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Information technology — Automatic identification and data capture techniques — Rectangular Micro QR Code (rMQR) bar code symbology specification

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The UK participation in its preparation was entrusted to Technical Committee IST/34, Automatic identification and data capture techniques.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Contents

Page

Foreword ... **v**
Introduction ... **vi**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Mathematical and logical symbols, abbreviated terms and conventions ... **3**
4.1 Mathematical and logical symbols ... 3
4.2 Abbreviated terms ... 3
4.3 Conventions ... 3
4.3.1 Module positions ... 3
4.3.2 Byte notation ... 3
4.3.3 Version references ... 3
5 Conformance ... **4**
6 rMQR specifications ... **4**
6.1 Basic characteristics ... 4
6.2 Summary of additional features ... 5
6.3 Symbol structure ... 5
6.3.1 General ... 5
6.3.2 Symbol Versions and sizes ... 8
6.3.3 Finder pattern ... 10
6.3.4 Separator ... 10
6.3.5 Timing pattern ... 10
6.3.6 Alignment patterns ... 11
6.3.7 Finder sub pattern ... 11
6.3.8 Corner finder pattern ... 12
6.3.9 Encoding region ... 12
6.3.10 Quiet zone ... 13
7 Requirements ... **13**
7.1 Encode procedure overview ... 13
7.2 Data analysis ... 14
7.3 Modes ... 15
7.3.1 General ... 15
7.3.2 Extended channel interpretation (ECI) mode ... 15
7.3.3 Numeric mode ... 15
7.3.4 Alphanumeric mode ... 15
7.3.5 Byte mode ... 15
7.3.6 Kanji mode ... 16
7.3.7 Mixing modes ... 16
7.3.8 FNC1 mode ... 16
7.4 Data encoding ... 16
7.4.1 Sequence of data ... 16
7.4.2 Extended channel interpretation (ECI) mode ... 18
7.4.3 Numeric mode ... 20
7.4.4 Alphanumeric mode ... 21
7.4.5 Byte mode ... 22
7.4.6 Kanji mode ... 22
7.4.7 Mixing modes ... 23
7.4.8 FNC1 modes ... 24
7.4.9 Terminator ... 25
7.4.10 Bit stream to codeword conversion ... 25
7.5 Error correction ... 28
7.5.1 Error correction capacity ... 28

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Full document details: BS ISO/IEC 23941:2022

7.5.2 Generating the error correction codewords ... 31
7.6 Constructing the final message codeword sequence ... 32
7.7 Codeword placement in matrix ... 33
7.7.1 Symbol character representation ... 33
7.7.2 Function pattern placement ... 33
7.7.3 Symbol character placement ... 33
7.8 Data masking ... 37
7.8.1 General ... 37
7.8.2 Data mask patterns ... 37
7.9 Format information ... 37

8 Symbol printing and marking ... 39
8.1 Dimensions ... 39
8.2 Human-readable interpretation ... 39
8.3 Marking guidelines ... 40

9 Symbol quality ... 40
9.1 Methodology ... 40
9.2 Symbol quality parameters ... 40
9.2.1 Fixed pattern damage ... 40
9.2.2 Scan grade and overall symbol grade ... 40
9.2.3 Grid non-uniformity ... 40
9.3 Process control measurements ... 40

10 Decoding procedure overview ... 40

11 Reference decode algorithm ... 41

12 Auto-discrimination capability ... 52

13 Transmitted data ... 52
13.1 General principles ... 52
13.2 Symbology identifier ... 52
13.3 Extended channel interpretations ... 52
13.4 FNC1 ... 53

Annex A (normative) **Error detection and correction generator polynomials ... 54**

Annex B (normative) **Error correction decoding steps ... 56**

Annex C (normative) **Format information ... 58**

Annex D (normative) **Position of alignment patterns ... 61**

Annex E (normative) **Symbology identifier ... 62**

Annex F (normative) **rMQR print quality – symbology – specific aspects ... 63**

Annex G (normative) **Byte mode character sets ... 69**

Annex H (informative) **JIS8 and Shift JIS character sets ... 70**

Annex I (informative) **Symbol encoding examples ... 72**

Annex J (informative) **User guidelines for printing and scanning of rMQR symbols ... 74**

Annex K (informative) **Autodiscrimination ... 76**

Annex L (informative) **Process control techniques ... 77**

Bibliography ... 79

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Foreword

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Introduction

Rectangular Micro QR Code (rMQR) is a matrix symbology. The symbol consists of an array of nominally square modules, arranged in a rectangular pattern. Included is a unique finder pattern located at a single corner which is intended to assist in easy location of the symbols position, size, and inclination. A wide range of sizes of symbol is provided for, together with two levels of error correction. Module dimensions are user-specified to enable symbol production by a wide variety of techniques.

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Information technology — Automatic identification and data capture techniques — Rectangular Micro QR Code (rMQR) bar code symbology specification

1 Scope

This document defines the requirements for the symbology known as rMQR. It specifies the rMQR symbology characteristics, data character encoding methods, symbol formats, dimensional characteristics, error correction rules, reference decoding algorithm, printing 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 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

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

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

3 Terms and definitions

For the purpose 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* (3.6)

3.2
encoding region
region of the symbol not occupied by *function patterns* (3.4) and available for encoding of data and error correction codewords, and for *format information* (3.3)

3.3
format information
encoded pattern containing information on the error correction level and *version* (3.15) applied to symbol characteristics

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3.4
function pattern
overhead component of the symbol [finder pattern, *separator* (3.12), *timing patterns* (3.14), alignment patterns, finder sub patterns and corner finder pattern] required for location of the symbol or identification of its characteristics to assist in decoding

3.5
masking
process of XORing the bit pattern in an area of the symbol with a mask pattern to equalize the number of light and dark modules

3.6
mode
method of representing a defined character set as a bit string

3.7
mode indicator
identifier indicating in which *mode* (3.6) the following data sequence is encoded

3.8
padding bit
zero bit, not representing data, used to fill empty positions of the final codeword during the encoding process

3.9
remainder bit
zero bit, not representing data, used to fill empty positions of the symbol *encoding region* (3.2) after the final symbol character, where the area of the *encoding region* (3.2) does not divide exactly into 8-bit symbol characters

3.10
remainder codeword
codeword, placed after the data codeword stream that was generated in data encoding process, used to fill empty codeword positions to meet the requirements of number of data codeword of the *version* (3.15) and error correction definitions

3.11
segment
sequence of data encoded according to the rules of one ECI or encoding mode

3.12
separator
function pattern (3.4) of all light modules, one module wide, used to separate the finder pattern from the rest of the symbol

3.13
terminator
bit pattern of defined number (depending on symbol) of all zero bits used to end the bit string representing data

3.14
timing pattern
alternating sequence of dark and light modules enabling module coordinates in the symbol to be determined

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3.15
version
size of the symbol represented in terms of the number of modules in the vertical and horizontal axes, indicated, for example, as R7x59

Note 1 to entry: The error correction level applied to the symbol can be suffixed to the Version Indicator, e.g., Version R11x27-M.

