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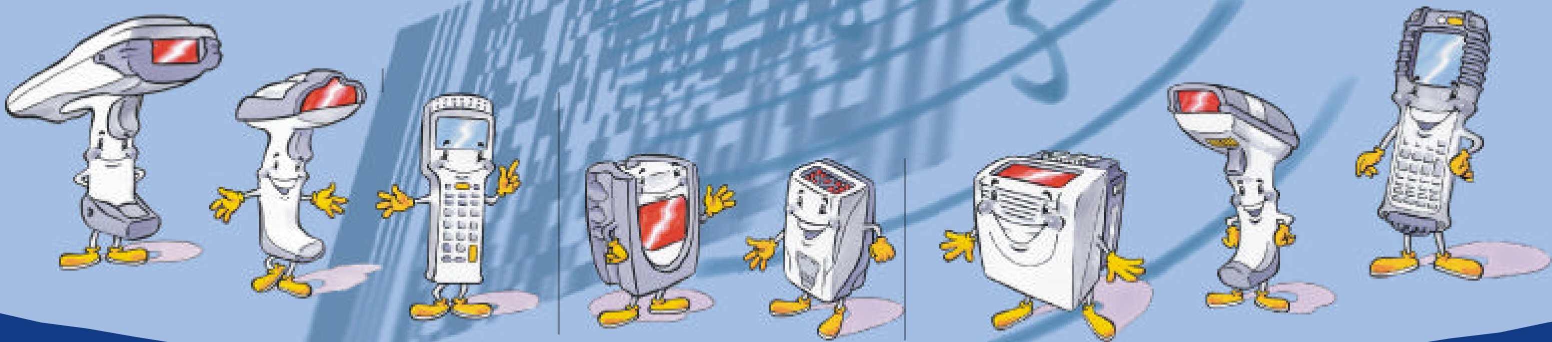
DATALOGIC

Reading Between the Lines

Bar Code Basics



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Why Use Automatic Identification?

Modern automated warehouses, conveyor belts and manufacturing facilities increasingly require the implementation of identification systems.

One of the main requirements of the production process is the link between the information and the material flow. Thus, objects can be identified in real-time locations, which results in increased flexibility in every phase of the work process.

Optical identification represents approximately 75% of all identification systems currently in use.

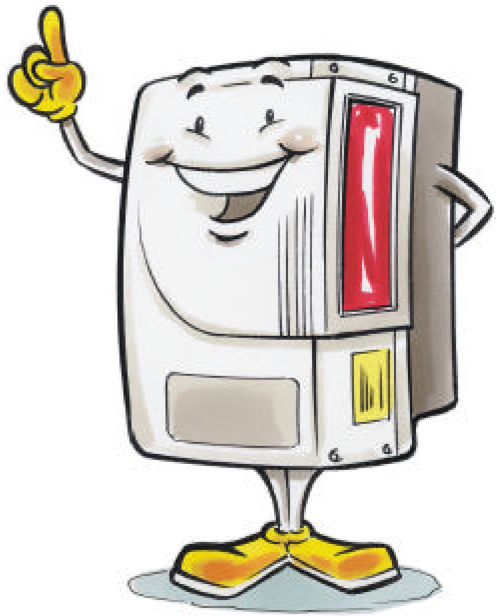
Thanks to bar codes, printed data can be easily and automatically read by means of a reading device. Bar code applications can be found in all fields of industry, retail, in the public sector and in everyday life.

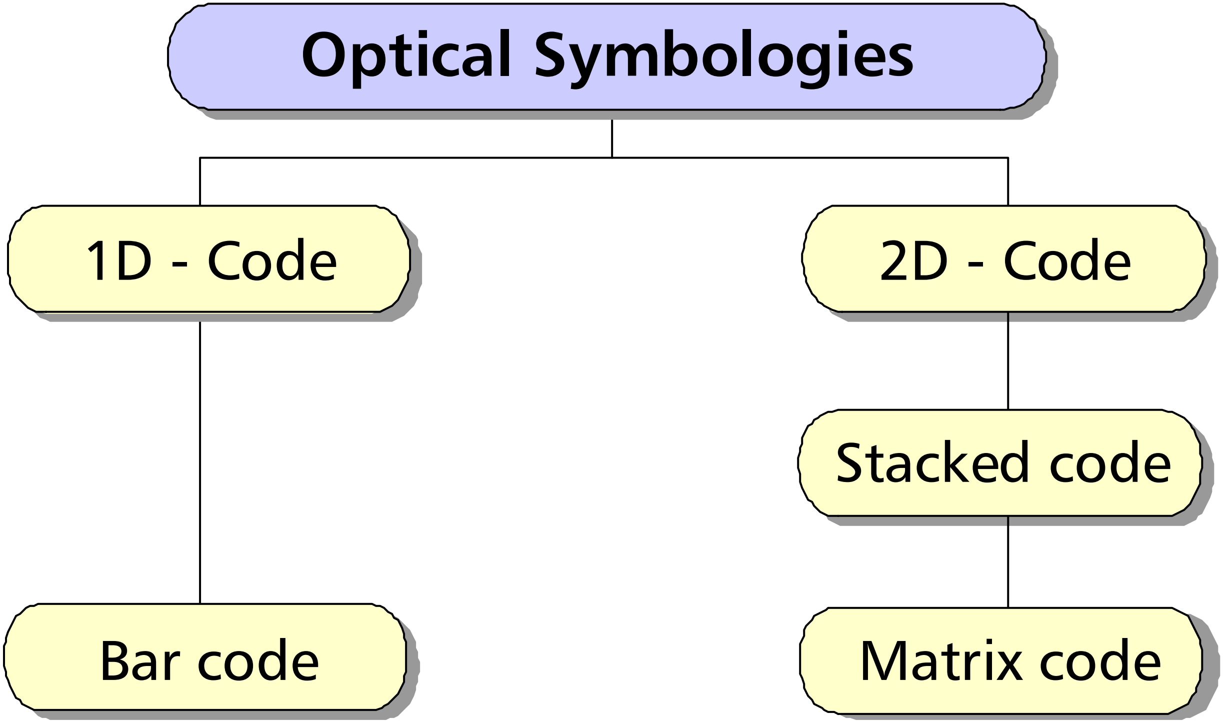
Moreover, a series of codes have been developed which can no longer be defined as bar codes, but as matrix codes, like the Data Matrix or MaxiCode. These two-dimensional codes are used mainly in the logistics field.

The information encoded in a bar code can be optically read by means of a special device. It must be taken into account that surrounding conditions can considerably influence the reading and therefore the correct identification of the code. For example, if the information contained in a label is not correctly decoded, the item may be sent to the wrong location or even be destroyed. Bar codes can be found on moving objects, delivery notes, warehouse schedules, identifying plates, labels, etc. With respect to directly printing characters on objects by means of laser or ink-jet, labels have the advantage of being printed before being used. In this case, the place where the code is printed and used can be different, and this enables a low-cost and high-quality mass production in printing works.

Thanks to technological progress in opto-electronics, today data printed in a certain format can be automatically read and then downloaded to a computer by means of standardised interfaces. A bar code on a stationary object can be read by means of any hand-held reading device.

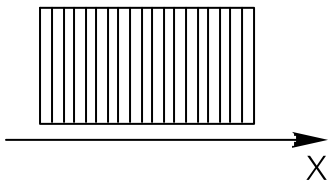
With a fixed-position laser scanner or a CCD-scanner, codes can be read at a remote distance on both moving and stationary objects. Automatic identification and today's computer technology have given industry improved control systems for managing transportation and production processes, as well as warehouses. Moreover, automatic identification systems simplify data management with regard to the issuance of warehouse and transportation documents (delivery notes, invoices, packing notes, etc.)




Optical Symbologies
1D - Code
2D - Code
Stacked code
Bar code
Matrix code

1D-Code

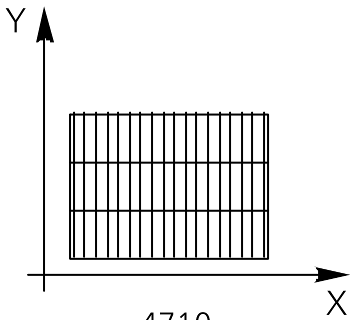
Standard code



4711

2D-Code

Stacked code

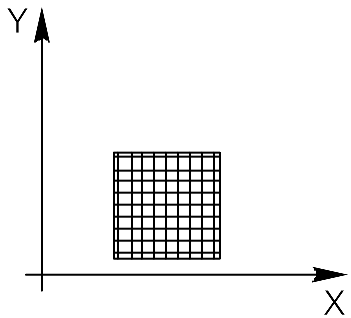


4710

4711

4712

Matrix code



n times 4711

(n > 10)

The contents of the codes are to be considered as examples

Why 1D-Codes?

Although a relatively recent technology, the world of bar codes is in continuous evolution. In the period between 1970 and 1980 all standard bar codes were developed, such as 2/5 Interleaved, Codabar, EAN/UPC, Code 39 and Code 128. At the same time, a number of special codes were created to meet the needs and demands of particular fields or applications. This is the case with Code 11, IBM Delta Distance, MSI-Code and many others. Only the best and most widely used bar code symbologies have survived and, in fact, since April 1993 the following bar codes have become the world-wide and European standard.

European standards:

- EN 797 Bar code Symbology EAN/UPC
- EN 798 Bar code Symbology Codabar
- EN 799 Bar code Symbology Code 128
- EN 800 Bar code Symbology Code 39
- EN 801 Bar code Symbology Code 2/5 Interl.

The use of the 5 above-mentioned 1-D codes is further restricted. In trade, EAN has always been the standard, while in industry, especially in materials handling, logistics and warehouse management, Code 128 and EAN128 are increasingly used. Code 2/5 Interleaved, on the other hand, will in the long term be replaced by Code 128 as the latter allows the encoding of numerical data in an even more compact form by means of the character set C.

Code EAN 128 is defined by the EN 799 standard. Full details about codes are available at the National EAN organisations and their local associations.

1988 - 1995: Development of the first stacked codes, such as Code 49, Code 16K, Codablock and PDF417.

The idea behind this kind of code is the connection between different codes related to each other. A check-digit over the total set of codes guarantees the reliability of the data. 2D-Codes are based on the concept of the two-dimensional representation of information This means that the standard bar code could be defined as a 1D-code, as information is encoded only in the X-axis. Stacked codes, on the other hand, include a second information level in the Y-axis. By condensing information in this way, i.e. stacking it, the area necessary for a 2D-Code can be relatively small. With respect to standard bar codes, the implementation of two-dimensional reading technology leads to a limited increase in costs, provided that the structure of standard bar codes remains unchanged. If this is not the case, special software drivers must be installed on the printing and reading devices.

1988 - 1995: Development of the first Matrix Codes, such as Data Matrix and MaxiCode.

At the same time, a series of codes were developed which can no longer be defined as bar codes, but as Matrix Codes. MaxiCode was specifically designed for omni-directional sortation of transport packages in a quick and reliable way. An error-correction algorithm guarantees the reliability of data. A quick image-processing system reads codes by means of a linear camera or a matrix camera whenever necessary.

Data Matrix, on the other hand, is particularly useful in applications requiring small spaces. Like MaxiCode, this code can be read omni-directionally. Data Matrix is very compact, reliable and can encode a great variety of characters and settings.

This is considered a major benefit in the pharmaceutical sector, as well as in different manufacturing sectors.

Markets According to Optical Coding

	Manufacture	Couriers	Food & Beverage	Retail	Electronic Industry	Automotive Industry	Pharma-ceutical Industry	Transport and Logistics
1D-Codes	Yes	Yes	Yes	Yes	Yes	Odette	Yes	Yes
2/5 Interleaved	✓	✓	✓	–	✓	–	✓	✓
Code 39	✓	✓	–	–	✓	✓	–	✓
Code 128	✓	✓	–	–	✓	–	✓	✓
EAN 128	✓	✓	✓	✓	✓	–	–	✓
EAN	✓	–	✓	✓	✓	–	–	✓
RSS	–	–	✓	✓	✓	–	✓	–
2D-Codes	Yes	Yes	No	No	Yes	No	Yes	Yes
Stacked Codes	No	No	–	–	No	–	Yes	Yes
Code 16K	–	–	–	–	–	–	–	
Code 49	–	–	–	–	–	–	–	–
Codablock	–	–	–	–	–	–	✓	–
PDF 417	–	–	–	–	–	–	–	✓
Matrix Codes	Yes	Yes	–	–	Yes	–	Yes	Yes
Data Matrix	✓	–	–	–	✓	–	✓	–
Maxi Code	–	✓	–	–	–	–	–	✓

Examples of Bar Code Applications

Manufacturing

On the shop-floor of industrial plants Datalogic devices identify objects being manufactured, capture information from the process and transmit it to the company IT system, to make real-time control of time and processes possible. Datalogic devices identify the single products in the isles, production lines and warehouses, guarantee automatic and immediate monitoring of the production process, and supply all the necessary information to maximise precision, quality and efficiency.

Transportation & Logistics

Datalogic products are used to control and guide the movements of goods and people. In warehouses and transit areas of goods, centres of gathering correspondence and airports, national carriers and big international couriers, airports and airline companies, post offices and providers of logistic services find Datalogic to be the ideal partner to guarantee total traceability of each movement.

Distribution & Retail

In supermarkets and shops Datalogic's readers enable consumers to pay without queuing at the cashier, enable the big chain stores to develop truly one-to-one promotions for their customers, and manufacturers of consumer goods to have a precise feedback on sales and the purchasing model of consumers.

OEM

OEMs require very reliable components that fit into their machines, minimising the integration effort and assuring the highest level of performance. Datalogic’s capability to define, develop and deliver specialised and customised devices in a fast and reliable way is crucial for OEMs in increasingly competitive markets.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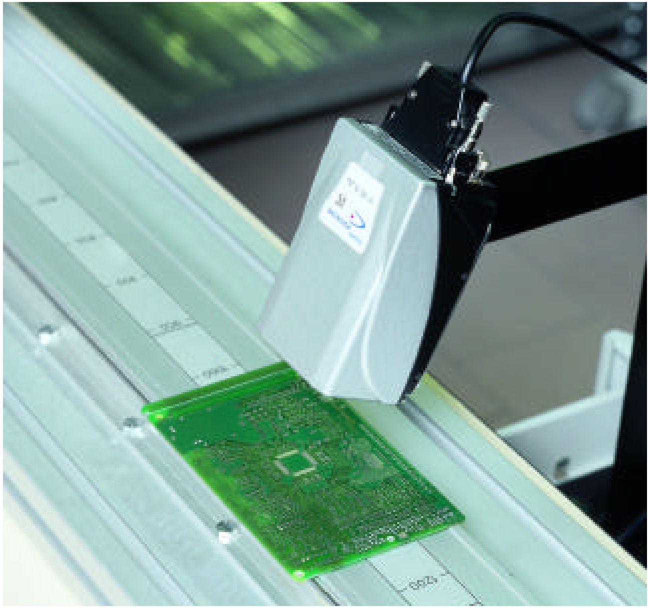
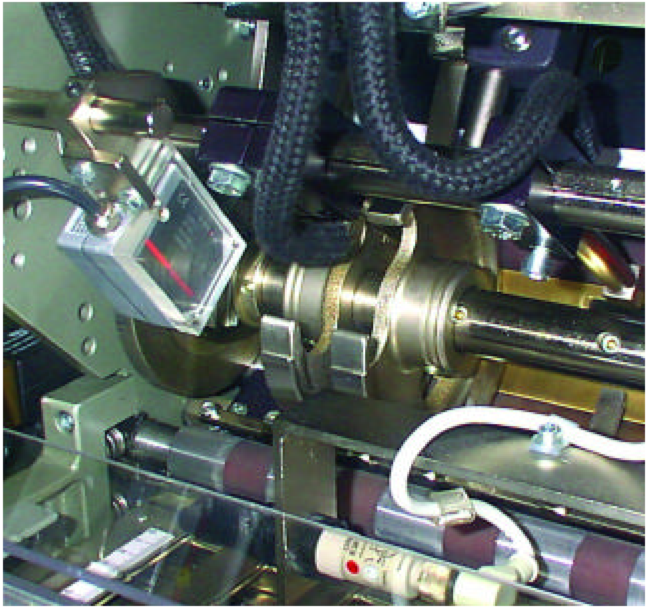
36
DISPARI


SIRO



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Terminology - 1D-Code

Bar The dark element in a bar code symbol.

Space The light element between two bars in a bar code symbol.

Intercharacter gap In a discrete code, the space between the last bar of a character and the first bar of the following character.

Element A bar or space in a bar code symbol.

Module The narrowest element in a bar code. Wide bars or spaces are expressed in multiples of modules.

X Dimension The width of the narrowest element.

Quiet zone Also called light margin or clear area. It is the blank area before and after the bar code. The quiet zone Q is necessary for setting the reading direction of the bar code symbol. The quiet zone must be at least 10 times the X dimension with anyway a minimum width of 2.5 mm. In scanner applications involving a large depth of field, the quiet zone must be wider: Q = 15 times the X dimension with a minimum width of 6.5 mm.

Bar Code Symbol The bar code symbol consists of a bar code, two quiet zones and an interpretation line. The bar code includes encoded data, which consists of coloured bars and blank spaces. The quiet zone precedes and follows the bar code and helps to identify the object to decode. The interpretation line is positioned below the bar code and translates all of the encoded information into readable characters.

Overview of Bar Code Types

As already mentioned, several bar code symbologies have been developed to meet different needs. This overview should help one to find the most suitable bar code, depending on the application, the printing method and the recognition philosophy. The code is in fact often required to respond to conflicting needs such as:

- Large print tolerance
- Wide decoding tolerance limits
- High Density Code
- Constant character width
- Self-checking capability
- The same number of bars for all characters

The better the print quality and therefore the higher the contrast, the easier the identification of the bar code.

