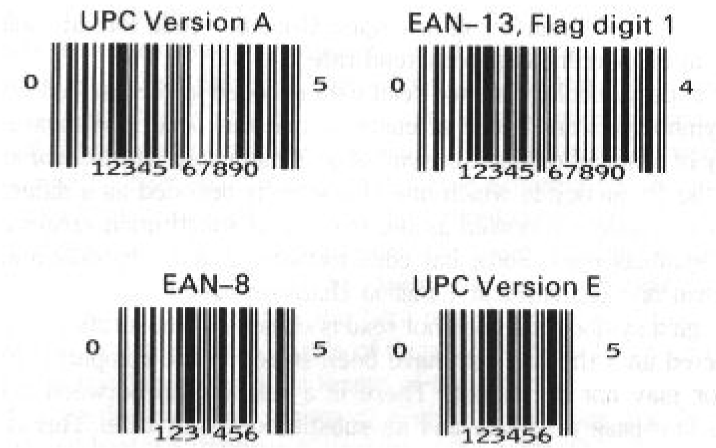
The Universal Product Code was the first bar code symbology widely adopted. Its birth is usually set at April 3, 1973, when the grocery industry formally established UPC as the standard bar code symbology for product marking. Foreign interest in UPC led to the adoption of the EAN code format, similar to UPC, in December 1976.

2005 Sunrise and the Global Trade Item Number initiatives from the UCC will begin on January 1, 2005. This is the "fourteen digit U.P.C." that everyone is talking about. There are quite a few misconceptions and considerable misinformation about the effect of this change. In a nutshell, if you are a manufacturer of a product that has an existing 8 or 12-digit UPC barcode, don't worry. You do not have to change anything. However, if you are a retailer or wholesaler with scanners, you potentially are affected. You will need to ensure that scanners are able to decode 8, 12, 13 and 14-digit barcodes (most scanners sold for the last 5 years can do this) and that database systems can handle the extra digits. Gregg London was kind enough to share an excellent white paper on the subject. Once January 1, 2005 comes, both EAN and UPC labels should scan properly worldwide.

There are now five versions of UPC and two versions of EAN. The Japanese Article Numbering (JAN) code has a single version identical to one of the EAN versions with the flag characters set to ``49".

UPC and EAN symbols are fixed in length, can only encode numbers, and are continuous symbologies using four element widths.



UPC version A symbols have 10 digits plus two overhead digits while EAN symbols have 12 digits and one overhead digit. The first overhead digit of a UPC version A symbol is a number related to the type of product while an EAN symbol uses the first two characters to designate the country of the EAN International organization issuing the number. UPC is in fact a subset of the more general EAN code. Scanners equipped to read EAN symbols can read UPC symbols as well. However, UPC scanners will not necessarily read EAN symbols.

The UPC symbology was designed to make it ideal for coding products. UPC can be printed on packages using a variety of printing processes. The format allows the symbol to be scanned with any package orientation. Omnidirectional scanning allows any package orientation provided the symbol faces the scanner. The UPC format can be scanned by hand-held wands and can be printed by equipment in the store. Version A of the symbology has a First Pass Read Rate of 99% using a fixed laser scanner and has a substitution error rate of less than 1 error in 10,000 scanned symbols.

Nominal X dimension is 13 mils. A magnification factor of 0.8 to 2.0 is allowed and, as a result, makes a printable range of X dimension values of 10.4 to 24 mils. In other words, the nominal size of a UPC symbol is 1.469" wide x 1.02" high. The minimum recommended size is 80% of the nominal size or 1.175" wide x .816" high. The maximum recommended size is 200% of the nominal size or 2.938" wide x 2.04" high. Larger UPC's scan better. Smaller UPC's do not scan as well or not at all.

The UPC format can be printed using a variety of printing techniques because it allows for different ink spreading. The amount of ink spreading depends on printing press conditions, amount and viscosity of ink and other factors which are difficult to precisely control. The UPC symbol is decoded by measuring the distance from leading edges to leading edge of bars, trailing edge to trailing edge of bars and leading edge to leading edge of characters. Since relative distances are measured for decoding, uniform ink spread will not affect the symbol's readability. However, excessive ink spread will make the spaces very small to the point that the reader will be unable to resolve them. Since UPC is a continuous code with exacting tolerances, it is more difficult to print on any equipment except printing presses.

UPC Version A

UPC version A is the basic version of UPC and is usually the version seen on grocery store items. The symbology is used to encode the 10 digit Universal Product Code. An eleventh digit indicates the type of product, and a twelfth digit is a modulo check digit. The symbol is divided into two halves, each containing 5 digits. The two six-digit patterns are surrounded by left, center and right guard patterns. The left six digits use odd parity encodation while the right six digits use even parity encodation.. The first digit is the UPC number system digit related to the type of product (0 for groceries, 3 for drugs, etc.). The next 5 digits are the UPC manufacturer's code. The first five digits of the right half are the product code. The final digit is the check digit. Although UPC A is continuous, the left and right halves of the symbol can be independently decoded.