3.16
version Indicator
five-bit identifier indicating symbol version used for a part of the *format information* (3.3)

3.17
error correction level indicator
one-bit identifier indicating error correction level used for a part of the *format information* (3.3)

4 Mathematical and logical symbols, abbreviated terms and conventions

4.1 Mathematical and logical symbols

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 is represented by the symbol $\oplus$.

4.2 Abbreviated terms

BCH Bose-Chaudhuri-Hocquenghem

ECI Extended Channel Interpretation

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. Module (0, 0) is therefore located at the upper left corner of the symbol.

4.3.2 Byte notation

Byte contents are shown as hexadecimal (hex) values.

4.3.3 Version references

Symbol versions are referred to in the form Version RC_VxC_H-E where C_V identifies the vertical number of modules (7, 9, 11, 13, 15, 17), C_H identifies the horizontal number of modules (27, 43, 59, 77, 99, 139), and E indicates the error correction level (M and H). For example, R13x27-M indicates a rectangular symbol that has 13 vertical modules, 27 horizontal modules, and an error correction level M. Versions may be referred to without error correction level. For example, R13x27.

NOTE For M and H, see 6.1 e).

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5 Conformance

rMQR symbols (and equipment designed to produce or read rMQR symbols) shall be considered as conforming with this document if they provide or support the features defined in this document.

6 rMQR specifications

6.1 Basic characteristics

rMQR is a matrix symbology with the following characteristics.

a) Encodable character set:

1) numeric data (digits 0 - 9);

2) alphanumeric data (digits 0 - 9; upper case letters A - Z; nine other characters, as shown in Table 5.);

3) byte data [default shall be the character set defined in Annex G; or other sets as otherwise defined (see 7.3.5)];

4) Kanji characters (Characters can be compacted into 13 bits (see 7.3.6).

b) Representation of data:

A dark module is nominally a binary one and a light module is nominally a binary zero. See 6.2 for details of reflectance reversal.

c) Symbol size (not including quiet zone):

See Table 1 for the symbol sizes for 7 x 43 modules to 17 x 139 modules (Version R7x43 to R17x139).

d) Data characters per symbol:

The maximum symbol size of Version R17x139-M is as specified below.

— numeric data: 361 characters

— alphanumeric data: 219 characters

— Byte data: 150 characters

— Kanji data: 92 characters

e) Selectable error correction:

This symbology supports two levels of Reed-Solomon error correction, M and H, which allows the recovery of rMQR codewords up to the indicated rate below.

— M 15 %

— H 30 %

f) Code type:

Matrix

g) Orientation independence:

Yes (both rotation and reflection)

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Figure 1 illustrates a Version R13x27 rMQR symbol in normal colour and with reflectance reversal (see 6.2), in both normal and mirror image orientations.

6.2 Summary of additional features

The use of the following additional features is optional in rMQR.

— 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. See 7.3.2.

— Reflectance reversal

Symbols are intended to be read when marked so that the image is 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. 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 rMQR finder pattern at the top left, and the finder sub pattern at the bottom right corners of the symbol, the effect of mirror imaging is to interchange the row and column positions of the modules. (See Figure 1.)

a) Normal orientation and normal reflectance arrangement

b) Normal orientation and reversed reflectances

c) Mirror image orientation and normal reflectance arrangement

d) Mirror image orientation and reversed reflectances

NOTE The corner marks in Figures 1 indicate the extent of the quiet zone.

Figure 1 — Examples of rMQR symbol encoding the text "12345678901234567890123456"

6.3 Symbol structure

6.3.1 General

Each rMQR symbol shall be constructed of nominally square modules set out in a rectangular array and shall consist of an encoding region and function pattern. The function pattern shall contain a finder pattern, separator, timing patterns, alignment patterns, finder sub patterns and corner finder pattern. See Figure 2.

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Function patterns do not encode data. The symbol shall be surrounded on all four sides by a quiet zone border.

Figures 2 to 7 illustrate the structure of a Version R7x43, R9x43, R11x43, R13x43, R15x43 and R17x43 symbols, respectively.