The most common bar code symbologies are:

137
2/5 5 industrial bar

4 012345 987652
EAN13

21 06 5 6 TELEPEN
Telepen

4022
2/5 interleaved

3757
2/5 5 IATA bar

0140
Codabar

Overview of Bar Code Types

415893641

Plessey Code

01

D IBM

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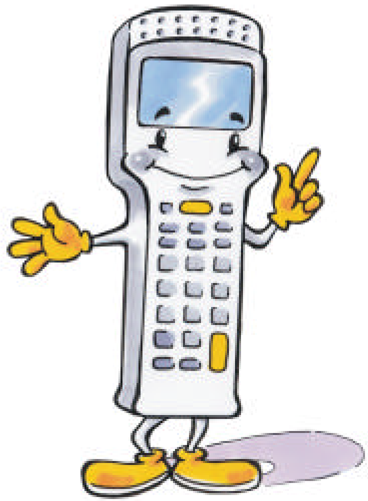
Code 39

Code 128

Code 93



Examples of Bar Codes

000 004

000 004

000 004

FARBE 04

02 20 02

20

Gewährleistung nur bei unbeschädigtem Etikett - warranty void if removed

001041

MUSTANG made by PYRAMID COMPUTER GmbH Germany

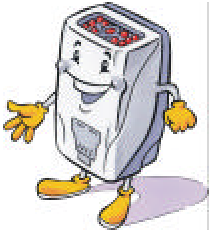
KAPTON HT

Examples of Stacked Codes

PDF 417

RSS14

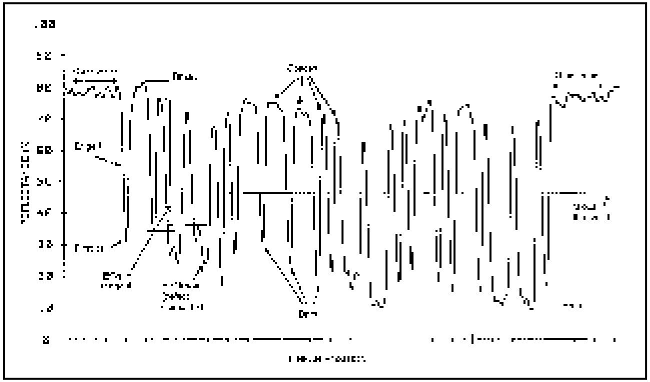
Examples of Matrix Codes



DATAMATRIX

Glossary - Print Quality

Rmin	Lowest reflectance in a scan profile (bar).
Rmax	Highest reflectance in a scan profile (space).
Global Threshold, GT	Average of Rmin and Rmax GT = (Rmax + Rmin)/2
Symbol Contrast, SC	Measure of the difference in reflectance from the highest and the lowest reflectance in a scan profile SC = Rmax - Rmin
Edge Contrast, EC	Difference between space reflectance Rs and bar reflectance Rb in two adjacent elements EC = Rs - Rb
Modulation, MOD	Ratio of minimum edge contrast to symbol contrast MOD = EC_{min} /SC
Defects	Defective spots and voids are imperfections in elements or quiet zones. Defects can be expressed as a ratio of the greatest reflectance variation to symbol contrast within an element Defects = ERN_{max}/SC ERN_{max} is the maximum difference in reflectance within an element
X-Dimension	Ideal (nominal) width of a narrow element in a bar code symbol.
Z-Dimension	Average width of narrow elements in a bar code symbol.



Contrast with infrared readers

Pens, distance readers, hand-held readers with infrared illumination (900 nm).

In this case the print colour of the bar must be opaque (with some colour ribbons this should not be taken for granted) on white background.

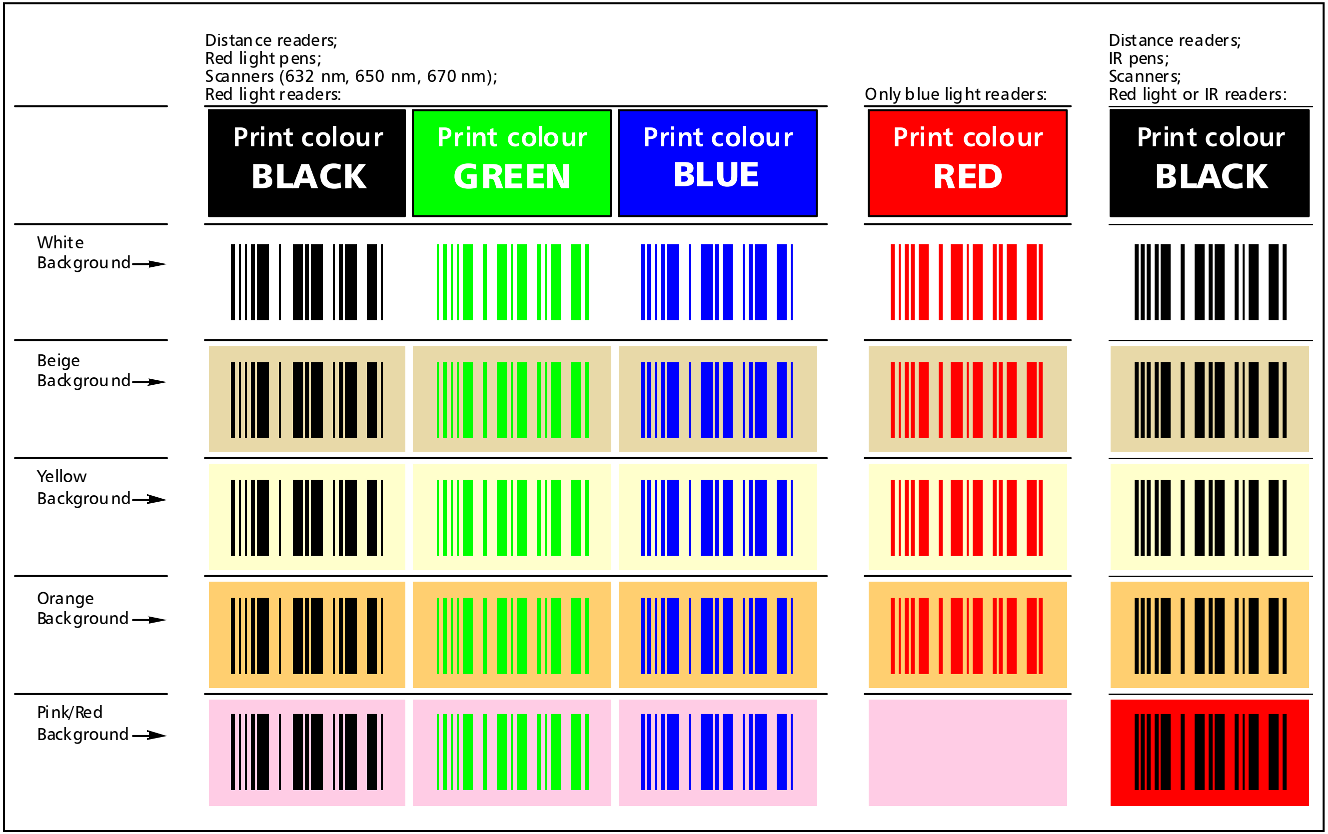
Contrast with red-light readers

Pens, distance readers, manual readers, laser scanners with laser tube (632 nm), scanners with laser diode (650 nm or 670 nm). In this case the print colour of the bar must be black, dark green or dark blue on a white, beige, yellow, orange or red background (muted colours, see Colour Matrix). The best contrast, however, is achieved by means of black bars on a white background.

Contrast with blue-light readers

Unlikely with the above-mentioned colour combinations, bar codes printed in red on a clear background (except a red or a rose-coloured one) can be read by means of a CCD reader emitting blue light (fluorescent lamp).

Matrix of Colour Combinations



Self-checking Capability

A key factor in bar code printing is the width of bars and spaces. The ratio of narrow and wide bars (or narrow and wide spaces) usually ranges from 1:2 to 1:3 according to the application and the printing method. This already guarantees a considerable accuracy in reading data. Most bar codes, however, have a further self-check. For example, if the number of narrow and wide bars by character is equal, the number of bars can be controlled. A further guarantee of the accuracy of read data can be achieved by adding a check-digit.

In bar codes the check-digit should always be used.

Poor Print Quality

When printing bar codes there may appear small defective voids and spots. The pen's resolution determines the limits of these areas. If the reader has a resolution of 0.15 mm, an imperfection cannot exceed a diameter of 0.06 mm, while with a resolution of 0.35 mm, the maximum allowable imperfection is 0.1 mm.

Check-digit Calculation

The check-digit, also called the control character, consists in a digit added to the code just before the stop character and is read together with the bar code. If the check-digit included in the code does not correspond to the one calculated by the decoder, decoded information is not transmitted.

The following is an example of a calculation applicable to bar codes belonging to the 2/5 family and EAN/UPC according to Modulo 10 with weighting factor 3. The weighting factors 3, 1, 3, ... are distributed under the data characters from right to left beginning with 3:

Example:

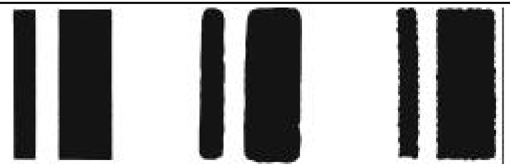
Interpretation line:	4	0	2	2
Check-digit:	2			
Sequence of data char.:	4	0	2	
Weighting factors:	3	1	3	
Individual product:	12	0	6	
Individual product sum:	12+0+6=18			
Modulo 10:	18 Mod. 10 = 8 (18/10 = 1 Rest 8)			
Check digit = subtraction from the next higher ten:	10 -	8=	2	
Check digit:	2			

With other kinds of bar codes the check-digit must be calculated according to the specifications of the code.

Generally speaking:

The chances for a simple, reliable read, as well as a first read rate, increase with a higher print quality. The risk of substitution errors with a different bar-space sequence decreases as well.

The following examples, with elements enlarged 20-50 times, show that the quality of printed bar codes (through an offset or a matrix printer) is much poorer than by using photographic methods. This means that bar code reading systems must be able to read in spite of imperfections in print. In order to check print quality and print tolerances, there are devices on the market which can judge the readability of the code. More complex devices can even measure the width of each bar and display the scan profile.



Nominal Code Photographic Code | Offset Printing | Code printed with a matrix printer

Printable with: 1. Matrix Printers

Print example

2. Ink-Jet Printers

Print example

3. Laser Printers

Print example

7321

4. Thermal-Transfer Printers

Print example

Frachtzentrum
Groß Gerau
05.06.91 16h CoP1 23
111119999012

5. Thermal Printers

Print example

a 0 0 0 0 0 1 4 7 a

6. Phototypesetting

Print example

498 88 5 31261 3

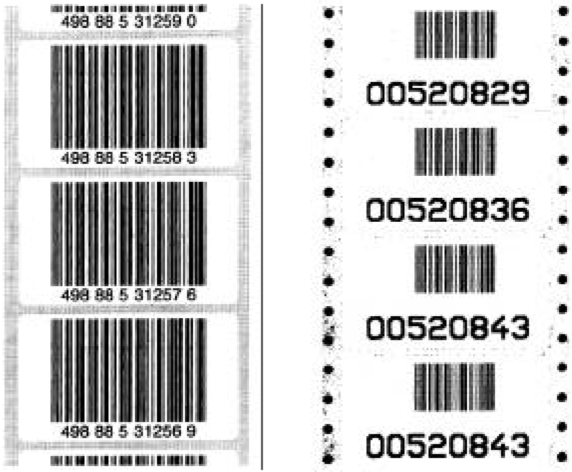
498 88 5 31260 6

Printing Methods for Labels

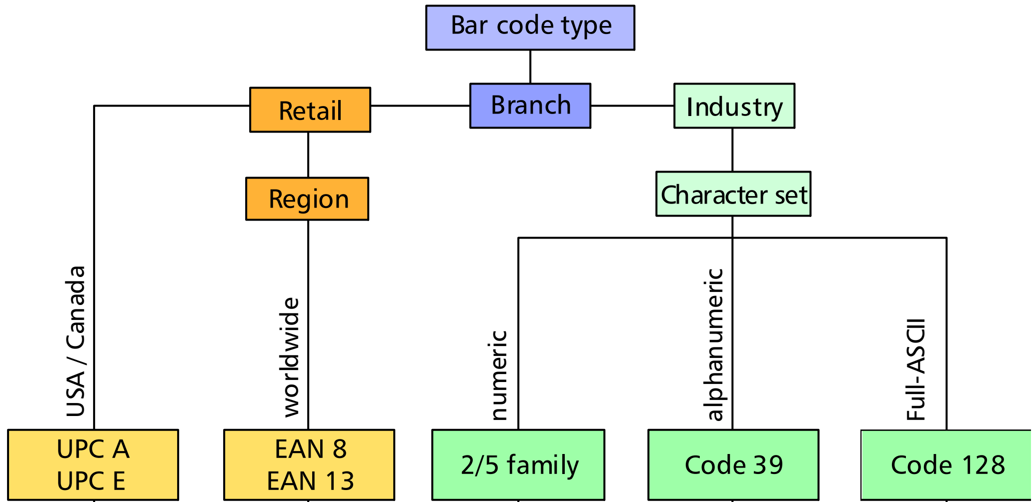
Mass-produced labels	Surface printing (Offset printing, ink pad printing) Copperplate printing Relief printing (Book printing, flexography) Silk-screen printing	Individual labels	Phototypesetting Thermal Transfer printing Thermal printing Laser printing Matrix printing Ink Jet printing Etching and laser engraving

For mass-produced goods. The content of all codes is the same.

For individual articles. The content of each code is different.



Criteria for Choosing 1D-Codes



	UPC A / UPC E	EAN 8 / EAN 13	2/5 family	Code 39	Code 128
Number of characters	10 digits	10 digits	10 digits	43 digits	128 ASCII
Self-checking	Yes	Yes	Yes	Yes	Yes
Variable code length	No (6, 12)	No (8, 13)	Yes/No, only even numbers	Yes	Yes
Ex. of application	Trade (POS)	Trade (POS)	Transport	Electronics	Logistics

Code 2/5 5 Bars Industry

General Numeric code consisting of the digits 0 to 9. The code comprises two wide and three narrow bars.
Code Ratio n:narrow bar: wide bar
n = 1 : 2 to 1 : 3.
The space between characters does not contain information.

Advantages The code only consists of bars, there is no information in the spaces. High print tolerance (± 15%). It can therefore be produced even with the simplest printing methods..

Disadvantages Limited information density.
Example: 4.2 mm per digit with the following minimum bar width
X = 0.3 mm and code ratio n = 1 : 3.

Printable with Offset, typographical and copperplate printing, flexography, numbering and printing, computer-controlled printing, phototypesetting.

Code chart	*Character*	*B1*	*B2*	*B3*	*B4*	*B5*
	1	1	0	0	0	1
	2	0	1	0	0	1
	3	1	1	0	0	0
	4	0	0	1	0	1
	5	1	0	1	0	0
	6	0	1	1	0	0
	7	0	0	0	1	1
	8	1	0	0	1	0
	9	0	1	0	1	0
	0	0	0	1	1	0
	Start	1	1	0		
	Stop	1	0	1		
	B1 - B5	= Bars 1 - 5				
	1	= Wide bar				
	0	= Narrow bar				

Examples of code: 2/5 Bars Industry

1 2 3 4 5 6 7 8 9

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7

1 2 3 4 5 6

1 2 3 4 5

1 2 3 4

1 2 3

1 2

1

1 2 3 4

1 2 3

1 2

1

2
3
9
1
5

Code 2/5 Interleaved

General Numeric code consisting of the digits 0 to 9. The code contains two wide bars and three narrow bars, two wide spaces and three narrow spaces.
Code Ratio n: narrow element: wide element n = 1 : 2 to 1 : 3.
Where the narrow element measures less than 0.5 mm, the ratio between the narrow and the wide element is as follows n = 1 : 2.25, to max. n = 1 : 3.
The first digit is represented by 5 bars, the second by the spaces immediately following the bars of the first digit.

Advantages High information density.
Example: 2.7 mm per digit with minimum bar width
X = 0.3 mm and Code Ratio n = 1 : 3.
Self-test capability.

Disadvantages All the spaces contain information and therefore the print tolerance is low, i.e. ± 10%.

Printable with Offset, typographical and copperplate, flexography, computer-controlled printing and phototypesetting.

Code Chart	*Character*	*B1*	*B2*	*B3*	*B4*	*B5*
	1	1	0	0	0	1
	2	0	1	0	0	1
	3	1	1	0	0	0
	4	0	0	1	0	1
	5	1	0	1	0	0
	6	0	1	1	0	0
	7	0	0	0	1	1
	8	1	0	0	1	0
	9	0	1	0	1	0
	0	0	0	1	1	0
	Start	0	0	0	0	
	Stop	1	0	0		

B1 - B5 = Bars/Spaces 1 - 5
1 = Wide bar/Space
0 = Narrow bar/Space

Examples of codes: 2/5 Interleavec

1 2 3 4

1 2 3 4 5 6

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 8 9 0

1 2 3 4 5 6 7 8 9 0 1 2

1 2 3 4 5 6 7 8 9 0 1 2 3 4

1 2 3 4 5 6 7 8

1 2 3 4 5 6

1 2 3 4

1 2

2508

59604 0

163841 0395 RM04

Codabar

General Numeric code containing 6 additional special characters in its set. It consists of the digits 0 to 9, and the following characters -, $, :, /, ., +.