A digit is coded as a sequence of two bars and two spaces within a space 7 modules wide. Bar and space widths may be 12, 3, or 4 modules wide. This results in 20 possible bar-space combinations. Ten of these patterns are used for the left odd parity digits and ten are used for the right even parity digits. The left digits always start with a space, while the right digits always start with a bar.

	Left Digits Odd Parity S B S B	Right Digit Even Parity B S B S
0	3 2 1 1	3 2 1 1
1	2 2 2 1	2 2 2 1
2	2 1 2 2	2 1 2 2
3	1 4 1 1	1 4 1 1
4	1 1 3 2	1 1 3 2
5	1 2 3 1	1 2 3 1

6	1 1 1 4	1 1 1 4
7	1 3 1 2	1 3 1 2
8	1 2 1 3	1 2 1 3
9	3 1 1 2	3 1 1 2

A typical UPC Version A symbol has center guard bars in the center of the symbol which are longer than the other bars. This divides the symbol into a right and left half. This division allows the symbol to scan in any orientation. The moving beam laser bar code reader in grocery stores produces orthogonal scanning beams either in a cross, starburst, or figure-eight. At least one beam will then pass through each half of the symbol, since the symbol's height is at least equal to half of the length of the symbol.

The height of the symbol should be at least half the length of the symbol. Sometimes the symbol's height is shortened to fit into the design of the package. This truncation of symbol height affects the ability to scan the symbol in any orientation, and will generally reduce the First Pass Read Rate.

The Quiet Zone should be 9 modules on the left and right of the symbol.

Version A may include either a 2 digit or a 5 digit supplemental encodation. These extra digits are primarily used on periodicals and books.

More information about Version A is available here.

UPC Version E

UPC version E is the next most common version of UPC. It is a zero suppression version of UPC. It is intended to be used on packaging which would be otherwise too small to use one of the other versions. The code is smaller because it drops out zeros which would otherwise occur in a symbol. For example, the code 59300-00066 would be encoded as 593663. The last digit (3 in the example) indicates the type of compression. Guard bars precede and follow the data (no middle guard bars). The digits are coded following the parity pattern **EVEN, EVEN, ODD, ODD, EVEN, ODD**. The data is enclosed between two left-hand guard bars and three right-hand guard bars. The six digit number is always preceded by a 0 and followed by the check digit. The way the check digit is computed is by expanding the type E to a type A, then doing the regular check.

More information about Version E along with a converter is available here.

There is a good explanation of Zero Suppression at the Infinity Graphics site with a table that shows how a Version A number may be reduced to Version E if the Numbering System Character is "0".

Other UPC Versions

There are three other versions of UPC. These other versions are not in wide use.

UPC version B is a special version originally developed to handle the National Drug Code and National Health Related Items Code. It allows for 11 digits plus one product type code. This version does not have any modulo check digit.

UPC version C is a special code designed to promote industry-wide compatibility. The code is 12 digits long with a product type digit and a modulo check sum digit.

UPC version D is a variable message length version of UPC. The symbol must contain at least 12 digits. The first digit is a product type code. This is followed by 10 information carrying digits. The twelfth digit is a modulo check sum, and this is followed by a variable number of digits.

There is a good explanation of the UPC Shipping Container Symbol (SCS) at the Infinity Graphics site.

EAN-13 and EAN-8

The EAN Article Numbering System (EAN),the Japanese Article Numbering (JAN) System and the International Article Numbering System (IAN) are identical to UPC except for the number of digits. The Japanese Article Numbering (JAN) System (JAN) codes are the same as the EAN codes, with the flag characters set to ``49''. There are two principal EAN versions.

Standard EAN (sometimes called EAN-13 or DUN-13) has 10 numeric characters, 2 or 3 "flag" characters which are usually a code for the country of the EAN International organization issuing the number , and a check digit. In all other respects, it is identical to UPC version A. JAN is the same as EAN-13. For compatibility with UPC, flags 00, 01, 03, 04, and 06 through 13 are assigned to the United States.

What are the country codes?

Lots of people have requested the codes. Here is a partial list. Remember, it indicates the country that issued the code, **NOT THE COUNTRY OF ORIGIN OF THE PRODUCT**. The authoritative list is here.

```
00-13   USA & Canada
20-29   reserved for local use (store/warehouse)
30 -37  France
400-440 Germany
45      Japan
46      Russian Federation
471     Taiwan
474     Estonia
475     Latvia
477     Lithuania
479     Sri Lanka
480     Philippines
482     Ukraine
484     Moldova
485     Armenia
486     Georgia
487     Kazakhstan
489     Hong Kong
49      Japan
```

