O (ASCII 79)
48	P	P	48	3 1 3 1 2 1	P (ASCII 80)
49	Q	Q	49	2 1 1 3 3 1	Q (ASCII 81)

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
50	R	R	50	2 3 1 1 3 1	R (ASCII 82)
51	S	S	51	2 1 3 1 1 3	S (ASCII 83)
52	T	T	52	2 1 3 3 1 1	T (ASCII 84)
53	U	U	53	2 1 3 1 3 1	U (ASCII 85)
54	V	V	54	3 1 1 1 2 3	V (ASCII 86)
55	W	W	55	3 1 1 3 2 1	W (ASCII 87)
56	X	X	56	3 3 1 1 2 1	X (ASCII 88)
57	Y	Y	57	3 1 2 1 1 3	Y (ASCII 89)
58	Z	Z	58	3 1 2 3 1 1	Z (ASCII 90)
59	[	[	59	3 3 2 1 1 1	[(ASCII 91)

Encoding

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
60	\	\	60	3 1 4 1 1 1	\ (ASCII 92)
61	]	]	61	2 2 1 4 1 1	] (ASCII 93)
62	^	^	62	4 3 1 1 1 1	^ (ASCII 94)
63	_	_	63	1 1 1 2 2 4	_ (ASCII 95)
64	NUL	'	64	1 1 1 4 2 2	` (ASCII 96)
65	SOH	a	65	1 2 1 1 2 4	a (ASCII 97)
66	STX	b	66	1 2 1 4 2 1	b (ASCII 98)
67	ETX	c	67	1 4 1 1 2 2	c (ASCII 99)
68	EOT	d	68	1 4 1 2 2 1	d (ASCII 100)
69	ENQ	e	69	1 1 2 2 1 4	e (ASCII 101)

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
70	ACK	f	70	1 1 2 4 1 2	f (ASCII 102)
71	BEL	g	71	1 2 2 1 1 4	g (ASCII 103)
72	BS	h	72	1 2 2 4 1 1	h (ASCII 104)
73	HT	i	73	1 4 2 1 1 2	i (ASCII 105)
74	LF	j	74	1 4 2 2 1 1	j (ASCII 106)
75	VT	k	75	2 4 1 2 1 1	k (ASCII 107)
76	FF	l	76	2 2 1 1 1 4	l (ASCII 108)
77	CR	m	77	4 1 3 1 1 1	m (ASCII 109)
78	SO	n	78	2 4 1 1 1 2	n (ASCII 110)
79	SI	o	79	1 3 4 1 1 1	o (ASCII 111)

Encoding

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
80	DLE	p	80	1 1 1 2 4 2	p (ASCII 112)
81	DC1	q	81	1 2 1 1 4 2	q (ASCII 113)
82	DC2	r	82	1 2 1 2 4 1	r (ASCII 114)
83	DC3	s	83	1 1 4 2 1 2	s (ASCII 115)
84	DC4	t	84	1 2 4 1 1 2	t (ASCII 116)
85	NAK	u	85	1 2 4 2 1 1	u (ASCII 117)
86	SYN	v	86	4 1 1 2 1 2	v (ASCII 118)
87	ETB	w	87	4 2 1 1 1 2	w (ASCII 119)
88	CAN	x	88	4 2 1 2 1 1	x (ASCII 120)
89	EM	y	89	2 1 2 1 4 1	y (ASCII 121

Value	Code A	Code B	Code C	Pattern B S B S B S	What ASCII Code Do I Print?
90	SUB	z	90	2 1 4 1 2 1	z (ASCII 122)
91	ESC	{	91	4 1 2 1 2 1	{ (ASCII 123)
92	FS	|	92	1 1 1 1 4 3	| (ASCII 124)
93	GS	}	93	1 1 1 3 4 1	} (ASCII 125)
94	RS	~	94	1 3 1 1 4 1	~ (ASCII 126)
95 (Hex 7F)	US	DEL	95	1 1 4 1 1 3	DEL (ASCII 127)
96 (Hex 80)	FNC 3	FNC 3	96	1 1 4 3 1 1	Ç (ASCII 128)
97 (Hex 81)	FNC 2	FNC 2	97	4 1 1 1 1 3	ü (ASCII 129)
98 (Hex 82)	SHIFT	SHIFT	98	4 1 1 3 1 1	é (ASCII 130)
99 (Hex 83)	CODE C	CODE C	99	1 1 3 1 4 1	â (ASCII 131)
100 (Hex 84)	CODE B	FNC 4	CODE B	1 1 4 1 3 1	ä (ASCII 132)
101 (Hex 85)	FNC 4	CODE A	CODE A	3 1 1 1 4 1	à (ASCII 133)
102 (Hex 86)	FNC 1	FNC 1	FNC 1	4 1 1 1 3 1	å (ASCII 134)

Start Code and Stop Code

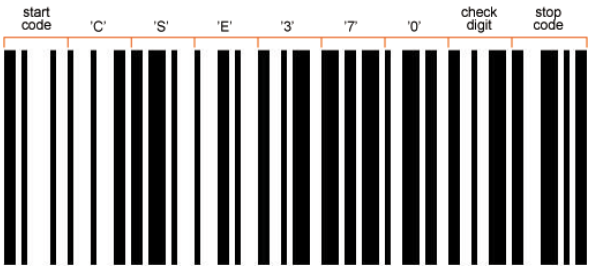
Value	Start Code	Pattern B S B S B S	What ASCII Code Do I Print?
103 (Hex 87)	START (Code A)	2 1 1 4 1 2	‡ (ASCII 135)
104 (Hex 88)	START (Code B)	2 1 1 2 1 4	ˆ (ASCII 136)
105 (Hex 89)	START (Code C)	2 1 1 2 3 2	‰ (ASCII 137)
106 (Hex 6A)	STOP (All Codes)	2 3 3 1 1 1 2	Š (ASCII 138)

Checksum character

- Take the value of the start character (103, 104, or 105) and make that the starting value of the running checksum
- Start with the first data character, take its value (between 0 and 102, inclusive) multiply it by its character position (1) and add that to the running checksum
- Take each additional character in the symbol, take its value, and multiply it by its character position, and add the total to the running checksum
- Divide the resulting running checksum by 103. The remainder becomes the checksum character which is added to the end of the symbol

Example: Encode “CSE370”

- Start code and data
  - Start-A = 103 = “211412” (bar, space, bar, …, space)
  - C = 35 = “131321”
  - S = 51 = “213113”
  - E = 37 = “132113”
  - 3 = 19 = “221132”
  - 7 = 23 = “312131”
  - 0 = 16 = “123122”



- Checksum
  - 103 + 35*1 + 51*2 + 37*3 + 19*4 + 23*5 + 16*6 = 638
  - Remainder of 638 divided by 103 = 20
  - 20 = “221231”
- Stop code
  - “2331112”

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Questions?