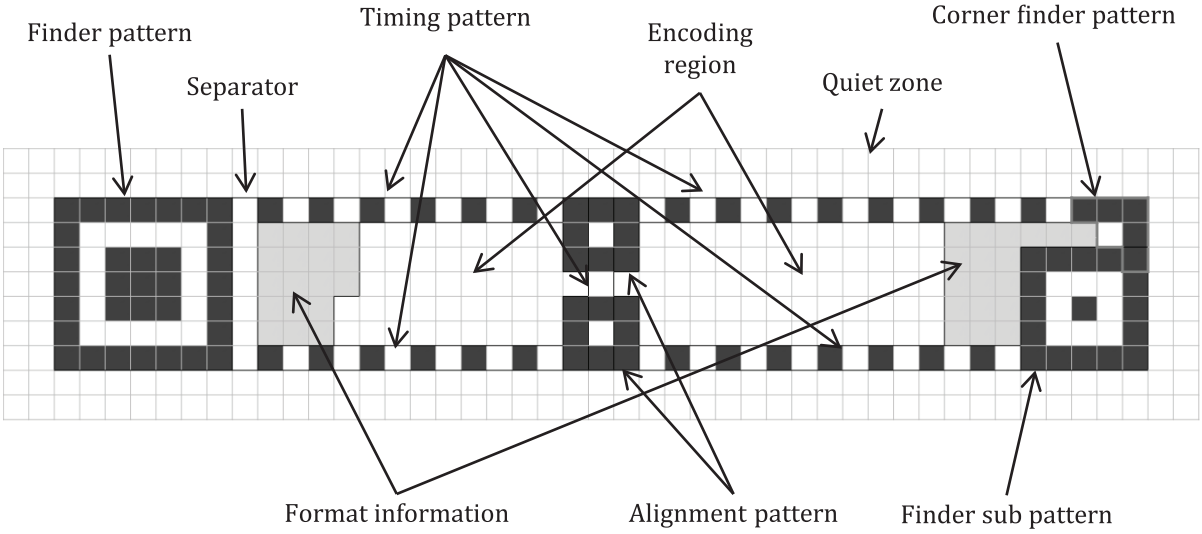

Figure 2 — Structure of Version R7x43 rMQR symbol

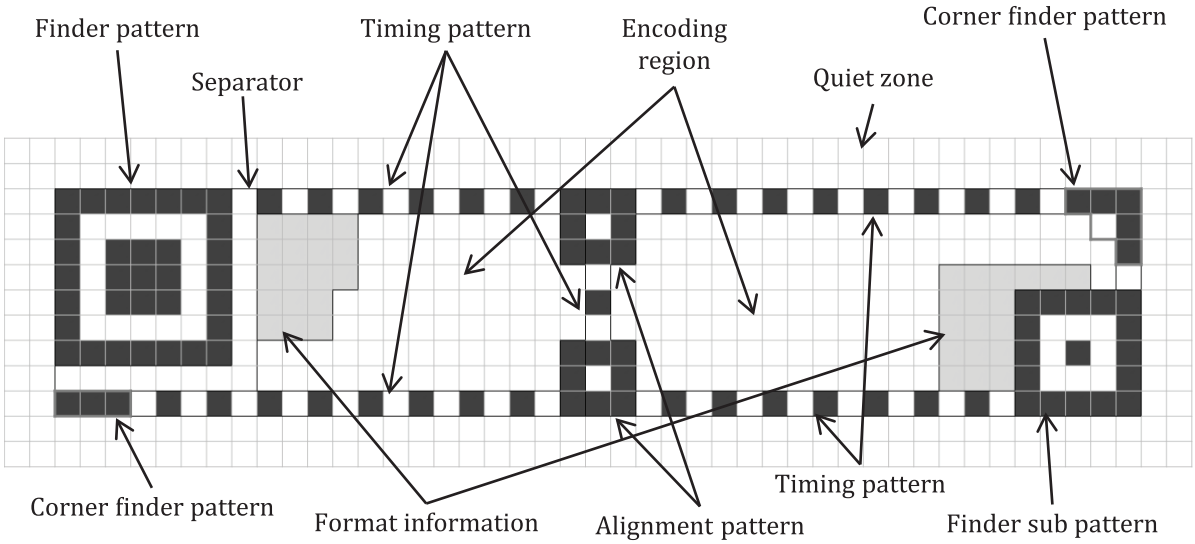

Figure 3 — Structure of Version R9x43 rMQR symbol

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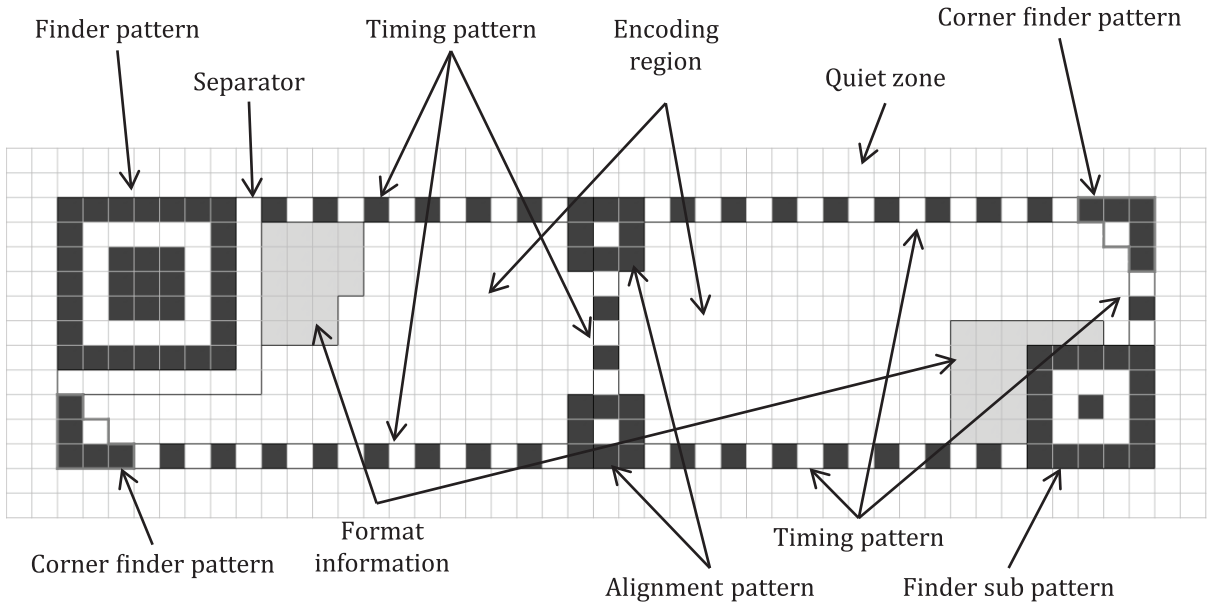

