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Second edition

Information technology — Automatic identification and data capture techniques — Data Matrix Rectangular Extension (DMRE) bar code symbology specification

PROOF/ÉPREUVE

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This second edition cancels and replaces the first edition (ISO/IEC 21471:2020), which has been technically revised.

The main changes are as follows: information duplicated from ISO/IEC 16022 has been removed

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Introduction

Data Matrix Rectangular Extension (DMRE) is a two-dimensional matrix symbology which is made up of nominally square modules arranged within a perimeter finder pattern. Though primarily shown and described in this document as a dark symbol on light background, Data Matrix Rectangular Extension symbols can also be printed to appear as light on dark.

This document is an extension of ISO/IEC 16022, to which it adds rectangular formats. Maximum compatibility is a design goal. This document only describes the required extension. Common properties are not repeated. It is a long time goal to join those documents, when DMRE is widely adopted.

This document is published separately because existing equipment supporting ISO/IEC 16022 will not recognize DMRE symbols. Only equipment that is enabled and configured to support DMRE will be capable of printing and scanning the new rectangular formats.

Manufacturers of bar code equipment and users of the technology require publicly available standard symbology specifications to which they can refer when developing equipment and application standards. The publication of standardized symbology specifications is designed to achieve this.

Information technology — Automatic identification and data capture techniques — Data Matrix Rectangular Extension (DMRE) bar code symbology specification

1 Scope

This document defines the requirements for the symbology known as Data Matrix Rectangular Extension (DMRE). This document specifies the DMRE code symbology characteristics, data character encodation, symbol formats, dimensions and print quality requirements, error correction rules, decoding algorithm, and user-selectable application parameters.

This document applies to all DMRE code symbols produced by any printing or marking technology.

Original Data Matrix code sizes are not covered by this document but defined in ISO/IEC 16022 using the same matrix placement, decoding and error correction algorithm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 15415, *Automatic identification and data capture techniques — Bar code symbol print quality test specification — Two-dimensional symbols*

ISO/IEC 16022, *Information technology — Automatic identification and data capture techniques — Data Matrix bar code symbology specification*

ISO/IEC 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO/IEC 29158, *Information technology — Automatic identification and data capture techniques — Direct Part Mark (DPM) Quality Guideline*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Symbols

e number of erasures

k total number of error correction codewords

n total number of data codewords

N the numerical base in an encodation scheme

p number of codewords reserved for error detection

S symbol character

t number of errors

X horizontal and vertical width of a module

ε error correction codeword

5 Symbol description

5.1 Basic characteristics

DMRE is a two-dimensional matrix symbology. It is an extension of the ISO/IEC 16022 Data Matrix symbology.

The characteristics of DMRE are:

a) An encodable character set of:

   1) values 0 to 127 according to the ISO/IEC 646 (International Reference Version) IRV,[2] i.e. all 128 ASCII characters;

   2) values 128 to 255 in according to ISO/IEC 8859-1 (these are referred to as extended ASCII);

   3) additional characters can be encoded using the ECI capabilities.

b) Data is represented as a dark module for the binary one and a light module for zero.

   This document specifies DMRE symbols in terms of dark modules marked on a light background. However, 5.2 indicates that symbols may also be produced with the module's colours reversed. In such symbols, dark modules would be a binary zero and light modules would be a binary one.

c) The symbol size in modules (not including quiet zone) are: 8 × 48 to 26 × 64 even values only (see Table 1).

   Symbol sizes 8 × 18, 8 × 32, 12 × 26, 12 × 36, 16 × 36 and 16 × 48 are defined by ISO/IEC 16022 and are not covered by this document. These rectangular Data Matrix sizes are fully compatible with this document.

   NOTE Only this characteristic is different to ISO/IEC 16022 Data Matrix symbology.

d) Data characters per symbol (for maximum symbol size) are as follows:

   1) alphanumeric data: up to 175 characters;

   2) 8-bit byte data: 116 characters;

   3) numeric data: 236 digits.

e) The code type is rectangular matrix.

f) The orientation is independent.

g) Error detection and correction: Reed Solomon.

5.2 Summary of additional features

Additional features which are inherent or optional in DMRE are:

a) Reflectance reversal (inherent): symbols are either dark on light or light on dark (see Figure 1). The specifications in this document are based on dark images on a light background, therefore references to dark or light modules should be taken as references to light or dark modules respectively in the case of symbols produced with reflectance reversal.

b) Extended channel interpretations (ECI) (inherent): this mechanism enables characters from other character sets (e.g. Arabic, Cyrillic, Greek, Hebrew) and other data interpretations or industry-specific requirements to be represented.

