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Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Code 128

Technologies de l'information — Techniques d'identification automatique et de capture des données — Spécifications pour les symboles des codes à barres — Code 128

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 15417 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Annexes A to C form a normative part of this International Standard. Annexes D to H are for information only.

Introduction

The technology of bar coding is based on the recognition of patterns encoded in bars and spaces of defined dimensions. There are numerous methods of encoding information in bar code form, known as symbologies. Code 128 is one such symbology. The rules defining the translation of characters into bar and space patterns, and other essential features of each symbology, are known as the symbology specification.

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 software.

Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Code 128

1 Scope

This International Standard defines the technical requirements for the bar code symbology known as Code 128. It specifies Code 128 symbology characteristics, data character encodation, dimensions, decoding algorithms and the application parameters which need to be defined by users. It specifies the Symbology Identifier prefix strings for Code 128 symbols.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

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

ISO/IEC 10646-1, *Information technology — Universal Multiple-Octet Coded Character Set (UCS) — Part 1: Architecture and Basic Multilingual Plane.*

ISO/IEC 15424, *Information technology — Automatic identification and data capture techniques — Data carrier/symbology Identifiers.*

ISO/IEC 15416, *Information technology — Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols.*

EN 1556, *Bar coding — Terminology.*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in EN 1556 apply.

4 Requirements

4.1 Symbology characteristics

The characteristics of Code 128 are:

a) Encodable character set:

1) All 128 ASCII characters, i.e. ASCII characters 0 to 127 inclusive, in accordance with ISO 646.

2) Characters with ASCII values 128 to 255 may also be encoded.

3) 4 non-data function characters.

4) 4 code set selection characters.

5) 3 Start characters.

6) 1 Stop character.

b) Code type: Continuous.

c) Elements per symbol character: 6, comprising 3 bars and 3 spaces, each of 1, 2, 3 or 4 modules in width (Stop character: 7 elements comprising 4 bars and 3 spaces).

d) Character self-checking: Yes.

e) Symbol length: Variable.

f) Bidirectionally decodable: Yes.

g) Symbol check character: One, mandatory (see annex A.1).

h) Data character density: 11 modules per symbol character (5.5 modules per numeric character).

i) Non-data overhead: Equivalent to 35 modules.

4.2 Symbol structure

Code 128 symbols shall comprise:

a) leading quiet zone

b) a Start character

c) one or more characters representing data and special characters

d) symbol check character

e) a Stop character

f) trailing quiet zone.

Figure 1 illustrates a Code 128 symbol encoding the text “AIM”.

Figure 1 — Code 128 symbol

4.3 Character assignments

Table 1 defines all the Code 128 character assignments. In the column headed 'Element Widths' the numeric values represent the widths of the elements in modules or multiples of the X dimension.

4.3.1 Symbol character structure

The sum of the bar modules in any symbol character is always even (even parity) and that of the space modules is therefore always odd. This parity feature enables character self-checking to be carried out.

Figure 2 below illustrates Start character A.

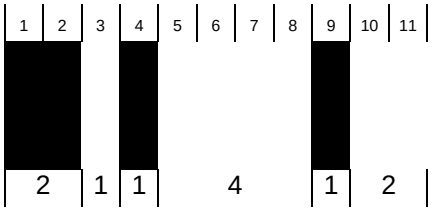

Figure 2 — Code 128 Start character A

Figure 3 below illustrates the encodation of the symbol character value 35, which represents data character ‘C’ in Code Sets A or B or the two digits ‘35’ in Code Set C.

Figure 3 — Symbol character value 35

Figure 4 below illustrates the Stop character.

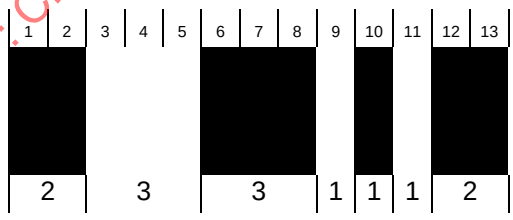

Figure 4 — Code 128 Stop character

4.3.2 Data character encodation

Code 128 has three unique data character code sets shown in Table 1 as Code Sets A, B, and C. The symbol character bar and space patterns shown represent the data characters listed under the columns for Code Set A, B, or C. The choice of code sets depends on the Start character or the use of Code A, Code B or Code C characters or the Shift character. If the symbol begins with Start character A, then Code Set A is defined initially. Code Set B and Code Set C are similarly defined by beginning the symbol with Start character B or C respectively. The code set can be redefined within the symbol by the use of Code A, Code B, and Code C characters or the Shift character (see 4.3.4.2 for the use of these special characters).

The same data may be represented by different Code 128 symbols, through the use of different combinations of Start, Code Set, and Shift characters. An application should not specify the code set to be used. Annex E contains rules to minimize the length of the symbol for any given data. A decoder shall in addition decode symbols which

use valid combinations of Start, Code Set, and Shift characters other than that specified in annex E, such as a symbol with a code set character at the end of the data.

Each symbol character is assigned a numeric value listed in Table 1. This value is used in calculating the symbol check character value. It may also be used to provide a conversion to and from ASCII values (see annex D).

Table 1 — Code 128 character encodation

SYMBOL CHAR. VALUE	CODE SET A	ASCII VALUE for Set A	CODE SET B	ASCII VALUE for Set B	CODE SET C	ELEMENT WIDTHS (modules)						ELEMENT PATTERN										
						B	S	B	S	B	S	1	2	3	4	5	6	7	8	9	10	11
0	space	32	space	32	00	2	1	2	2	2	2	■	■		■	■			■	■		
1	!	33	!	33	01	2	2	2	1	2	2	■	■			■	■		■	■		
2	"	34	"	34	02	2	2	2	2	2	1	■	■			■	■			■	■	
3	#	35	#	35	03	1	2	1	2	2	3	■			■			■	■			
4	$	36	$	36	04	1	2	1	3	2	2	■			■				■	■		
5	%	37	%	37	05	1	3	1	2	2	2	■				■			■	■		
6	&	38	&	38	06	1	2	2	2	1	3	■			■	■			■			
7	apos-trophe	39	apos-trophe	39	07	1	2	2	3	1	2	■			■					■		
8	(	40	(	40	08	1	3	2	2	1	2	■			■	■				■		
9	)	41	)	41	09	2	2	1	2	1	3	■	■			■			■			
10	*	42	*	42	10	2	2	1	3	1	2	■	■			■				■		
11	+	43	+	43	11	2	3	1	2	1	2	■	■				■			■		
12	comma	44	comma	44	12	1	1	2	2	3	2	■		■	■			■	■			
13	-	45	-	45	13	1	2	2	1	3	2	■			■	■		■	■			
14	full stop	46	full stop	46	14	1	2	2	2	3	1	■			■	■			■	■	■	
15	/	47	/	47	15	1	1	3	2	2	2	■		■	■	■			■	■		
16	0	48	0	48	16	1	2	3	1	2	2	■			■	■			■	■		
17	1	49	1	49	17	1	2	3	2	2	1	■			■	■				■	■	
18	2	50	2	50	18	2	2	3	2	1	1	■	■			■	■	■			■	
19	3	51	3	51	19	2	2	1	1	3	2	■	■			■		■	■	■		
20	4	52	4	52	20	2	2	1	2	3	1	■	■			■			■	■	■	
21	5	53	5	53	21	2	1	3	2	1	2	■	■		■	■	■			■		
22	6	54	6	54	22	2	2	3	1	1	2	■	■			■	■	■		■		
23	7	55	7	55	23	3	1	2	1	3	1	■	■	■		■	■		■	■	■	
24	8	56	8	56	24	3	1	1	2	2	2	■	■	■		■			■	■		
25	9	57	9	57	25	3	2	1	1	2	2	■	■	■			■		■	■		
26	colon	58	colon	58	26	3	2	1	2	2	1	■	■	■			■			■	■	
27	semi-colon	59	semi-colon	59	27	3	1	2	2	1	2	■	■	■		■	■			■		
28	<	60	<	60	28	3	2	2	1	1	2	■	■	■			■	■		■		
29	=	61	=	61	29	3	2	2	2	1	1	■	■	■			■	■			■	
30	>	62	>	62	30	2	1	2	1	2	3	■	■		■	■		■	■			
31	?	63	?	63	31	2	1	2	3	2	1	■	■		■	■				■	■	
32	@	64	@	64	32	2	3	2	1	2	1	■	■				■	■		■	■	
33	A	65	A	65	33	1	1	1	3	2	3	■		■				■	■			
34	B	66	B	66	34	1	3	1	1	2	3	■				■		■	■			
35	C	67	C	67	35	1	3	1	3	2	1	■				■				■	■	

SYMBOL CHAR. VALUE	CODE SET A	ASCII VALUE for Set A	CODE SET B	ASCII VALUE for Set B	CODE SET C	ELEMENT WIDTHS (modules)						ELEMENT PATTERN										
						B	S	B	S	B	S	1	2	3	4	5	6	7	8	9	10	11
36	D	68	D	68	36	1	1	2	3	1	3	■		■	■				■			
37	E	69	E	69	37	1	3	2	1	1	3	■				■	■		■			
38	F	70	F	70	38	1	3	2	3	1	1	■				■	■				■	
39	G	71	G	71	39	2	1	1	3	1	3	■	■		■				■			
40	H	72	H	72	40	2	3	1	1	1	3	■	■				■		■			
41	I	73	I	73	41	2	3	1	3	1	1	■	■				■				■	
42	J	74	J	74	42	1	1	2	1	3	3	■		■	■		■	■	■			
43	K	75	K	75	43	1	1	2	3	3	1	■		■	■				■	■	■	
44	L	76	L	76	44	1	3	2	1	3	1	■				■	■		■	■	■	
45	M	77	M	77	45	1	1	3	1	2	3	■		■	■	■		■	■			
46	N	78	N	78	46	1	1	3	3	2	1	■		■	■					■	■	
47	O	79	O	79	47	1	3	3	1	2	1	■			■	■	■			■	■	
48	P	80	P	80	48	3	1	3	1	2	1	■	■			■	■			■	■	
49	Q	81	Q	81	49	2	1	1	3	3	1	■	■		■				■	■	■	
50	R	82	R	82	50	2	3	1	1	3	1	■	■				■		■	■	■	
51	S	83	S	83	51	2	1	3	1	1	3	■	■		■	■	■		■			
52	T	84	T	84	52	2	1	3	3	1	1	■	■		■	■	■				■	
53	U	85	U	85	53	2	1	3	1	3	1	■	■		■	■	■		■	■	■	
54	V	86	V	86	54	3	1	1	1	2	3	■	■	■		■		■	■			
55	W	87	W	87	55	3	1	1	3	2	1	■	■	■		■				■	■	
56	X	88	X	88	56	3	3	1	1	2	1	■	■	■				■		■	■	
57	Y	89	Y	89	57	3	1	2	1	1	3	■	■	■		■	■		■			
58	Z	90	Z	90	58	3	1	2	3	1	1	■	■	■		■	■				■	
59	[	91	[	91	59	3	3	2	1	1	1	■	■	■				■	■		■	
60	\	92	\	92	60	3	1	4	1	1	1	■	■	■		■	■	■	■		■	
61	]	93	]	93	61	2	2	1	4	1	1	■	■			■					■	
62	^	94	^	94	62	4	3	1	1	1	1	■	■	■	■				■		■	
63	_	95	_	95	63	1	1	1	2	2	4	■		■			■	■				
64	NUL	00	grave accent	96	64	1	1	1	4	2	2	■		■					■	■		
65	SOH	01	a	97	65	1	2	1	1	2	4	■			■		■	■				
66	STX	02	b	98	66	1	2	1	4	2	1	■			■					■	■	
67	ETX	03	c	99	67	1	4	1	1	2	2	■					■		■	■		
68	EOT	04	d	100	68	1	4	1	2	2	1	■					■			■	■	
69	ENQ	05	e	101	69	1	1	2	2	1	4	■		■	■			■				
70	ACK	06	f	102	70	1	1	2	4	1	2	■		■	■					■		
71	BEL	07	g	103	71	1	2	2	1	1	4	■			■	■		■				
72	BS	08	h	104	72	1	2	2	4	1	1	■			■	■					■	
73	HT	09	i	105	73	1	4	2	1	1	2	■					■	■		■		
74	LF	10	j	106	74	1	4	2	2	1	1	■					■	■			■	

SYMBOL CHAR. VALUE	CODE SET A	ASCII VALUE for Set A	CODE SET B	ASCII VALUE for Set B	CODE SET C	ELEMENT WIDTHS (modules)						ELEMENT PATTERN										
						B	S	B	S	B	S	1	2	3	4	5	6	7	8	9	10	11
75	VT	11	k	107	75	2	4	1	2	1	1	■	■					■			■	
76	FF	12	l	108	76	2	2	1	1	1	4	■	■			■		■				
77	CR	13	m	109	77	4	1	3	1	1	1	■	■	■	■		■	■	■		■	
78	SO	14	n	110	78	2	4	1	1	1	2	■	■					■		■		
79	SI	15	o	111	79	1	3	4	1	1	1	■				■	■	■	■		■	
80	DLE	16	p	112	80	1	1	1	2	4	2	■		■			■	■	■			
81	DC1	17	q	113	81	1	2	1	1	4	2	■			■		■	■	■			
82	DC2	18	r	114	82	1	2	1	2	4	1	■			■			■	■	■	■	
83	DC3	19	s	115	83	1	1	4	2	1	2	■		■	■	■	■	■		■		
84	DC4	20	t	116	84	1	2	4	1	1	2	■			■	■	■	■		■		
85	NAK	21	u	117	85	1	2	4	2	1	1	■			■	■	■	■			■	
86	SYN	22	v	118	86	4	1	1	2	1	2	■	■	■	■		■			■		
87	ETB	23	w	119	87	4	2	1	1	1	2	■	■	■	■			■		■		
88	CAN	24	x	120	88	4	2	1	2	1	1	■	■	■	■			■			■	
89	EM	25	y	121	89	2	1	2	1	4	1	■	■		■	■	■	■	■			
90	SUB	26	z	122	90	2	1	4	1	2	1	■	■		■	■	■	■		■	■	
91	ESC	27	{	123	91	4	1	2	1	2	1	■	■	■	■		■	■		■	■	
92	FS	28	|	124	92	1	1	1	1	4	3	■		■		■	■	■	■			
93	GS	29	}	125	93	1	1	1	3	4	1	■		■				■	■	■	■	
94	RS	30	~	126	94	1	3	1	1	4	1	■				■		■	■	■	■	
95	US	31	DEL	127	95	1	1	4	1	1	3	■		■	■	■			■			
96	FNC3		FNC3		96	1	1	4	3	1	1	■		■	■	■					■	
97	FNC2		FNC2		97	4	1	1	1	1	3	■	■	■	■		■		■			
98	SHIFT		SHIFT		98	4	1	1	3	1	1	■	■	■	■		■				■	
99	CODE C		CODE C		99	1	1	3	1	4	1	■		■	■	■		■	■	■	■	
100	CODE B		FNC4		CODE B	1	1	4	1	3	1	■		■	■	■			■	■	■	
101	FNC4		CODE A		CODE A	3	1	1	1	4	1	■	■	■		■		■	■	■	■	
102	FNC1		FNC1		FNC1	4	1	1	1	3	1	■	■	■	■		■		■	■	■	
103			Start A			2	1	1	4	1	2	■	■		■					■		
104			Start B			2	1	1	2	1	4	■	■		■			■				
105			Start C			2	1	1	2	3	2	■	■		■			■	■			

SYMBOL CHAR. VALUE	CODE SET A	CODE SET B	CODE SET C	ELEMENT WIDTHS (modules)							ELEMENT PATTERN													
				B	S	B	S	B	S	B	1	2	3	4	5	6	7	8	9	10	11	12	13
-	Stop			2	3	3	1	1	1	2	■	■				■	■	■		■		■	■

NOTE The Stop character comprises 13 modules in four bars and three spaces. Every other character is 11 modules wide, starts with a bar and ends with a space and comprises six elements, each of which varies from one to four modules in width.

The numeric values in the B and S columns represent the number of modules in each bar or space element respectively in the symbol characters.

4.3.3 Code Sets

4.3.3.1 Code Set A

Code Set A includes all of the standard upper case alphanumeric characters and punctuation characters together with the control characters, i.e. characters with ASCII values from 00 to 95, and seven special characters.

4.3.3.2 Code Set B

Code Set B includes all of the standard upper case alphanumeric characters and punctuation characters together with the lower case alphabetic characters (i.e. ASCII characters 32 to 127 inclusive) and seven 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 three special characters. This allows numeric data to be encoded as two data digits per symbol character.

4.3.4 Special characters

The last seven characters of Code Sets A and B (character values 96 - 102) and the last three characters of Code Set C (character values 100 - 102) are special non-data characters with no ASCII character equivalents, which have particular significance to the bar code reading device.

4.3.4.1 Code Set and shift characters

Code Set and shift characters shall be used to change from one code set to another within a symbol. They shall not be transmitted by the decoder.

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

b) **Shift character** The Shift character changes the code set from A to B or B to A for the single character following the shift character. Characters following the affected character shall revert to the Code Set A or B defined prior to the Shift character. The shifted symbol character shall not be a Code Set or Shift character.

4.3.4.2 Function characters

Function Characters (FNC) define instructions 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 (Message Append) instructs the bar code reader to store temporarily the data from the symbol containing the FNC2 character and transmit it as a prefix to the data of the next symbol. This may be used to concatenate several symbols before transmission. This character may occur anywhere in the symbol. Where the sequence of data is significant, provision should be made to ensure reading of the symbols in the correct sequence.

c) FNC3 (Initialise) instructs the bar code reader to interpret the data from the symbol containing the FNC3 character as instructions for initialization or reprogramming of the bar code reader. The data from the symbol shall not be transmitted by the bar code reader. This character may occur anywhere in the symbol.

d) FNC4 is used to represent an extended ASCII character set (byte values 128 to 255) as specified in ISO 8859-1 or otherwise in an application specification. If a single FNC4 character is used, the value 128 is added to the ASCII value of the following data character in the symbol. A Shift character may follow the FNC4 character if it is necessary to change code set for the following data character. Subsequent data characters revert to the standard ASCII set. If two consecutive FNC4 characters are used, the value 128 is added to the ASCII value of following data characters until two further consecutive FNC4 characters are encountered or the end of the symbol is reached. If during this sequence of extended ASCII encodation a single FNC4 character is encountered it is used to revert to standard ASCII encodation for the next data character only. Shift and code set characters shall have their normal effect during such a sequence. The default reference character set for extended ASCII values 128 - 255 is the corresponding half of ISO 8859-1, Latin Alphabet 1, as shown in annex F, but application specifications may define or reference alternative sets corresponding to byte values 128 to 255.

4.3.4.3 Start and Stop characters

Start characters A, B and C define the corresponding code set to be used initially in the symbol.

The Stop character is common to all code sets.

Start and Stop characters shall not be transmitted by the decoder.

4.3.5 Symbol check character

The symbol check character shall be included as the last symbol character before the Stop character. Annex A.1 defines the algorithm for its calculation. The symbol check character shall not be represented in the human readable interpretation, nor shall it be transmitted by the decoder.

4.4 Dimensional requirements

Code 128 symbols shall conform to the following dimensions:

4.4.1 Minimum width of a module (X)

This should be defined by the application specification, having due regard to the availability of equipment for the production and reading of symbols and complying with the general requirements of the application.

The X dimension shall be constant throughout a given symbol.

4.4.2 Quiet zone

Minimum width of the quiet zone (to the left and right of the Code 128 symbol): 10X

4.5 Reference decode algorithm

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 the decodability value described in ISO/IEC 15416.

The algorithm contains the following steps to decode each bar coded character:

1. Calculate eight width measurements p, e_1, e_2, e_3, e_4, b_1, b_2, and b_3 (Figure 5).

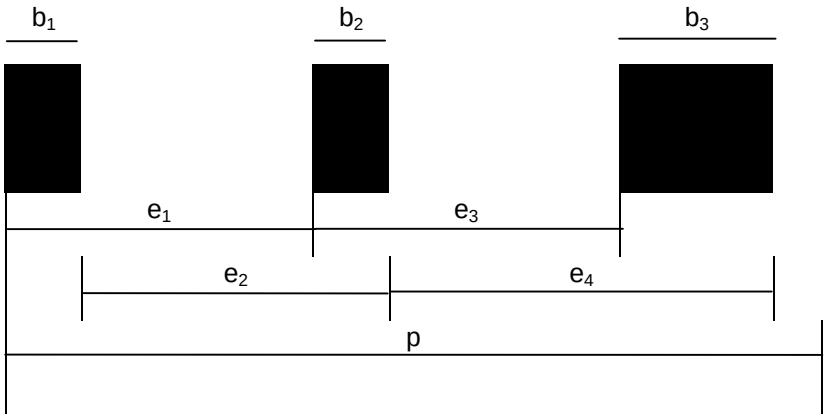

Figure 5 — Decode measurements

2. Convert measurements e_1, e_2, e_3, and e_4 to normalized values E_1, E_2, E_3, and E_4 which will represent the integral module width (E_i) of these measurements. The following method is used for the i-th value.

   If $1,5p/11 \leqslant e_i < 2,5p/11$, then $E_i = 2$.

   If $2,5p/11 \leqslant e_i < 3,5p/11$, then $E_i = 3$.

   If $3,5p/11 \leqslant e_i < 4,5p/11$, then $E_i = 4$.

   If $4,5p/11 \leqslant e_i < 5,5p/11$, then $E_i = 5$.

   If $5,5p/11 \leqslant e_i < 6,5p/11$, then $E_i = 6$.

   If $6,5p/11 \leqslant e_i < 7,5p/11$, then $E_i = 7$.

Otherwise the character is in error.

3. Look up character in decode table using the four values E_1, E_2, E_3, and E_4 as the key. (See Table 2.)

4. Retrieve character self-checking value V which is stored in the table with the character. The value V is equal to the sum of the modules for the bars as defined for that character.

5. Verify that:

   $(V-1,75)p / 11 < (b1 + b2 + b3) < (V + 1,75)p / 11$.

   Otherwise the character is in error.

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

Using these five steps, decode the first character. If it is a Start character, continue decoding the symbol in the normal forward direction. If it is not a Start character but decodes as a Stop character, attempt to decode all subsequent characters in the reverse direction.

After all characters have been decoded, make sure there was a valid Start character, a valid Stop character, and that the symbol check character is correct.

Translate the symbol characters into the appropriate data characters from Code Set A, B, or C according to the Start character, code characters, and shift characters used in the symbol.

In addition, perform such other secondary checks on quiet zones, beam acceleration, absolute timing, dimensions, etc., as are deemed prudent and appropriate considering the specific reading device and intended application environment.

NOTE In this algorithm the symbol is decoded using "edge to similar edge" measurements (e), plus an additional measurement of the sum of the three bar widths.

Table 2 — Edge differences for decoding Code 128

Char. Value	E1	E2	E3	E4	V	Char. Value	E1	E2	E3	E4	V
00	3	3	4	4	6	54	4	2	2	3	6
01	4	4	3	3	6	55	4	2	4	5	6
02	4	4	4	4	6	56	6	4	2	3	6
03	3	3	3	4	4	57	4	3	3	2	6
04	3	3	4	5	4	58	4	3	5	4	6
05	4	4	3	4	4	59	6	5	3	2	6
06	3	4	4	3	4	60	4	5	5	2	8
07	3	4	5	4	4	61	4	3	5	5	4
08	4	5	4	3	4	62	7	4	2	2	6
09	4	3	3	3	4	63	2	2	3	4	4
10	4	3	4	4	4	64	2	2	5	6	4
11	5	4	3	3	4	65	3	3	2	3	4
12	2	3	4	5	6	66	3	3	5	6	4
13	3	4	3	4	6	67	5	5	2	3	4
14	3	4	4	5	6	68	5	5	3	4	4
15	2	4	5	4	6	69	2	3	4	3	4
16	3	5	4	3	6	70	2	3	6	5	4
17	3	5	5	4	6	71	3	4	3	2	4
18	4	5	5	3	6	72	3	4	6	5	4
19	4	3	2	4	6	73	5	6	3	2	4
20	4	3	3	5	6	74	5	6	4	3	4
21	3	4	5	3	6	75	6	5	3	3	4
22	4	5	4	2	6	76	4	3	2	2	4
23	4	3	3	4	8	77	5	4	4	2	8
24	4	2	3	4	6	78	6	5	2	2	4
25	5	3	2	3	6	79	4	7	5	2	6
26	5	3	3	4	6	80	2	2	3	6	6
27	4	3	4	3	6	81	3	3	2	5	6
28	5	4	3	2	6	82	3	3	3	6	6
29	5	4	4	3	6	83	2	5	6	3	6
30	3	3	3	3	6	84	3	6	5	2	6
31	3	3	5	5	6	85	3	6	6	3	6
32	5	5	3	3	6	86	5	2	3	3	6
33	2	2	4	5	4	87	6	3	2	2	6
34	4	4	2	3	4	88	6	3	3	3	6
35	4	4	4	5	4	89	3	3	3	5	8
36	2	3	5	4	4	90	3	5	5	3	8
37	4	5	3	2	4	91	5	3	3	3	8
38	4	5	5	4	4	92	2	2	2	5	6
39	3	2	4	4	4	93	2	2	4	7	6
40	5	4	2	2	4	94	4	4	2	5	6
41	5	4	4	4	4	95	2	5	5	2	6
42	2	3	3	4	6	96	2	5	7	4	6
43	2	3	5	6	6	97	5	2	2	2	6
44	4	5	3	4	6	98	5	2	4	4	6
45	2	4	4	3	6	99	2	4	4	5	8
46	2	4	6	5	6	100	2	5	5	4	8
47	4	6	4	3	6	101	4	2	2	5	8
48	4	4	4	3	8	102	5	2	2	4	8
49	3	2	4	6	6	103	3	2	5	5	4
50	5	4	2	4	6	104	3	2	3	3	4
51	3	4	4	2	6	105	3	2	3	5	6
52	3	4	6	4	6	$Stop_A$	5	6	4	2	6
53	3	4	4	4	8	$Stop_B$	3	2	2	4	6

NOTE $Stop_A$ values are for decoding in forward direction. $Stop_B$ values apply to the first six elements of the Stop character starting at the rightmost side, when scanned in reverse direction.

4.6 Symbol quality

4.6.1 General

ISO/IEC 15416 defines a standardized methodology for measuring and grading bar code symbols. Code 128 symbols shall be evaluated according to that standard. The reference decode algorithm defined in section 4.5 of this specification shall be used for the assessment of the "decode" and "decodability" parameters under ISO/IEC 15416.

4.6.2 Decodability

For the calculation of the decodability value V the following provisions apply, which are additional to those in ISO/IEC 15416:

Substitute V1 for V_C in the formula $V_C = K / (S / 2n)$.

Calculate V2:

$$V2 = \frac{1{,}75 - \left(\mathrm{ABS}\left((W_b \times 11/S) - M\right)\right)}{1{,}75}$$

where: M = number of dark modules in the character

S = total width of the character

W_b = sum of the bar widths in the character

V_C is the lesser of V1 and V2.

NOTE The Stop character comprises an additional terminating bar. For the purpose of measuring decodability, the Stop character should be checked twice, first using the six leftmost elements and then the six rightmost elements from right to left. Both sets of six elements are equivalent in width to a standard character.

4.6.3 Quiet zones

ISO/IEC 15416 allows for additional pass/fail criteria to be stipulated by a symbology specification. In the case of Code 128, a minimum quiet zone of 10Z is specified. Both left and right quiet zones on each scan reflectance profile under ISO/IEC 15416 shall be measured and graded as follows:

Quiet Zone $\geqslant$ 10Z: Grade 4

Quiet Zone < 10Z: Grade 0

4.7 User-defined application parameters

User-defined application parameters are discussed below and in annex G.

4.7.1 Symbology and data characteristics

Application specifications should consider the following parameters:

a) Selection of a subset of the encodable character set if required.

b) The 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 (in addition to the mandatory symbol check character) is to be used and if so the algorithm for its calculation. A standard reader will not validate a data check character.

d) Minimum X dimension or range of X dimensions may or may not be specified provided that an appropriate minimum symbol quality grade (with measuring aperture and wavelength stated) is specified.

e) Minimum bar height.

f) Minimum quiet zone width larger than the 10X minimum, if expected scanning conditions require it, e.g. wand scanning of symbols with X dimension below a certain value.

g) Reference extended character set for use with FNC4.

