BRITISH STANDARD

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12323:2005

AIDC technologies — Symbology specifications — Code 16K

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ICS 35.040

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee IST/34, Automatic identification and data capture techniques, which has the responsibility to:

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This document (EN 12323:2005) has been prepared by Technical Committee CEN/TC 225 "AIDC Technologies", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2005, and conflicting national standards shall be withdrawn at the latest by November 2005.

This document supersedes EN 12323:1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

The technology of bar coding is based on the recognition of patterns encoded in bars and spaces of defined dimensions. There are a number of methods of encoding information in bar code form, known as symbologies, and the rules defining the translation of characters into bar and space patterns and other essential features are known as the symbology specifications. "Code 16K" is one such symbology.

Previously, symbology specifications have been developed and published by a number of different private organisations, resulting in certain instances in conflicting requirements for certain symbologies.

Manufacturers of bar code equipment and users of bar code technology require publicly available standard symbology specifications to which they can refer when developing equipment and application standards.

1 Scope

This document:

— specifies the requirements for the multi row bar code symbology known as "Code 16K";

— specifies "Code 16K" symbology characteristics, data character encodation, dimensions, tolerances, decoding algorithms and user-defined application parameters;

— describes a subset of "Code 16K" assigned to EAN International.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1556:1998, *Bar coding — Terminology*

EN ISO/IEC 15416, *Information technology — Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols (ISO/IEC 15416:2000)*

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 8859–1:1998, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

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

EAN•UCC *General Specifications (EAN International, Brussels)*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1556:1998 and the following apply.

3.1
guard bar
additional bar used to separate the trailing space of a start character from the leading space of the first symbol character in a row

3.2
mode character
symbol character in the first position after the start character in the first row of a symbol, used to define the initial code set and any implied special characters

3.3
separator bar
horizontal bar separating two rows of a symbol or abutting the top or bottom of the first or last row respectively

4 Requirements

4.1 Symbology characteristics

The characteristics of "Code 16K" are:

a) encodable character set:

   1) all 128 ASCII characters, i.e. ASCII characters 0 to 127 inclusive, in accordance with ISO/IEC 646:1991;

   2) characters with ASCII values 128 to 255 in accordance with ISO 8859-1:1998 may also be encoded. See 4.3.4.4 d);

   3) 4 non data function characters;

   4) 3 code set selection characters;

   5) 7 shift characters;

   6) 8 start characters;

   7) 8 stop characters;

   8) 1 pad character;

b) code type: continuous, multi row;

c) elements per symbol character: 6, comprising 3 spaces and 3 bars, each of 1, 2, 3 or 4 modules in width;

d) character self-checking: yes;

e) row self-checking: yes;

f) symbol width: 81X inclusive of minimum quiet zones;

g) symbol height: variable (2 to 16 rows);

h) bidirectional decoding: yes;

i) number of symbol check characters: 2, mandatory (see Annex A);

j) symbol character density: 11 modules per symbol character representing data (equivalent to 5,5 modules per data character in code set C);

k) representative data capacity: 2 row symbol: 7 ASCII characters, 14 numeric characters;

l) maximum data capacity 16 row symbol: 77 ASCII characters, 154 numeric characters;

m) non-data overhead:

   per row: 15 modules;

   per symbol: 33 modules minimum, 81 modules maximum.

4.2 Symbol structure

Each "Code 16K" symbol consists of 2 to 16 rows. Each row shall comprise:

a) leading quiet zone;

b) start character;

c) 1X guard bar (where X is the nominal width of a narrow bar or space);

d) 5 symbol characters;

e) 1 stop character;

f) trailing quiet zone.

Figure 1 illustrates the row structure. Rows shall be separated from each other by a horizontal separator bar. The top and bottom of the symbol shall also have separator bars which shall extend to the ends of the quiet zones.