50	UK
520	Greece
528	Lebanon
529	Cyprus
531	Macedonia
535	Malta
539	Ireland
54	Belgium & Luxembourg
560	Portugal
569	Iceland
57	Denmark
590	Poland
594	Romania
599	Hungary
600-601	South Africa
609	Mauritius
611	Morocco
613	Algeria
619	Tunisia
622	Egypt
625	Jordan
626	Iran
64	Finland
690-692	China
70	Norway
729	Israel
73	Sweden
740-745	Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica & Panama
746	Republica Dominicana
750	Mexico
759	Venezuela
76	Switzerland
770	Colombia
773	Uruguay
775	Peru
777	Bolivia
779	Argentina
780	Chile
784	Paraguay
785	Peru
786	Ecuador
789	Brazil
80 -83	Italy
84	Spain
850	Cuba
858	Slovakia
859	Czech
860	Yugoslavia
869	Turkey
87	Netherlands
880	South Korea
885	Thailand
888	Singapore
890	India
893	Vietnam
899	Indonesia
90 -91	Austria
93	Australia
94	New Zealand
955	Malaysia

```
        977     ISSN   (International   Standard   Serial   Number   for
periodicals)
        978     ISBN (International Standard Book Number)
        979     ISMN (International Standard Music Number)
        980     Refund receipts
        99      Coupons
```

More information about EAN-13 is available here.

EAN-8 has a left-hand guard pattern, four odd parity digits, a center guard pattern, four even parity digits, and a right-hand guard pattern. An EAN-8 bar code has two flag digits, five data digits, and one check digit. There is additional information about EAN-8 here.

Information about Bookland EAN and ISBN numbering of books can be found at BarCode 1's Bookland EAN and ISBN Page.

There is a good explanation of Bookland EAN bar code symbols used by the publishing industry at the Infinity Graphics site. There is also a very good explanation about Bookland EAN Add-On Code, used for storing the price of a book or magazine.

Other UPC And EAN Resources

George J. Laurer is the developer of UPC in 1973 and EAN later. There is a history at his site.

Uniform Code Council has a home page that provides a catalog of information they sell and an electronic version of their newsletter.

EAN International is is the organization that manages the EAN system worldwide, currently there are national organizations in 92 countries on the 5 continents. (can be slow to access from North America). They have a FAQ with some basic information about EAN. They also have a complete list of the addresses and phone numbers of the local EAN organizations by country. This list also has links to on-line sites of EAN organizations in some countries. There is much more very good information at the EAN site. The site is a must visit for information about EAN.

There is another site which provides product descriptions. It's called the Internet UPC Database, an on-line database for Universal Product Codes (UPC).

You now can purchase a UPC database from Gregg London.

1-800-Database sells a database of UPC product codes.

Swiss companies and EAN/UPC codes can be looked up at EAN Switzerland.

EAN AUSTRALIA is the Australia trade association that administers EAN. They also have an EAN check digit calculator that runs under Windows. The site also has many manuals available for downloading in Adobe Acrobat format here.

A nice JavaScript that calculates the check digits for EAN and UCC Identification numbers is at the EAN International site.

A abstract from EE students' project on how to build a UPC decoder. There are schematics and a description about how to encode and decode the symbol.

There is a good explanation for children about How UPC Bar Codes Work from Howstuffworks.com

A very good explanation about UPC/EAN-128 Coupon Extended Code for cents-off coupons can be found at the Infinity Graphics site.

Information about using UPC on cents-off coupons can be found here.

There is a good explanation about coupon codes here.

A white paper about GTIN can be found at the Uniform Code Council site.

Html Page: http://www.barcodeisland.com/ean13.phtml

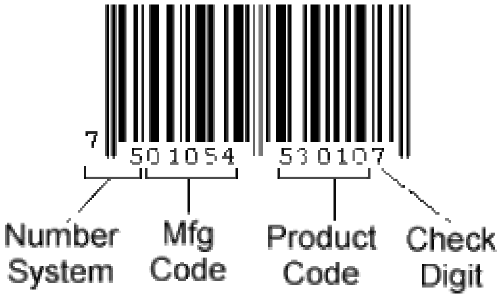
EAN-13 BACKGROUND INFORMATION

EAN-13, based upon the UPC-A standard, was implemented by the International Article Numbering Association (EAN) in Europe. This standard was implemented mostly because the UPC-A standard was not well designed for international use, but probably partly because no-one likes the U.S. to be in charge of anything-especially the Europeans. :)

EAN-13 is a superset of UPC-A. This means that any software or hardware capable of reading an EAN-13 symbol will automatically be able to read an UPC-A symbol. *The only difference between EAN-13 and UPC-A is that the number system code in UPC-A is a single digit from 0 through 9 whereas an EAN-13 number system code consists of two digits ranging from 00 through 99*, which is essentially a country code. Each country has a numbering authority which assigns manufacturer codes to companies within its jurisdiction. The manufacturer code is still five digits long, as is the product code, and the check digit is calculated in exactly the same way.