Each character is made up of 7 elements (4 bars and 3 spaces). To display the code, 2 or 3 wide elements and 4 or 5 narrow elements are used.

The spaces between the characters do not contain information.

Code Ratio n: narrow element : wide element n = 1 : 2.25, max. n = 1 : 3.

Advantages Besides 0 - 9, it is possible to display 6 further special characters. The spaces between characters do not contain information.

Disadvantages Low information density. Example: 5.5 mm per digit with minimum bar width X = 0.3 mm and Code Ratio n = 1 : 3.

Printable with Offset, typographical and copperplate printing, flexography, numbering and printing, computer-controlled printing and phototypesetting.

Code Chart	*Character*	*B1*	*S1*	*B2*	*S2*	*B3*	*S3*	*B4*
	1	0	0	0	0	1	1	0
	2	0	0	0	1	0	0	1
	3	1	1	0	0	0	0	0
	4	0	0	1	0	0	1	0
	5	1	0	0	0	0	1	0
	6	0	1	0	0	0	0	1
	7	0	1	0	0	1	0	0
	8	0	1	1	0	0	0	0
	9	1	0	0	1	0	0	0
	0	0	0	0	0	0	1	1
	-	0	0	0	1	1	0	0
	$	0	0	1	1	0	0	0
	:	1	0	0	0	1	0	1
	/	1	0	1	0	0	0	1
	.	1	0	1	0	1	0	0
	+	0	0	1	0	1	0	1
	A	0	0	1	1	0	1	0
	B	0	1	0	1	0	0	1
	C	0	0	0	1	0	1	1
	D	0	0	0	1	1	1	0

B1 - B4 = Bars/Spaces 1 - 4
S1- S3 = Spaces 1 - 3
1 = Wide bar/Wide space
0 = Narrow bar/Narrow space

Examples of codes: Codabar

1 2 3 4 5 6

1 2 3 4 5

1 2 3 4

1 2 3

1 2

1

1 2 3 4 5 6

1 2 3 4 5

1 2 3 4

1 2 3

1 2

1

122 9

Code 39

General Alphanumeric code consisting of the digits 0 to 9, 26 letters, and 7 special characters. Each character contains 9 elements, 5 bars and 4 spaces. 3 elements are wide and 6 are narrow, except for the display of the special characters. The space between the characters does not contain information.
Code Ratio n: narrow element : wide element
n = 1 : 2 to 1 : 3.
Where the narrow element measures less than 0.5 mm, the ratio between the narrow and the wide element is as follows:
narrow element : wide element
n = 1 : 2.25, max. n = 1 : 3.

Advantages Alphanumeric representation.

Disadvantages Low information density.
Example: 4.8 mm per digit with the following minimum bar width
X = 0.3 mm and Code Ratio n = 1 : 3.
Low information density (± 10%).

Printable with Offset, typographical and copperplate printing, flexography, computer-controlled printing and phototypesetting.

Code Chart	*Character*	*B1*	*S1*	*B2*	*S2*	*B3*	*S3*	*B4*	*S4*	*B5*
	1	1	0	0	1	0	0	0	0	1
	2	0	0	1	1	0	0	0	0	1
	3	1	0	1	1	0	0	0	0	0
	4	0	0	0	1	1	0	0	0	1
	5	1	0	0	1	1	0	0	0	0
	6	0	0	1	1	1	0	0	0	0
	7	0	0	0	1	0	0	1	0	1
	8	1	0	0	1	0	0	1	0	0
	9	0	0	1	1	0	0	1	0	0
	0	0	0	0	1	1	0	1	0	0
	A	1	0	0	0	0	1	0	0	1
	B	0	0	1	0	0	1	0	0	1
	C	1	0	1	0	0	1	0	0	0
	D	0	0	0	0	1	1	0	0	1
	E	1	0	0	0	1	1	0	0	0
	F	0	0	1	0	1	1	0	0	0
	G	0	0	0	0	0	1	1	0	1
	H	1	0	0	0	0	1	1	0	0
	I	0	0	1	0	0	1	1	0	0
	J	0	0	0	0	1	1	1	0	0
	$	0	1	0	1	0	1	0	0	0
	/	1	1	0	1	0	0	0	1	0
	K	1	0	0	0	0	0	0	1	1
	L	0	0	1	0	0	0	0	1	1

Code 39

Code Chart	Character	B1	S1	B2	S2	B3	S3	B4	S4	B5
	M	1	0	1	0	0	0	0	1	0
	N	0	0	0	0	1	0	0	1	1
	O	1	0	0	0	1	0	0	1	0
	P	0	0	1	0	1	0	0	1	0
	Q	0	0	0	0	0	0	1	1	1
	R	1	0	0	0	0	0	1	1	0
	S	0	0	1	0	0	0	1	1	0
	T	0	0	0	0	1	0	1	1	0
	U	1	1	0	0	0	0	0	0	1
	V	0	1	1	0	0	0	0	0	1
	W	1	1	1	0	0	0	0	0	0
	X	0	1	0	0	1	0	0	0	1
	Y	1	1	0	0	1	0	0	0	0
	Z	0	1	1	0	1	0	0	0	0
	-	0	1	0	0	0	0	1	0	1
	.	1	1	0	0	0	0	1	0	0
	Space	0	1	1	0	0	0	1	0	0
	Start/ Stop	0	1	0	0	1	0	1	0	0
	+	0	1	0	0	0	1	0	1	0
	%	0	0	0	1	0	1	0	1	0

1 = Wide bar/space

0 = Narrow bar/space

Examples of codes: Code 39

A B C D E F

A B C D E

A B C D

A B C

A B

A

A B C

A B

A

General
Code 128 is able to encode the complete set of ASCII characters without using combinations of characters (see Code 39 and 93). However, this does not mean that Code 128 can directly represent the complete set of ASCII-characters. This is only possible by utilising 3 character subsets, A, B and C, which are used according to the problem to be solved. The different subsets can also be mixed.
In order to encode the complete set of ASCII characters, the start characters A or B must be used in connection with the special characters of Code 128.
Each character consists of 11 modules, divided into 3 bars and 3 spaces. Bars always comprise an even number of modules (even parity), while spaces contain an odd number of modules. The stop character is an exception as it includes 13 modules, i.e. 11 modules and one 2-module boundary bar.

Advantages Representation of the complete set of ASCII characters. High information density.

Disadvantages Low print tolerance. The code uses four different bar or space widths. The complete set of ASCII characters cannot be represented with one character set.

Printable with Offset, typographical, copperplate, thermal transfer printing and phototypesetting.

EAN 128

Logistics code used in trade applications. Differently from Code 128, the start character consists of the combination of Start A, Start B or Start C with the character FNC1. (For any further information, please address yourself to the National EAN organizations and their local associations).

Examples of codes: Code 128

Code128

12345

Code12

1234

Code1

123

Code

12

Cod

1

Co

C

Code Chart for Code 128

Value	Code A	Code B	Code C	B1	S1	B2	S2	B3	S3
0	SP	SP	00	2	1	2	2	2	2
1	!	!	01	2	2	2	1	2	2
2	"	"	02	2	2	2	2	2	1
3	#	#	03	1	2	1	2	2	3
4	$	$	04	1	2	1	3	2	2
5	%	%	05	1	3	1	2	2	2
6	&	&	06	1	2	2	2	1	3
7	'	'	07	1	2	2	3	1	2
8	(	(	08	1	3	2	2	1	2
9	)	)	09	2	2	1	2	1	3
10	*	*	10	2	2	1	3	1	2
11	+	+	11	2	3	1	2	1	2
12	,	,	12	1	1	2	2	3	2
13	-	-	13	1	2	2	1	3	2
14	.	.	14	1	2	2	2	3	1
15	/	/	15	1	1	3	2	2	2
16	0	0	16	1	2	3	1	2	2
17	1	1	17	1	2	3	2	2	1
18	2	2	18	2	2	3	2	1	1
19	3	3	19	2	2	1	1	3	2
20	4	4	20	2	2	1	2	3	1
21	5	5	21	2	1	3	2	1	2
22	6	6	22	2	2	3	1	1	2
23	7	7	23	3	1	2	1	3	1
24	8	8	24	3	1	1	2	2	2
25	9	9	25	3	2	1	1	2	2
26	:	:	26	3	2	1	2	2	1
27	;	;	27	3	1	2	2	1	2
28	<	<	28	3	2	2	1	1	2
29	=	=	29	3	2	2	2	1	1
30	>	>	30	2	1	2	1	2	3
31	?	?	31	2	1	2	3	2	1
32	§	§	32	2	3	2	1	2	1
33	A	A	33	1	1	1	3	2	3
34	B	B	34	1	3	1	1	2	3
35	C	C	35	1	3	1	3	2	1
36	D	D	36	1	1	2	3	1	3
37	E	E	37	1	3	2	1	1	3
38	F	F	38	1	3	2	3	1	1
39	G	G	39	2	1	1	3	1	3
40	H	H	40	2	3	1	1	1	3
41	I	I	41	2	3	1	3	1	1
42	J	J	42	1	1	2	1	3	3
43	K	K	43	1	1	2	3	3	1
44	L	L	44	1	3	2	1	3	1
45	M	M	45	1	1	3	1	2	3
46	N	N	46	1	1	3	3	2	1
47	O	O	47	1	3	3	1	2	1
48	P	P	48	3	1	3	1	2	1
49	Q	Q	49	2	1	1	3	3	1
50	R	R	50	2	3	1	1	3	1
51	S	S	51	2	1	3	1	1	3
52	T	T	52	2	1	3	3	1	1
53	U	U	53	2	1	3	1	3	1
54	V	V	54	3	1	1	1	2	3
55	W	W	55	3	1	1	3	2	1
56	X	X	56	3	3	1	1	2	1
57	Y	Y	57	3	1	2	1	1	3
58	Z	Z	58	3	1	2	3	1	1
59	[	[	59	3	3	2	1	1	1

Value	Code A	Code B	Code C	B1	S1	B2	S2	B3	S3
60	\	\	60	3	1	4	1	1	1
61	]	]	61	2	2	1	4	1	1
62	^	^	62	4	3	1	1	1	1
63	_	_	63	1	1	1	2	2	4
64	NUL	`	64	1	1	1	4	2	2
65	SOH	a	65	1	2	1	1	2	4
66	STX	b	66	1	2	1	4	2	1
67	ETX	c	67	1	4	1	1	2	2
68	EOT	d	68	1	4	1	2	2	1
69	ENQ	e	69	1	1	2	2	1	4
70	ACK	f	70	1	1	2	4	1	2
71	BEL	g	71	1	2	2	1	1	4
72	BS	h	72	1	2	2	4	1	1
73	HT	i	73	1	4	2	1	1	2
74	LF	j	74	1	4	2	2	1	1
75	VT	k	75	2	4	1	2	1	1
76	FF	l	76	2	2	1	1	1	4
77	CR	m	77	4	1	3	1	1	1
78	SO	n	78	2	4	1	1	1	2
79	SI	o	79	1	3	4	1	1	1
80	DLE	p	80	1	1	1	2	4	2
81	DC1	q	81	1	2	1	1	4	2
82	DC2	r	82	1	2	1	2	4	1
83	DC3	s	83	1	1	4	2	1	2
84	DC4	t	84	1	2	4	1	1	2
85	NAK	u	85	1	2	4	2	1	1
86	SYN	v	86	4	1	1	2	1	2
87	ETB	w	87	4	2	1	1	1	2
88	CAN	x	88	4	2	1	2	1	1
89	EM	y	89	2	1	2	1	4	1

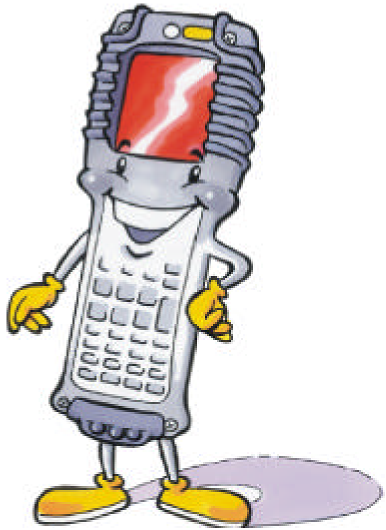
Value	Code A	Code B	Code C	B1	S1	B2	S2	B3	S3
90	SUB	z	90	2	1	4	1	2	1
91	ESC		91	4	1	2	1	2	1
92	FS		92	1	1	1	1	4	3
93	GS		93	1	3	1	1	4	1
94	RS		94	1	3	1	1	4	1
95	US	DEL	95	1	1	4	1	1	3
96	FNC3	FNC3	96	1	1	4	3	1	1
97	FNC2	FNC2	97	4	1	1	1	1	3
98	SHIFT	SHIFT	98	4	1	1	3	1	1
99	CODE C	CODE C	99	1	1	3	1	4	1
100	CODE B	FNC4	CODE B	1	1	4	1	3	1
101	FNC4	CODE A	CODE A	3	1	1	1	4	1
102	FNC1	FNC1	FNC1	4	1	1	1	3	1
103	START (CODE A)			2	1	1	4	1	2
104	START (CODE B)			2	1	1	2	1	4
105	START (CODE C)			2	1	1	2	3	2

Stop Character	B1	S1	B2	S2	B3	S3	B4
STOP	2	3	3	1	1	1	2

B1 to B3	= Bars 1 to 3
S1 to S3	= Spaces 1 to 3
1	= Bar/space width: 1 module
2	= Bar/space width: 2 modules
3	= Bar/space width: 3 modules
4	= Bar/space width: 4 modules

Special characters: CODE A, CODE B, CODE C, SHIFT
Function characters: FNC1, FNC2, FNC3, FNC4

General	Numeric code consisting of the digits 0 to 9. Each character includes 11 elements. All bars and spaces contain information. Only 8 or 13 characters can be represented.
Advantages	High information density in 10 different sizes.
Disadvantages	Very low tolerance.
Printable with	Offset, typographical, copperplate and laser printing, thermal printing starting from one set size only, phototypesetting.
Code Chart	Full details about EAN and EAN 128 are available at the National EAN organizations and their local associations.



General

All application Identifiers and their data contents can be represented with the UCC/EAN 128 bar code. A subset of Code 128, EAN 128 is characterised by the use of a special character, i.e. the function character 1 (FNC 1)1), which directly follows the start character at the beginning of the bar code symbol. The use of this combination of characters is reserved to the International Article Numbering Organization, EAN, and to the American Uniform Code Council, UCC.

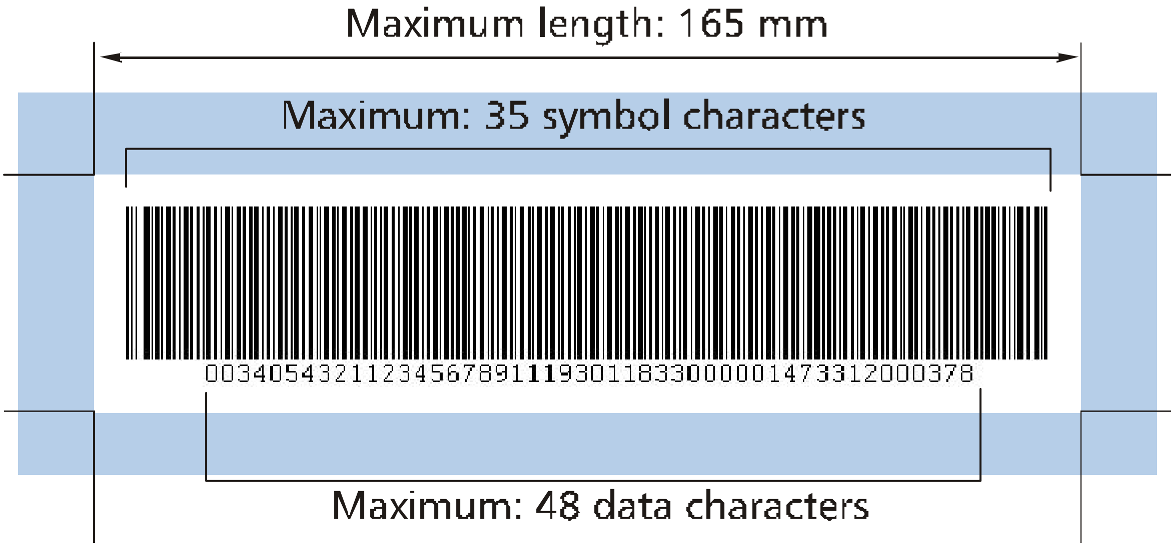
Three parameters have to be taken into consideration when defining the maximum length of an EAN 128 symbol: the number of encoded characters, the physical length of the code, which depends on the enlargement factor, the number of data characters encoded excluding auxiliary and symbol characters.

The maximum length of any EAN 128 symbol must respect the following limits:

- The physical length cannot exceed 165 mm including quiet zones.
- The maximum number of encoded data, including application identifiers, is 48, excluding auxiliary and symbol check characters. 1) If FNC1 characters are used as separator characters, they can be considered as data characters.

Including all auxiliary and symbol check characters, the EAN 128 symbol should not exceed 35 symbol characters. Otherwise, there is the risk that an inadequate enlargement factor must be chosen for major company applications.

Moreover, it has to be considered that in code set C a certain number of data characters can be encoded using a smaller number of symbol characters.


Maximum length: 165 mm
Maximum: 35 symbol characters
00340543211234567891119301183300000147331200037 8
Maximum: 48 data characters

Limits of fixed- and variable-length data strings

Application Identifiers identify variable- or fixed-length data strings. When multiple Application Identifiers are concatenated with their data contents into a symbol, a FNC 1 character must follow each variable data string, unless it is the last string in the bar code symbol. Separator characters are not required with fixed-length data contents.