Figure 4 — Structure of Version R11x43 rMQR symbol

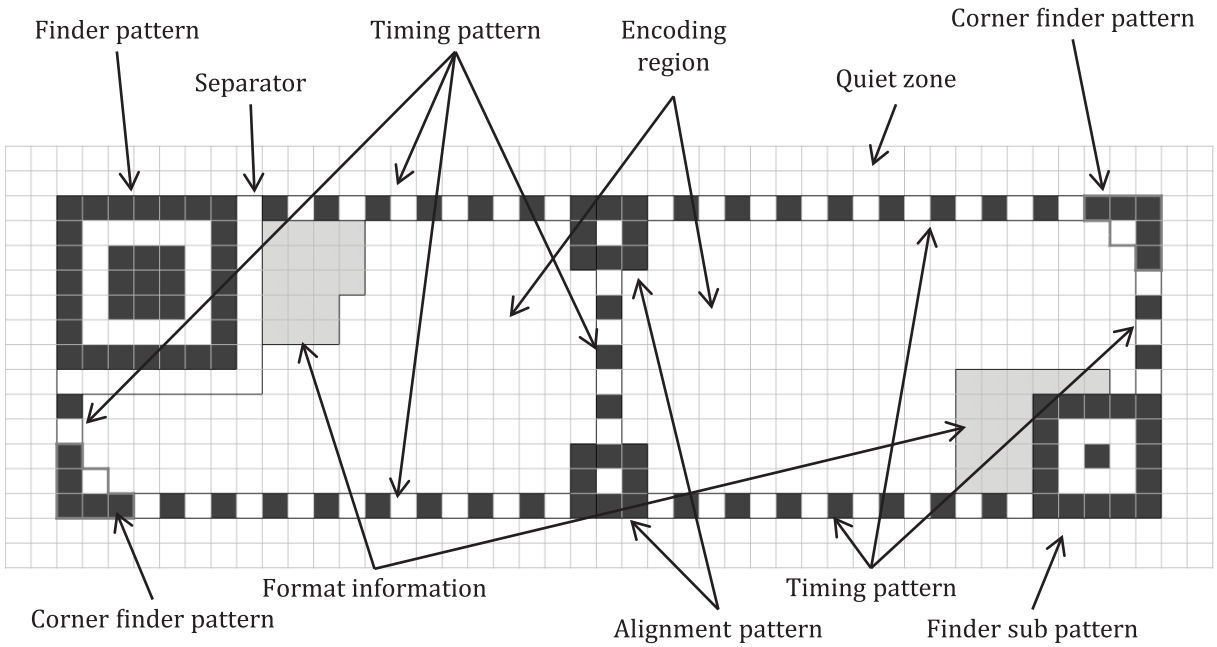

Figure 5 — Structure of Version R13x43 rMQR symbol

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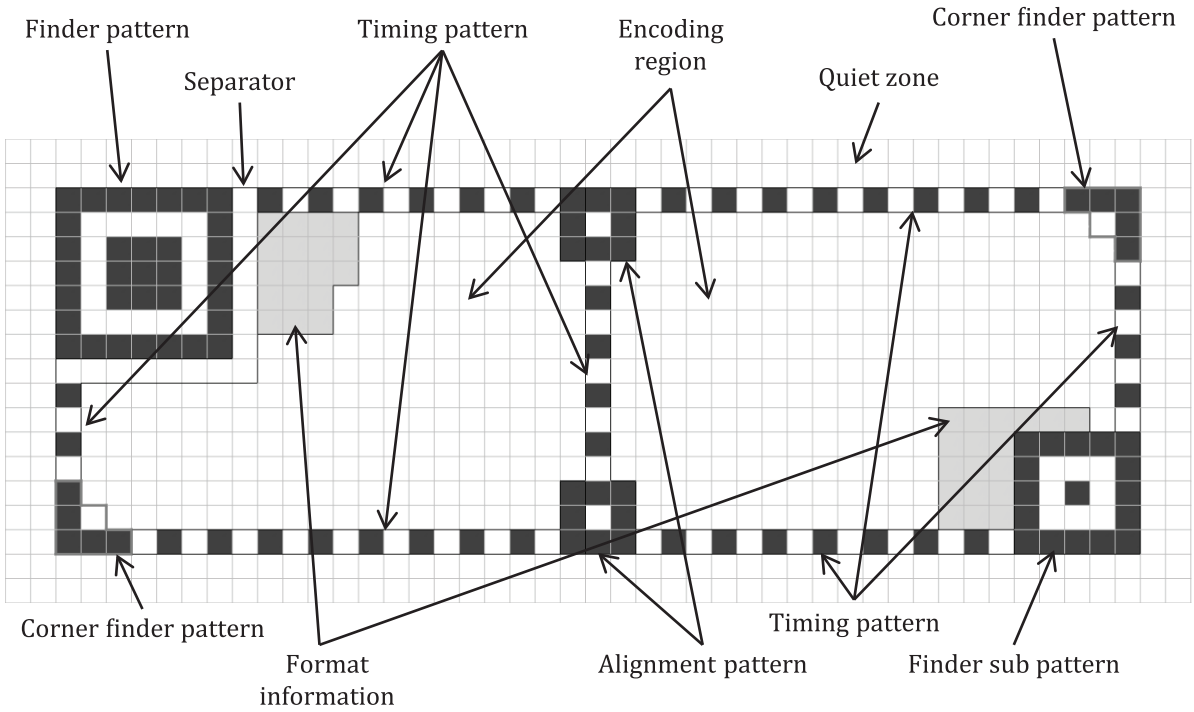

Figure 6 — Structure of Version R15x43 rMQR symbol

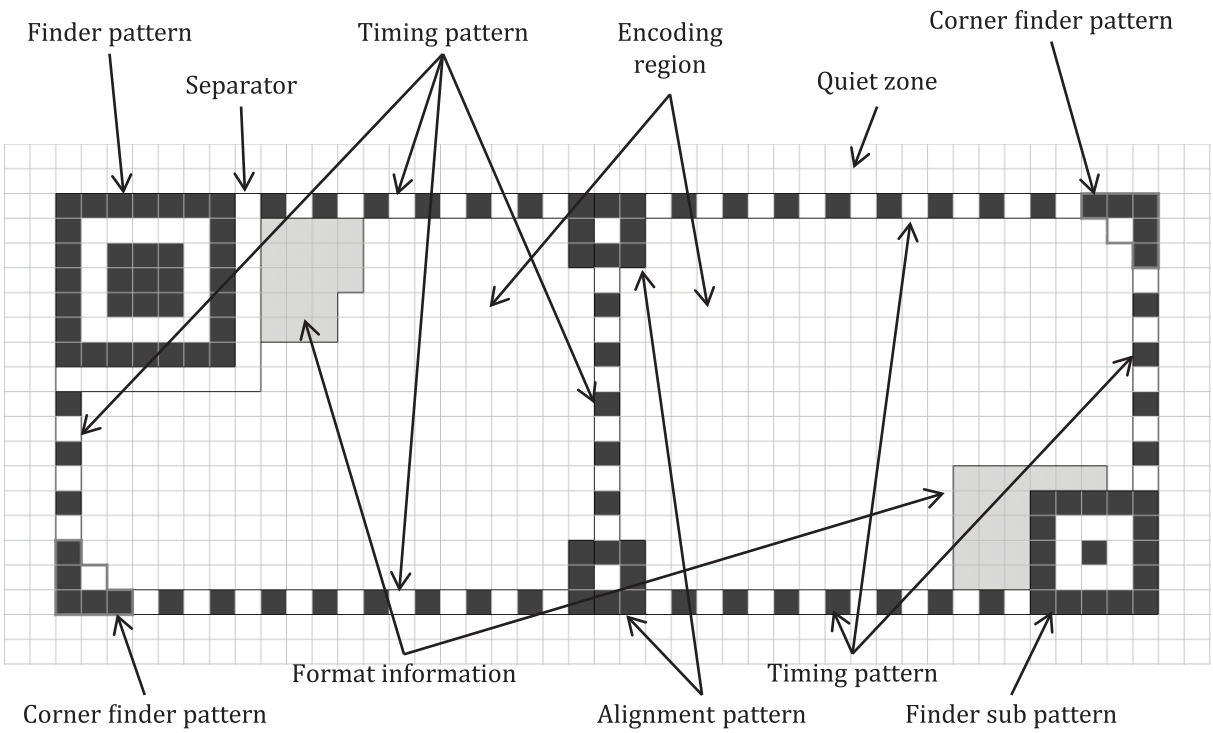

Figure 7 — Structure of Version R17x43 rMQR symbol

6.3.2 Symbol Versions and sizes

There are 32 sizes of rMQR symbol, referred to as Version R7x43 to R17x139. The vertical module has 6 sizes depending on the number of modules, e.g., 7, 9, 11, 13, 15, 17, and the horizontal module has 6 sizes depending on the number of modules, e.g., 27, 43, 59, 77, 99, 139. Table 1 shows code sizes for all versions. Figure 8 illustrates the structure of symbols with 11 vertical modules and 27 to 139

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horizontal modules. Figure 9 illustrates the structure of symbols with 43 horizontal modules and 7 to 17 vertical modules.