> **NOTE**: Since EAN-13 is a superset of UPC-A and requires very little additional effort to handle than an UPC-A code, it is recommended that all new designs implement EAN-13 rather than UPC-A. As already mentioned, this guarantees compatibility with UPC-A but also will make your software/hardware appealing to the international community. Otherwise your design will be restricted to the U.S. and Canada. Additionally, the UCC Council has announced that as of January 1, 2005, all barcode systems in the U.S. and Canada must be able to handle EAN-13 barcodes so that international manufacturers do not have to worry about printing a different barcode for their products destined for North America.

A typical EAN-13 barcode looks something like this:



The only difference between a UPC-A symbol and an EAN-13 symbol is that the number system code is 2-digits long in EAN-13 as opposed to 1 digit in UPC-A. Visually, the human-readable check digit is placed below the barcode instead of to the right of it, but this does not make any difference, technically speaking, regarding the encoding itself.

NOTE: In reality, an UPC-A symbol is an EAN-13 symbol with the first number system digit set to 0. For example, take the UPC-A code "**075678164125**". This same code, expressed as an EAN-13 symbol, would be "**0075678164125**". As you can see, we just slapped a leading "0" in front. Compare the original UPC-A symbol (top) to the EAN-13 symbol (bottom):

At first glance, the two barcodes look different. In UPC-A there is a number to the left and right of the barcode (a 0 number system and a 5 check digit), and below the barcode are two groups of 5 digits each (the manufacturer code and the product code). In the EAN-13 symbol, there is no check digit to the right of the barcode, and the numbers below the barcode consist of two groups of 6 digits each.

However, look closely at the barcodes themselves; that is, look at the bars and spaces the make up the two barcodes. As you can see, the bars and spaces themselves are identical in both UPC-A and EAN-13. The only difference is where the "human-readable" numbers are placed. Logically, if a UPC-A barcode is a subset of EAN-13, the EAN-13 representation of a UPC-A symbol must be identical. As witnessed above, that is the case.

COMPONENTS OF AN EAN-13 BARCODE

An EAN-13 barcode is divided into four areas: 1) The number system, 2) The manufacturer code, 3) the product code, and 4) the check digit. Normally the first number system digit is printed just to the left of the barcode, the second number system digit is printed as the first character of the group of six numbers on the left-hand side below the barcode, the manufacturer code is the next five digits on the left-hand side below the barcode, the product code product code is the first five digits on the right-hand side below the barcode, and the check digit is the last digit on the right-hand side below the barcode.

Number System: The number system consists of two digits (sometimes three digits) which identify the country (or economic region) numbering authority which assigned the manufacturer code. Any number system which starts with the digit **0** is a UPC-A barcode. The valid number system codes are presented in the following table:

00-13: USA & Canada	20-29: In-Store Functions	30-37: France

40-44: Germany	45: Japan (also 49)	46: Russian Federation
471: Taiwan	474: Estonia	475: Latvia
477: Lithuania	479: Sri Lanka	480: Philippines
482: Ukraine	484: Moldova	485: Armenia
486: Georgia	487: Kazakhstan	489: Hong Kong
49: Japan (JAN-13)	50: United Kingdom	520: Greece
528: Lebanon	529: Cyprus	531: Macedonia
535: Malta	539: Ireland	54: Belgium & Luxembourg
560: Portugal	569: Iceland	57: Denmark
590: Poland	594: Romania	599: Hungary
600 & 601: South Africa	609: Mauritius	611: Morocco
613: Algeria	619: Tunisia	622: Egypt
625: Jordan	626: Iran	64: Finland
690-692: China	70: Norway	729: Israel
73: Sweden	740: Guatemala	741: El Salvador
742: Honduras	743: Nicaragua	744: Costa Rica
746: Dominican Republic	750: Mexico	759: Venezuela
76: Switzerland	770: Colombia	773: Uruguay
775: Peru	777: Bolivia	779: Argentina
780: Chile	784: Paraguay	785: Peru
786: Ecuador	789: Brazil	80 - 83: Italy
84: Spain	850: Cuba	858: Slovakia
859: Czech Republic	860: Yugloslavia	869: Turkey
87: Netherlands	880: South Korea	885: Thailand
888: Singapore	890: India	893: Vietnam
899: Indonesia	90 & 91: Austria	93: Australia
94: New Zealand	955: Malaysia	977: International Standard Serial Number for Periodicals (ISSN)
978: International Standard Book Numbering (ISBN)	979: International Standard Music Number (ISMN)	980: Refund receipts
981 & 982: Common Currency Coupons	99: Coupons	

Manufacturer Code: The manufacturer code is a unique code assigned to each manufacturer by the numbering authority indicated by the number system code. All products produced by a given company will use the same manufacturer code.

EAN uses what is called "variable-length manufacturer codes." Assigning fixed-length 5-digit manufacturer codes, as the UCC has done until recently, means that each manufacturer can have up to 99,999 product codes--and many manufacturers don't have that many products, which means hundreds or even thousands of potential product codes are being wasted on manufacturers that only have a few products. Thus if a potential manufacturer knows that it is only going to produce a few products, EAN may issue it a longer manufacturer code, leaving less space for the product code. This results in more efficient use of the available manufacturer and procuct codes.