In order to transmit the length of predefined fixed-length strings after the reading has taken place, a table of indicators has been established. Some of the indicators listed in the table here below are already in use today as Application Identifiers (i.e. "00", "01") and have been included in most Application Identifiers (i.e. "31", "41").

The table shows the total length of data strings, which consist of the Application Identifiers and the data contents. In this way, however, no information is conveyed regarding the length of the Application Identifiers or the (numeric or alphanumeric) format of the data content.

Length Indicators	Length of Data Strings
00	20
01	16
02	16
03	16
04	18
11	8
12	8
13	8
14	8
15	8
16	8
17	8
18	8
19	8
20	4
31	10
32	10
33	10
34	10
35	10
36	10
41	16

- All the strings not included in this table must be followed by an FNC 1 or a stop character.
- New data strings are not clearly separated by means of FNC 1 characters.

The table includes provisions for the future and is therefore firmly established. If further fixed-length data strings are standardised in the future, their Application Identifiers will be selected from this table. Thus, processing software can be developed independently of any future additional release of data strings. This table must always be included in the processing software, otherwise the division of the bar string into single elements cannot be guaranteed.

EAN 128

Data content

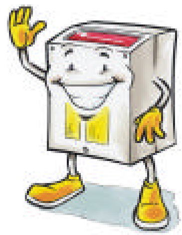
According to the application, the data content following an Application Identifier may consist of numeric or alpha-numeric characters and may contain up to 30 characters in length.

The length of data fields in which data contents will be encoded may be either fixed or variable. A fixed-length data field must always contain its set number of characters (numbers and/or letters). If necessary a data field must be filled with leading zeros, in order to reach its assigned data length. For variable-length data fields, a maximum length has been defined. This maximum cannot be exceeded for any reason.

DB	*Data Content*	*Format**
00	Serial Shipping Container Code	n2+n18
01	EAN of the shipping code	n2+n14
02	Reserved for: "EAN-number of goods contained within another unit", see section 6.10	n2+n14
10	Batch or Lot Number	n2+an..20
11(**)	Production Date (YYMMDD)	n2+n6
13(**)	Packaging Date (YYMMDD)	n2+n6
15(**)	Sell By Date (YYMMDD)	n2+n6
17(**)	Expiration Date (YYMMDD)	n2+n6
20	Product Variant	n2+n6
21	Serial Number	n2+n2
22	Reserved for: "HIBCC-quantity, date, batch and link", see section 6.10	n2+an..20
23	Reserved for: "Lot Number (transitional use)", see section 6.10	n3+n..19
30	Quantity in number of pieces (variable measure items)	n4+n..8
310(***)	Net Weight, Kilograms (variable measure items)	n4+n6
311(***)	Length or 1st Dimension, Metres (variable measure items)	n4+n6
312(***)	Width, Diameter or 2nd Dimension, Metres (variable measure items)	n4+n6
313(***)	Height of the 3rd Dimension (variable measure items)	n4+n6
314(***)	Area, Square Metres (variable measure items)	n4+n6
315(***)	(Net) Volume, Litres (variable measure items)	n4+n6

DB	Data Content	Format*
316(***)	(Net) Volume, Cubic Metres (variable measure items)	n4+n6
320(**)	Reserved for: "Net weight, (engl.) pounds"	n4+n6
330(***)	Gross Weight, Kilograms	n4+n6
331(***)	Length or 1st Dimension, Metres	n4+n6
332(***)	Width, Diameter or 2nd Dimension, Metres	n4+n4
333(***)	Height or 3rd Dimension, Metres	n4+n6
334(***)	Area, Square Metres	n4+n6
335(***)	(Gross) Volume, Litres	n4+n6
336(***)	(Gross) Volume, Cubic Metres	n4+n6
340	Reserved for: "Gross weights, (engl.) pounds", see section 6.10	n4+n6
37	Reserved for: "Quantity", see section 6.10	n2+n..8
400	Customer's Purchase Order Number	n3+an..30
410	Ship to (Deliver To), Location Code of the Party to which goods should be delivered	n3+n13
411	Bill To (Invoice To), Location Code of the Party to whom an invoice is issued	n3+n13
412	Purchase From, Location Code of the Supplier	n3+n13
420	Ship To (Deliver To), Postal Code of the Party to which goods should be delivered within a Single Postal Authority	n3+an..9
421	Ship To (Deliver To), Postal Code with a 3-Digit ISO Country Code Prefix	n3+n3+an..9
8001	Roll Products - Width, Length, Core Diameter, Direction of Rolling and Splices	n4+n14
8002	Reserved for: "Electronic Serial Number for Cellular Mobile Telephones", see section 6.10	n4+an..20

DB	Data Content	Format*
90	Internal and/or Mutually Agreed Applications	n2+an..30
91	Internal, Raw Material, Packaging, Components	n2+an..30
92	Internal, Raw Material, Packaging, Components	n2+an..30
93	Internal, Manufacturer	n2+an..30
94	Internal, Manufacturer	n2+an..30
95	Internal, Carriers (Consignment Note No., etc.)	n2+an..30
96	Internal, Carriers	n2+an..30
97	Internal, Wholesale and Retail Trade	n2+an..30
98	Internal, Wholesale and Retail Trade	n2+an..30
99	Mutually Agreed Texts	n2+an..30



(*): The first position corresponds to the length (data length of the Application Identifier). The following positions refer to the format of the data content.

(**): To indicate only year and month, DD must be filled with "00".

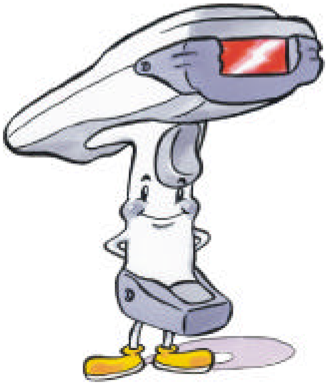
(***): The fourth position denotes the decimal point indicator.

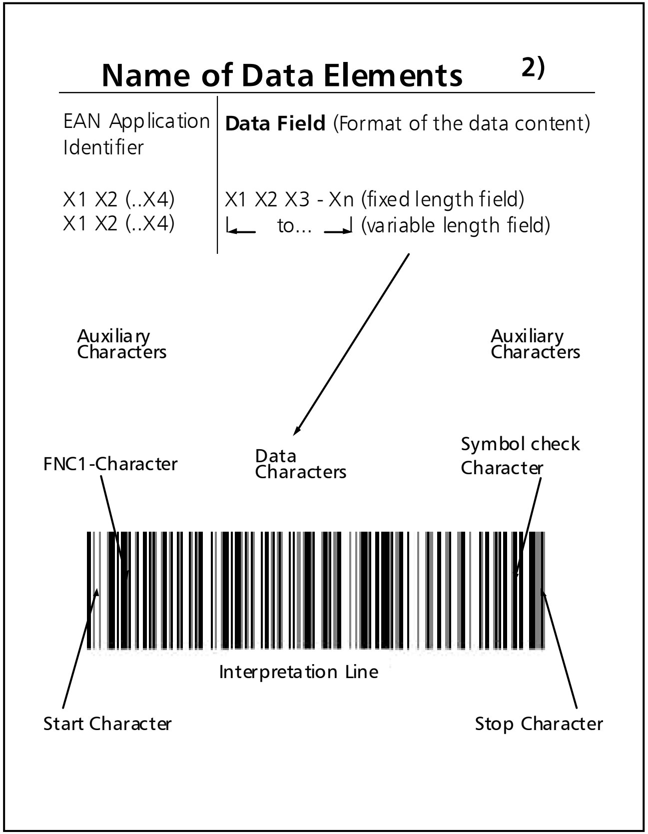
Example:

3100 Net Weight in kilos without decimals.
3102 Net Weight in kilos with two decimals.

Note:

The measurement of variable measure items can only be indicated by means of one specific Application Identifier (30 and 3100 to 3169). Thus, by establishing a one-to-one relationship between the item EAN code and the measurement, the risk of confusion among different indications of measurements is avoided, i.e. for logistics purposes. The Application Identifiers 3300 to 3369, 340 and 37 identify measurements required for logistics purposes.





Examples of code: 8-digit EAN-Symbol (Short code)

SC 0
(Enl. Factor 0.8)

SC 3
(Enl. Factor 1.1)

SC 1
(Enl. Factor 0.9)

SC 4
(Enl. Factor 1.2)

SC 2
(Enl. Factor 1)

SC 5
(Enl. Factor 1.4)

SC 6
(Enl.
Factor 1.5)

4 012345 987652

SC 8
(Enl.
Factor 1.85)

4 012345 987652

SC 7
(Enl.
Factor 1.7)

4 012345 987652

SC 9
(Enl. Factor 2)

4 012345 987652

SC 6
(Enl.
Factor 1.5)

4 012345 987652

SC 8
(Enl.
Factor 1.85)

4 012345 987652

SC 7
(Enl.
Factor 1.7)

4 012345 987652

SC 9
(Enl. Factor 2)

4 012345 987652

General The RSS family consists of three main symbols. RSS-14 encodes 14 digits of numerical data (GTIN) and indicator digit values are limited to 0 to 9. RSS Limited is a linear symbology which encodes the same RSS14 data (GTIN), with indicator digit values limited to 1 or 0. RSS Expanded is a variable length, linear symbology, encoded differently than RSS-14. It can hold up to 74 numeric or 41 alphabetic characters and encode 14 digits (GTIN), or more using all types of EAN/UCC Application Identifiers, as used for the EAN/UCC Code 128. Both RSS-14 and RSS-Expanded can be printed in two to eleven rows of 2 segments each, reducing the overall length of the linear code. Composite codes always have a linear (or stacked in the case of RSS) part, with a 2D component that is positioned just above the linear part and with a separator pattern between the two. There are three main symbols in the CS family. CC-A, based on a variant of MicroPDF417, encodes up to 56 digits of alphanumeric data and can be combined with any EAN/UCC symbols, with the exception of ITF-14. CC-B, based on MicroPDF417, can encode up to 338 digits of alphanumeric data and can be combined with any of the EAN-UCC symbols, with the exception of ITF-14. CC-C, based on PDF417, must only be combined with UCC/EAN-128 and can encode up to 2361 digits of alphanumeric data.

Advantages The most compact symbologies available today which satisfy new requirements of the ID market: the need of a bar code symbology printed on smaller items, of a greater amount of data on a symbol, of an omni-directional symbology. These bar codes provide new ways of using the EAN/UCC system for bar coding items which previously did not carry a bar code, satisfying emerging target markets/applications in Retail/Food industries and Healthcare.

Disadvantages At the moment, CS symbologies can only be read by 2D bar code readers.

Printable with Offset, typographical and copperplate printing, flexography, numbering and printing, computer-controlled printing, phototypesetting.

Principle RSS14 usually has the following structure:

Example: RSS14

General Code 49 is a version of the stacked code based on its own code structure. Each symbol can consist of between 2 and 8 rows, each containing 70 modules, a start character (2 modules), 4 data words (4 x 16 modules) and a stop character (4 modules). During the reading process row numbers can be determined by representing each data word in strictly pre-defined combinations. Maximum capacity is 49 ASCII characters or 81 numeric characters.

Advantages Compact Code. Flexibility in adapting the information to encode to a given area thanks to variable height and information density. All the reading devices on the market can be used. However, the decoder must be expanded, as Code 49 is based on its own structure. The decoder must read the whole code before transmitting the contents of the code the central computer system.

Disadvantages Rigid format. The stacked structure must be respected during the reading process.

Printable with Any printing method suitable for UPC or for Code 39.

Principle CODE 49 usually has the following structure:

Start	Data Word combination 1 C1	Stop
	Data Word combination 2 C2	
	Data Word combination 3 C3	
	Data Word combination n Cn	

Cx = Check character

Example of Code 49

General

CODABLOCK was developed as a stacked version of the standard bar codes Code 39 and Code 128 able to encode the information context when the label is not wide enough and therefore several shorter bar codes should be printed. Each row includes a row indicator, which shows the orientation of the reading and two check characters, which guarantee the accuracy of the whole message. There are three varieties to this code.

CODABLOCK A: Based on the structure of Code 39, it can encode 1 to 61 characters with up to 22 rows (totalling maximum 1,340 characters). The check digit over the whole message is calculated on Modulo 43.

CODABLOCK F: Based on the structure of Code 128, this code can contain 2 to 44 rows, with 4 to 62 characters per row (totalling maximum 2,725 characters).

CODABLOCK 256: This variety has the same structure of CODABLOCK F, but has special start and stop characters. It can consist of 2 to 44 rows, each containing 4 to 62 characters (totalling maximum 2,725 characters). Each row contains error correction, so that minor damage can be repaired.

Advantages

Increased reliability of data of one single CODABLOCK label with respect to several separate labels to encode one message. Flexibility in adapting the information to encode to a given area thanks to variable height and information density. All the reading devices on the market can be used, as the CODABLOCK is based on already existing bar code symbologies. Re-assembling each line to reproduce the complete message in the right sequence can also be achieved by means of an overhead calculation system.

Disadvantages

The stacked structure must be respected during the reading process.

Codablock

Printable with Any printing method suitable for Code 39 or for Code 128.

Principle CODABLOCK usually has the following structure:

Start	R1							Stop
	R2							
	R3							
	Rn					C1	C2	

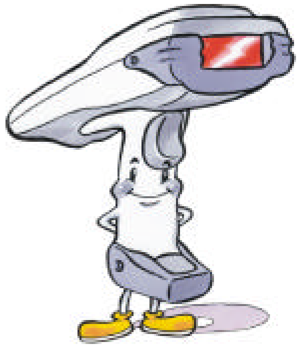
Rx = Row indicator
Cx = Check character

Example: CODABLOCK A

123456

Example: CODABLOCK F

Example: CODABLOCK 256



Code 16K

General Code 16K is a version of the stacked code based on UPC and Code 128 elements. It can encode 77 ASCII characters or 154 digits on an area of 2.4 cm^2 and can use between 2 and 16 rows. Each row is indirectly identified by means of start-stop character pairings. The reliability of the data is guaranteed by means of 2 error-correcting check characters. Calculation takes place according to Modulo 107.

Advantages Very compact code. Flexibility in adapting information to a given area thanks to variable height, width and information density. All reading devices on the market can be used. Only the decoder must be slightly expanded, as CODE 16K is based on already existing bar code symbologies. However, the decoder must first read the whole code before transmitting the contents to the central computer system.

Disadvantages The stacked structure must be respected during the reading.

Printable with All printing methods suitable for UPC codes or for Code 128.

Principle CODE 16K usually has the following structure:

Start 1								Stop 1
Start 2								Stop 2
Start 3								Stop 3
Start n						C1	C2	Stop n

Cx = Check character

Example: CODE 16K

General PDF 417 is a version of the stacked code based on its own structure. Characters are encoded in so-called "codewords". Each codeword consists of 17 modules each containing 4 bars and 4 spaces. The code can contain up to 1,108 bytes and can use between 3 and 90 rows. Each row contains two row indicators, which show the position of the row on the symbol. At least two codewords are used as check characters, which guarantee the reliability of the whole message. Error correction can be carried out by means of further codewords (up to 512) and takes place in different steps.

Advantages Very compact code. Flexibility in adapting information to a given area thanks to variable height, width and information density. All the reading devices on the market can be used. Only the decoder must be expanded, as PDF 417 is based on its own very complex structure. However, the decoder must read the whole code before transmitting the contents of the code to the central computer system.

Disadvantages The stacked structure must be respected during the reading.

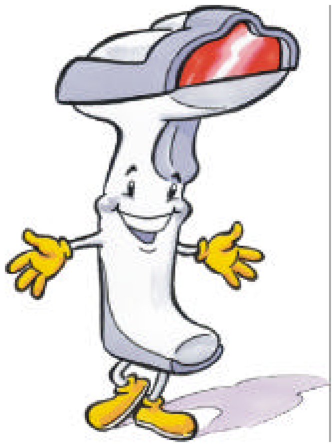
Printable with Printing methods using the necessary driver software.

Principle PDF 417 usually has the following structure:

Start	R1						R1	Stop
	R2						R2	
	R3						R3	
	Rn					C1	Rn C2	

Rx = Row indicator/Left and Right
Cx = Check character/Code word

Example: PDF 417



Data Matrix

General Data Matrix is a version of the Matrix Code and has two main subsets, ECC 000-140 and ECC 200. ECC 200 is the latest revision recommended for use. Data Matrix has the variable square size of a matrix. Symbols can range from a size of 10 x 10 to 144 x 144, thus representing either 8x18 or 16x48 symbol elements in a squared area. Data Matrix can encode 2,334 ASCII characters (each consisting of 7 bits), 1,558 expanded ASCII characters (each consisting of 8 bits), or 3,116 digits in their largest size. A horizontal and a perpendicular border form a corner, which indicates the orientation of the reading. The opposite sides of the square present alternating light and dark square elements, used to indicate both position and size of the symbol. The information density amounts to 13 characters to 100 mm^2.

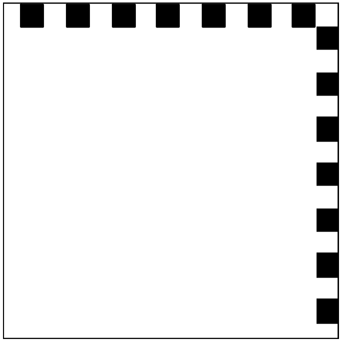
Advantages Very compact code. It is very reliable, as it includes a very powerful error-correction algorithm, Reed Solomon. Contents can be reconstructed by means of a minimum amount of error-correction characters even if up to 25% of the whole code is damaged.

Disadvantages Only readable with image-processing devices.