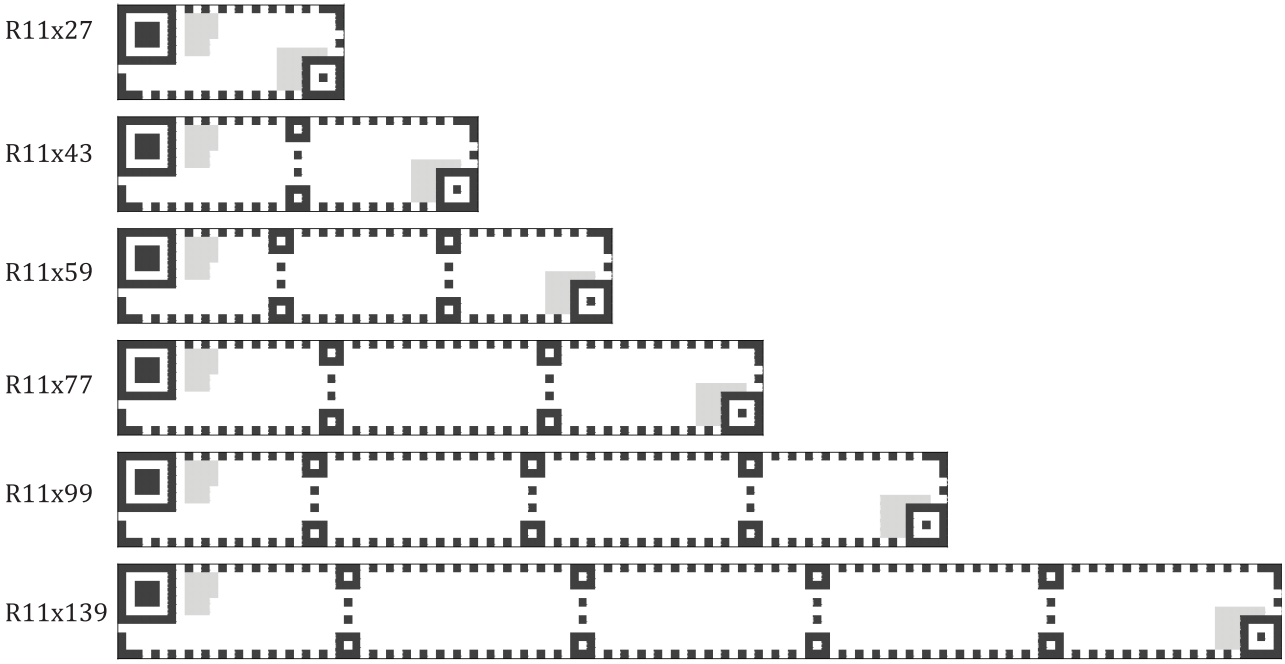

Figure 8 — rMQR symbols with 11 vertical modules and 27 to 139 horizontal modules

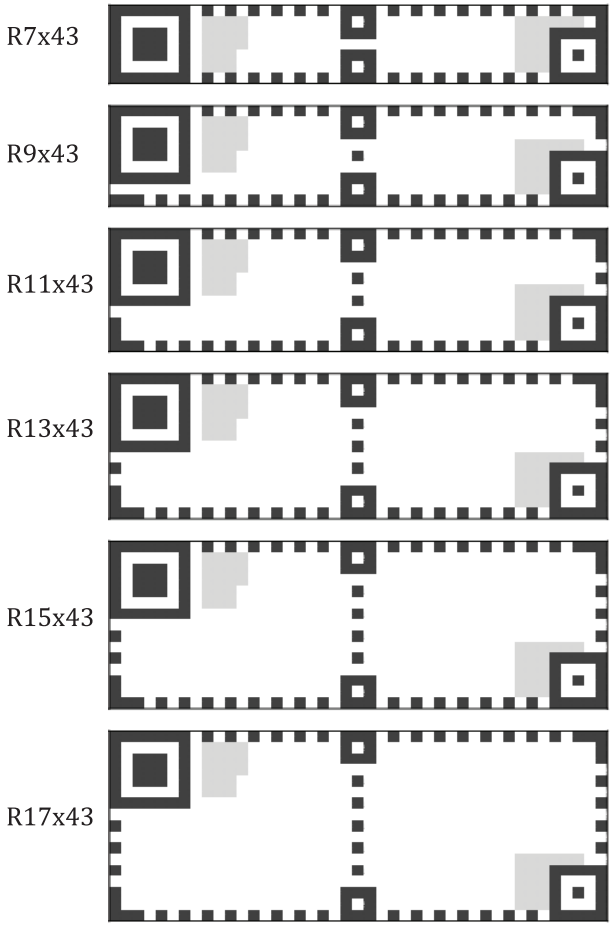

Figure 9 — rMQR symbols with 43 horizontal modules and 7 to 17 vertical modules

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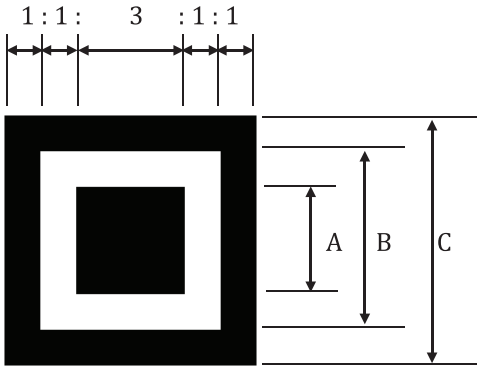
6.3.3 Finder pattern

A single finder pattern is located at the upper left corner of the symbol as illustrated in Figures 2 to 7. For a symbol with 7 vertical modules, it is located at the leftmost of the symbol. Each finder pattern may be viewed as three superimposed concentric squares and is constructed of 7 × 7 dark modules, 5 × 5 light modules and 3 × 3 dark modules. The ratio of module widths in each finder pattern is 1 : 1 : 3 : 1 : 1 as illustrated in Figure 10. Identification of the finder pattern together with the timing patterns unambiguously defines the size, location and rotational orientation of the symbol in the field of view.



Key

A 3 modules

B 5 modules

C 7 modules

Figure 10 — Structure of finder pattern

6.3.4 Separator

A one-module wide separator, constructed of all light modules, is placed between each finder pattern and the encoding region, as illustrated in Figures 2 to 7.

6.3.5 Timing pattern

The horizontal and vertical timing patterns respectively consist of a one-module wide row or column of alternating dark and light modules. They enable the symbol density and version to be determined and provide datum positions for determining module coordinates.

The horizontal timing pattern runs across row 0 of the symbol between a separator at the right of the finder pattern and a corner finder pattern at the right end of the symbol. It also runs across the lowermost row of the symbol between a corner finder pattern at the left end of the symbol and the finder sub pattern, excluding the position of the alignment pattern. The vertical timing pattern runs down column 0 of the symbol between a separator below the finder pattern and a corner finder pattern at the lowermost end of the symbol. It also runs down the rightmost column between a corner finder pattern at the upper end of the symbol and a finder sub pattern. The timing pattern also runs down a column of symmetrically located upper and lower alignment patterns, from the top to the bottom of the alignment patterns. Figure 11 illustrates the timing pattern area of Version R17x43 symbol. Timing patterns are areas enclosed by dotted lines in this figure. Symbols with 7 to 11 vertical modules do not have timing patterns at the column 0, nor do symbols with 7 and 9 vertical modules have timing patterns at the right end of the symbol. See Figures 2 to 7.