Product Code: The product code is a unique code assigned by the manufacturer. Unlike the manufacturer code, which must be assigned by the UCC, the manufacturer is free to assign product codes to each of their products without consulting any other organization. Since the UCC will already have guaranteed that the manufacturer code is unique, the manufacturer need only make sure that they do not repeat their own product codes.

Check Digit: The check digit is an additional digit used to verify that a barcode has been scanned correctly. Since a scan can produce incorrect data due to inconsistent scanning speed, print imperfections, or a host of other problems, it is useful to verify that the rest of the data in the barcode has been correctly interpreted. The check digit is calculated based on the rest of the digits of the barcode. Normally, if the check digit is the same as the value of the check digit based on the data that has been scanned, there is a high level of confidence that the barcode was scanned correctly. The method of calculating the check digit will be discussed later in this page.

ENCODING EAN-13 (AND UPC-A)

The encoding for EAN-13 (and UPC-A) barcodes is relatively straight-forward. To encode a value as an EAN-13 barcode, the checksum digit must first be calculated and the entire barcode, including check digit, may then be encoded as a sequence of bars and spaces.

> **NOTE:** Encoding a UPC-A symbol is identical to encoding a EAN-13, a "0" is simply inserted in front of the UPC-A code itself (i.e., if the barcode is **075678164125**, a zero is inserted before the code, making the EAN-13 symbol **0075678164125)**.

COMPUTING THE CHECKSUM DIGIT

Before an EAN-13 symbol may be encoded, the software must compute the correct checksum digit which will be appended to the barcode. The checksum digit is based on a modulo 10 calculation based on the weighted sum of the values of each of the digits in the number system, manufacturer code, and product code. In simple English, that means we must calculate a checksum value for the barcode. First, we take the rightmost digit of the value and consider it to be an "odd" character. We then move right-to-left, alternating between odd and even. We then sum the numeric value of all the even positions, and sum the numeric value multiplied by three of all the odd positions.

The steps for calculating the check digit are as follows:

1. Consider the right-most digit of the message to be in an "odd" position, and assign odd/even to each character moving from right to left.
2. Sum the digits in all odd positions, and multiply the result by 3.
3. Sum the digits in all even positions.
4. Sum the totals calculated in steps 2 and 3.

5. The check digit is the number which, when added to the totals calculated in step 4, result in a number evenly divisible by 10.
6. If the sum calculated in step 4 is evenly disivisible by 10, the check digit is "0" (not 10).

This is easier to understand with an example. Let's calculate the checksum digit for the barcode **0075678164125**. Actually, we know the checksum digit is the last digit in the barcode, "5". This means the "message" itself of the barcode is really **007567816412** (we just dropped the last character of the barcode). This represents a number system of "**00**", a manufacturer code of "**75678**" and a product code of "**16412**". Thus, we must calculate a check digit for the message **007567816412**.

Barcode	**0**	**0**	**7**	**5**	**6**	**7**	**8**	**1**	**6**	**4**	**1**	**2**
Position	E	O	E	O	E	O	E	O	E	O	E	O
Weighting	1	3	1	3	1	3	1	3	1	3	1	3
Calculation	0 * 1	0 * 3	7 * 1	5 * 3	6 * 1	7 * 3	8 * 1	1 * 3	6 * 1	4 * 3	1 * 1	2 * 3
Weighted Sum	0	0	7	15	6	21	8	3	6	12	1	6

Summing up the weighted sum for each digit, we get 0 + 0 + 7 + 15 + 6 + 21 + 8 + 3 + 6 + 12 + 1 + 6 = 85. This is the checksum value. However, there is only one checksum digit. The checksum digit is the value which must be added to the checksum value in order to make it even divisible by 10. In this case, the next number following 85 which is evenly divisible by 10 is the number 90. We must add 5 to 85 to get 90, therefore our check digit is "5". We subsequently append the original barcode message (**007567816412**) with our newly calculated check digit (**5**), to arrive at the final value of **0075678164125**.

Comparing this with our original barcode, we find that our calculated check digit is in fact the same as the check digit that we found on the barcode. Our calculation, therefore, is correct.

> **NOTE**: You may be wondering why the first character in the EAN-13 symbol is considered an "even" position and the second is considered "odd," etc. Logic would dictate that the first character be considered "odd" and the second considered "even," etc. Do not dispair, there is a logical reason for this.
>
> This was done to preserve compatability with the original UPC-A format. The original UPC-A symbol only had a single digit number system, therefore what is the second character of an EAN-13 symbol is what would be considered the first character of an UPC-A symbol, and would therefore be in an "odd" position. Rather than rewriting and confusing the specification, when the EAN-13 standard was defined they simply inserted the new, leading character in front and called it "even" thereby maintaining compatability with existing UPC-A barcodes and, to some extent, with existing UPC-A documentation.

