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Structure of Barcode

The following explains the format of a barcode.
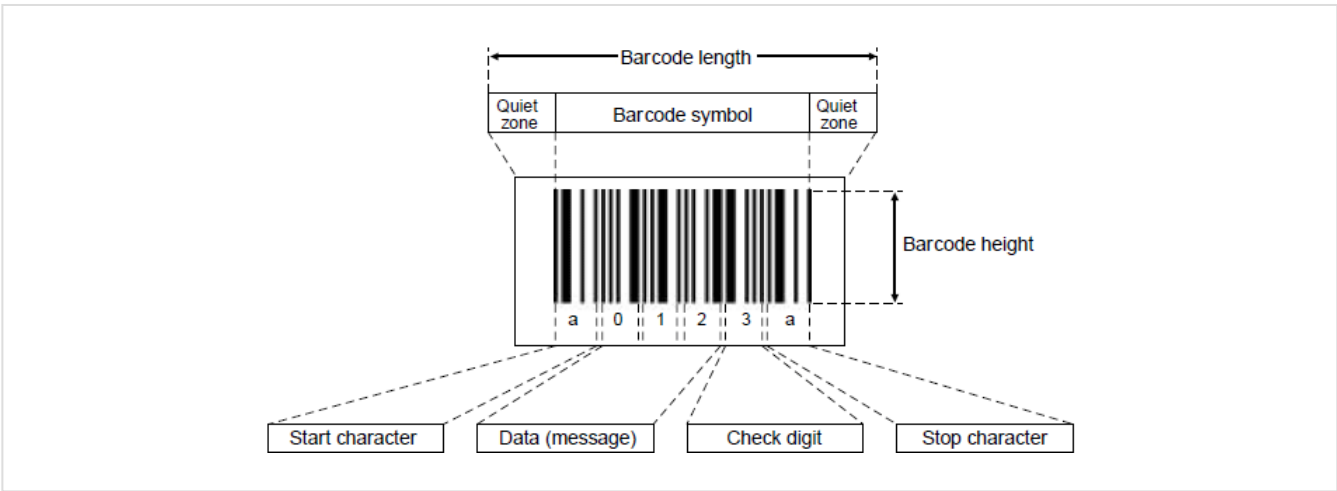
Quiet zone (margin)

The right and left ends of the barcode symbol.

If the margin is not wide enough, the barcode reader cannot scan the barcode data.

Both the right and left margins should be at least 10 times as wide as the narrow bar width (minimum element width). (See page here for narrow bar width.)

Unless the quiet zones are wide enough, it becomes unstable for the barcode reader to scan the barcode data.

Start/stop character

Character to indicate start or end of the data.

Start/stop character varies depending on the type of the barcode. CODE 39 uses "*" and CODABAR uses "a","b","c" and "d". (EAN and ITE uses, instead of a character a bar pattern which indicates the start/end of the data.)

Data (message)

Bar patterns representing the data (numerical characters, alphabet, etc.) are arranged from left.

The drawing above shows that the data of "012" is demonstrated, with the bar patterns representing 0, 1, and 2 being arranged respectively from the left.

Check digit

A numeric value calculated to check for read error It is appended directly after the barcode data.
(See page here for details)

Barcode length

Barcode length defines the total length including the right and left quiet zones.
If the barcode length, includinng quiet zones, does not fit in the scan width, the barcode reader cannot scan the data.

Barcode height

It is recommended to make the barcode as high as the printer permits.
If the barcode is not high enough, the laser may deviate from the barcode, causing unstable readings.
It is recommended to keep the height greater than 15 % of the barcode length.

Narrow Bar and Wide Bar

The following explains bars and spaces that are the minimum unit to form a barcode. A barcode is a combination of narrow and wide bars and spaces. Each bar and space are named as listed below:

NB	Narrow bar
WB	Wide bar
NS	Narrow space
WS	Wide space

Narrow and wide widths are determined at the following ratio:
NB:WB = NS:WS =1:2 to 1:3

If the ratio of narrow and wide is out of the range above, the barcode reader may perform unstable readings.
For preparing a barcode, careful attention shall be made to this ratio. The following ratio is normally recommended for preparing a barcode.
NB:WB = NS:WS =1:2.5 (Recommended ratio)

The width of a narrow bar is a key for selecting a barcode reader
Narrow bar width is also named "minimum element width".