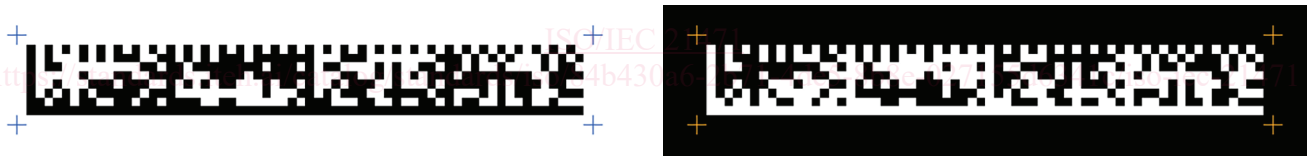
c) Structured append (optional): this allows files of data to be represented in up to 16 Data Matrix Rectangular Extension symbols. The original data can be correctly reconstructed regardless of the order in which the symbols are scanned. If the feature is not implemented, data should not be transmitted in case of a structured append symbol.

NOTE All those additional features are identical to ISO/IEC 16022 Data Matrix symbology.

5.3 Symbol structure

5.3.1 General

Each DMRE symbol consists of data regions which contain nominally square modules set out in a regular array. In larger symbols, data regions are separated by alignment patterns. The data region is surrounded by a finder pattern, and this shall be surrounded on all four sides by a quiet zone border. Figure 1 illustrates two representations of a Data Matrix Rectangular Extension symbol, dark on light and reflectance reversal.



a) DMRE, dark on light **b) DMRE, light on dark (reflectance reversal)**

Figure 1 — DMRE "A1B2C3D4E5F6G7H8I9J0K1L2"

5.3.2 Finder pattern

The finder pattern is a perimeter to the data region and is one module wide. Two adjacent sides, the left and lower sides, forming the L boundary, are solid dark lines; these are used primarily to determine physical size, orientation and symbol distortion. The two opposite sides are made up of alternating dark and light modules. These are used primarily to define the cell structure of the symbol, but also can assist in determining physical size and distortion. The extent of the quiet zone is indicated by the corner marks in Figure 1.

5.3.3 Symbol sizes and capacities

DMRE symbols have an even number of rows and an even number of columns. The symbols are rectangular with sizes from 8 × 48 to 26 × 64 not including quiet zones. For all Data Matrix Rectangular Extension code symbols, the upper right corner module has the opposite reflectance state (i.e. light or dark) of the "L" finder pattern (see Figure 1). The complete attributes are given in Table 1.

6 DMRE requirements

6.1 Encoding procedure overview

6.1.1 General

This subclause provides an overview of the encoding procedure. Subclauses 6.1.2 to 6.14 provide more details. An encoding example for DMRE is given in Annex E. The following steps given in 6.1.2 to 6.14 convert user data to a DMRE symbol.

6.1.2 Step 1: data encodation

As DMRE includes various encodation schemes that allows a defined set of characters to be converted into codewords more efficiently than the default scheme, analyse the data stream to identify the variety of different characters to be encoded. Insert additional codewords to switch between the encodation schemes and to perform other functions. Add pad characters as needed to fill the required number of codewords. If the user does not specify the matrix size, then choose the smallest size that accommodates the data. A complete list of matrix sizes is shown in Table 1.

Refer to ISO/IEC 16022 Data Matrix for a description of this step.

6.1.3 Step 2: error checking and correcting codeword generation

Generate the error correction codewords for the data codeword stream from above step. The result of this process expands the codeword stream by the number of error correction codewords. Place the error correction codewords after the data codewords.

6.1.4 Step 3: module placement in matrix

Place the codeword modules in the matrix. Insert the alignment pattern modules, if any, in the matrix. Add the finder pattern modules around the matrix.

6.2 DMRE symbol attributes

6.2.1 Symbol sizes and capacity

There are 18 rectangular symbols available in DMRE. These are as specified in Table 1.

Table 1 — DMRE symbol attributes

Symbol size[a]		Data region		Mapping matrix size	Total codewords		Reed-Solomon block		Inter-leaved blocks	Max. data capacity			% of code-words used for error correction	Max. cor-rectable codewords Error/ erasure[c]
Row	Col	Size	No.		Data	Error	Data	Error		Num.	Alphanum[b]	Byte		
8	48	6 × 22	2	6 × 44	18	15	18	15	1	36	25	16	45,5	7/12
8	64	6 × 14	4	6 × 56	24	18	24	18	1	48	34	22	42,9	9/15
8	80	6 × 18	4	6 × 72	32	22	32	22	1	64	46	30	40,7	11/19
8	96	6 × 22	4	6 × 88	38	28	38	28	1	76	55	36	42,4	14/25
8	120	6 × 18	6	6 × 108	49	32	49	32	1	98	72	47	39,5	16/29
8	144	6 × 22	6	6 × 132	63	36	63	36	1	126	93	61	36,4	18/33
12	64	10 × 14	4	10 × 56	43	27	43	27	1	86	63	41	38,6	13/24
12	88	10 × 20	4	10 × 80	64	36	64	36	1	128	94	62	36	18/33

[a] Symbol size does not include quiet zones.

[b] Based on text or C40 encoding without switching or shifting; for other encoding schemes, this value may vary depending on the mix and grouping of character sets.

[c] See 6.4 for more information on those Read-Solomon error correction parameters.