You may use the following **EAN-13 Checksum Calculator** to calculate the final checksum digit for any EAN-13 barcode. Simply enter the first 12 characters of the barcode in the first field, click the "Calculate" button, and the final checksum digit will appear in the field below. The calculator requires that you have *JavaScript* enabled.

Enter EAN-13 message (12 characters):

Check Digit:

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 an EAN-13 barcode for the value **0075678164125**.

In the following text, we will discuss the encoding of the barcode by considering that the number "1" represents a "dark" or "bar" section of the barcode whereas a "0" represents a "light" or "space" section of the barcode. 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 barcode as:

1101

An EAN-13 barcode has the following physical structure:

- Left-hand guard bars, or start sentinel, encoded as **101**.
- The second character of the number system code, encoded as described below.
- The five characters of the manufacturer code, encoded as described below.
- Center guard pattern, encoded as **01010**.
- The five characters of the product code, encoded as right-hand characters, described below.
- Check digit, encoded as a right-hand character, described below.
- Right-hand guard bars, or end sentinel, encoded as **101**.

The characters that are encoded to the left of the center guard pattern are considered the "left hand side" of the symbol whereas all characters encoded to the right of the center guard pattern are considered the "right hand side" of the symbol.

The first character of the EAN-13 number system code (i.e., the first digit of the EAN-13 value) is encoded in the parity of the characters of the left-hand side of the symbol. That is to say, the value of the first character of the EAN-13 value determines the parity with which each of the characters in the left-hand side of the barcode will be encoded from the following table.

> **NOTE**: For "left-hand encoding", odd and even parity is often referred to as "character set A" (odd) and "character set B" (even).

EAN CHARACTER SET ENCODING TABLE

This table indicates how to encode each digit of an EAN-13 barcode depending on which half (left or right) of the barcode the digit is found in. In the case of a left-hand digit, the encoding (odd or even parity) is based on the value of the first digit of the number system code (see parity encoding table below).

DIGIT	LEFT-HAND ENCODING		RIGHT-HAND ENCODING
	ODD PARITY (A)	EVEN PARITY (B)	ALL CHARACTERS
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

OBSERVATIONS:

- An EAN-13 character is represented in 7 elements consisting of 2 bars and 2 spaces. No bar or space may be longer than 4 elements. The only exception to this rule is the left and right guard bars (3 elements each) and the center guard bar (5 elements long).
- All characters in the left-hand side of the barcode always start with a 0 (space) while all characters in the right-hand side of the barcode always start with a 1 (bar).
- The "right-hand" encoding pattern is exactly the same as the "left-hand odd" encoding pattern, but with 1's changed to 0's, and 0's changed to 1's.
- The "left-hand even" encoding pattern is based on the "left-hand odd" encoding pattern. To arrive at the even encoding, work from the left encoding and do the following: 1) Change all the 1's to 0's and 0's to 1. 2) Read the resulting encoding in reverse order (from right to left). The result is the "left-hand even" encoding pattern.

EAN PARITY ENCODING TABLE

The following table indicates the parity with which each character in the left-hand side of the barcode should be encoded. The parity is based on the first digit of the EAN-13 value. For example, our CD had the EAN-13 value of 0075678164125. In this case, the first digit of the number system code is the first digit "0," so the parity would be based on the number 0 in the following table:

FIRST NUMBER SYSTEM DIGIT	PARITY TO ENCODE WITH					
	SECOND NUMBER SYSTEM DIGIT	MANUFACTURER CODE CHARACTERS				
		1	2	3	4	5
0 (UPC-A)	Odd	Odd	Odd	Odd	Odd	Odd
1	Odd	Odd	Even	Odd	Even	Even

2	Odd	Odd	Even	Even	Odd	Even
3	Odd	Odd	Even	Even	Even	Odd
4	Odd	Even	Odd	Odd	Even	Even
5	Odd	Even	Even	Odd	Odd	Even
6	Odd	Even	Even	Even	Odd	Odd
7	Odd	Even	Odd	Even	Odd	Even
8	Odd	Even	Odd	Even	Even	Odd
9	Odd	Even	Even	Odd	Even	Odd

OBSERVATIONS:

- The second number system digit is always encoded with odd parity (this becomes important at decode-time).
- A UPC-A barcode always has a first number system digit of zero, and therefore uses exclusively odd parity. In fact, any EAN-13 symbol which has a first number system digit of 0 is actually an UPC-A symbol, not an EAN-13 symbol.
- All EAN-13 symbols (that have a first number system digit that is non-zero) always have three left-hand characters that are encoded using even parity and two that are encoded using odd parity.

The last two tables are the key and the genius in EAN-13 encoding and its compatability with existing UPC-A symbols.