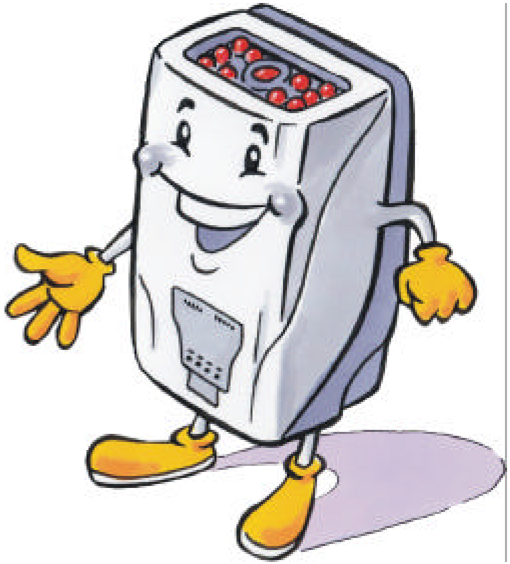
Printable with All printing methods equipped with the necessary printer drivers.

AIM International Symbology Specification - Data Matrix.

Principle Data Matrix usually has the following structure:



Example: Data Matrix



Maxi Code

General Maxi Code is a version of the Matrix Code. It has a fixed size of 25.4 mm by 25.4 mm (1 inch by 1 inch) and can represent 144 symbol characters in an area of 646 mm², maximum 93 ASCII characters or 138 digits. A finder pattern, or bull's eye, consisting of 3 concentric rings, is in the centre of the 2D Code and indicates the presence of a Maxi Code label. Around it 866 hexagons arranged in 33 rows carry the information. Each row consists of a maximum of 30 hexagonal elements. 6 orientation hexagons each with 3 hexagonal elements are arranged around the finder pattern at a distance of 60 degrees to indicate location during omni-directional reading. Information density amounts to 13 characters to 100 mm².

Example Maxi Code

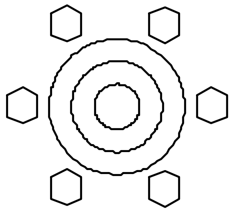
Advantages Very compact code. It is very reliable, as it includes a very powerful error-correction algorithm. Contents can be reconstructed even if up to 25% of the whole code is damaged. Omni-directionally readable also at high speeds.

Disadvantages Rigid parameters. Only readable with image-processing devices.

Printable with All printing methods equipped with the necessary printer drivers.

AIM International Symbology Specification - Maxi Code.

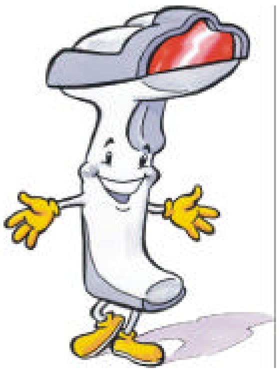
Principle Maxi Code usually has the following structure.



6 orientation hexagons make it possible to determine the position.

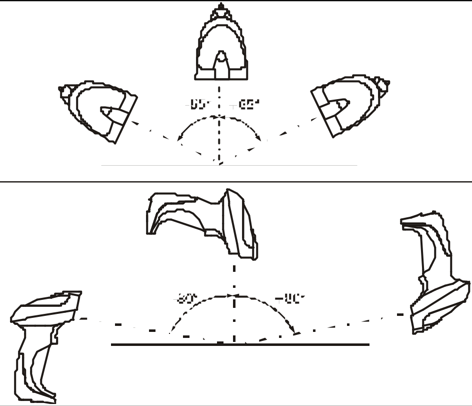
Hand-held CCD readers

The CCD reader is like a bar code camera with a built-in CCD array. This is why the bar code must be illuminated, so that it can be projected with sufficient contrast onto the CCD array. Fixed reading distance, depth of field and, if applicable, angular positioning are all key factors to be considered. All CCD readers have an integrated decoder and can use a large number of interfaces (USB, RS232, IBM46xx, OCIA, OCR, POS interface, keyboard wedge and wand emulation).



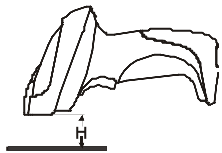
Pitch

Skew



Conditions of Use

Maximum reading distance

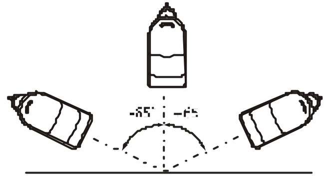


X Dimension	H
0.13 mm	13 cm
0.33 mm	28 cm
0.50 mm	37 cm

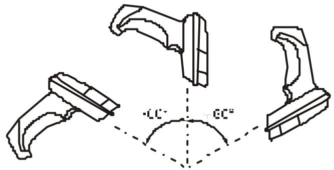
Hand-held laser readers

The hand held laser reader is based on the same principle as the laser scanner. An in-built laser diode emits the laser beam, which is deflected by an oscillating mirror. The beam of light is made to move over the surface to be read and thus captures the bar code. With hand held laser readers bar codes can be easily read over a wide range of distances with large depths of field and extreme angular positions. Decoder performance is high and different interfaces are available (USB, RS232, IBM46xx, OCIA, OCR, POS interface, wand emulation and keyboard wedge).

Pitch



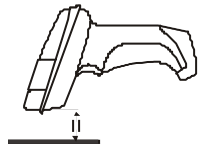
Skew



Conditions of Use

Standard Optics

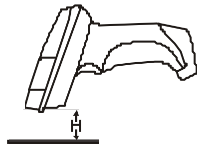
Maximum reading distance



X Dimension	H
0.13 mm	11 cm
0.33 mm	42 cm
0.50 mm	66 cm

Long Range Optics

Maximum reading distance



X Dimension	H
0.25 mm	31 cm
0.38 mm	83 cm
0.50 mm	100 cm

2D Image Readers

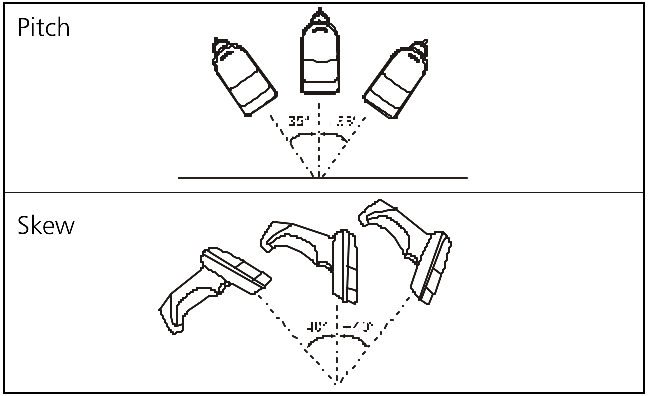
The new generation of bar code readers available on the market are based on camera technology. They use a small video camera to capture an image of a bar code.

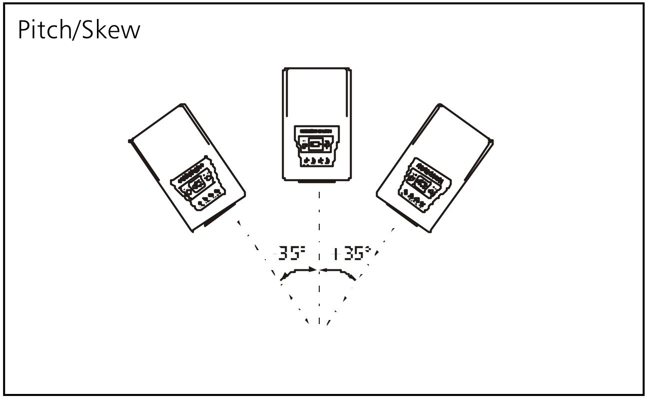
The 2D image reader allows "omnidirectional" reading of the most common 1D symbologies as well as 2D and stacked codes using sophisticated digital image processing techniques to decode the bar code.

The video camera is based on CCD technology. The CCD technology is the same of the CCD bar code reader except that a video camera has hundreds of rows of sensors arranged in a two dimensional array to generate an image, as opposed to having a single row of sensors.

Recently, a new technology based on a Complementary Metal Oxide Semiconductor (CMOS) imaging sensor has been implemented on most of 2D barcode readers. CMOS is a new cost-effective solution that will help increase use of the 2D barcode on the marketplace.

Image readers are equipped with a multi-standard interface to allow connection to the host via USB, Wedge, RS232, RS485 or Ethernet interface.

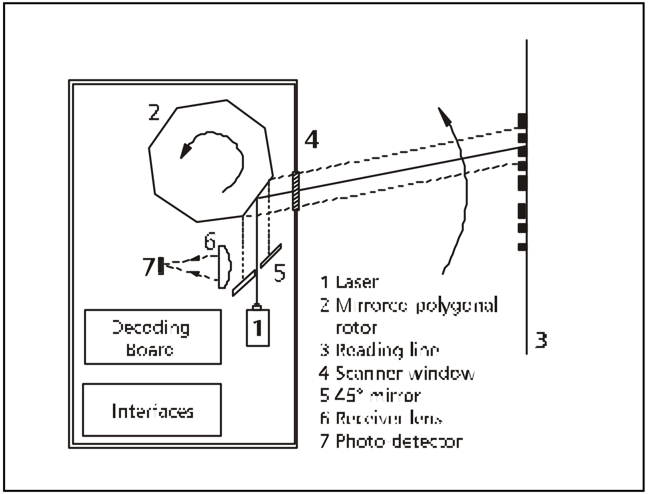




Laser Scanners

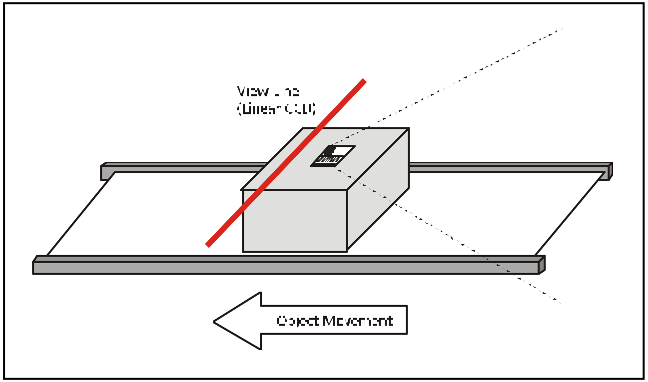
A laser diode (1) emits a coherent light beam, which hits a mirrored polygonal rotor (2). Thanks to the rotation of the wheel and the reflection of each single mirror, the laser beam is deflected out to a surface.

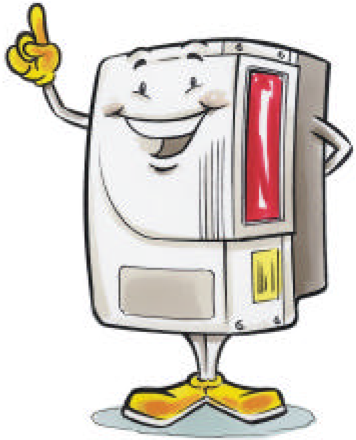
Therefore, a spot of light continually moves across the reading line (3). Where a bar code is in this reading line, the light beam sweeps over the bars and spaces. The light reflected from the dark bars is inferior to that of the white spaces. As a result of this, the bar code can be electrically detected by the scanner. A portion of this light is reflected back through the scanner window (4) onto the polygonal rotor. It is then reflected by a 45° mirror (5) onto a receiver lens (6), which focuses the light onto a photo-detector (7). The intensity of the reflected light is further converted into an electrical signal, which is amplified and digitised. A decoder then decodes the information contained in the signal and the collected data is finally transmitted to the central computer system through a built-in interface.



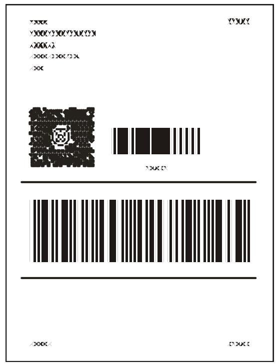
Linear CCD technology for 2D scanners

Linear CCD technology is based on linear CCD Sensors, composed of a single line of 4K, 6K or 8K pixels. The image is captured by means of multiple acquisitions of single lines of pixels. The complete image is composed by exploiting the movement of the object under the camera view line.
To assure the correct representation of the object in the image, the line acquisition frequency must be proportional to the object speed.

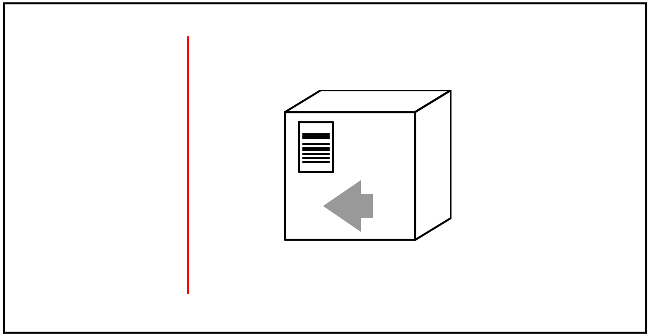




High resolution label image

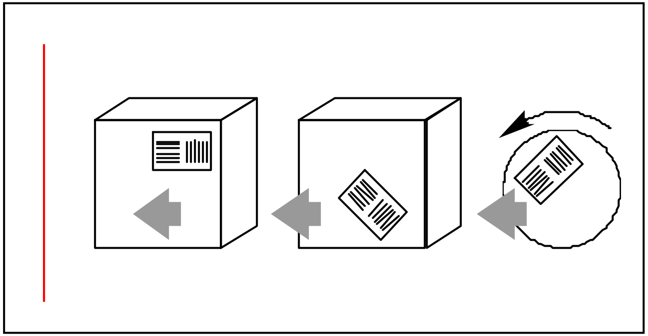


1. Single line Scanners



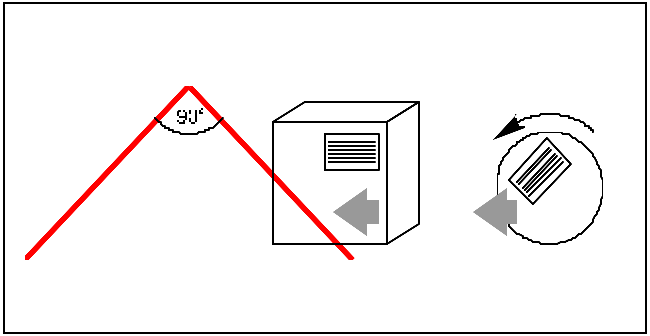
When the bars of the bar code symbol are placed horizontally (ladder orientation) and the laser beam moves perpendicularly, several portions of the code are scanned successively as the bar coded item moves on the conveyor linear reading.
The advantage is that the vertical position of the bar code is not critical as the laser beam can capture the entire bar code with each scan (standard application).

2. Single Line Scanners with T-Codes (oversquared)



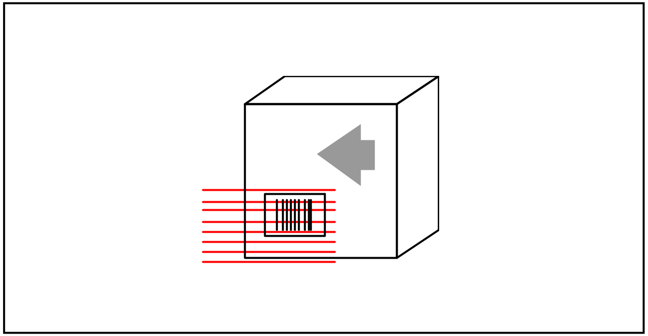
In this position the bar code can be read regardless of orientation in the whole height of the laser beam. The bar code is printed twice, with one print turned 90° (T-Code). The requirement is that the height of the code (bar length) should exceed the width. The advantage is a high transportation speed and a small gap between the parcels. The T-Code, however, needs more space on the label than a standard code. In order not to use an outsize label, the undersquared variant of the T-Code has been developed. It consists of 2 standard codes, which are not oversquared. In order to read this T-Code, a decoder with **ACR**™ technology must be used.

3. Two Single Line Scanners at 90°



With an oversquared bar code and 2 scanners placed at 90°, the bar code can be read regardless of orientation. In this case, however, a large distance between the objects is necessary.

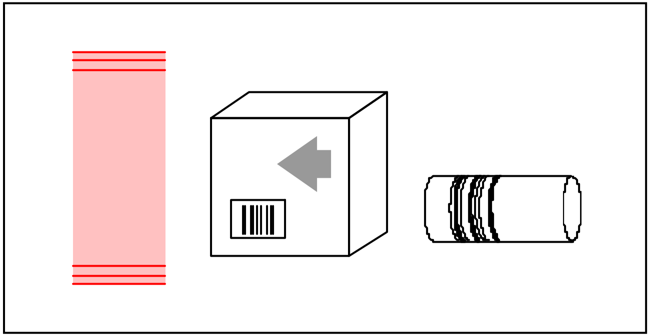
4. Multiple-Beam Scanners or Raster Scanners



If the bars of the code are perpendicular to the scan lines (picket fence orientation), the bar code will be read in different positions by individual lines of the laser beam projected at different heights.

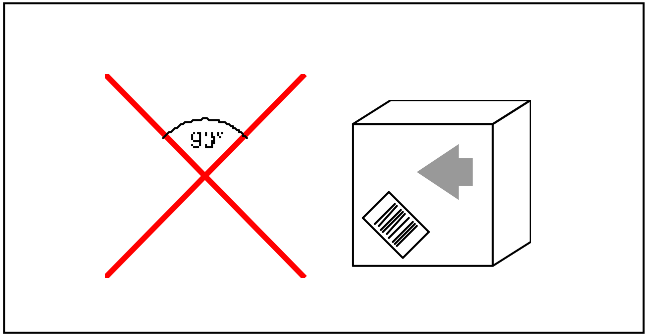
The disadvantage in this case is that the bar code must be accurately positioned as it passes the scanner, as at least 2 scan lines must cross the bar code (at best all scan lines fall within the bar code).

