



## 2.1 Structure

The EAN/UPC Symbology consists of four symbol types;

- EAN-13 encodes a GTIN-13
- EAN-8 encodes a GTIN-8
- UPC-A encodes a GTIN-12
- UPC-E encodes a zero suppressed GTIN-12

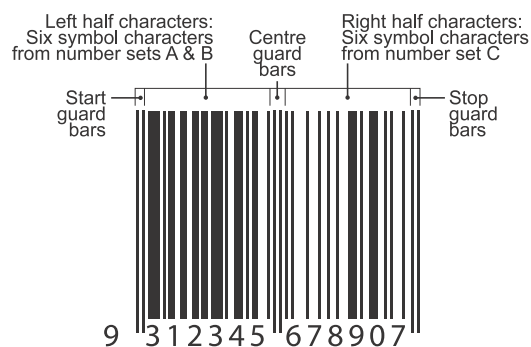
For EAN/UPC Symbol dimensions refer to chapter 8, section 8.6.5 EAN/UPC Bar Code Dimensions on page 80.

EAN-13, EAN-8 and UPC-A Symbols follow a standard structure. An example with an EAN-13 is shown in Figure 2 below.

- Left Quiet Zone
- Left guard bar pattern
- Left half of the encoded numbers
- Centre guard bar pattern
- Right half of the encoded numbers
- Right guard bar pattern
- Right Quiet Zone

The structure of a UPC-E Symbol is as follows:

- Left Quiet Zone
- Left guard bar pattern
- Encoded numbers
- Special guard bar pattern
- Right Quiet Zone

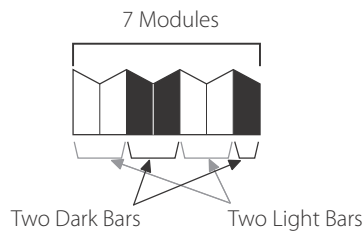


**Figure 2 - EAN-13 Bar Code Format**



## 2.2 Encoding EAN/UPC Symbols

Each human readable digit in an EAN/UPC Symbol is represented by a combination of seven dark and light modules, collectively called a symbol character. An EAN/UPC symbol character has two dark bars and two light bars, comprising of between one and four modules each, as seen in the figure below.



**Figure 3 - EAN/UPC Symbol Character**

Auxiliary symbol characters are in addition to the symbol characters representing the human readable interpretation. They comprise fewer modules and are used as guard bar patterns for beginning, ending and separating the symbol.

Symbol Type	Left Quiet Zone	Left guard bar pattern	Left half character	Centre guard bar pattern	Right half character	Right guard bar pattern	Right Quiet Zone	Total
EAN-13	7 modules	3 modules	6 x 7 = 42 modules	5 modules	6 x 7 = 42 modules	3 modules	11 modules	113 modules
EAN-8	7 modules	3 modules	4 x 7 = 28 modules	5 modules	4 x 7 = 28 modules	3 modules	7 modules	81 modules
UPC-A	9 modules	3 modules	6 x 7 = 42 modules	5 modules	6 x 7 = 42 modules	3 modules	9 modules	113 modules

The number of modules listed for Quiet Zones is the minimum allowable.  
The total number of modules includes the minimum left and right Quiet Zones.

**TABLE 4.** EAN-13, EAN-8 and UPC-A Structure and Total Modules

Symbol Type	Left Quiet Zone	Left guard bar pattern	Characters	Special guard bar pattern	Right Quiet Zone	Total
UPC-E	9 modules	3 modules	42 modules	6 modules	7 modules	67 modules

The number of modules listed for Quiet Zones is the minimum allowable.  
The total number of modules includes the minimum left and right Quiet Zones.

**TABLE 5.** UPC-E Structure and Total Modules



Each symbol character is encoded from different number sets known as A, B, and C, while the encodation of auxiliary characters remain the same. Note that symbol characters representing digits in:

- Number set A have an **odd** number of dark modules (shown as 1's in Table 7). These are called symbol characters with **odd parity**.
- Number sets B and C have an **even** number of dark modules. These are called symbol characters with **even parity**.
- Number sets A and B always begin with a light module on the left (shown as 0's in Table 7), and end with a dark module on the right.
- Number set C always begins on the left with a dark module and end on the right with a light module.

**For EAN-13 Symbols** the left half of the symbol is encoded by variable parity (see "Variable Parity Encoding of the 13th Digit" on page 9) using a combination of characters from number sets A and B, determined by the value of the 13th digit. The right half of the symbol is always encoded using number set C.

**Note:** The 13th digit is always the digit in the left most position of the GTIN-13 (for GTIN-13s allocated by GS1 Australia this number is a 9), with the remaining 12 digits in the number, represented by symbol characters, in sequence from left to right.

**For EAN-8 and UPC-A Symbols** the left half of the bar code is encoded using number set A, while the right half is encoded using number set C

**UPC-E Symbols** are encoded by variable parity from either number sets A or B, the combination of which is dependent on the value of the Check Digit.

Every symbol character in a bar code begins and ends with a different module than the one before or after it, be it light or dark. This means that you can always visually distinguish the boundary between two characters, which is essential for unambiguous decoding.