The size of a barcode becomes small.

A barcode with many digits can be printed in a given space.

The readable range (reading depth) for a barcode is narrowed.

High performance is required for the printer to print a barcode.(laser printer,thermal transfer printer)

If the narrow width is large

The size of a barcode becomes large.

The readable range (reading depth) for a barcode is widened.

Low performance is allowed for the printer to print a barcode.(dot printer,ink jet printer for FA)

Binary Level and Multiple Level

Barcodes in the categories of CODE 39, CODABAR and ITF consist of bars and spaces that have two steps of narrow and wide widths. It is named the "binary level" barcode.
The ratio between narrow and wide is 1 : 2 to 1 : 3. Some allowance is possible.
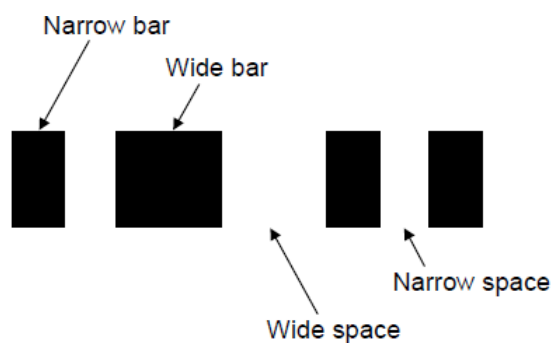
Barcodes in the categories of EAN and CODE 128 consist of bars and spaces that have four steps of narrow and wide widths. It is named the "multiple level" barcode.
The ratio is 1 : 2 : 3 : 4. Allowance is very limited.
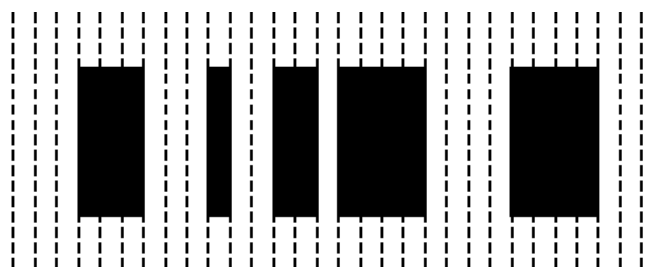
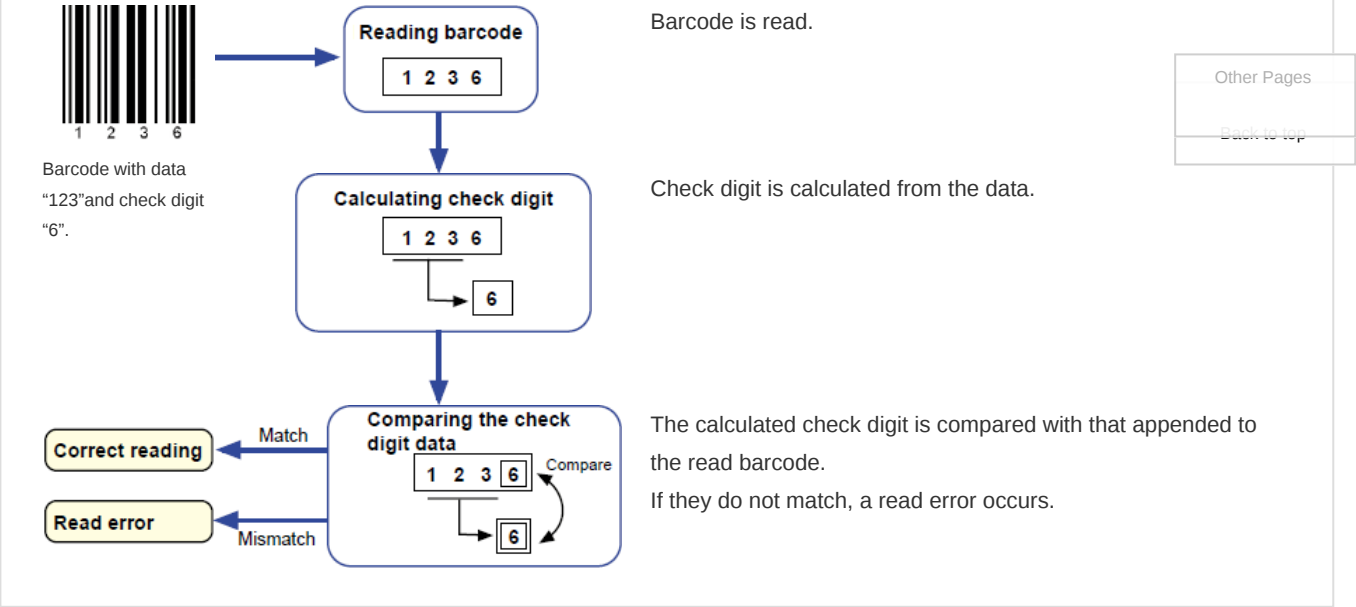"Multiple level" EAN and CODE 128 have four steps of bar width.