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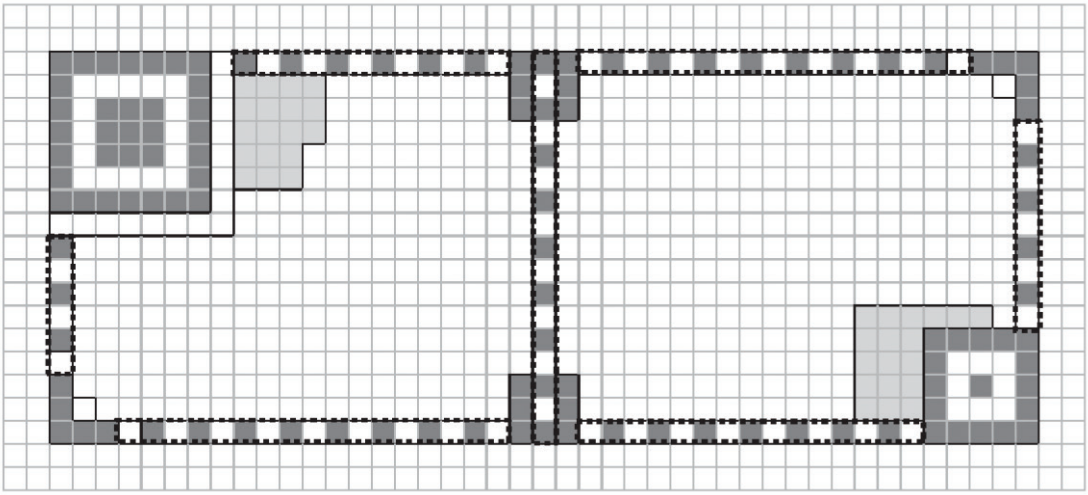
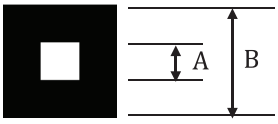


Figure 11 — Timing pattern area of Version R17x43

6.3.6 Alignment patterns

Alignment patterns are present in symbols with 43 or more horizontal modules. Each alignment pattern may be viewed as two superimposed concentric squares, constructed of 3 x 3 dark modules, and a single central light module. The structure of an alignment pattern is shown in Figure 12. The number of alignment patterns depends on the number of horizontal modules. The alignment patterns shall be placed at the position defined in Annex D, except for symbols with 27 horizontal modules.



Key

A 1 module

B 3 modules

Figure 12 — Structure of alignment pattern

6.3.7 Finder sub pattern

The finder sub pattern is placed at the right-hand bottom of the symbol, as illustrated in Figures 2 through 7. The finder sub pattern may be viewed as three superimposed concentric squares, and is constructed of 5 x 5 dark modules, 3 x 3 light modules, and a single central dark module. The structure of finder sub pattern is shown in Figure 13.

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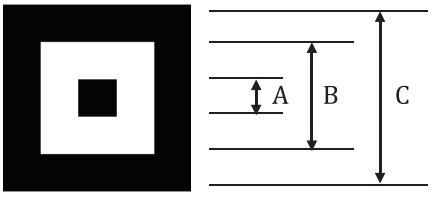


Key

A 1 module

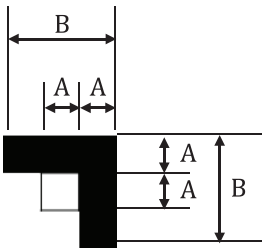
B 3 modules

C 5 modules

Figure 13 — Structure of finder sub pattern

6.3.8 Corner finder pattern

The corner finder pattern is located at the upper right and the lower left of rMQR symbol, as illustrated in Figures 2 through 7. The corner finder pattern is constructed of 3 dark modules in the horizontal direction, and 3 dark modules in the vertical direction that intersect at the upper right or lower left of the symbol, and 1 light module which is located so as to contact an angle made by the dark modules described above. See Figure 14. Symbols with 7 vertical modules do not have a lower left corner finder pattern. Symbols with 9 vertical modules have a lower left corner finder pattern of 3 dark modules in the horizontal direction, as shown in Figure 15.

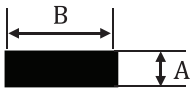


Key

A 1 module

B 3 modules

Figure 14 — Structure of corner finder pattern



Key

A 1 module

B 3 modules

Figure 15 — Structure of lower left corner finder pattern of symbols with 9 vertical modules

6.3.9 Encoding region

This region shall contain the symbol characters representing data, those representing error correction codewords, and the format information. Refer to 7.7.1 for details of the symbol characters. Refer to 7.9 for details of the format information.

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6.3.10 Quiet zone

The width of the quiet zone shall be 2X, surround the symbol on all four sides, and shall be free of all other markings. Its nominal reflectance value shall be equal to that of the light modules.

7 Requirements

7.1 Encode procedure overview

This clause provides an overview of the steps required to convert input data to a rMQR symbol. (For examples of encoding, see Annex I.)

Step 1 Data analysis

Analyze the input data stream to identify the variety of different characters to be encoded. The rMQR symbol format supports the extended channel interpretation feature, enabling data differing from the default character set to be encoded. rMQR includes several modes (see 7.3) to allow different sub-sets of characters to be converted into symbol characters in efficient ways. Switch between modes as necessary in order to achieve the most efficient conversion of data into a binary string. Select the required error correction level. A list of rMQR symbol versions and their data capacities are shown in Table 1.

Step 2 Data encoding

Convert the data characters into a bit stream in accordance with the rules for the mode in force, as defined in 7.4.2 to 7.4.7, inserting mode indicators as necessary to change modes at the beginning of each new mode segment, and a terminator at the end of the data sequence. Split the resulting bit stream into 8-bit codewords. Add remainder codewords as necessary to fill the number of data codewords (as defined in Table 6) required for the version and error correction level.

Step 3 Error correction coding

Divide the codeword sequence into the required number of blocks (as defined in Table 8) to enable the error correction algorithms to be processed. Generate the error correction codewords for each block, appending the error correction codewords to the end of the data codeword sequence.

Step 4 Structure final message

Interleave the data and error correction codewords from each block as described in 7.6 (step 3), and add remainder bits as necessary.

Step 5 Module placement in matrix

Place the codeword modules in the matrix together with the finder pattern, separators, timing pattern, alignment patterns (if required), finder sub pattern and corner finder pattern. Refer to 7.7 for details of codeword placement in matrix.

Step 6 Data masking

Apply the data masking patterns to the encoding region of the symbol. Refer to 7.8 for details of data masking.

Step 7 Format information

Generate the format information and complete the symbol. Refer to 7.9 for details of format information.