See Table 7 on page 10 for a list of all combinations of dark and light modules for each human readable digit. The number sets in this table are shown graphically in Figure 5 on page 11.



## 2.2.1 Variable Parity Encoding of the 13th Digit

For an EAN-13 Bar Code you encode the value of the 13th digit by permutation, using number sets A and B for the six digits in the left half of the bar code. This is known as using variable parity coding. For all possible permutations for the 13th digit, see Table 6. The EAN-13 Symbol itself comprises 12 symbol characters. The 13th human readable digit is not represented by a symbol character.

Australia's country prefix is 93, therefore, the 13th digit for numbers using this prefix is always **9**.

Using prefix 9 causes the left half of the bar code to have variable parity, because it comprises a combination of number set A (odd parity) and number set B (even parity) symbol characters.

Figure 4 uses the GTIN-13 9312345678907 as an example.

Number sets used for coding left half of bar code						
Value of 13th digit	12th digit	11th digit	10th digit	9th digit	8th digit	7th digit
0	A	A	A	A	A	A
1	A	A	B	A	B	B
2	A	A	B	B	A	B
3	A	A	B	B	B	A
4	A	B	A	A	B	B
5	A	B	B	A	A	B
6	A	B	B	B	A	A
7	A	B	A	B	A	B
8	A	B	A	B	B	A
9	A	B	B	A	B	A

**TABLE 6.** Coding system for the 13th digit



**Figure 4 - EAN-13 Permutation for Bar Code Digit Positions**



## 2.2.2 EAN/UPC Symbol Encodation

### Symbol Characters

All EAN/UPC Symbol characters are 7 modules.

Value of digit	Number set A	Number set B	Number set C
0	0001101	0100111	1110010
1	0011001	0110011	1100110
2	0010011	0011011	1101100
3	0111101	0100001	1000010
4	0100011	0011101	1011100
5	0110001	0111001	1001110
6	0101111	0000101	1010000
7	0111011	0010001	1000100
8	0110111	0001001	1001000
9	0001011	0010111	1110100

Note: 0 represents a light module and 1 represents a dark module.

**TABLE 7.** Module Composition of EAN/UPC Symbol Characters

### Auxiliary Characters

An auxiliary symbol character is a representation in dark bars and light bars (spaces) of data other than human readable digits; that is, left guard bar pattern, centre guard pattern, right guard bar pattern or special guard bar pattern.

The composition of modules for these auxiliary symbol characters is shown in the table below.

Auxiliary characters	Number of modules	Module set
Left and right guard bar pattern	3	1 0 1
Centre guard bar pattern	5	0 1 0 1 0
Special guard bar pattern (for UPC-E Symbols)	6	0 1 0 1 0 1

Note: 0 represents a light module and 1 represents a dark module













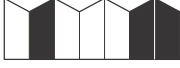

















**TABLE 8.** Module Composition of EAN/UPC Auxiliary Characters





## 2.2.3 Module Composition Represented Graphically

### Symbol Characters




Value of Digit	Number Set A (Odd)	Number Set B (Even)	Number Set C (Even)
0			
1*			
2*			
3			
4			
5			
6			
7*			
8*			
9			

\* Characters 1, 2, 7, and 8 have a special dimensional requirements.

**Figure 5 - Graphic Representation of EAN/UPC Symbol Characters**



## Auxiliary Characters

Auxiliary Character	Graphic Representation
Left and Right Guard Bar Pattern	
Centre Guard Bar Pattern	
UPC-E Special Guard Bar Pattern	

**Figure 6 - Graphic Representation of EAN/UPC Auxiliary Characters**

## 2.2.4 Nominal Dimensions of Symbol Characters

Bar codes can be printed at various densities to accommodate a variety of printing and scanning processes. The width of each bar (dark element) and space (light element) is determined by multiplying the X-dimension (the width of a single module) by the module width of each bar and space (1, 2, 3, or 4). There is an exception for characters 1, 2, 7, and 8. For these characters the bars and spaces are reduced or enlarged by one-thirteenth of a module to provide a uniform distribution of bar width tolerances and thus improve scanning reliability. The reduction or enlargement in millimetres at nominal size (X-dimension 0.33mm) of the bars and spaces for the characters 1, 2, 7, and 8 in the number sets A, B, and C is shown in Table 8.

Character Value	Number Set A		Number Sets B and C	
	Bar (Dark Element)	Space (Light Element)	Bar (Dark Element)	Space (Light Element)
1	-0.025	+0.025	+0.025	-0.025
2	-0.025	+0.025	+0.025	-0.025
7	+0.025	-0.025	-0.025	+0.025
8	+0.025	-0.025	-0.025	+0.025

Note: All measurements are in millimetres

**TABLE 9.** Reduction/Enlargement for Characters 1, 2, 7 and 8 at nominal size (X-dimension 0.33mm)

For details on the X-dimensions for EAN/UPC Bar Codes please refer to chapter 8, section 8.6.5 EAN/UPC Bar Code Dimensions on page 80.

