CODE 39 SYMBOLOGY

See Also:

Quick Links: **Background**   **Check Digit**   **Encoding**   **Structure**   **Encoding Table**   **Example**   **Full ASCII Mode**

CODE 39 BACKGROUND INFORMATION

Code 39, the first alpha-numeric symbology to be developed, is still widely used-especially in non-retail environments. It is the standard bar code used by the United States Department of Defense, and is also used by the Health Industry Bar Code Council (HIBCC). Code 39 is also known as "3 of 9 Code" and "USD-3".

A typical Code 39 bar code is:

TEST8052

Code 39 is a discrete, variable-length symbology. It is self-checking in that a single print defect cannot transpose one character into another valid character.

COMPUTING THE CHECKSUM DIGIT

Since Code 39 is self-checking, a check digit normally isn't necessary. However, in applications that require an extremely high level of accuracy a modulo 43 checksum digit may be added.

To calculate the optional checksum digit, follow the following steps.

1. Take the value (0 through 42) of each character in the bar code. The start and stop characters are not included in the checksum calculation.
2. Sum the value of each of the values of each of the characters described in step 1.
3. Divide the result from step 2 by 43.
4. The remainder from the division in step 3 is the checksum character that will be appended to the data message before the stop character.
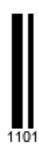
ENCODING THE SYMBOL

Once the checksum digit has been calculated we know the entire message which must be encoded in the bars and spaces. Continuing with our example, we will encode, from zero, the Code 39 bar code we used in our example above: **HI345678** with a checksum digit of 67.

In the following text, we will discuss the encoding of the bar code by considering that the number "1" represents a "dark" or "bar" section of the bar code whereas a "0" represents a "light" or "space" section of the bar code. Thus the numbers 1101 represents a double-wide bar (11), followed by a single-wide space (0), followed by a single-wide bar (1). This would be printed in the bar code as:

1101

STRUCTURE OF A CODE 39 BARCODE

A Code 39 bar code has the following structure:

1. A start character - the asterisk (*) character.
2. Any number of characters encoded from the table below.
3. An optional checksum digit calculated as described above and encoded from the table below.
4. A stop character, which is a second asterisk character.

CODE 39 ENCODING TABLE

This table indicates how to encode each digit of a Code 39 bar code. Note that the "Width Encoding" column is expressed as "N" for narrow and "W" for wide while the "Barcode Encoding" column represents how the bar code will actually be encoded as described above in "Encoding the Symbol."

Keep in mind that each character begins and ends with a bar, thus the "bar code encoding" always starts and ends with a "1".

CHECK VALUE	ASCII CHAR	WIDTH ENCODING	BARCODE ENCODING	CHECK VALUE	ASCII CHAR	WIDTH ENCODING	BARCODE ENCODING
0	0	NNNWWNWNN	101001101101	22	M	WNWNNNNWN	110110101001
1	1	WNNWNNNNW	110100101011	23	N	NNNNWNNWW	101011010011
2	2	NNWWNNNNW	101100101011	24	O	WNNNWNNWN	110101101001
3	3	WNWWNNNNN	110110010101	25	P	NNWNWNNWN	101101101001
4	4	NNNWWNNNW	101001101011	26	Q	NNNNNNWWW	101010110011
5	5	WNNWWNNNN	110100110101	27	R	WNNNNNWWN	110101011001
6	6	NNWWWNNNN	101100110101	28	S	NNWNNNWWN	101101011001
7	7	NNNWNNWNW	101001011011	29	T	NNNNWNWWN	101011011001
8	8	WNNWNNWNN	110100101101	30	U	WWNNNNNNW	110010101011
9	9	NNWWNNWNN	101100101101	31	V	NWWNNNNNW	100110101011
10	A	NNWWNNWNN	110101001011	32	W	WWWNNNNNN	110011010101
11	B	NNWNNWNNW	101101001011	33	X	NWNNWNNNW	100101101011
12	C	WNWNNWNNN	110110100101	34	Y	WWNNWNNNN	110010110101
13	D	NNNNWWNNW	101011001011	35	Z	NWWNWNNNN	100110110101
14	E	WNNNWWNNN	110101100101	36	-	NWNNNWNNW	100101011011
15	F	NNWNWWNNN	101101100101	37	.	WWNNNWNNN	110010101101
16	G	NNNNNWWNW	101010011011	38	SPACE	NWWNNWNNN	100110101101
17	H	WNNNNWWNN	110101001101	39	$	NWNWNWNNN	100100100101
18	I	NNWNNWWNN	101101001101	40	/	NWNWNNNWN	100100101001
19	J	NNNNWWWNN	101011001101	41	+	NWNNNWNWN	100101001001
20	K	WNNNNNWW	110101010011	42	%	NNNWNWNWN	101001001001
21	L	NNWNNNNWW	101101010011	n/a	*	NWNNWNWNN	100101101101