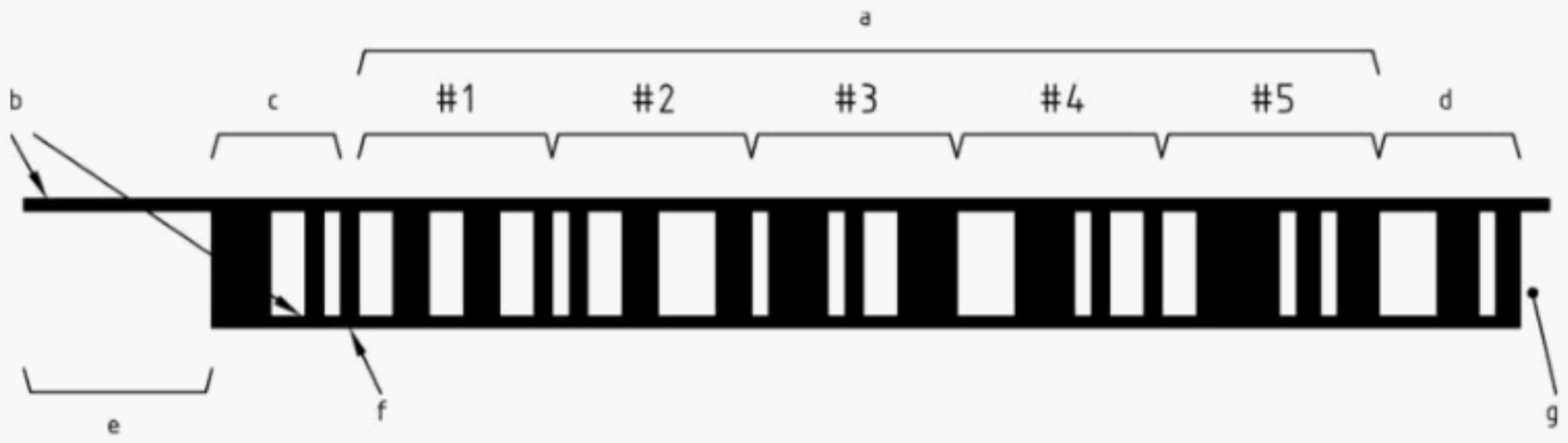

Figure 1 – "Code 16K" row structure

Figure 2 shows the structure of a full 16-row symbol. The symbol characters are ordered from the leftmost character of the first (top) row, through each row left to right to the rightmost character in the last (bottom) row. The first symbol character is the "mode" character S. The last two characters are the check characters C1 and C2. The remaining symbol characters encode the data for the symbol.

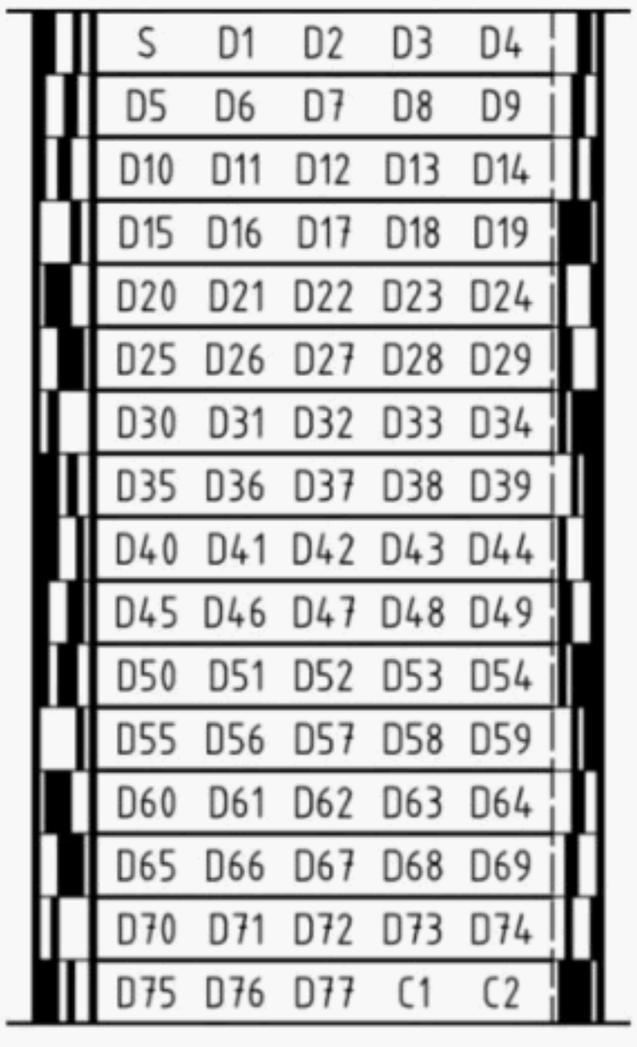

Figure 2 – "Code 16K" symbol structure

Figure 3 illustrates a complete symbol encoding the data “ab0123456789” in “Code 16K”.

Figure 3 – “Code 16k” symbol encoding “ab0123456789”

4.3 Character assignments

4.3.1 Symbol character encodation

There are 107 "Code 16K" symbol characters. Each symbol character consists of eleven 1X-wide modules. Each symbol character consists of three space elements alternating with three bar elements, starting with a space. Each bar or space element may consist of 1 to 4 modules.

Table 1 defines all the "Code 16K" character assignments. In the column headed 'Symbol Character Structure' the numeric value represent the widths of the elements in modules or multiples of the X dimension.

Symbol character parity is defined by the sum of the bar modules in any symbol character. In "Code 16K" this sum shall always be odd (odd parity). This odd parity feature enables character self-checking to be carried out. Figure 4 illustrates the symbol character value 33.