Consider, for a moment, a UPC-A symbol. As already mentioned, a UPC-A symbol is simply an EAN-13 symbol that has its first number system digit as an "implied" zero. Consulting the parity table above, it is obvious that when the first number system digit is zero, all the characters in the left-hand side of the barcode will be encoded with "odd" parity. That is to say, all UPC-A barcodes use exclusively odd parity. This was the original standard in UPC-A. EAN-13 just expanded on that standard and defined the non-zero characters with other parity patterns. This is what makes UPC-A compatible with EAN-13 (and also what makes EAN-13 incompatible with UPC-A).

ENCODING EXAMPLE

This example will encode the EAN-13 barcode which represents the value "**7501031311309**". This is number system "75", manufacturer code "01031", product code "31130" (the check digit is "9", but we're going to calculate that in this example). This is the barcode from a 12-ounce can of Pepsi in the country of Mexico.

First, we calculate the check digit:

Barcode	**7**	**5**	**0**	**1**	**0**	**3**	**1**	**3**	**1**	**1**	**3**	**0**
Position	E	O	E	O	E	O	E	O	E	O	E	O
Weighting	1	3	1	3	1	3	1	3	1	3	1	3
Calculation	7 * 1	5 * 3	0 * 1	1 * 3	0 * 1	3 * 3	1 * 1	3 * 3	1 * 1	1 * 3	3 * 1	0 * 3
Weighted	7	15	0	3	0	9	1	9	1	3	3	0

Sum													

Summing the weighted sums we arive at 7 + 15 + 0 + 3 + 0 + 9 + 1 + 9 + 1 + 3 + 3 + 0 = 51. We must add 9 to make 51 evenly divisible by 10 (51 + 9 = 60), therefore the check digit is 9. This matches the trailing "9" that we observed in the barcode, so we calculated it correctly.

Next, we observe that the first digit of the number system code (the left-most digit in the barcode) is the digit "7". Consulting the parity encoding table for the digit "7", we find that the parity for the second number system digit and the manufacturer code should follow the pattern "Odd/Even/Odd/Even/Odd/Even." That means the second number system digit will be encoded from the "left-hand odd" parity table, the first digit of the manufacturer code will be encoded with "left-hand even" parity, etc. We can now start encoding our barcode with the following steps, or sections. The barcode is then constructed by simply concatenating all the strings together.

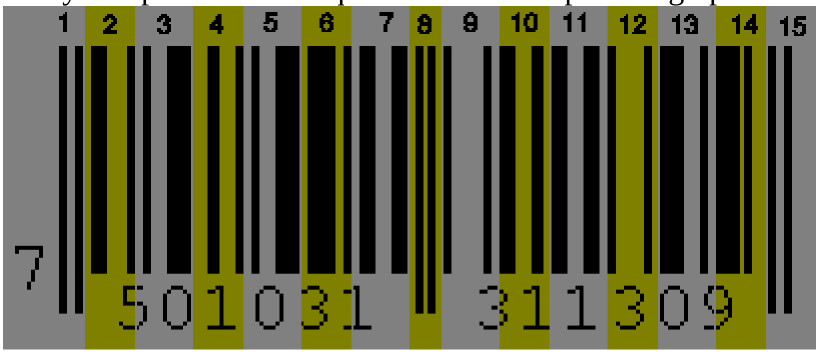
1. LEFT GUARD BARS (always the same): **101**.
2. SECOND NUMBER SYSTEM DIGIT [5]: Encoded with left-hand odd parity, **0110001**.
3. 1st MANUFACTURER DIGIT [0]: Encoding with left-hand even parity, **0100111**.
4. 2nd MANUFACTURER DIGIT [1]: Encoded with left-hand odd parity, **0011001**.
5. 3rd MANUFACTURER DIGIT [0]: Encoded with left-hand even parity, **0100111**.
6. 4th MANUFACTURER DIGIT [3]: Encoded with left-hand odd parity, **0111101**.
7. 5th MANUFACTURER DIGIT [1]: Encoded with left-hand even parity, **0110011**.
8. CENTAR GUARD BARS (always the same): **01010**.
9. 1st PRODUCT CODE DIGIT [3]: Encoded as right-hand character, **1000010**.
10. 2nd PRODUCT CODE DIGIT [1]: Encoded as right-hand character, **1100110**.
11. 3rd PRODUCT CODE DIGIT [1]: Encoded as right-hand character, **1100110**.
12. 4th PRODUCT CODE DIGIT [3]: Encoded as right-hand character, **1000010**.
13. 5th PRODUCT CODE DIGIT [0]: Encoded as right-hand character, **1110010**.
14. CHECK DIGIT [9]: Encoded as right-hand character, **1110100**.
15. RIGHT GUARD BARS (always the same): **101**.