5. Oscillating Mirror Reader



If the bars of the code are perpendicular to the scan lines, the entire surface of the moving item can be captured by means of an oscillating mirror reader.
In this case, the bar code is captured by an oscillating mirror mounted on a single-line scanner. The distance between the scan lines depends on deflection speed and on the amplitude of the oscillating mirror. The advantage is that multiple codes can be read (i.e. Odette label), even though each must be clearly distinguished.

6. Omni-directional Reader

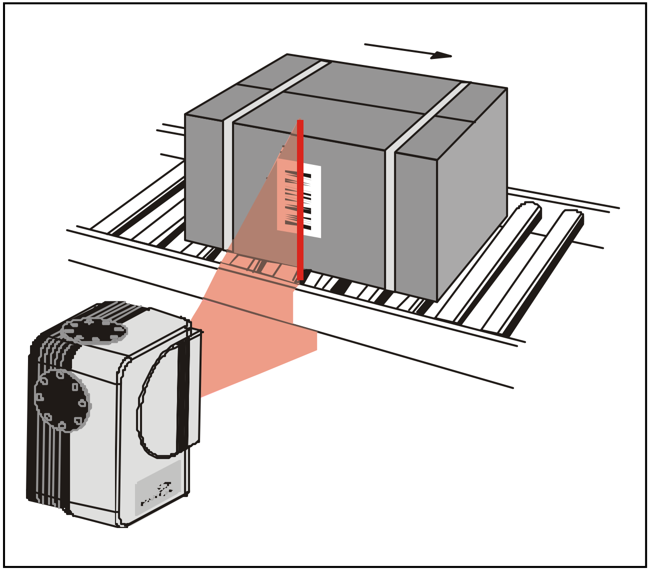


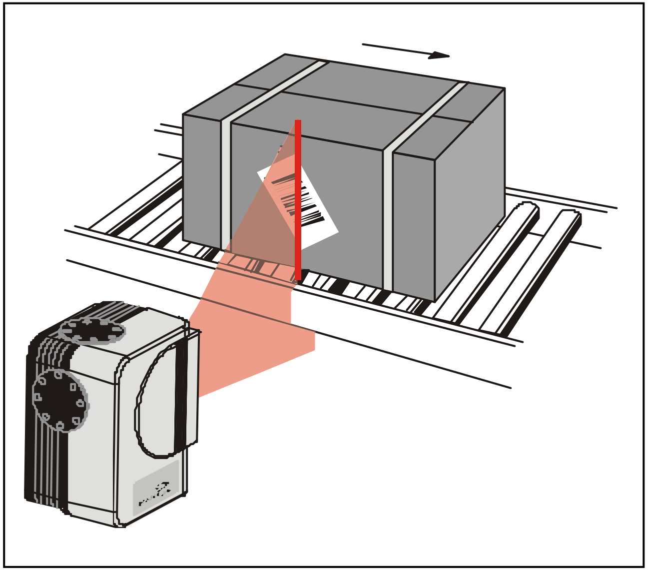
With 2 scanners placed at 90° and **ACR**™ technology a bar code can be read omnidirectionally.

Side reading

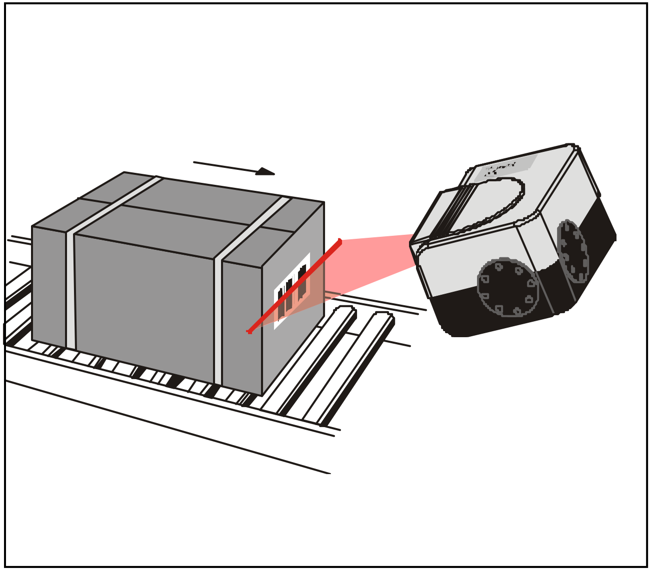
Bar code in ladder orientation (standard position); vertical reading tolerance.

Code reconstruction (**ACR**™) is necessary when some bars are not exposed to the laser beam, i.e. with a large tilt angle.

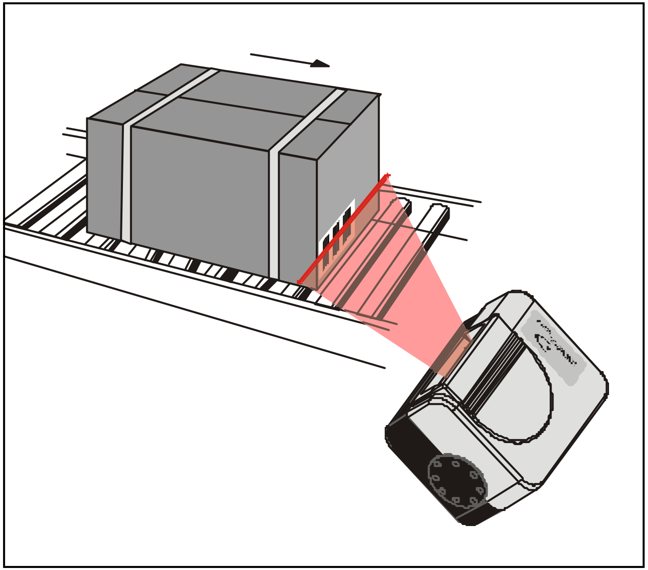




Reading diagonally from above object front.
Label on object front.
Scanner placed diagonally above the moving item.
The laser beam scans the bar code in its whole bar length from bottom to top thanks to the movement of the conveyor belt.

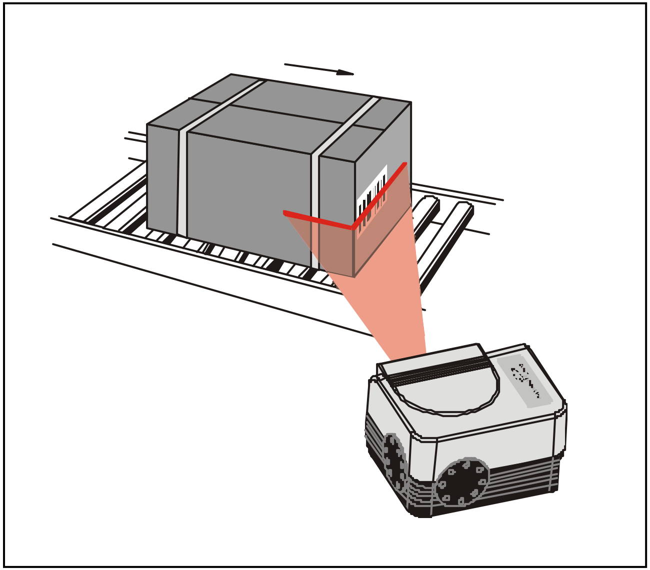


Reading diagonally from below object front.
Label on object front.
Scanner placed diagonally below the moving item.
The laser beam scans the bar code in its whole bar length from top to bottom thanks to the movement of the conveyor belt.



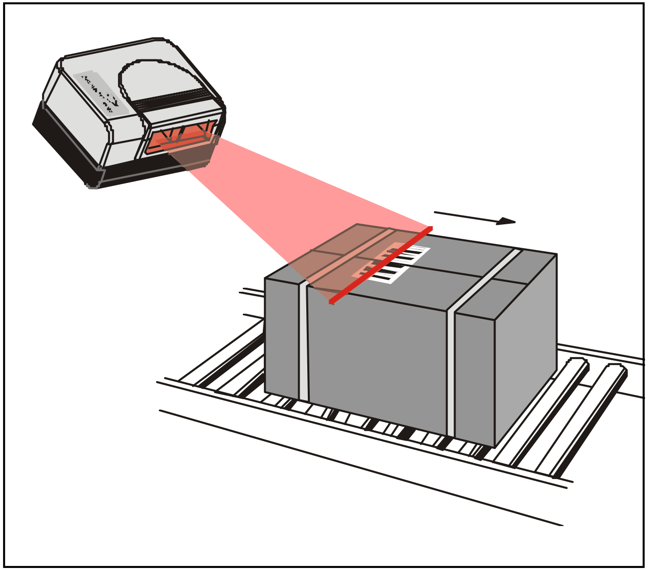
Reading diagonally from below object front.

Bar code in a corner of the object front.
Scanner placed diagonally outside the conveyor.
The laser beam scans the bar code in its whole bar length from top to bottom thanks to the movement of the conveyor belt. The scanner reads diagonally on 2 sides.



Reading diagonally from above.

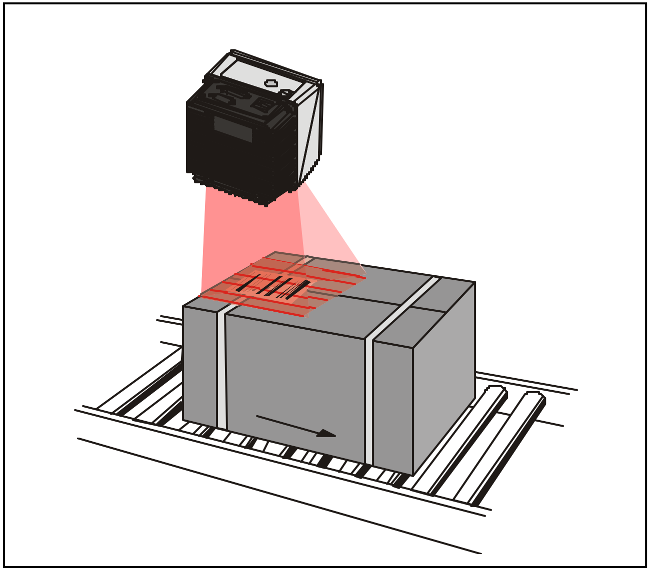
Bar code on top of the object in ladder orientation.
Bars parallel to the direction of travel.
Scanner placed diagonally above the moving item.
The laser beam scans the bar code in its whole bar length thanks to the movement of the conveyor belt.



The raster pattern should allow at least 2 laser beams and ideally all laser beams to continually scan the bar code.

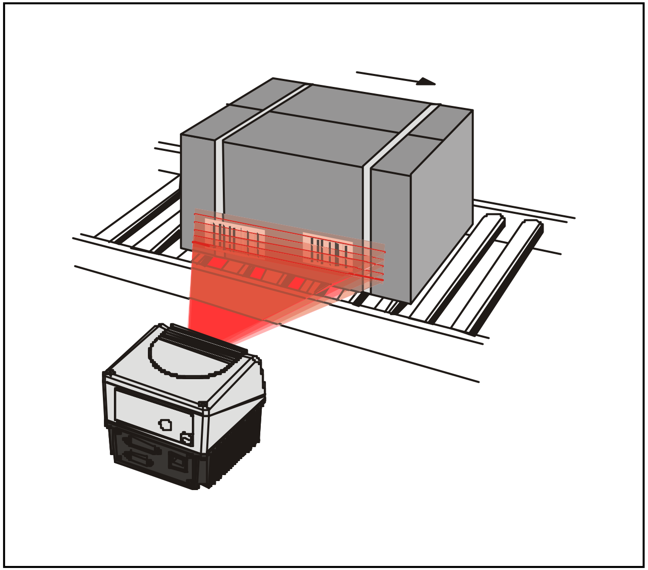
Top reading

Bar code on top of the object.
Bars perpendicular to the direction of travel.



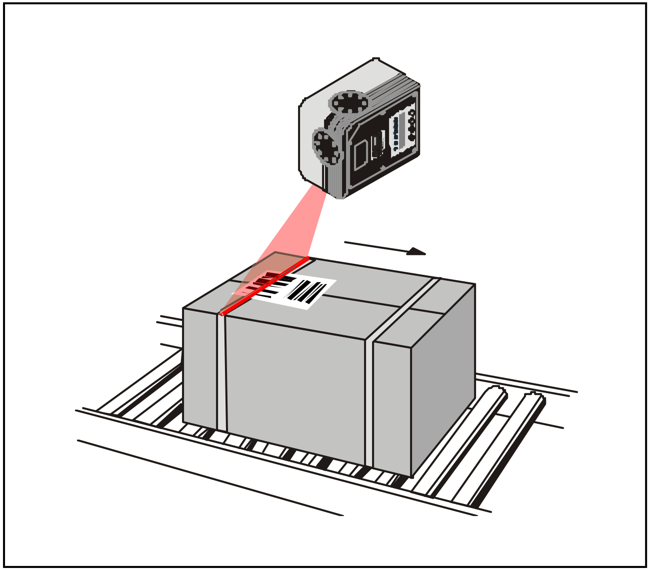
Side reading

Bar code on the side of the object.
Bars perpendicular in picket-fence orientation.



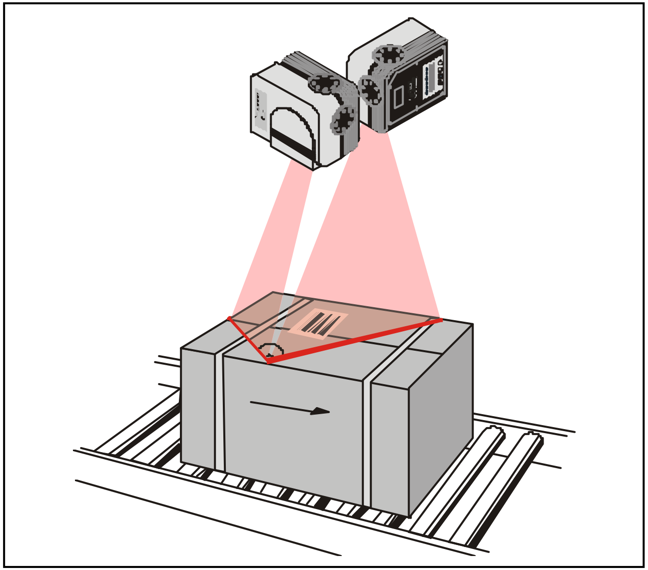
Reading from above with a T-Code (oversquared) single-line scanner

T-Code omnidirectional

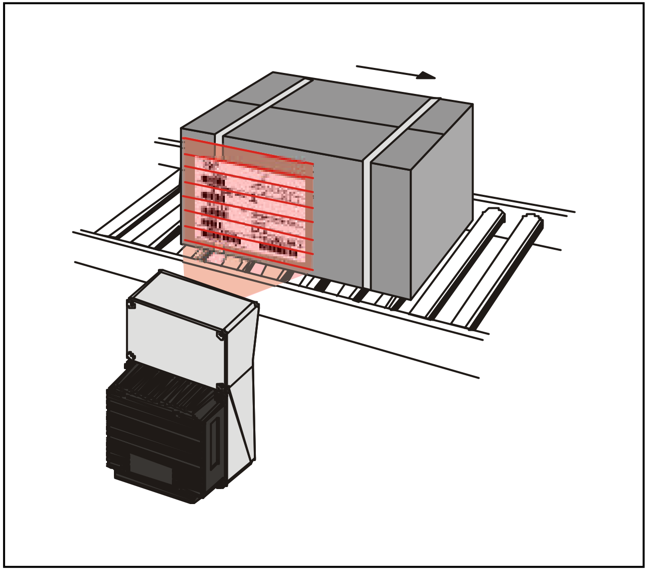


Reading from above with 2 single-line scanners

Scanners placed at 90° (oversquared)

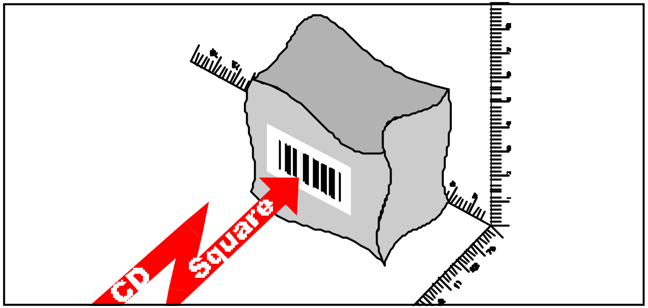


With the oscillating mirror the laser beam can be considerably deflected. This is useful in applications that require the reading of one or more bar codes on a wide surface.
The deflection frequency and amplitude can be adjusted in each scanner.



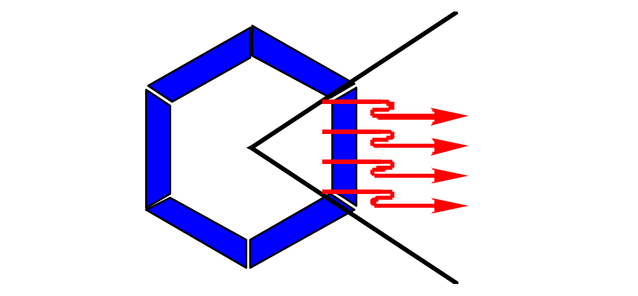
Lateral reading

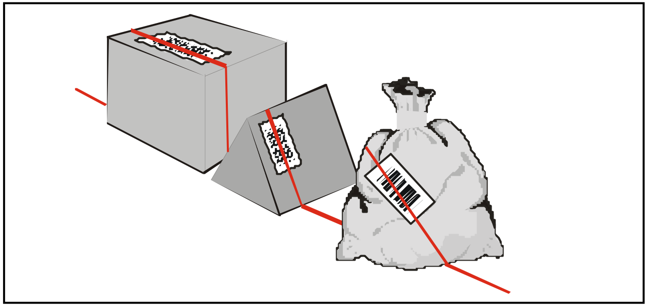
Bars perpendicular to the direction of travel.
Several bar codes one on top of one another can all be captured in one scan. Bar codes must be clearly distinguishable from each other.