If a Code 39 bar code starts with a space, that bar code will be appended to any previous code 39 bar code in the buffer and the system will wait for additional bar code(s). If a Code 39 bar code doesn't start with a space, the bar code will be appended to any previous code 39 bar codes and the entire message will be delivered to the application.

In other words, if a code 39 bar code has additional bar codes to follow, it must start with a space-if the bar code is the last bar code in the message it must not start with a space.

CODE 39 ENCODING EXAMPLE

We will now code the example we used above, **TEST8052**. In this case we will not use a check digit.

1. The START character (*): **100101101101**.
2. The digit "T": enocded as **101011011001**.
3. The digit "E": enocded as **110101100101**.
4. The digit "S": enocded as **101101011001**.
5. The digit "T": enocded as **101011011001**.
6. The digit "8": enocded as **110100101101**.
7. The digit "0": enocded as **101001101101**.
8. The digit "5": enocded as **110100110101**.
9. The digit "2": enocded as **101100101011**.
10. The STOP character (*): **100101101101**.

This is shown in the following graphical representation where the bar code has been sectioned-off into areas that reflect each of the 10 components just mentioned.

Are you a developer? Try out the [HTML to PDF API](#)

NOTE: In the above encoding example note that there is an inter-character space between each character. This is not listed in the list of 10 components, but there is an inter-character space between each character. This inter-character space is represented in the graphic by the white space separating the grey areas.

EXTENDED CODE 39 ENCODING TABLE

It is possible, using Code 39's "Full ASCII Mode" to encode all 128 ASCII characters. This is accomplished by using the $, /, %, and + symbols as "shift" characters. Those characters combined with the single character that follows indicate which Full ASCII character is to be used.

ASCII	ENCODING	ASCII	ENCODING	ASCII	ENCODING	ASCII	ENCODING
NUL	%U	SP	Space	@	%V	`	%W
SOH	$A	!	/A	A	A	a	+A
STX	$B	"	/B	B	B	b	+B
ETX	$C	#	/C	C	C	c	+C
EOT	$D	$	/D	D	D	d	+D
ENQ	$E	%	/E	E	E	e	+E
ACK	$F	&	/F	F	F	f	+F
BEL	$G	'	/G	G	G	g	+G
BS	$H	(	/H	H	H	h	H

HT	$I	)	/I	I	I	i	+I
LF	$J	*	/J	J	J	j	+J
VT	$K	+	/K	K	K	k	+K
FF	$L	,	/L	L	L	l	+L
CR	$M	-	-	M	M	m	+M
SO	$N	.	.	N	N	n	+N
SI	$O	/	/O	O	O	o	+O
DLE	$P	0	0	P	P	p	+P
DC1	$Q	1	1	Q	Q	q	+Q
DC2	$R	2	2	R	R	r	+R
DC3	$S	3	3	S	S	s	+S
DC4	$T	4	4	T	T	t	+T
NAK	$U	5	5	U	U	u	+U
SYN	$V	6	6	V	V	v	+V
ETB	$W	7	7	W	W	w	+W
CAN	$X	8	8	X	X	x	+X
EM	$Y	9	9	Y	Y	y	+Y
SUB	$Z	:	/Z	Z	Z	z	+Z
ESC	%A	;	%F	[	%K	{	%P
FS	%B	<<	%G	\	%L	|	%Q
GS	%C	=	%H	]	%M	}	%R
RS	%D	>	%I	^	%N	~	%S
YS	%E	?	%J	_	%O	DEL	%T, %X, %Y, %Z