



## Data matrix code

The "data matrix code" is probably the best known member of the 2D code family and is frequently used for permanent direct labelling on, for example, tools, engine and motor components, and surgical/medical instruments.

The data matrix code is also increasingly being used in production, vehicle manufacturing, chemical and biomedical analysis instruments as well as document handling.



Data matrix code (ECC 200)

The data matrix code was developed in the USA in the late 80s. It exists in various stages of development (ECC  $n$ ,  $0 \leq n \leq 200$ ; Error Checking and Correction algorithm). The latest and most reliable version is the data matrix code ECC 200. The size of the rectangular code is variable and the symbol elements are square. This data matrix code is standardised by AIM International where a specification is available.

<http://www.aimi.org/aimstore/matrixsymbolologies.htm> - Data Matrix

*Excerpt from the AIM International specification:*

(11/96) ANSI/AIM BC11 International Symbology Specification - Data Matrix

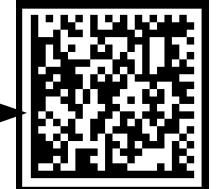
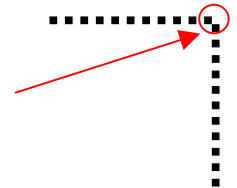
“Data Matrix is a two-dimensional matrix symbology containing dark and light square data modules. It has a finder pattern of two solid lines and two alternating dark and light lines on the perimeter of the symbol. A two-dimensional imaging device such as a CCD camera is necessary to scan the symbology. Data Matrix is designed with a fixed level of error correction capability. It supports industry standard escape sequences to define international code pages and special encodation schemes. Data Matrix is used for small item marking applications using a wide variety of printing and marking technologies.”



## Structure of the data matrix code

The data matrix code consists of 4 main components:

- The fixed boundary line ('corner'). This fixed boundary line is used for pattern detection and for calculating the rotational position of the data matrix code.
- The open boundary (opposite corner). This open corner is used for identifying the number of rows and columns. Referred to as the "matrix density". With ECC 200, the element in the top right-hand corner is white.
- The memory area. This contains the binary information in coded form. The possible number of items of information depends on the cell size.
- The 'clear zone'. This empty zone surrounds the data matrix code. It contains neither information nor is it used for orientation purposes. The width of the clear zone is one field/row.



The corner which consists of a horizontal and vertical boundary line is used as a finder pattern for code orientation. With large codes, "grid alignment bars" are also used. This code can be used to encode up to 1558 ASCII characters and special characters (extended character set, 8 bit), or 2334 ASCII characters (7 bit) or 3116 digits.

The Reed-Solomon error correction ensures a high level of data integrity. Reconstruction of the data content is then possible even if parts of the code are concealed or destroyed.

## Advantages of the data matrix code

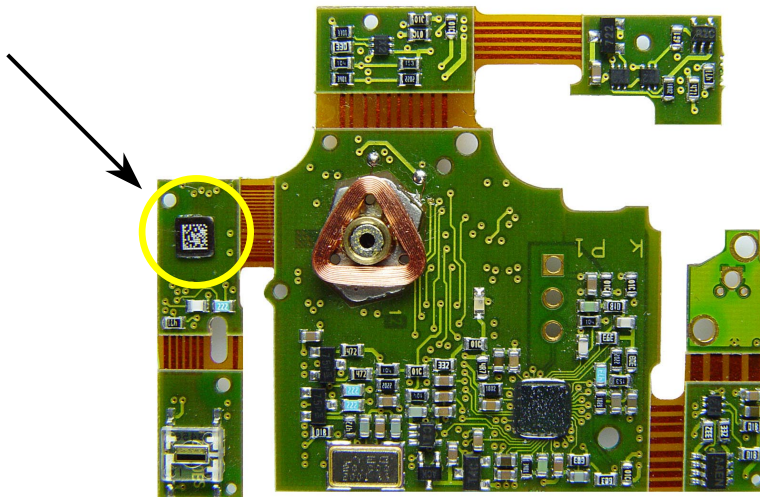
- Flexible application size



- Very high information density in minimum space
- Reading is possible at any angle
- Minimum requirements with regard to colour contrast and print quality, therefore also suitable for direct labelling devices (e.g. laser labellers or pin-punchers); requires lower contrast than for bar codes
- Error correction by means of "Reed-Solomon" algorithm - up to 25 % of the code can be destroyed.

## Application examples

- Reading of permanent direct labels (e.g. on tools, engine components, motor components, surgical/medical instruments etc.)
- Production / manufacturing (labelling of electronic components, tools)
- Chemical and biomedical analysis instruments
- Electronic circuit boards
- Small pharmaceutical packages
- Incoming/outgoing goods inspection
- Special access control
- Discrete labelling (e.g. documents or personnel cards)
- Mail, letter, document tracing

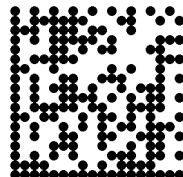


Data matrix code as a component on a circuit board

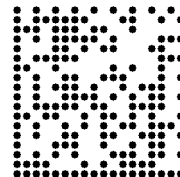
## Distinction between data matrix code and dot matrix code



Data matrix



Dot matrix 100%



Dot matrix 80 %



## Size of data matrix code ECC 200

How much data can fit into a data matrix code?