ACR™ technology (Advanced Code Reconstruction) is the basis for the implementation of powerful omni-directional reading stations, performing bar code image reconstruction and decoding on small dimension labels placed on parcels with any orientation. It features a new powerful multi-processor architecture and improved algorythms, while working in real time and collecting partial slices of the code to be read to reconstruct a complete code. The **ACR**™ software algorythm offers maximum efficiency and decoding reliability. It also performs multiple code reading which does not depend on the label aspect ratio. **ACR**™ technology also enhances the readability of poorly printed or damaged codes providing a great advantage in all reading conditions.

CDSQUARE™ (Code Distance Detector) is a revolutionary technology allowing accurate detection of bar code label positioning wherever the bar code is located, independent of the object shape. The **CDSQUARE**™ system analyses the analog signal collected by the photodiode receiver, and identifies the area in which the code is located. It then measures the code distance from the scanner. All these operations are done in real time for multiple bar codes and for every scan up to a maximum of 2,000 scans. The information provided by **CDSQUARE**™ is used to optimize decoding processing and perform object tracking, as well as offering the possibility to provide information about the object’s shape or dimensions.



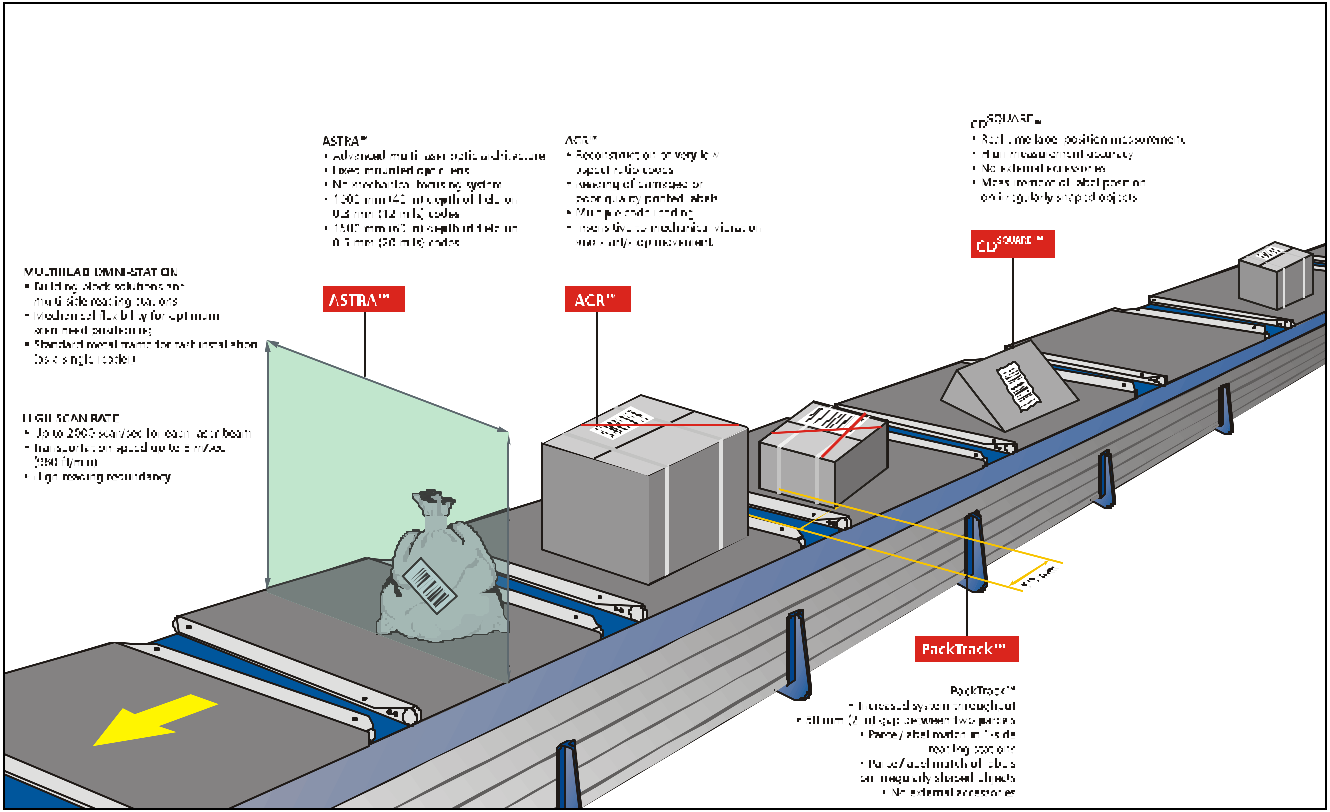


ASTRA™ (Automatically SwiTched Reading Area) is the Datalogic patented multi-laser architecture, which provides a solution to a fundamental need in the Material Handling sector: to read medium-high density bar codes in a large reading area on very fast conveyors. In order to increase the processes' throughputs, today's conveyors go faster and faster, while the distance between two objects becomes shorter and shorter. Following this technological trend, the conveyor systems must be fitted with Auto-ID equipment able to read simultaneously (in the same scan line) two bar code labels placed, for example, on two parcels with different heights. With multi-laser architecture the reading area can reach 1 m (40 in) depth of field and 1 m (40 in) width with an X dimension of X=0.3 mm (0.12 in).

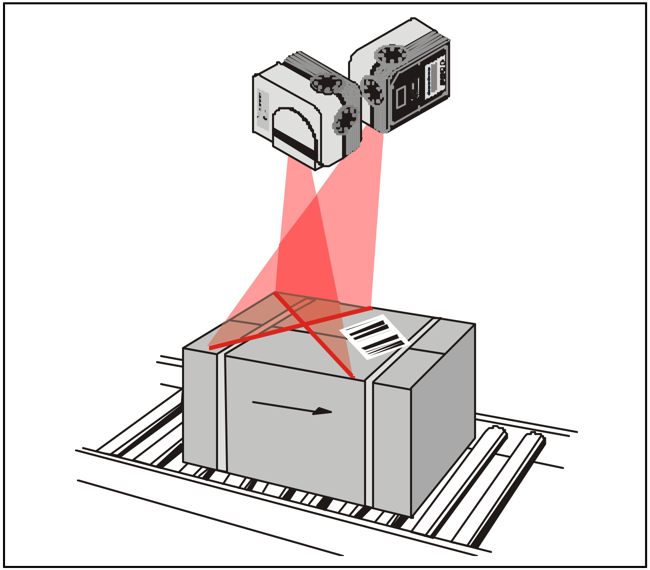
Thanks to a sophisticated controller, **PackTrack**™ tracks parcels as they pass through a reading station, matching the codes to the correct box. **PackTrack**™ can manage the most demanding applications, such as 6-sided reading systems, where traditional systems are unable to detect the real position of the code, necessary for tracking. Today, the limitations of these applications are overcome by **CD**$^{\textbf{SQUARE}}$™ and **PackTrack**™ which assure 100% correct bar code assignment with 50 mm minimum gap between objects. **PackTrack**™ eliminates the need for external accessories required by the traditional tracking systems, such as photocells, encoders and height detector barriers, making installation and setting of the whole transport system less expensive, faster and easier.

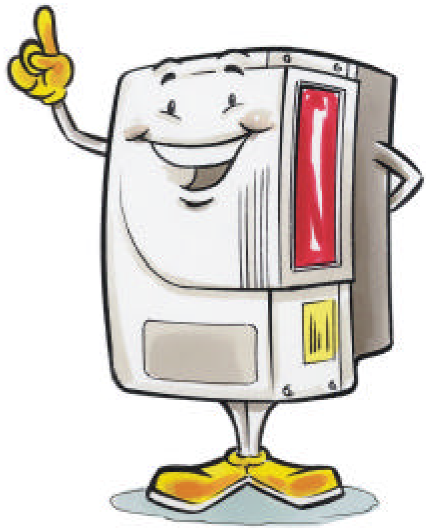
FLASH™ represents a dynamic focus system, fully controlled via SW, which covers an impressive reading range of over 2 meters. Thanks to a very reliable linear motor, **FLASH™** is capable of reacting in less than 10msec. **FLASH™** can operate in the following modes: FIXED, CONTINUOUS when the focus is continuosly running from a minimum to a maximum position, TRIGGERED with the focus set by an external input and D-**FLASH™** mode where the focus position is set by a measured distance between the scanner and the scanned object. This system is the ideal solution for many reading applications (WIP tracking, Warehousing, Tracking and goods sorting).

Step-A-Head™ provides an innovative mechanical design, with the scanner separated in two parts (the reading head and decoder base) making it possible to always install the scanner in the ideal position by simply rotating the Head/Base. Thanks to the "Step-A-Head™" feature, which is unique in the industrial barcode reader market, the cable panel can be optimally positioned in any situation. The space required is reduced, and access to the panel is always easy and fast. By simply changing the orientation of the Head and Base, installation flexibility is dramatically increased.


ASTRA™
• Advanced multi-laser optic architecture
• Fixed mounted optic lens
• No mechanical focusing system
ACR™
• Multiple code reading
CD SQUARE™
• Real time label position measurements
• High measurement accuracy
• No external accessories
MULTIHEAD OMNI-STATION
• Building block solutions for
multi-side reading stations
HIGH SCAN RATE
• High reading redundancy
ASTRA™
ACR™
CD SQUARE™
PackTrack™
PackTrack™
• No external accessories

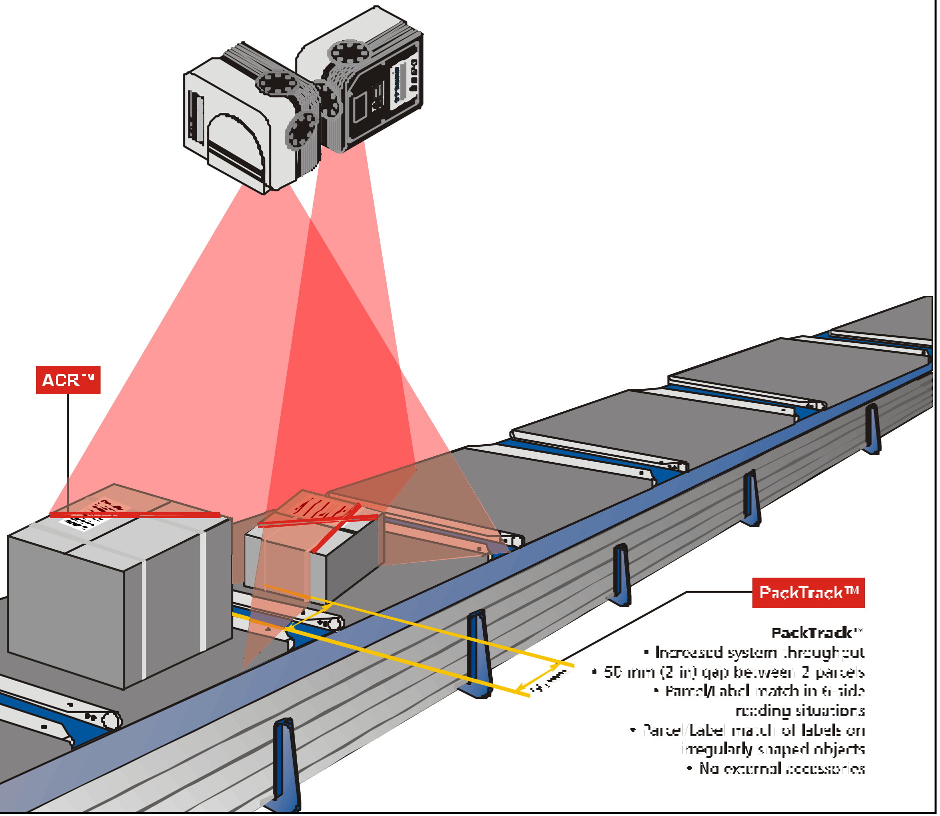
The following pictures further illustrate **ACR™** applications in which Datalogic's scanners are used.
Omnidirectional Reading Station with **ACR™** technology (standard labels):



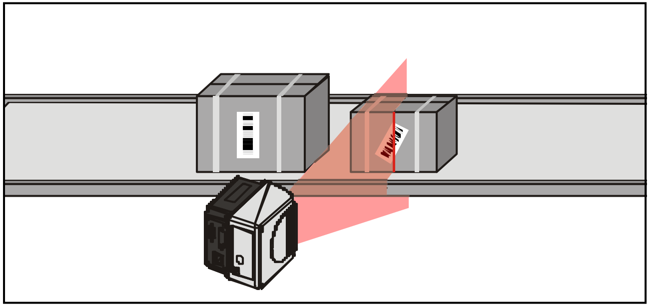


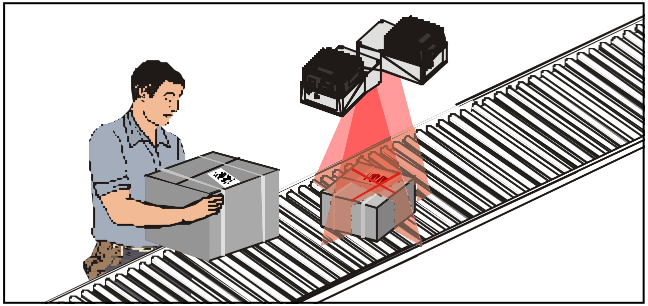
MULTIHEAD OMNI-STATION
- Building block solutions and multi-side reading stations
- Mechanical flexibility for optimum scan head positioning
- Standard metal frame for fast installation

ACR™
- Reconstruction of very low aspect ratio codes
- Reading of damaged or poor quality printed labels
- Multiple code reading
- Insensitive to mechanical vibration and start/stop movement



PackTrack™
- Increased system throughput
- 50 mm (2 in) gap between 2 parcels
- Parcel/Label match in 6 side reading situations
- Parcel/Label match of labels on irregularly shaped objects
- No external accessories





High tolerance label positioning

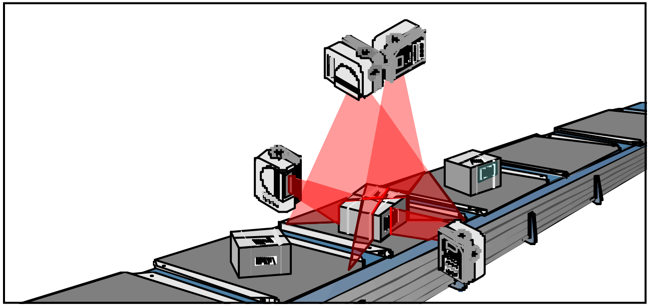
Label position control is no longer necessary. The installation of scanners equipped with **ACR**™ technology reduces costs and makes your process more flexible.

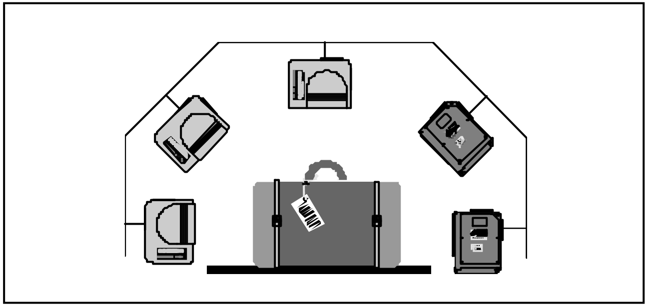
An **ACR**™ scanner improves system performance even when a traditional linear bar code can do the job.

ACR™ offers the benefit of enhancing the reading result on poorly printed codes.

Loading/unloading conveyor system

The omni-station is the ideal solution for express courier and postal applications requiring a large number of reading stations in warehouses and distribution centres. The inexpensive omni-station justifies the use of fixed position scanners even in applications where hand held bar code readers are usually implemented. The innovative Datalogic omni-station offers: compact dimensions, high scan rate, multiple label reading, Code Reconstruction technology, reading of small codes, integrated **Pack-Track**™.