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Table 1 — Codeword capacity of all versions of rMQR symbols

Version	No. of modules/ side		Function pattern modules (C)	Format information modules (D)	Symbol capacity - Data modules except (D) (E = AB – C – D)	Data capacity [codewords] [a] (E)	Remainder bits
	Vertical (A)	Hori-zontal (B)					
R7x43	7	43	161	36	104	13	0
R7x59	7	59	206	36	171	21	3
R7x77	7	77	242	36	261	32	5
R7x99	7	99	299	36	358	44	6
R7x139	7	139	392	36	545	68	1
R9x43	9	43	181	36	170	21	2
R9x59	9	59	228	36	267	33	3
R9x77	9	77	264	36	393	49	1
R9x99	9	99	323	36	532	66	4
R9x139	9	139	418	36	797	99	5
R11x27	11	27	139	36	122	15	2
R11x43	11	43	188	36	249	31	1
R11x59	11	59	237	36	376	47	0
R11x77	11	77	273	36	538	67	2
R11x99	11	99	334	36	719	89	7
R11x139	11	139	431	36	1062	132	6
R13x27	13	27	143	36	172	21	4
R13x43	13	43	194	36	329	41	1
R13x59	13	59	245	36	486	60	6
R13x77	13	77	281	36	684	85	4
R13x99	13	99	344	36	907	113	3
R13x139	13	139	443	36	1328	166	0
R15x43	15	43	200	36	409	51	1
R15x59	15	59	253	36	596	74	4
R15x77	15	77	289	36	830	103	6
R15x99	15	99	354	36	1095	136	7
R15x139	15	139	455	36	1594	199	2
R17x43	17	43	206	36	489	61	1
R17x59	17	59	261	36	706	88	2
R17x77	17	77	297	36	976	122	0
R17x99	17	99	364	36	1283	160	3
R17x139	17	139	467	36	1860	232	4

[a] All codewords are 8 bits in length.

7.2 Data analysis

Analyse the input data string to determine its content and select the default or other appropriate ECI and the appropriate mode to encode each sequence as described in 7.4. Each mode in sequence from Numeric mode to Kanji mode progressively requires more bits per character. When modes are mixed, it is possible to switch from mode to mode within a symbol in order to minimize the bit stream length for data, parts of which can more efficiently be encoded in one mode than other parts, e.g., numeric sequences followed by alphanumeric sequences. It is in theory most efficient to encode data in the

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mode requiring the fewest bits per data character, but as there is some overhead in the form of mode indicator and character count indicator associated with each mode change, it does not always result in the shortest overall bit stream to change modes for a small number of characters. Also, because the capacity of symbols increases in discrete steps from one version to the next, it is not always necessary to achieve the maximum conversion efficiency in every case.

7.3 Modes

7.3.1 General

The modes defined below are based on the character values and assignments associated with the default ECI. When any other ECI is in force, the byte values rather than the specific character assignments shall be used to select the optimum data compaction mode. For example, numeric mode would be appropriate if there is a sequence of data byte values within the range 30_{HEX} to 39_{HEX} inclusive. In this case the compaction is carried out using the default numeric or alphabetic equivalents of the byte values.

NOTE $\ldots_{HEX}$ data is figured in hexadecimal.

7.3.2 Extended channel interpretation (ECI) mode

The extended channel interpretation (ECI) protocol defined in References [21] to [23], allows the output data stream to have interpretations different from that of the default character set. The ECI protocol is defined consistently across a number of symbologies. The ECI protocol provides a consistent method to specify particular interpretations of byte values before printing and after decoding.

The default interpretation for rMQR symbol shall be ECI 000003 representing the ISO/IEC 8859-1 character set.

International applications using other character sets should use the ECI protocol. For instance, the interpretation corresponding to the JIS8 and Shift JIS character sets is ECI 000020.

The effect of ECI mode is to insert an ECI escape sequence at that point in the data. It is immediately followed by another mode indicator (e.g., for efficient data encoding) and remains in force until the end of the message or a subsequent ECI mode indicator.

7.3.3 Numeric mode

Numeric mode encodes data from the decimal digit set (**0 - 9**) (byte values 30_{HEX} to 39_{HEX}). Normally, 3 data characters are represented by 10 bits.

7.3.4 Alphanumeric mode

Alphanumeric mode encodes data from a set of 45 characters, i.e. 10 numeric digits (**0 - 9**) (byte values 30_{HEX} to 39_{HEX}), 26 alphabetic characters (**A - Z**) (byte values 41_{HEX} to $5A_{HEX}$) , and 9 symbols (**SP**, **$**, **%**, *****, **+**, **-**, **.**, **/**, **:**) (byte values 20_{HEX}, 24_{HEX}, 25_{HEX}, $2A_{HEX}$, $2B_{HEX}$, $2D_{HEX}$ to $2F_{HEX}$, $3A_{HEX}$ respectively). Normally, two input characters are represented by 11 bits.

7.3.5 Byte mode

In this mode, data is encoded at 8 bits per character.

In closed-system national or application-specific implementations of rMQR, an alternative 8-bit character set, for example as defined in an appropriate part of ISO/IEC 8859, may be specified for Byte mode. When an alternative character set is specified, however, the parties intending to read the rMQR symbols require to be notified of the applicable character set in the application specification or by bilateral agreement.

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7.3.6 Kanji mode

The Kanji mode efficiently encodes Kanji characters in accordance with the Shift JIS system based on JIS X 0208. The Shift JIS Kanji coding values are shifted from the JIS X 0208 values. JIS X 0208:1997, Annex 1 gives details of the shift coded representation. Each two-byte character value is compacted to a 13-bit binary codeword. See Annex H for JIS8 and Shift JIS character sets.

When the character set specified for 8-bit byte mode makes use of byte values in the ranges 81_{HEX} to $9F_{HEX}$ and/or $E0_{HEX}$ to EB_{HEX}, it is not always possible to use Kanji mode unambiguously, as reading systems are unable to determine from the transmitted data whether such byte values are the lead byte of a double byte character. It may be possible to achieve a shorter bit stream by using the Kanji mode compaction rules when an appropriate sequence of byte values occurs in the data [i.e. lead bytes in the ranges 81_{HEX} to $9F_{HEX}$ and/or $E0_{HEX}$ to EA_{HEX}) followed by trailer bytes in the range 40_{HEX} to FC_{HEX},except $7F_{HEX}$, or EB_{HEX} followed by 40_{HEX} to BF_{HEX} except $7F_{HEX}$)]. Figure H.1 shows the byte combinations graphically.

7.3.7 Mixing modes

The rMQR symbols may contain sequences of data in a combination of any of the modes available for the version of the symbol as described in 7.3.2 to 7.3.6.

7.3.8 FNC1 mode

FNC1 mode is used for messages containing specific data formats. In the "first position" it designates data formatted in accordance with the GS1 General Specifications. In the "second position" it designates data formatted in accordance with a specific industry application previously agreed with AIM Inc. FNC1 mode applies to the entire symbol and is not affected by subsequent mode Indicators.

NOTE "First position" and "second position" do not refer to actual locations but are based on the positions of FNC1 character in Code 128 symbols, when used in an equivalent manner.

7.4 Data encoding

7.4.1 Sequence of data

Input data is converted into a bit stream consisting of one or more segments each in a separate mode. In the default ECI, the bit stream commences with the first mode indicator. If the initial ECI is other than the default ECI, the bit stream commences with an ECI header, followed by the first segment.

The ECI header (if present) shall comprise:

— ECI mode indicator (3 bits)

— ECI designator (8, 16 or 24 bits)

The ECI header shall begin with the first (most significant) bit of the ECI mode indicator and end with the final (least significant) bit of the ECI designator.