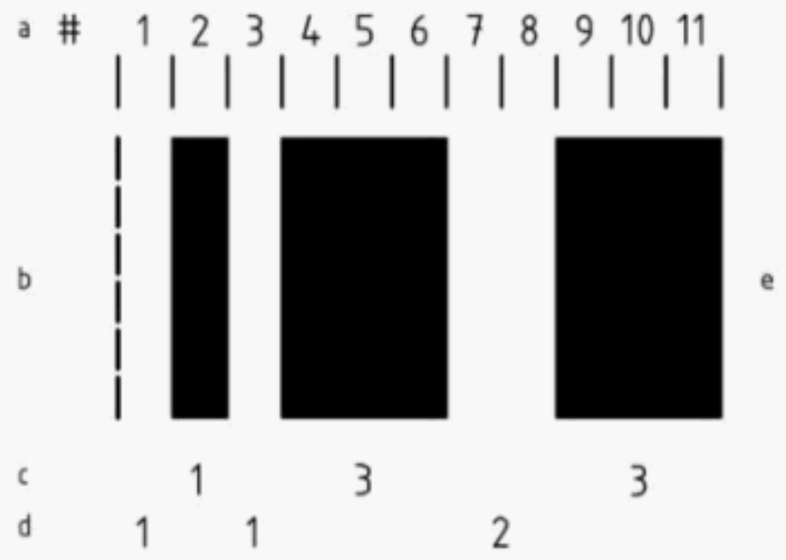

Figure 4 – Symbol character value 33

4.3.2 Data character encodation

"Code 16K" has three unique data character sets, shown in Table 1 as code sets A, B and C. The symbol character bar and space patterns shown are equivalent to the data characters listed in the columns for code A, B or C. The choice of data character set depends on the mode character (starting symbol character), or the use of code set A, code set B or code set C characters or the shift characters. The code set can be redefined within the symbol by the use of code set or shift characters.

The same data may be represented by different "Code 16K" symbol characters, through the use of different combinations of mode, code set or shift characters. Annex F contains guidelines to generate the smallest symbol for given data. An application need not specify the code set to be used.

Each symbol character is assigned a numeric value listed in Table 1. This value is used in calculating the check characters C1 and C2. It may also be used to provide a conversion to and from ASCII decimal values when encoding in code sets A and B (see Annex G).

4.3.3 Code sets

4.3.3.1 Code set A

Code set A includes all of the standard upper case alphanumeric characters together with the control characters (i.e. characters with ASCII values from 00 to 95 inclusive), and eleven special characters.

4.3.3.2 Code set B

Code set B includes all of the standard upper case alphanumeric characters together with the lower case alphabetic characters (i.e. characters with ASCII values from 32 to 127 inclusive), and eleven special characters.

4.3.3.3 Code set C

Code set C includes the set of 100 digit pairs from 00 to 99 inclusive, as well as seven special characters. This allows numeric data to be encoded, two data digits per symbol character, at effectively twice the density of standard data.

Table 1 – "Code 16K" character encodations

VALUE	CODE SET A	CODE SET B	CODE SET C	ENCODATION PATTERN	s b s b s b
0	SP	SP	00		212222
1	!	!	01		222122
2	"	"	02		222221
3	#	#	03		121223
4	$	$	04		121322
5	%	%	05		131222
6	&	&	06		122213
7	'	'	07		122312
8	(	(	08		132212
9	)	)	09		221213
10	*	*	10		221312
11	+	+	11		231212
12	,	,	12		112232
13	-	-	13		122132
14	.	.	14		122231
15	/	/	15		113222
16	0	0	16		123122
17	1	1	17		123221
18	2	2	18		223211
19	3	3	19		221132
20	4	4	20		221231
21	5	5	21		213212
22	6	6	22		223112
23	7	7	23		312131
24	8	8	24		311222
25	9	9	25		321122
26	:	:	26		321221
27	;	;	27		312212
28	<	<	28		322112
29	=	=	29		322211
30	>	>	30		212123
31	?	?	31		212321
32	@	@	32		232121
33	A	A	33		111323
34	B	B	34		131123
35	C	C	35		131321
36	D	D	36		112313
37	E	E	37		132113
38	F	F	38		132311
39	G	G	39		211313
40	H	H	40		231113
41	I	I	41		231311
42	J	J	42		112133
43	K	K	43		112331
44	L	L	44		132131
45	M	M	45		113123
46	N	N	46		113321
47	O	O	47		133121
48	P	P	48		313121
49	Q	Q	49		211331
50	R	R	50		231131
51	S	S	51		213113
52	T	T	52		213311
53	U	U	53		213131
54	V	V	54		311123
56	X	X	56		331121
57	Y	Y	57		312113
58	Z	Z	58		312311
59	[	[	59		332111
60	\	\	60		314111
61	]	]	61		221411
62	^	^	62		431111
63	_	_	63		111224
64	NUL	`	64		111422
65	SOH	a	65		121124
66	STX	b	66		121421
67	ETX	c	67		141122
68	EOT	d	68		141221
69	ENQ	e	69		112214
70	ACK	f	70		112412
71	BEL	g	71		122114
72	BS	h	72		122411
73	HT	i	73		142112
74	LF	j	74		142211
75	VT	k	75		241211
76	FF	l	76		221114
77	CR	m	77		413111
78	SO	n	78		241112
79	SI	o	79		134111
80	DLE	p	80		111242
81	DC1	q	81		121142
82	DC2	r	82		121241
83	DC3	s	83		114212
84	DC4	t	84		124112
85	NAK	u	85		124211
86	SYN	v	86		411212
87	ETB	w	87		421112
88	CAN	x	88		421211
89	EM	y	89		212141
90	SUB	z	90		214121
91	ESC	{	91		412121
92	FS	|	92		111143
93	GS	}	93		111341
94	RS	~	94		131141
95	US	DEL	95		114113
96	FNC 3	FNC 3	96		114311
97	FNC 2	FNC 2	97		411113
98	1S B	1S A	98		411311
99	CODE C	CODE C	99		113141
100	CODE B	FNC 4	CODE B		114131
101	FNC 4	CODE A	CODE A		311141
102	FNC 1	FNC 1	FNC 1		411131
103	pad	pad	pad		211412
104	2S B	2S A	1S B		211214
105	2S C	2S C	2S B		211232
106	3S C	3S C	3S B		211133

NOTE 1 Shift is denoted as 1S, Double Shift is denoted as 2S, Triple Shift is denoted as 3S.