Remember, a "1" represents a bar and a "0" represents a space. Thus if we convert this string of numbers to their graphical representation we end up with the following barcode:

7 501031 311309

In order to see more clearly the construction of the barcode, the following graphic shows the exact same barcode but each character, or section, of the barcode is indicated by alternating colors. Above the barcode, in each colored section, is a number from 1 to

15, which corresponds to each of the "steps," or sections, described above. You may easily compare the 1-0 sequence of each step to the graphical representation below:



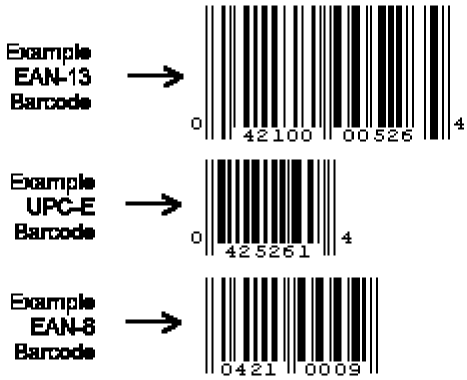
JAN BACKGROUND INFORMATION

JAN (Japanese Numbering Authority) are EAN codes that use the number system "**49**".

EAN8
Page: http://www.barcodeisland.com/ean8.phtml

UPC-E BACKGROUND INFORMATION

EAN-8 is the EAN equivalent of UPC-E in the sense that it provides a "short" barcode for small packages. As can be seen in the following graphic, an EAN-8 barcode is shorter than an EAN-13 barcode, although somewhat longer than an UPC-E barcode.



> **NOTE**: The three barcodes above are shown only for relative size comparison. The three barcodes do *not* necessarily represent the same product, nor do they represent equivalent values.

The similarities end there, however. Unlike UPC-E in which only 6 digits are explicitly encoded, EAN-13 explicitly encodes all eight digits; the parity of the digits carries no particular significance. This means that although EAN-13 is compatible with UPC-A, EAN-8 has absolutely no compatability with UPC-E.

Another difference between UPC-E and EAN-13 is that UPC-E has a direct UPC-A equivalence--a UPC-E barcode may be "expanded" back to UPC-A. This is not the case with EAN-8. An EAN-8 barcode is a 2- or 3-digit number system code followed by a 4- or 5-digit product code. The EAN-8 product codes are assigned directly by the numbering authority. This has the advantage that any company can request an EAN-8 code regardless of its EAN-13 manufacturer or product code. It has the disadvantage that the EAN-8 codes must be stored in each database as a separate product since there is no way to translate an EAN-8 code to an EAN-13 equivalent.

ENCODING

EAN-8 is encoded using the three EAN-13 character sets. EAN-8 also has a check digit that is calculated in the same way as EAN-13. Assuming we wish to encode the 7-digit message "**5512345**", we would calculate the checksum in the following manner:

Barcode	**5**	**5**	**1**	**2**	**3**	**4**	**5**
Position	O	E	O	E	O	E	O
Weighting	3	1	3	1	3	1	3
Calculation	5 * 3	5 * 1	1 * 3	2 * 1	3 * 3	4 * 1	5 * 3
Weighted Sum	15	5	3	2	9	4	15

The total is 15 + 5 + 3 + 2 + 9 + 4 + 15 = 53. 7 must be added to 53 to produce a number evenly divisible by 10, thus the checksum digit is 7 and the completed barcode value is "**55123457**".

STRUCTURE

An EAN-8 barcode has the following physical structure:

1. Left-hand guard bars, or start sentinel, encoded as **101**.
2. Two number system characters, encoded as left-hand odd-parity characters.
3. First two message characters, encoded as left-hand odd-parity characters.
4. Center guard bars, encoded as **01010**.
5. Last three message characters, encoded as right-hand characters.
6. Check digit, encoded as right-hand character.
7. Right-hand guar bars, or end sentinel, encoded as **101**.

ENCODING EXAMPLE

Encoding the data "**55123457**" (the trailing "7" is the check digit), we obtain the following:

1. LEFT GUARD BARS (always the same): **101**.
2. 1st EAN-8 NUMBER SYSTEM DIGIT [5]. Encoding with left-hand odd parity, **0110001**.
3. 2nd EAN-8 NUMBER SYSTEM DIGIT [5]. Encoded with left-hand odd parity, **0110001**.
4. 1st EAN-8 DATA DIGIT [1]. Encoded with left-hand odd parity, **0011001**.
5. 2nd EAN-8 DATA DIGIT [2]. Encoded with left-hand odd parity, **0010011**.
6. CENTAR GUARD BARS (always the same): **01010**.
7. 3rd EAN-8 DATA DIGIT [3]: Encoded as right-hand character, **1000010**.
8. 4th EAN-8 DATA DIGIT [4]: Encoded as right-hand character, **1011100**.
9. 5th EAN-8 DATA DIGIT [5]: Encoded as right-hand character, **1001110**.
10. CHECK DIGIT [7]: Encoded as right-hand character, **1000100**.
11. RIGHT GUARD BAR (always the same): **101**.

In order to see more clearly the construction of the barcode, the following graphic shows the exact same barcode but each character, or section, of the barcode is indicated by alternating colors. Above the barcode, in each colored section, is a number from 1 to 11, which corresponds to each of the "steps," or sections, described above. You may easily compare the 1-0 sequence of each step to the graphical representation below: