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

Technologies de l'information — Techniques d'identification automatique et de capture des données — Spécification de la symbologie de code à barres QR code

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 fourth edition cancels and replaces the third edition (ISO/IEC 18004:2015), which has been technically revised.

The main changes are as follows:

- continuous grading according to ISO/IEC 15415 ~~was~~ has been adopted for grade fixed pattern damage;
- ~~Clarification of the~~ reference decoding algorithm has 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

There are four technically different, but closely related members of the QR code family, which represent an evolutionary sequence.

- QR code model 1 ~~was~~ the original specification for QR code and is described in AIM ITS 97-001~~[20] International Symbolology Specification QR Code.21].~~
- QR code model 2 ~~was~~ an enhanced form of the symbology with additional features (primarily, the addition of alignment patterns to assist navigation in larger symbols~~);~~) and ~~was~~ the basis of the first edition of ~~this document (i.e. ISO/IEC 18004:2000).~~
- QR code ~~{~~the basis of the second edition of ~~this document (i.e. ISO/IEC 18004:2006)}~~ is ~~close~~~~ly~~~~very~~ similar to QR code model 2~~;:~~ its QR code format differs only in the addition of the facility for symbols to appear in a mirror image orientation for reflectance reversal (light symbols on dark backgrounds) and the option for specifying alternative character ~~sets~~~~is~~ ~~set~~ to the default.
- The micro QR code format ~~{~~also specified in the second edition of ~~this document (i.e. ISO/IEC 18004:2006)}~~, is a variant of QR code with a reduced number of overhead modules and a restricted range of sizes, which enables small to moderate amount of data to be represented in a small symbol, particularly suited to direct marking on parts and components, and to applications where the space available for the symbol is severely restricted.

QR code is a matrix symbology. The symbols consist of an array of nominally square modules arranged in an overall square pattern, including a unique finder pattern located at three corners of the symbol (in micro QR code symbols, at a single corner) and intended to assist in easy location of its position, size, and inclination. A wide range of sizes of symbol is provided for, together with four levels of error correction. Module dimensions are user-~~specified~~~~specific~~ to enable symbol production by a wide variety of techniques.

QR code model 2 symbols are fully compatible with QR code reading systems.

~~QR code~~ model 1 ~~QR Code~~ symbols are recommended only to be used in closed system applications ~~and it is not a requirement that~~. Equipment complying with this document ~~should~~~~are~~ ~~not~~ ~~required~~ ~~to~~ support ~~QR code~~ model 1 ~~symbols~~. Since QR code is the recommended model for new, open ~~systems~~~~system~~ application of QR code, this document describes QR code fully, ~~and~~. ~~This document also~~ lists the features in which ~~QR code~~ model 1 ~~QR Code~~ differs from QR code in Annex N.

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

1 Scope

This document specifies the requirements for the symbology of a quick response (QR) code. This document specifies the QR code symbology characteristics, data character encoding methods, symbol formats, dimensional characteristics, error correction rules, reference decoding algorithm, production quality requirements, and user-selectable application parameters.

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 8859-1:1998, Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1 (<https://standards.iteh.ai>)

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

ISO/IEC 15424, Information technology — Automatic identification and data capture techniques — Data Carrier Identifiers (including Symbology Identifiers) (<https://standards.iteh.ai/document/iso-iec/15424-8d6c-47e7-98fa-ccadd7cd9a6/iso-iec-prf-18004>)

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

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 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/>

3.1

character count indicator

bit sequence which defines the data string length in a *mode* (3.1210)

3.2

data masking

process of XORing the bit pattern in the *encoding region* (3.4) with a data mask pattern to provide a symbol with more evenly balanced numbers of dark and light modules, and reduced occurrence of patterns which would interfere with fast processing of the image

**3.3
data mask pattern reference**

~~three~~3-bit identifier of the *data masking* (3.2) patterns applied to the symbol

**3.4
encoding region**

region of the symbol not occupied by *function patterns* (3.98) and available for encoding ~~of~~ data and error correction codewords, and for *version* (3.20) and *format information* (3.7)

**3.5
exclusive subset**

subset of characters within the character set of a *mode* (3.1210) which are not shared with the more restricted character set of another mode (3.12)

**3.6
extension pattern**

function pattern (3.8) in model 1 symbols, which does not encode data

**3.7
format information**

encoded pattern containing information on symbol characteristics essential to enable the remainder of the *encoding region* (3.4) to be decoded

**3.8
QR Code**

~~pertaining to QR Code symbols identified as versions 1 to 40, as distinct from Micro QR Code symbols~~

**3.9
function pattern**

overhead component of the symbol (finder, *separator* (3.1816), *timing patterns* (3.21),19) and alignment patterns) required for location of the symbol or identification of its characteristics to assist in decoding

**3.109
masking**

process of XORing the bit pattern in an area of the symbol with a mask pattern to reduce the occurrence of patterns which would interfere with fast processing of the image

3.1110

~~Micro QR Code pertaining to Micro QR Code symbols identified as versions M1 to M4, as distinct from QR Code symbols~~

**3.12
mode**

method of representing a defined character set as a bit string

**3.1311
mode indicator**

~~one~~1-bit to ~~four~~4-bit identifier (depending on symbol size) indicating in which *mode* (3.10) the following data sequence is encoded

~~3.14~~12

padding bit

zero bit, not representing data, used to fill empty positions of the final codeword after the *terminator* (3.18) in a data bit string

~~3.15~~13

remainder bit

zero bit, not representing data, used to fill empty positions of the symbol *encoding region* (3.4) after the final symbol character, where the area of the encoding region (3.4) available for symbol characters does not divide exactly into 8-bit symbol characters

~~3.16~~14

remainder codeword

pad codeword, placed after the error correction codewords, used to fill empty codeword positions to complete the symbol if the total number of data and error correction codewords does not exactly fill its nominal capacity

~~3.17~~15

segment

sequence of data encoded according to the rules of one ~~EC~~extended channel interpretation or encoding mode

~~3.18~~16

separator

function pattern (3.98) of all light modules, one module wide, separating the finder patterns from the rest of the symbol

~~3.19~~17

symbol number

~~three~~3-bit field indicating the symbol *version* (3.20) and error correction level applied, used as part of the *format information* (3.7) in micro QR code symbols

~~3.20~~18

terminator

bit pattern of defined number (depending on the symbol) of all zero bits used to end the bit string representing data

~~3.21~~19

timing pattern

alternating sequence of dark and light modules enabling module coordinates in the symbol to be determined

~~3.22~~20

version

size of the symbol represented in terms of its position in the sequence of permissible sizes for micro QR code symbols from 11 × 11 modules (version M1) to 17 × 17 modules (version M4) or, for QR code symbols, from 21 × 21 modules (version 1) to 177 × 177 (version 40) modules

Note 1 to entry: The error correction level applied to the symbol can be suffixed to the version designation, e.g. version 4-L or version M3-Q.

3.2321

version information

encoded pattern in certain QR code symbols containing information on ~~the~~ symbol version (3.20) together with error correction bits for this data

4 Mathematical and logical symbols, abbreviations abbreviated terms and conventions

4.1 Mathematical and logical symbols

~~For the purposes of this document, the following mathematical operations apply.~~

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

NOTE XOR is represented by the symbol \oplus .

4.2 Abbreviations

4.2 Abbreviated terms

BCH Bose-Chaudhuri-Hocquenghem

DPM direct part mark

ECI extended channel interpretation

FNC1 function 1 symbol character

RS Reed-Solomon

4.3 Conventions

4.3.1 Module positions

For ease of reference, module positions are defined by their row and column coordinates in the symbol, in the form (i, j) where i designates the row (counting from the top downwards) and j the column (counting from left to right) in which the module is located, with counting commencing at 0. The module $(0, 0)$ is therefore located at the upper left corner of the symbol.

4.3.2 Byte notation

Byte ~~contents are~~ content is shown as a hex ~~values~~ value.