NOTE 2 The numeric value in the "s" and "b" columns represent the number of modules in each of the symbol character bars and spaces.

NOTE 3 Dashed line indicates trailing edge of the preceding character.

4.3.4 Special characters

4.3.4.1 Introduction

The special characters defined below provide information to the reader and are not transmitted as data.

4.3.4.2 Mode character

The mode character, S, defines

initial mode value : m

the number of rows : r

The initial mode specifies the initial code set and may also represent an implied leading FNC1 character or implied leading Shift character as shown in Table 2. Implied characters function as if they were actual symbol characters but do not occupy any space.

Table 2 – Initial mode value

m	Initial code set	Implied character
0	Code set A	none
1	Code set B	none
2	Code set C	none
3	Code set B	FNC1
4	Code set C	FNC1
5	Code set C	Shift B
6	Code set C	Double shift B

The value, s, of the mode character is a packed number between 0 and 104 representing seven different initial mode set combinations and fifteen different numbers of rows:

$$s = 7 (r - 2) + m$$

where

r is the number of rows (2 through 16) and "m" is the initial mode.

Where the extended data length symbol option is used (see Annex C), the value of s shall be 105.

4.3.4.3 Code set and shift characters

a) The code set A, code set B and code set C characters change the code set from the code set defined previously to the new code set defined by the code set character. This change applies to all symbol characters following the code set character until either the end of the symbol or another code set character is encountered.

b) The shift characters are used to change the code set temporarily. The code set will automatically revert to the code set defined prior to the shift character after one, two or three symbol characters respectively, when single, double or triple shift characters are used. The characters so shifted shall not themselves be code set or shift characters.

NOTE Annex F contains a complete guideline for the use of these characters.

4.3.4.4 Function characters

Function characters (FNC1 to FNC4) define instruction to the bar code reading device to allow for special operations and applications

a) **FNC1** shall be subject to the special considerations defined in Annex B.

b) **FNC2** shall be subject to the special consideration defined in Annex C.

c) **FNC3** Initialize. This instructs the reader to interpret the data contained in the symbol for reader initialization or programming. The FNC3 may appear anywhere within the symbol following the starting symbol character.

d) **FNC4** Extended ASCII Mode – (EAM). FNC4 is used to represent the extended ASCII character set (ASCII values 128 to 255) as specified in ISO 8859-1:1998. When in code set A or B, if the FNC4 character is encountered the value 128 is added to the ASCII value of the following data character in the symbol, which may, if necessary, be preceded by a shift or code set character. The reference character set shall be ISO 8859-1:1998, but application specifications may define alternative sets corresponding to ASCII values 128 to 255.

4.3.4.5 Pad character

The pad character has two functions.

a) The first position (D1) following mode character, a pad character identifies symbols which conform to a specific industry standard, similar to FNC1.

b) When one or more pad characters appear at the end of the symbol, just before the check characters, they represent no data; they are used to fill out the last row or rows following the final data.

4.3.5 Start and stop characters

a) The start character is a bar-space-bar-space pattern 7X wide. The patterns are edge to similar edge decodable and have even parity. The eight patterns are defined as shown in Table 3.

Table 3 – Start patterns

Value	b	s	b	s
0	3	2	1	1
1	2	2	2	1
2	2	1	2	2
3	1	4	1	1
4	1	1	3	2
5	1	2	3	1
6	1	1	1	4
7	3	1	1	2

b) The stop character is a space-bar-space-bar pattern 7X wide. The patterns are edge to similar edge decodable and odd parity. The eight patterns are defined the same as the start character but with bars and spaces exchanged, as shown in Table 4.

Table 4 – Stop patterns

Value	s	b	s	b
0	3	2	1	1
1	2	2	2	1
2	2	1	2	2
3	1	4	1	1
4	1	1	3	2
5	1	2	3	1
6	1	1	1	4
7	3	1	1	2

Each row in the symbol is assigned a unique pair of start and stop characters which identifies the row as shown in Table 5.

Table 5 – Start and stop values defining row numbers

Row	Start value	Stop value
1	0	0
2	1	1
3	2	2
4	3	3
5	4	4
6	5	5
7	6	6
8	7	7
9	0	4
10	1	5
11	2	6
12	3	7
13	4	0
14	5	1
15	6	2
16	7	3

The rows of the symbol are numbered starting with row one at the top of the symbol.

c) Guard bar: a 1X wide guard bar is used following the start pattern.

4.3.6 Check characters

Annex A defines the check characters (C1 and C2) positions and calculations.

4.3.7 Separator bars

Horizontal separator bars shall border the top and bottom of each row of the symbol. The height of the separator bars shall be 1X minimum, 4X maximum and shall be constant throughout the symbol. The very top and bottom separators shall be at least 81X long, indicating the extent of the quiet zones. The interior separators shall be 70X long as shown in Figure 2.

4.4 Transmitted data

All encoded data characters are included in the data transmission. The mode character, code characters, shift characters, function characters (see Annex D for transmission of FNC1), pad characters and the two check characters are not transmitted. When required the "Code 16K" symbology identifier (see Annex E) shall be transmitted.

4.5 Dimensions

"Code 16K" shall use the following nominal dimensions:

a) minimum width of a module (X) should be defined by the application specification. Selection of the X dimension should be made having regard to the availability of suitable bar code printing and reading equipment;

b) g is the height of the separator bar, as a multiple of X ;

c) quiet zones: the leading quiet zone should be at least 10X wide and the trailing quiet zone should be at least 1X wide;

d) row height (Y dimension): minimum 8X.

The dimensions of a "Code 16K" symbol, including quiet zones, may be calculated as follows:

a) symbol width: the physical width is equal to 81X. This is the sum of 10X minimum left quiet zone, 70X in the bar and spaces and 1X minimum right quiet zone;

b) symbol height: the physical height of a symbol is proportional to the number of rows required for the message, as given in the formula:

$$H = X[r(h+g)+g]$$

where

H is the height of the symbol in mm;

h is the height of the row bars, in multiple of X;

r is the number of rows required for message (2 to 16);

X is the nominal narrow element width in mm;

g is the height of separator bar.

4.6 Reference decode algorithm

4.6.1 Introduction

Bar code reading systems are designed to read imperfect symbols to the extent that practical algorithms permit. This section describes the reference decode algorithm used in the computation of decodability value described in EN ISO/IEC 15416.

4.6.2 Start and stop characters

The algorithm to decode the start and stop characters contains the following steps:

a) Calculate the three width measurements p, e_1 and e_2 as shown in Figure 5.

b) Convert measurements e_1 and e_2 to normalized values E_1 and E_2 which represent the integer module width (E_i) of these measurements. The following method is used for the i-th value:

if $1{,}5p/7 \leq e_i < 2{,}5p/7$, then E_i is 2

if $2{,}5p/7 \leq e_i < 3{,}5p/7$, then E_i is 3

if $3{,}5p/7 \leq e_i < 4{,}5p/7$, then E_i is 4

if $4{,}5p/7 \leq e_i < 5{,}5p/7$, then E_i is 5

otherwise the character is in error.

c) Look up the character in a decode table using the two values E_1 and E_2 as the key. The table should indicate the character value 0-7 and whether it is a start or a stop character or whether it is in error. The first start or stop character decoded will be used to define the direction of the scan. The direction will be used to determine the location of the symbol characters in the row.

If the character is in error or the start or stop pairing is not valid, then the row is in error.

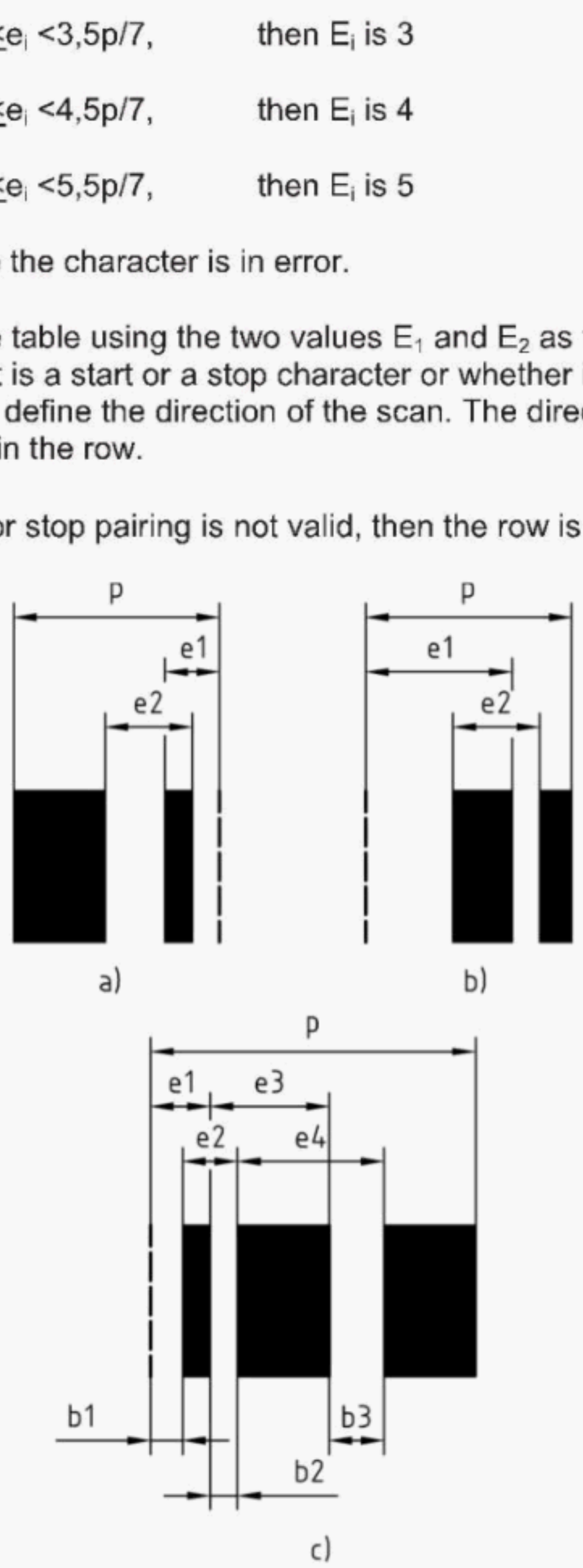

Figure 5 – Decode measurements

4.6.3 Symbol characters

a) Calculate the eight width measurements p, e1, e2, e3, e4, b1, b2, and b3 as shown in Figure 5.

b) Convert measurements e1, e2, e3, and e4 to normalized values E1, E2, E3, and E4 which represent the integer module width (Ei) of these measurements. The following method is used for the i-th value:

if 1,5p/11 ≤ei <2,5p/11, then Ei is 2

if 2,5p/11 ≤ei <3,5p/11, then Ei is 3

if 3,5p/11 ≤ei <4,5p/11, then Ei is 4

if 4,5p/11 ≤ei <5,5p/11, then Ei is 5

if 5,5p/11 ≤ei <6,5p/11, then Ei is 6

if 6,5p/11 ≤ei <7,5p/11, then Ei is 7

otherwise the character is in error.

c) Look up the character in a decode table using the four values E1, E2, E3 and E4 as the key.

d) Retrieve the character self-checking value V that is equal to the sum of the modules widths for the spaces as defined for that character.

e) Verify that:

(V-1,75)p/11 ≤b1+b2+b3<(V+1,75)p/11

otherwise the character is in error.

This calculation indirectly uses character parity to detect all decode errors caused by single non systematic one-module edge error.

Using these five steps, decode each character. If any of the symbol characters is in error, the row scan is invalid.

4.6.4 Symbol decode

When a row is decoded without error, store it as one of the "Code 16K" possible rows according to the start and stop values. If a row is decoded with a number which has already been found and in which the data decoded is different, reject all previous rows decoded for the symbol.

When row number one is decoded, determine the number of rows from the starting symbol character. When all the rows in the symbol are decoded, calculate and verify the two check characters. If a check character is in error, reject all the row decodes.

4.6.5 Message decode

After all of the characters have been decoded, translate the symbol characters into the appropriate data characters from code set A, B, or C according to the mode, code characters and shift characters used in the symbol.

4.6.6 Additional checks

Perform checks for quiet zones, character to character widths, the 1X guard bar and absolute timing counts to reduce the occurrence of erroneous row decode.

4.7 User-defined application parameters

4.7.1 Introduction

Application standards shall define parameters of "Code 16K" symbols specified in this document as variable, as follows:

4.7.2 Symbology and dimensional characteristics

In order for a "Code 16K" symbol to be printed and to be scannable in a given application it is necessary for the following symbology and dimensional parameters to be specified:

a) selection of a set of the encodable character set;

b) number of data characters in the symbol, which may be fixed, variable or variable up to a defined maximum;

c) whether a data check character is to be used and if so the algorithm for its calculation;

d) range of X dimension;

e) minimum bar height;

f) reference extended character set to be used with FNC4.

NOTE For additional factors that should be taken into consideration when specifying "Code 16K" applications see Annex H.

4.7.3 Optical specifications

In order for a bar code to be scannable in a given application, it is necessary to specify certain optical parameters. The selection of parameters shall be made in the application standard and shall include the specification of:

a) peak response wavelength;

b) spectral half power band width which the symbol and the scanner should conform;

c) spot size of the scanner;

d) parameters for reflectance of the bars and spaces;

e) condition under which optical measurements should be made;

f) extent of permissible imperfections.

4.7.4 Test specifications

4.7.4.1 Introduction

In order to verify whether a symbol meets the specifications in this document it shall be tested using the test specifications defined in EN ISO/IEC 15416, which lays down conditions under which measurements should be made and methods of measuring dimensions and other attributes of the bar code symbol and determining its conformity with the standard.

EN ISO/IEC 15416 allows for additional pass/fail criteria to be stipulated by a symbology specification. For "Code 16K", the additional criteria are given in 4.7.4.2 and 4.7.4.3. Any individual scan profile which does not meet these requirements shall receive a grade of "0".

4.7.4.2 Quiet zone

The left hand quiet zone shall be a minimum of 10Z, the right hand quiet zone shall be a minimum of 1Z, where Z is the measured narrow element width.

4.7.4.3 Guard bar

The guard bar width shall not exceed 1,5 times Z, where Z is the measured narrow element width.

Annex A
(normative)

Symbol check characters

The check characters shall be used to detect and prevent symbol decode errors. The next to last symbol character is the first check character C1, and the last symbol character is the second check character C2. The check characters are the modulo 107 weighted sum of the preceding symbol characters in the symbol.

The encodation of the weighted modulo 107 check character C1 is determined as follows:

a) Assign a numeric value to every symbol character in the symbol as shown in Table 1.

b) Assign a sequence of weights 2, 3, 4,..., i+2 to each symbol character beginning with the mode character (S in Figure 2), continuing with the characters D1 through Di, including all necessary trailing pad characters, where i is the number of Dx characters in the symbol (D1 through D77 in Figure 2).

c) Multiply each of the symbol character values S and D1 through Di by the weight assigned to the character position.

d) Sum the products obtained in step 3 and divide the sum by 107.

e) The remainder obtained in step 4 is the value of the symbol check character C1, shown in Table 1.