### Square symbols

Symbol size	Possible			Maximum correctable errors	Figure
	Digits	Characters	Bytes		
10x10	6	3	1	2	1
12x12	10	6	3	3	2
14x14	16	10	6	5	3
16x16	24	16	10	6	4
18x18	36	25	16	7	5
20x20	44	31	20	9	6
22x22	60	43	28	10	7
24x24	72	52	34	12	8
26x26	88	64	42	14	9
32x32	124	91	60	18	10
36x36	172	127	84	21	11
40x40	228	169	112	24	12
44x44	288	214	142	28	13
48x48	348	259	172	34	14
52x52	408	304	202	42	15
64x64	560	418	278	56	16
72x72	736	550	366	72	17
80x80	912	682	454	96	
88x88	1152	862	574	112	
96x96	1392	1042	694	136	
104x104	1632	1222	814	168	
120x120	2100	1573	1048	204	
132x132	2608	1954	1302	248	
144x144	3116	2335	1556	310	



Figure 1



Figure 2



Figure 3

### Rectangular symbols

8x18	10	6	3	7	18
8x32	20	13	8	11	19
12x24	32	22	14	32	20
12x36	44	31	20	44	21
16x36	64	46	30	64	22
16x48	98	72	47	98	23



Figure 18



Figure 20



Figure 22



Figure 19



Figure 21



Figure 23



Figure 4

Figure 9

Figure 14



Figure 5

Figure 10

Figure 15



Figure 6

Figure 11

Figure 16



Figure 7

Figure 12

Figure 17



Figure 8

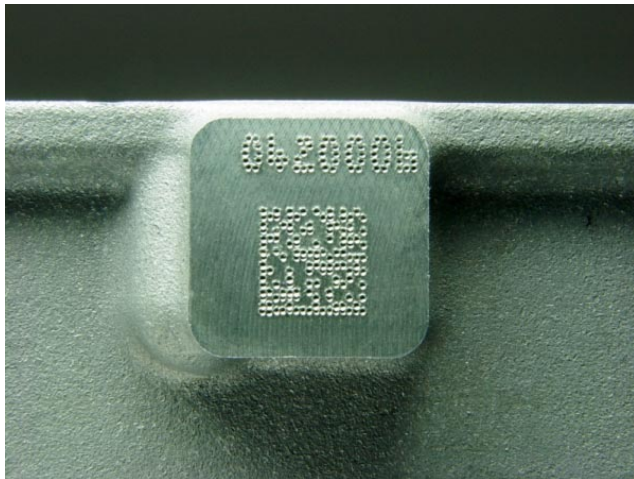
Figure 13



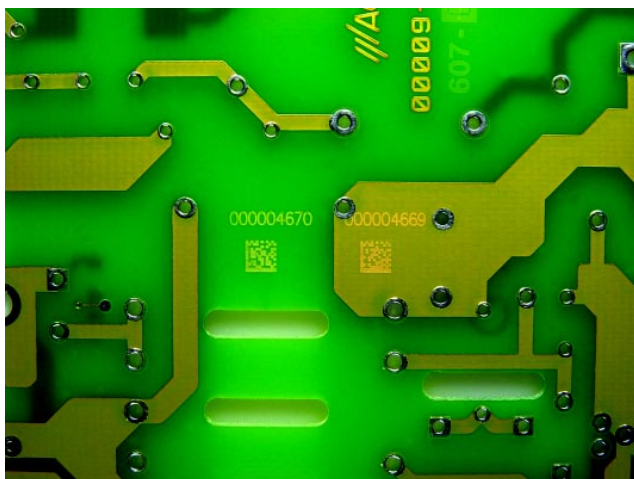
## Direct marking with data matrix code



Data matrix code, direct marking (lasered)



Data matrix code, direct marking (pin-punched)



Data matrix code, direct marking (lasered)

Unlike 1D bar codes, 2D bar codes always need a "camera system" for detection and evaluation. Here the information is collected and evaluated two-dimensionally using a camera. To allow this, the surface of 2D bar codes must be illuminated by a light source; the light reflected by the 2D bar code is then projected onto a "focal plane", e.g. a CMOS sensor, and evaluated.



The stationary and omnidirectional 2D codereader **visionREADER 2300** from Leuze electronic reads both one- and two-dimensional codes (bar codes, stacked bar codes and Data Matrix codes). The reading distance ist max. 250 mm, depending on the application. With the **visionREADER 2300** it is even possible to read reflective, fouled, damaged, or incomplete codes. Even codes with poor contrast, directly marked on engine components, circuit boards, etc. are decoded easily.



**visionREADER 2300**

The **IT 6300** is a hand-held device for flexible and mobile use. The IP 54 protected 2D code reader, designed for rough industrial environment, is particularly suitable for the identification of directly marked Data Matrix codes (laser or dot peening) with poor contrast, e.g. on metal, plastic, etc. For wireless applications, the device is optionally available as **IT 6320** with radio transmission.



**IT 6300**



**IT 6320**