The remainder of the bit stream is then made up of segments each comprising: (see Figure 16):

— mode indicator;

— character count indicator;

— data bit stream.

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ECI header		Segment 1			.....	Segment *n*			Terminator
ECI mode indicator	ECI designator	Mode indicator 1	Character count indicator	Data	.....	Mode indicator *n*	Character count indicator	Data	

Segment 1			Segment 2			.....	Segment *n*			Terminator
Mode indicator 1	Character count indicator	Data	Mode indicator 2	Character count indicator	Data	.....	Mode indicator *n*	Character count indicator	Data	

Figure 16 — Format of data stream with and without ECI header

Each mode segment shall begin with the first (most significant) bit of the mode indicator and end with the final (least significant) bit of the data bit stream. There shall be no explicit separator between segments as their length is defined unambiguously by the rules for the mode in force and the number of input data characters.

To encode a sequence of input data in a given mode, the steps defined in 7.4.2 to 7.4.7 shall be followed. Table 2 defines the mode indicators (3 bits) for each mode. Table 3 defines the length of the character count indicator, which varies according to the applied mode and symbol version.

Table 2 — Mode and Mode indicators for rMQR

Mode	Mode indicators (3 bits)
Numeric	001
Alphanumeric	010
Byte	011
Kanji	100
FNC1[a]	101 (First position) 110 (Second position)
ECI	111
Terminator (End of message)[b]	000

[a] See 7.4.8.2 and 7.4.8.3.

[b] The terminator is not a mode indicator as such and may be truncated.

Table 3 — Number of bits of character count indicator

Version	No. of modules/side		Numeric mode	Alphanumeric mode	Byte mode	Kanji mode
	Vertical	Horizontal				
R7x43	7	43	4	3	3	2
R7x59	7	59	5	5	4	3
R7x77	7	77	6	5	5	4
R7x99	7	99	7	6	5	5
R7x139	7	139	7	6	6	5
R9x43	9	43	5	5	4	3
R9x59	9	59	6	5	5	4

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Table 3 *(continued)*

Version	No. of modules/side		Numeric mode	Alphanumeric mode	Byte mode	Kanji mode
	Vertical	Horizontal				
R9x77	9	77	7	6	5	5
R9x99	9	99	7	6	6	5
R9x139	9	139	8	7	6	6
R11x27	11	27	4	4	3	2
R11x43	11	43	6	5	5	4
R11x59	11	59	7	6	5	5
R11x77	11	77	7	6	6	5
R11x99	11	99	8	7	6	6
R11x139	11	139	8	7	7	6
R13x27	13	27	5	5	4	3
R13x43	13	43	6	6	5	5
R13x59	13	59	7	6	6	5
R13x77	13	77	7	7	6	6
R13x99	13	99	8	7	7	6
R13x139	13	139	8	8	7	7
R15x43	15	43	7	6	6	5
R15x59	15	59	7	7	6	5
R15x77	15	77	8	7	7	6
R15x99	15	99	8	7	7	6
R15x139	15	139	9	8	7	7
R17x43	17	43	7	6	6	5
R17x59	17	59	8	7	6	6
R17x77	17	77	8	7	7	6
R17x99	17	99	8	8	7	6
R17x139	17	139	9	8	8	7

The end of the data in the complete symbol is indicated by a terminator consisting of 3 zero bits (see Table 2), which is truncated if the remaining number of data bits after the data bit stream is less than the required bit length of terminator. The terminator is not a mode indicator as such.

7.4.2 Extended channel interpretation (ECI) mode

7.4.2.1 General

This mode, used for encoding data subject to alternative interpretations of byte values (e.g., alternative character sets) in accordance with the AIM ECI specification which defines the pre-processing of this type of data, is invoked by the use of mode indicator 111.

The extended channel interpretation can only be used with readers enabled to transmit the symbology identifier. Readers that cannot transmit the symbology identifier cannot transmit the data from any symbol containing an ECI.

Input ECI data shall be handled by the encoding system as a series of byte values.

Data in an ECI sequence may be encoded in whatever mode or modes permit the most efficient encoding of the byte values of the data, irrespective of their significance. For example, a sequence of bytes in the range 30_{HEX} to 39_{HEX} can be encoded in numeric mode (see 7.4.3) as though it were a sequence of digits

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0 – 9 even though it does not actually represent numeric data. In order to determine the value of the character count indicator, the number of bytes (or, in Kanji mode, of byte pairs) shall be used.

7.4.2.2 ECI Designator

Each Extended Channel Interpretation is designated by a six-digit assignment number which is encoded in the rMQR symbol as the first one, two or three codewords following the ECI mode indicator. The encoding rules are defined in Table 4. The ECI designator appears in the data to be encoded as character $5C_{HEX}$ [\ or backslash (reverse solidus) in ISO/IEC 8859-1, ¥ or yen sign in JIS8] followed by the six-digit assignment number. Where $5C_{HEX}$ appears as true data it shall be doubled in the data string before encoding in symbols to which the ECI protocol applies.

When a single occurrence of $5C_{HEX}$ is encountered in the input to the decoder, an ECI mode indicator is inserted followed by the ECI designator. When a doubled $5C_{HEX}$ is encountered, it is encoded as two $5C_{HEX}$ bytes.

On decoding, the binary pattern of the first ECI designator codeword (i.e. the codeword following the mode indicator in ECI mode), determines the length of the ECI designator sequence. The number of 1 bits before the first 0 bit defines the number of additional codewords after the first used to represent the ECI assignment number. The bit sequence after the first 0 bit is the binary representation of the ECI assignment number. The lower numbered ECI assignments may be encoded in multiple ways, but the shortest way is preferred.

Table 4 — Encoding ECI assignment number

ECI assignment value	No. of codewords	Codeword values
000000 to 000127	1	**0**bbbbbbb
000000 to 016383	2	**10**bbbbbb bbbbbbbb
000000 to 999999	3	**110**bbbbb bbbbbbbb bbbbbbbb
		where b … b is the binary value of the ECI Assignment number

Example

Assume data to be encoded is in Greek, using character set ISO/IEC 8859-7 (ECI 000009) in version R17x139-H symbol.

Input data: \000009**ΑΒΓΔΕ** (character values $A1_{HEX}$, $A2_{HEX}$, $A3_{HEX}$, $A4_{HEX}$, $A5_{HEX}$)

Bit sequence in symbol:

ECI mode indicator	**111**
ECI Assignment number (000009)	**0 0001001**
Mode indicator (byte)	**011**
Character count indicator (5)	**00000101**
Data:	**10100001 10100010 10100011 10100100 10100101**
Final bit string:	**111 00001001 011 00000101 10100001 10100010 10100011 10100100 10100101**

See 13.3 for example of transmission of this data following decoding.

7.4.2.3 Multiple ECIs

Refer to the AIM ECI specification for the rules defining the effect of a subsequent ECI designator in an ECI data segment. For example, data to which a character set ECI has been applied can also be subject

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