The encodation of the weighted modulo 107 check character C2 is determined as follows:

a) Assign a numeric value to every symbol character in the symbol as shown in Table 1.

b) Assign a sequence of weights 1, 2, 3, 4,..., i+2 to each symbol character beginning with the mode character (S in Figure 2), continuing with the characters D1 through Di, and ending with the previously calculated check character C1.

c) Multiply each of the symbol character values S and D1 through C1 by the weight assigned to the character position.

d) Sum the products obtained in step 3 and divide the sum by 107.

e) The remainder obtained in step 4 is the value of the check character C2, shown in Table 1.

EXAMPLE Check character calculation for "Code 16K" symbol encoding "ab0123456789".

Position	S	D1	D2	D3	D4	D5	D6	D7	
Data char.		a	b	01	23	45	67	89	
Sym char values	6	65	66	1	23	45	67	89	
Weights	2	3	4	5	6	7	8	9	
Products	12	195	264	5	138	315	536	801	
Sum of products	12	+195	+264	+5	+138	+315	+536	+801	=2266

2266/107 = 21 with a remainder of 19

C1 = 19

Position	S	D1	D2	D3	D4	D5	D6	D7	C1	
Data char.		a	b	01	23	45	67	89		
Sym char values	6	65	66	1	23	45	67	89	19	
Weights	1	2	3	4	5	6	7	8	9	
Products	6	130	198	4	115	270	469	712	171	
Sum of products	6	+130	+198	+4	+115	+270	+469	+712	+171	=2075

2075/107 = 19 with a remainder of 42

C2 = 42

Annex B
(normative)

Special considerations relating to the use of Function Code 1 (FNC1)

The FNC1 character in position D1 or D2 identifies a symbol which conforms to a specific industry standard. Unless following an application standard agreed with AIM International, users shall not use FNC1 in either of these positions.

FNC1 shall be used as defined in the EAN•UCC General Specifications either in the first position (symbol character position D1) or implied by the mode character (S).

The FNC1 character may also be used as a field separator in positions D3 to D77, in which case it will be represented in the transmitted message as GS (ASCII value 29). In applications where FNC1 is used as field separator, the ASCII control character GS shall not be used as a data character. See Annex D.

Annex C
(normative)

Using two or more “Code 16K” symbols to distribute longer data messages

C.1 General

This annex provides two procedures to encode data beyond the capacity of a single "Code 16K" symbol.

A typical scan line is many times longer than the short length (70 modules) of a "Code 16K" symbol. It could easily cross more than two symbols arranged horizontally. Therefore it is preferable for symbols to be arranged in a single vertical stack; with one exception defined in C.2.

Users should consider whether their systems are open or closed. In open systems, bar code labels produced by one company are scanned by other organisations. Given the fact that the organisation producing the symbol cannot be certain of the different types of scanner which can be used, the more robust procedures defined in C.2 shall be followed for open systems applications.

The X dimension shall be constant for all "Code 16K" symbols logically linked.

C.2 Extended data length mode

"Code 16K" symbols conforming to this option shall:

— have 16 rows;

— start data encodation in code set B;

— have different start and stop patterns for odd and even numbered symbols (see Table C.1).

In an extended data length symbol, each row in the symbol shall be assigned a unique pair of start and stop characters which identifies the row and the odd or even symbol block. Table C.1 specifies the start and stop characters.

Table C.1 – Extended data length mode start and stop values

	Odd symbol block		Even symbol block	
Row	Start	Stop	Start	Stop
1	0	0	0	2
2	1	1	1	3
3	2	2	2	4
4	3	3	3	5
5	4	4	4	6
6	5	5	5	7
7	6	6	6	0
8	7	7	7	1
9	0	4	0	6
10	1	5	1	7
11	2	6	2	0
12	3	7	3	1
13	4	0	4	2
14	5	1	5	3
15	6	2	6	4
16	7	3	7	5

NOTE The odd symbol block has start and stop character combinations as specified in Table 5. The even symbol block has start and stop character combinations which are unique to extended data length mode.

This procedure shall require the first three symbol characters to have the following structure:

Symbol Character Position	S	D1	D2
Symbol Character Value	105	position - 1	total symbols - 1

The symbol character values of D1 and D2 are used to define the sequence m of the symbol and the total number of symbols n in the extended data length option.

EXAMPLE To indicate the third symbol of a set of seven, the symbol character values for D1 and D2 shall be calculated as follows:

Third position: D1 = 3-1 = 2

Total seven symbols: D2 = 7-1 = 6

If only two symbols are to be logically linked in extended data length mode, they may be arranged horizontally or vertically adjacent to each other. If more symbols are to be logically linked, they shall be arranged in a single vertical stack. The maximum number of symbols should be specified for the application.

C.3 Message append

Message append should only be used in closed systems. The procedure shall require the first three symbol characters to have the following structure:

Symbol Character Position	S	D1	D2
Symbol Character	Any of the values defined in 4.3.4.2 (mode character)	Position of symbol within set in format of m of n symbols	FNC2

The symbol character value of D1 is used to define the sequence m of the symbol and the total number of symbols n in the Message append. The first digit of the symbol character value identifies the position m of the particular symbol. The second digit identifies the total number of symbols to be concatenated in the message append.

EXAMPLE To indicate the third symbol of a set of seven, this shall be encoded thus:

Third position: 1st digit = 3

Total 7 symbols: 2nd digit = 7

Symbol character value: 37

As each numbered row of a "Code 16K" symbol has identical structuring rules in each symbol, it is possible for a scan of the nth row of one symbol to be transposed with the nth row of another "Code 16K" symbol. This will almost certainly be detected by the double check character, but will still result in the symbol not being decoded.

To overcome this probable risk, symbols in a message append should not be arranged horizontally, but only in a single vertical stack.

Annex D
(normative)

Transmitted data

When used in position D1, D2 or implied in character S, FNC1 shall not be represented in the transmitted message, although its presence shall be indicated by the use of option value 1 or 2 respectively in the symbology identifier.

When used as a field separator FNC1 shall be represented in the transmitted message by the ASCII character <GS> (ASCII value 29).

Application standards may specify requirements for the representation of FNC1, depending on the capabilities of symbol printing equipment.

Annex E
(normative)

Symbology identifiers

The symbology identifier allocated to "Code 16K" by ISO/IEC 15424 which may be added as a preamble to the decoded data by a suitably programmed decoder is:

]Km

where:

] (ASCII value 93 in accordance with ISO 646:1991) is the symbology identifier flag character;

K is the code character for the "Code 16K" symbology;

m is a hexadecimal modifier value equal to the option value from Table E.1 below representing the applicable active option.

Table E.1 – Option Values for "Code 16K"

Value of modifier character	Option
0	Default value if none of the conditions defined in 1, 2 or 4 apply
1	FNC1 implied by mode character S, or explicit in character position D1
2	FNC1 in character position D2
4	Pad character in character position D1
Permissible values of m: 0, 1, 2, 4	

This information shall not be encoded in the bar code symbol, but should be generated by the decoder after decoding and transmitted as a preamble to the data message.

Annex F
(informative)

Use of mode, code and shift characters to minimize symbol size

The same data may be represented by different "Code 16K" symbols through the use of different combinations of mode, code and shift characters. The following guidelines may be used by programmers to minimize the symbol length. The guidelines use the following data character definitions. See also Table 1 for the "Code 16K" encodations.

control: Data characters in code set A for values 64 through 95 (ASCII values 0 inclusive to 31);

standard: Data characters in code set A and B for values 0 through 63 (ASCII values 32 to 95 inclusive) containing upper case alphabetic, numeric and punctuation. Standard also includes the four "Code 16K" function characters;

numeric: The digits 0 through 9 (ASCII values 48 to 57 inclusive);

non-numeric: Standard characters without the numeric characters;

lower case: Data characters in code set B for values 64 through 95 (ASCII values 96 to 127 inclusive).

The mode m for the mode character from the leading data characters is determined, applying the rules in order until a rule is satisfied:

a) if FNC 1 is followed by two or more numerics, then m = (code set C/FNC1);

b) if FNC 1 is followed by one numeric, standard or lower case, then m = (code set B/FNC1);

c) if an even number of numerics, then m = (code set C);

d) if an odd number of three or more numerics, then m = (code set C/Shift B);

e) if a non-numeric or lower case character is followed by an even number of numerics, then m = (code set C/Shift B);

f) if a non-numeric or lower case character is followed by an odd number of three or more numerics, then m = (code set C/ Double Shift B);

g) if a standard or lower case character is followed by a numeric or lower case followed by an even number of numerics, then m = (code set C/ Double Shift B);

h) if a control character occurs before a lower case character, then m = code A;

i) otherwise, m = code B.

Annex G
(informative)

Relationship of symbol character value to ASCII Value

In order to convert symbol character value (V) to ASCII decimal value or vice-versa, the following relationships are applicable to code A and code B sets.

Code Set A

If $V \leq 63$ then ASCII value = V + 32

If $64 \leq V \leq 95$ then ASCII value = V - 64

Code Set B

If $V \leq 95$ then ASCII value = V + 32

NOTE As described in 4.3.4.4 d) the presence of the FNC4 character has the effect of adding 128 to the ASCII value of the following data character derived from the rules given above.

Annex H
(informative)

Guidelines for the use of "Code 16K"

H.1 Autodiscrimination compatibility

"Code 16K" may be read by suitably programmed bar code decoders which have been designed to autodiscriminate it from other symbologies. The code is, in particular, fully distinguishable from, and thus compatible with:

Code 39

Code 49

Code 93

Code 128

EAN/UPC

Interleaved 2/5

The decoder's valid set of symbologies should be limited to those needed by an application to maximize reading security.

H.2 System considerations

It is important that the various components (printers, labels, scanners) making up a bar code installation operate together as a system. A failure in any component, or mismatch between them, can compromise the performance of the overall system.

The characteristics of the printer, symbol and scanner should be matched to achieve the desired performance. Deviations should only be considered where standard specifications do not yield acceptable results, and where system component vendors and integrators take appropriate care to match these components in the system.

H.3 Human readable interpretation

A human readable interpretation of the data characters (which should correspond to the characters transmitted by the decoder) should be printed with the "Code 16K" symbol encoding them. Start, stop and special characters (see Annex B for specific case of FNC1) should not be printed. Character size and font are not specified, and the interpretation may be printed anywhere in the area surrounding the symbol, as long as quiet zone boundaries are not violated (see 4.5.1 b)).

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[1] ISO/IEC 15418, *Information technology — EAN/UCC application identifiers and fact data identifiers and maintenance*

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