If the print quality is not good enough to identify the bar width, reading error tends to occur

The printers with poor print quality including dot impact printer are not suitable for EAN and CODE 128.

What Is Check Digit?

A check digit is a numeric value calculated to check for read error

The following explains the check figure calculation method.

Barcode with data "123"and check digit "6".

Reading barcode

1 2 3 6

Barcode is read.

Calculating check digit

1 2 3 6 → 6

Check digit is calculated from the data.

Comparing the check digit data

1 2 3 6   Compare → 6

Match → **Correct reading**

Mismatch → **Read error**

The calculated check digit is compared with that appended to the read barcode.
If they do not match, a read error occurs.

Calculating the check digit

The following explains how to calculate the check digit, taking Modulus 10/3 Weight as an example, which is applied for EAN and ITF.

①Number the code value sequentially starting from the right.
②Multiply each odd numbered value by 3 and each even numbered value by 1.
③Total the multiplied values and then subtract the last digit value of the total value from 10 to get the check digit.

12	11	10	9	8	7	6	5	4	3	2	1
4	9	7	1	2	3	4	5	6	7	8	9
x	x	x	x	x	x	x	x	x	x	x	x
1	3	1	3	1	3	1	3	1	3	1	3
‖	‖	‖	‖	‖	‖	‖	‖	‖	‖	‖	‖

$$4 + 27 + 7 + 3 + 2 + 9 + 4 + 15 + 6 + 21 + 8 + 27$$
$$= 133$$

$$10 - 3 \text{ (the last digit value of 133)} = 7$$

Thus, the check digit is calculated to be 7.

Barcode Types (EAN, CODE 39, ITF, CODABAR, CODE 128)

About 100 types of barcode are available in the world.
The followings are typical barcodes:

Name	EAN,UPC	ITF	CODE39	CODABAR	CODE128
Symbol	4 912345 123459	1 2 3 4 5 6	A B C 1 2 3	A 1 2 3 4 5 6 A	A B a b 1 2
Character type	Numeric values(0 to 9)only	Numeric values(0 to 9)only	Numeric values(0 to 9) Alphabet Symbol(-,.,space,$,/,+,%) Start/stop character (*:asterisk)	Numeric values(0 to 9) Symbol(-,$,/,.,+) Start/stop character(a to d)	All ASCI codes Numeric values(0 to 9) Alphabet upper case/lower case

					([CR] [STX] etc.)
Features	Standardized as the distribution code.	Allows a barcode size smaller than other barcode types with the same digits.	Availability of alphabet and symbol allows indication of article numbers.	Possible to indicate some alphabets and symbols.	Supp... char... Allows the minimum size of barcode for indication with the numeric values only. (more than 12 digits)
Printable digits	13 digits or 8 digits	Even digits only	Any digits	Any digits	Any digits
Bar structure	Four bar sizes No start/stop character Indicates one character with two bars and two spaces.	Two bar sizes No start/stop character Indicates one character with five bars (or five spaces).	Two bar sizes Uses asterisk * for start/stop character. Indicates one character with five bars and four spaces.	Two bar sizes Uses a to d for start/stop character. Indicates one character with four bars and three spaces.	Four bar sizes Three types of start/stop characters. Each type supports its own character type. Indicates one character with three bars and three spaces.
Application performance	World universal code Marked on most daily goods Book industry	Standardized as the distribution code.	Widely used as the industrial barcode. Automobile Industry Action Group (AIAG) Electronic Industries Alliance (EIA)	Blood bank Slip of door-to-door delivery service(Japan)	Starts to be used as EAN-128 in each industry. Distribution business industry Food industry Medical industry

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