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Information technology — Automatic identification and data capture techniques — Data Matrix bar code symbology specification

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Technologies de l'information — Techniques automatiques d'identification et de capture des données — Spécification de symbologie de code à barres Data Matrix

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Contents

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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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 third edition cancels and replaces the second edition (ISO/IEC 16022:2006), which has been technically revised.

The main changes are as follows:

— ~~—~~the extended channel interpretations and rectangular formats have become a mandatory feature;

— ~~—~~the historic data matrix variant "ECC 000" to "ECC 140" has been removed;

— ~~—~~continuous grading according to ISO/IEC 15415 has been introduced to all quality measurements;

— ~~—~~transition ratio grading has been changed;

— ~~—~~new quality parameter “print growth” has been added;

— ~~—~~the reference decode algorithm has been revised;

— ~~—~~the interleaving blocks for ~~144x144~~144 x 144 matrix size ~~has~~have been clarified.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

Data Matrix 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 symbols can also be printed to appear as light on dark.

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

Information technology — Automatic identification and data capture techniques — Data Matrix bar code symbology specification

1 Scope

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

It applies to all Data Matrix symbols produced by any printing or marking technology.

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 15424, *Information technology — Automatic identification and data capture techniques — Data Carrier Identifiers (including Symbology Identifiers)*

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

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

ISO/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

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 and the following apply.

ISO and IEC maintain terminologicalterminology 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/

3.1
codeword
symbol character value
intermediate level of coding between source data and the graphical encodation in the symbol

3.2
module
„single cell of element in a matrix symbology symbol used to encode one bit of the *codeword* (3.1module“ as defined in)

[SOURCE: ISO/IEC 19762:2016, 04.02.06]

3.3
pattern randomising
procedure to convert an original bit pattern to another bit pattern by inverting selected bits

Note 1 to entry: The resulting bitstream is less likely to have repeating patterns.

4 Symbols

e	number of erasures
k	total number of error correction codewords
n	total number of data codewords
N	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 Mathematical or logical notations

div	integer division operator
mod	integer remainder after division
XOR	exclusive-or logic function whose output is one only when its two inputs are not equivalent

6 Symbol description

6.1 Basic characteristics

Data Matrix is a two-dimensional matrix symbology.

The characteristics of Data Matrix are:

a) a) Encodable character set:

   1) 1) values 0 – 127 in accordance with ISO/IEC 646 IRV, i.e. all 128 ASCII characters;

   2) 2) values 128 - 255 in accordance with ISO/IEC 8859-1. These (these are referred to as extended ASCII.):

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

b) ~~b)~~ Representation of data: A dark module is a binary one and a light module is a zero.

This document specifies Data Matrix symbols in terms of dark modules marked on a light background. However, 6.2~~6.2~~ provides that symbols can 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) ~~c)~~ Symbol size in modules (not including quiet zone) ranging from 10 x 10 to 144 x 144 square and rectangular versions ranging from ~~8x18~~8 x 18 to ~~16x48~~16 x 48 (see Table 10~~table 10~~).).

NOTE Additional rectangular symbol sizes are defined in ISO/IEC 21471 (see Reference [4~~bibliography [4]~~.]).

d) ~~d)~~ Data characters per symbol (for maximum symbol size):

1) ~~1)~~ Alphanumeric data: up to 2 335 characters

2) ~~2)~~ 8-bit byte data: 1 555 characters

3) ~~3)~~ Numeric data: 3 116 digits.

e) ~~e)~~ Code type: Matrix

f) ~~f)~~ Orientation independence: Yes

g) ~~g)~~ Error detection and correction: Reed Solomon.

6.2 Summary of additional features

The following summarises additional features which are inherent or optional in Data Matrix:

a) ~~a)~~ Reflectance reversal: (inherent): Symbols are either dark on light or light on dark (see Figure 1~~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) ~~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) ~~c)~~ Rectangular symbols: (inherent): Six symbol formats are specified in a rectangular form.

NOTE ~~:~~ Additional rectangular symbol formats are available by ISO/IEC 21471 (see Reference [4~~bibliography [4]~~.]).

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

6.3 Symbol structure

6.3.1 General

Each Data Matrix 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, or set of data regions and alignment patterns, is surrounded by a finder pattern, and this shall in turn be surrounded on all four sides by a quiet zone border. Figure 1~~Figure 1~~ illustrates two representations of a Data Matrix symbol, dark on light and reflectance reversal.

a) Data Matrix, dark on light b) Data Matrix, light on dark (reflectance reversal)

Figure 1 — Data Matrix "A1B2C3D4E5F6G7H8I9J0K1L2"

6.3.2 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 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~~Figure 1~~.

6.3.3 Symbol sizes and capacities

Data Matrix symbols have an even number of rows and an even number of columns. Some symbols are square with sizes from 10 x 10 to 144 x 144 not including quiet zones. Some symbols are rectangular with sizes from 8 x 18 to 16 x 48 not including quiet zones. For all Data Matrix 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~~Figure 1~~).). The complete attributes are given in Table 10~~Table 10~~.