Fixed Position Omni-Station

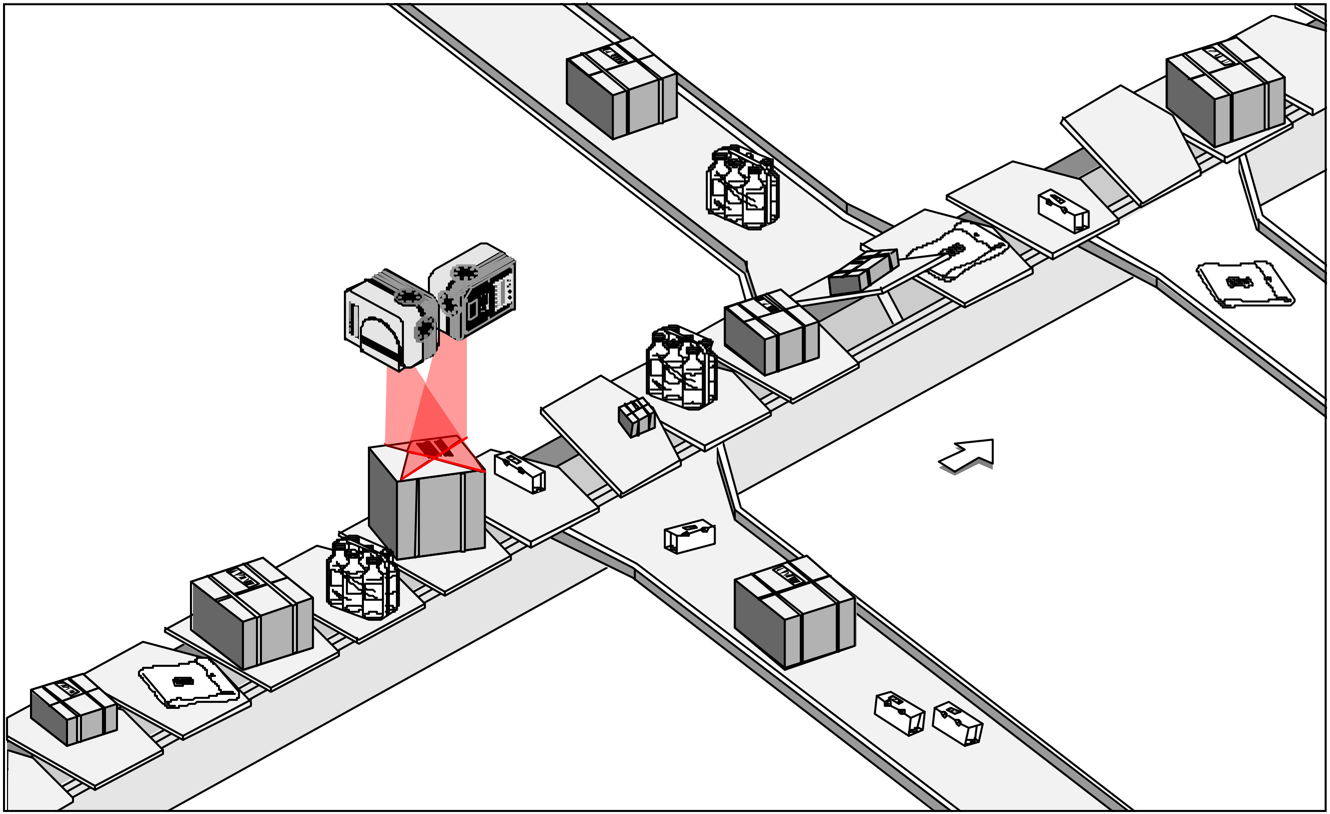
Ever-growing technology makes conveyor systems faster and parcel throughput higher. Omni-stations offer high reading performance combined with advanced **ACR**™ technology suitable for all high-speed conveyors.

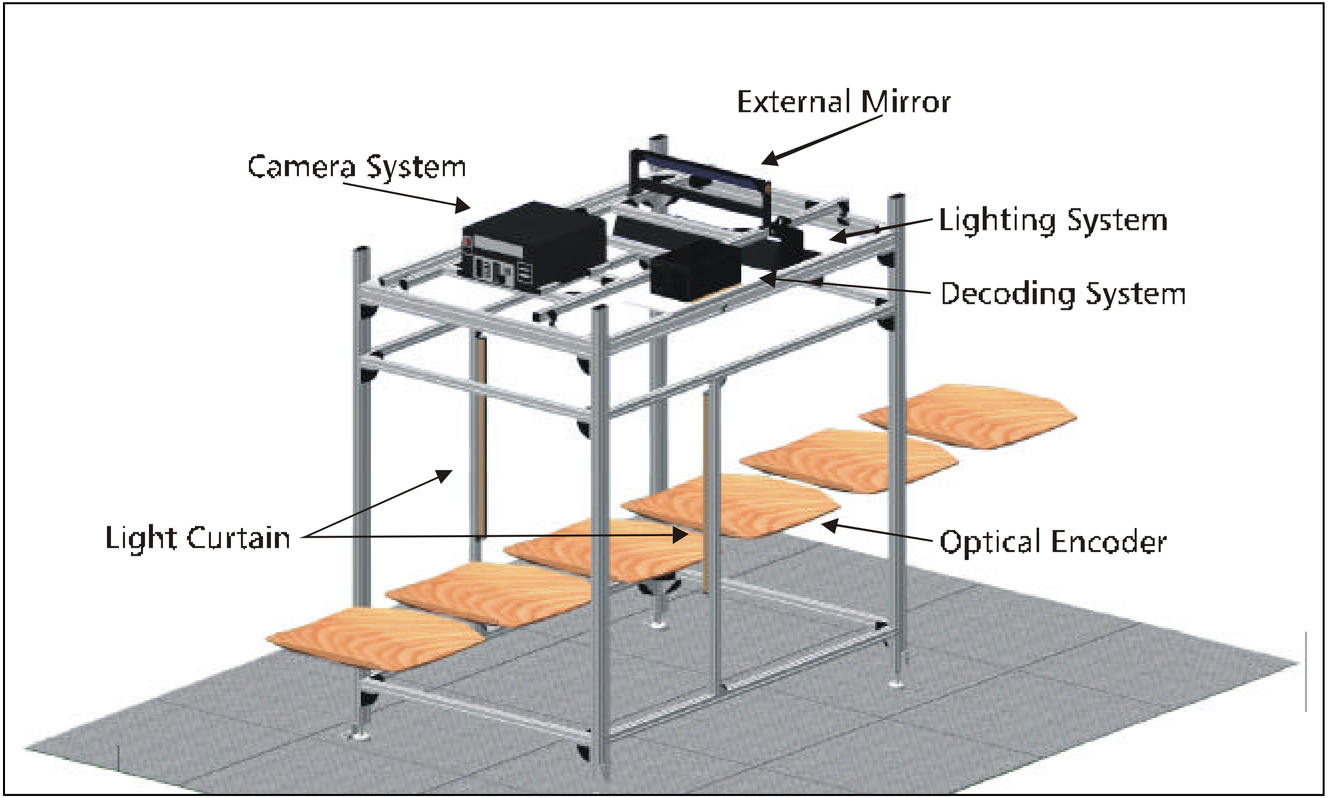
The maximum scan rate of 2,000 scans/sec, **ACR**™ technology and real time decoding, as well as integrated **PackTrack**™ functions are the main benefits offered by Datalogic omni-solutions.

As the Datalogic omni-station does not need any external sensors, its installation is faster, easier and less expensive. The user-friendly **WINHOST**™ software program takes care of the station parameters setting.

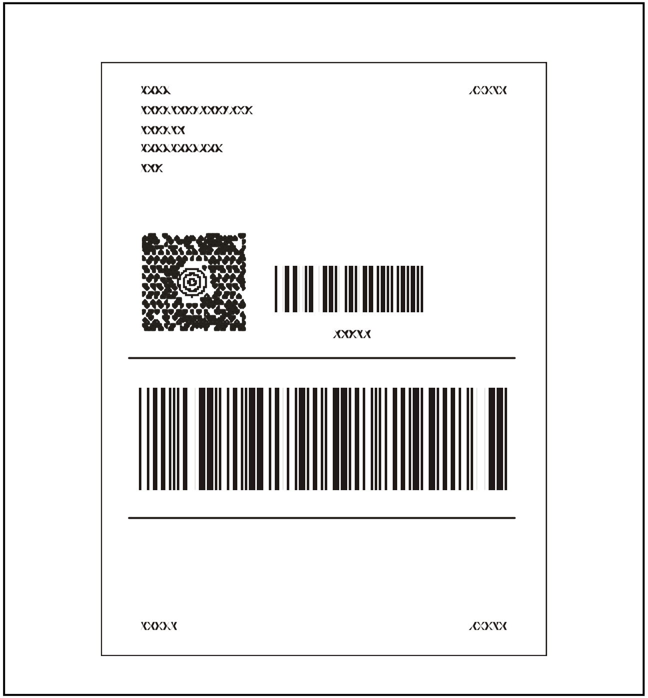
Automatic Baggage Handling and Cargo Applications

The technical features of Datalogic scanners are tailored to 6-sided omnidirectional reading stations installed at 360° around the conveyor, overcoming several limitations of today's technology. Thanks to the performance of **CDSQUARE**™, the scanner can detect the label position, even where the latter is not correlated to baggage shape. The label position is the basic information used by **PackTrack**™ in order to trace the baggage and labels when they pass through the reading station. It is thus possible to reduce the gap to 50 mm between two pieces of baggage. This system is particularly useful when the conveyor is based on tilt-tray system. Code Reconstruction and the self-adjusting digitizer enhance bar code reading on poorly printed or damaged codes.




External Mirror
Camera System
Lighting System
Decoding System
Light Curtain
Optical Encoder

The high quality image captured by a linear camera system is processed by advanced image processing software. All codes (linear and 2D) present on the object surface are detected and decoded with automatic auto-discrimination.



2D Codes

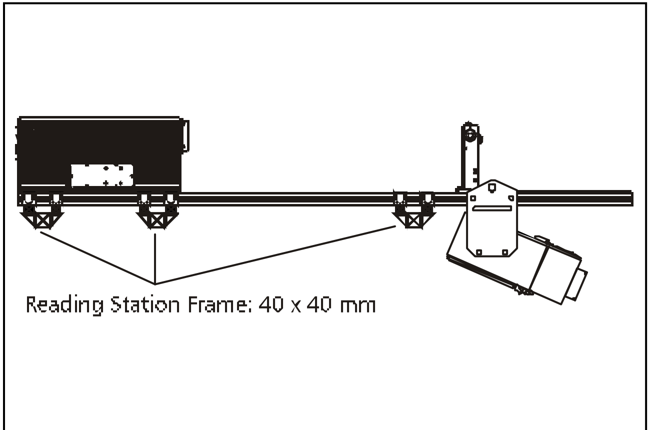
- PDF417
- Maxicode
- DataMatrix

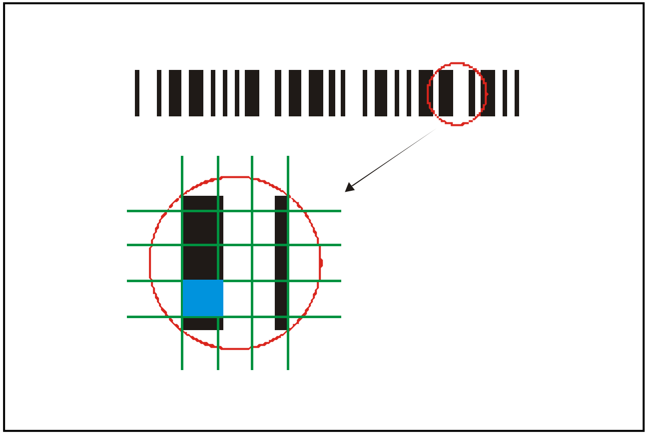
Barcodes

- Code 39
- Code 128
- Code 93
- Interleaved 2/5
- UPC/EAN

Others...

Image Resolution represents one of the image quality parameters. It is usually defined by DPI (dots per inch). The correct resolution must be provided on the image to be able to detect and decode codes placed on objects. For example, high resolution barcodes which feature narrow bars require high resolution images and vice versa.

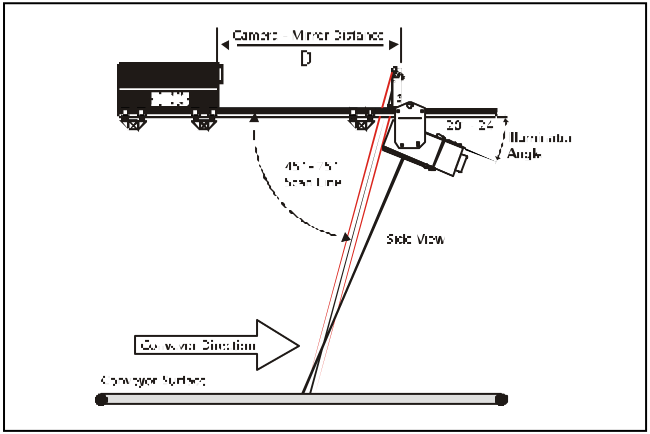


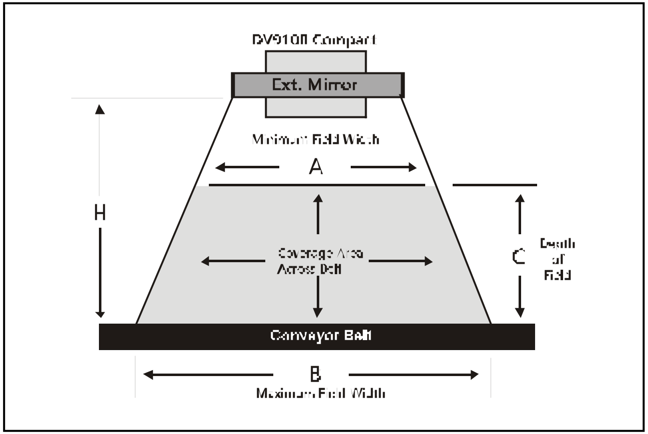


MODEL DESCRIPTION (CAMERA ONLY)	IMAGE RESOLUTION (DPI)	MAX. RESOLUTION 1D and Stacked Codes (mm/mils)	MAX. RESOLUTION Matrix Codes (mm/mils)
DV9100-1000 BCR HIGH RES.	200	0.25 / 10	0.38 / 15
DV9100-1200 BCR LOW RES.	130	0.38 / 15	0.60 / 23

Image Resolution

For a given linear CCD sensor, the captured image resolution is related to the amplitude of the camera field of view (FOV). For example, with 6k pixels, a 200 dpi image can be obtained on 780 mm of FOV, and a 100 dpi image can be obtained on 1560 mm FOV.





MODEL DESCRIPTION (CAMERA ONLY)	A (mm)	B (mm)	C (mm)	D* (mm)	H* (mm)
DV9100-1000 BCR HIGH RES.	650	780	650	2120	1550
DV9100-1200 BCR LOW RES.	900	1200	900	1380	1700

*D + H is the total focus distance. This relationship can be modified.

By choosing the communication port, hardware requirements for data transmission between the reading device and the computer or PLC (Programmable Logic Controller) are clearly established. Several interfaces offering different features are available in order to meet different needs.

The main parameters to consider in order to select the right type of interface are the following:

- Distance
- Wiring connection (cable type)
- Transmission rate
- Bus structure
- Fail safe

Here is a short description of the different interfaces available and their main features.

RS232 (V24)

With the RS232 or V24 interface, data transfer is serial and asynchronous. Internationally, this interface has been defined according to V.24/V.28 , where V.24 identifies functional features and V.28 electrical features. Later, the RS232 concept came into use. This interface only allows a point-to-point connection. In practice, either 5 or even only 3 wires are used in this kind of communication.

In 5-wire communication:
Ground (GND), Transmitted Data (Tx), Received Data (Rx), Request to send (RTS), Clear to send (CTS).

In 3-wire communication:
Ground (GND), Transmitted Data (Tx), Received Data (Rx)
The connectivity pattern has not been clearly defined, as well as the precise kind of connector to be used. The nominal length of the communication line is 15 m. with a transmission rate of 9,600 Bd.

RS422

Like the RS232, the V.11 or RS422 interface only allows point-to-point connection, but permits transmission over longer distances as a result of differential voltage levels. A major benefit is cross-talk attenuation, which leads to electrical noise limitation. Maximum cable length is 1,200 m. with a transmission rate of 9600 Baud.

RS485

The RS485 interface has the same electrical parameters as the RS422. Compared to the RS422, the RS485 is designed for multidrop communication, while the RS422 is only point-to-point. The RS485 can also have up to 32 transmitter/ receiver pairs on a data bus, with a maximum cable length of 1200 m., while the RS422 only allows one transmitter on one data bus.

Keyboard Emulation

This interface connects the keyboard to the PC or terminal. It is not standardised, but is developed by each PC or terminal manufacturer. The interface can range from asynchronous and synchronous ASCII-TTL to parallel interfaces. As keyboard emulation is a convenient way of connecting reading devices to computer systems, readers support a variety of different interfaces.

This kind of interface is designed only for short distances and slow transmission rates. As a result, extending the cable and increasing the transmission rate is not necessary

Ethernet

The interest for Ethernet in automation is continuously growing, since this bus is the ideal data link between office and factory floor levels. The TCP/IP protocols provide many interesting functions that offer important advantages to the customer.

HTTP client allows the scanner to be connected to a WEB Server (the Host) through Ethernet and directly send data to a WEB database. WEB databases are becoming more and more common because they are a useful tool for storing data in a secure and flexible way.

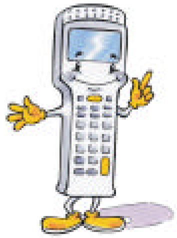
SMTP client allows the scanner to send e-mail messages to a mail server. The SMTP engine provides the scanner with the benefit of completely automated messaging.

Profibus

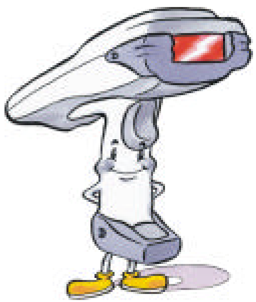
Profibus is the world's most popular FieldBus, with approximately 20% of the market, this bus is widespread in Europe and also popular in North America, South America and parts of Africa / Asia. ProfiBus can handle large amounts of data at high speeds and serves the needs of the majority of automation applications. Today, it is commonly found in process control, large assembly and material handling machines.

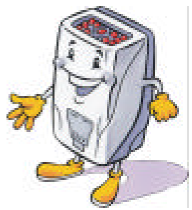
Devicenet

Devicenet is the most popular fieldbus in the US market. This communication link connects industrial devices (such as switches, photoelectric sensors, motor starters, frequency drives, panel display). The main goal of Devicenet is to provide an open network standard, with reduced overall costs. The Devicenet communication link is based on Contolled area Network (CAN) for the European automotive market.



Read me!!!





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