4.3.3 Version references

For QR code symbols, symbol versions are referred to in the form version V-E where V identifies the version number (1 to 40) and E indicates the error correction level (L, M, Q, H).

For micro QR code symbols, symbol versions are referred to in the form version MV-E where the letter M indicates the micro QR code format ~~and V, V identifies the version number~~ (with a range of 1 to 4) and E indicates the error correction level (with values L, M and Q) ~~have the meanings defined above.~~

5 Symbol description

5.1 Basic characteristics

QR code is a matrix symbology with the following characteristics:

a) Formats:

- 1) QR code, with full range of capabilities and maximum data capacity;
- 2) micro QR code, with reduced overhead, some restrictions on capabilities and reduced data capacity (compared with QR code symbols).

b) Encodable character set:

- 1) numeric data (digits 0 - 9);
- 2) alphanumeric data (digits 0 - 9; upper case letters A - Z; nine other characters: space, \$ % * + - . /:);
- 3) byte data [default: ISO/IEC 8859-1; or other sets as otherwise defined (see 7.3.5)];
- 4) Kanji characters— (Kanji characters in QR code can be compacted into 13 bits).

c) Representation of data: a dark module is nominally a binary one and a light module is nominally a binary zero. However, see 6.5.2 for details of reflectance reversal.

d) Symbol size (not including quiet zone):

- 1) for micro QR code symbols: 11 × 11 modules to 17 × 17 modules (versions M1 to M4, increasing in steps of two modules per side);
- 2) for QR code symbols: 21 × 21 modules to 177 × 177 modules (versions 1 to 40, increasing in steps of four modules per side).

e) Data characters per symbol:

- 1) maximum micro QR code symbol size, version M4-L):
 - numeric data: 35 characters;
 - alphanumeric data: 21 characters;
 - byte data: 15 characters;
 - Kanji data: 9 characters;
- 2) maximum QR code symbol size, version 40-L:
 - numeric data: 7 089 characters;
 - alphanumeric data: 4 296 characters;
 - byte data: 2 953 characters;

— Kanji data: 1 817 characters.

f) Selectable error correction: four levels of Reed-Solomon error correction (referred to as L, M, Q and H in increasing order of capacity) allowing the symbol codeword recovery of:

— L: 7 %%,

— M: 15 %%,

— Q: 25 %%, ans

— H: 30 %%,

of the symbol codewords.

For micro QR code symbols, error correction level H is not available. For version M1 micro QR code symbols, the RS capacity is limited to error detection only.

g) Code type: matrix.

Matrix

h) Orientation independence: yes (both rotation and reflection).

Figure 1 illustrates a version 1 QR code symbol in normal colour and with reflectance reversal (see 6.5.2), in both normal and mirror image orientations.

Figure 2 illustrates a version M2 micro QR code symbol in normal colour and with reflectance reversal (see 6.5.2), in both normal and mirror image orientations.

5.2 Summary of additional features

The use of the following additional features is optional in QR code:

— Structured append: This allows files of data to be represented logically and continuously in up to 16 QR code symbols. These can be scanned in any sequence to enable the original data to be correctly reconstructed. Structured append is not available with micro QR code symbols.

— Extended channel interpretations ~~(ECI)~~

: This mechanism enables data using character sets other than the default encodable set (e.g. Arabic, Cyrillic, Greek) and other data interpretations (e.g. compacted data using defined compression schemes) or other industry-specific requirements to be encoded. ~~Extended Channel Interpretations~~ ECIs other than the default interpretation are not available in micro QR code symbols.

— Reflectance reversal: Symbols are intended to be read when marked so that the image is either dark on light or light on dark (see Figures 1 and 2). The specifications in this document are based on dark images on a light background, therefore in the case of symbols produced with reflectance reversal references to dark or light modules should be taken as references to light or dark modules respectively.

— Mirror imaging: The arrangement of modules defined in this document represents the "normal" orientation of the symbol. It is, however, possible to achieve a valid decode of a symbol in which the arrangement of the modules has been laterally transposed. When viewed with the finder patterns