4.7.2 Test specification

The parameters for the evaluation of symbols shall be defined by specifying a quality grade in accordance with ISO/IEC 15416 in the application standard. The grade shall include a grade level, measuring aperture, and the wavelength of light used for the measurement.

EXAMPLE

1,5 / 10 / 660

where 1,5 is the overall symbol quality grade

10 is the measuring aperture reference number (in this example 0,25mm diameter)

660 is the peak response wavelength in nanometers.

4.8 Transmitted data

Transmitted data from a decoded Code 128 symbol shall comprise the byte values of the data characters. It is prefixed by the symbology identifier defined in annex C, if used. The Start and Stop characters, function characters, code set and shift characters and symbol check character shall not be included in the transmitted data.

Annex A
(normative)

Additional features of Code 128

A.1 Symbol check character

The Code 128 symbol check character shall be calculated according to the following rules.

1. Retrieve the symbol character value from Table 1.

2. Each symbol character position is given a weighting. The Start character is weighted 1. Then, beginning on the left with the first symbol character following the Start character, the weights are 1,2,3,4, ... , n, for all following symbol characters up to, but not including, the symbol check character itself; n denotes the number of symbol characters representing data or special information in the symbol, exclusive of the Start/Stop characters and symbol check character.

   NOTE Both the Start character and the first symbol character following the Start character are weighted "1".

3. Each symbol character value is multiplied by its weighting.

4. The products of the calculation in step 3 are summed.

5. The sum of the products is divided by 103.

6. The remainder derived from the calculation in step 5 is the symbol character value of the symbol check character.

For example, to calculate the symbol check character value for the data "AIM1234":

Characters	**Start B**	**A**	**I**	**M**	**Code C**	**12**	**34**
Character Values (Step 1)	104	33	41	45	99	12	34
Weights (Step 2)	1	1	2	3	4	5	6
Products (Step 3)	104	33	82	135	396	60	204
Sum of Products (Step 4)		1014					
Divide by 103 (Step 5)		1014 / 103 = 9					
Remainder = symbol check character value		**87**					

The symbol check character shall be positioned immediately following the final data or special character and before the Stop character.

NOTE The symbol check character shall not be shown in the human-readable interpretation.

A.2 Human readable interpretation

A human-readable interpretation of the data characters (which should correspond with the characters transmitted by the decoder) should be printed with the Code 128 symbol encoding them. Start/Stop and special characters shall 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 4.4.2).

Annex B
(normative)

Special considerations relating to Function Code 1 (FNC1)

B.1 FNC1 in the first position — Reserved use for EAN.UCC system

By agreement between AIM, Inc., EAN International and the Uniform Code Council (UCC), the use of FNC1 in Code 128 symbols in the first symbol character position following the Start character has been reserved exclusively for the EAN.UCC system. EAN International and the Uniform Code Council have developed a coherent international application standard for the use of Code 128 in conjunction with data structures for the encodation of data in a wide range of specific categories. This standard is described fully in the EAN.UCC specifications.

The addresses of these organisations are:

EAN International
rue Royale 145
B-1000 BRUSSELS
Belgium

Uniform Code Council
7887 Washington Village Drive
Suite 300
Dayton, OH 45458
USA

The latest version of the EAN.UCC specifications may be obtained from these bodies, or their affiliated National Numbering Organisations.

B.2 FNC1 in the second position — Reserved use by AIM, Inc.

By agreement between AIM and other bodies, the use of FNC1 in Code 128 symbols in the second symbol character position following the Start character has been reserved to denote symbols complying with specific applications, where the need for such symbols to be unambiguously distinguished from other Code 128 symbols has been demonstrated. Permissible characters in the first symbol character position are 00 to 99 in Code Set C, A to Z, and a to z.

Details of these applications are available from AIM, Inc. whose address is:

AIM, Inc.
634 Alpha Drive,
Pittsburgh, PA 15238
USA

B.3 Other uses

The FNC1 symbol character may validly occur as the symbol check character.

FNC1 in the third or subsequent character position is transmitted as the ASCII character 29 (GS).

B.4 Transmitted data

Any application which utilizes Code 128 symbols with FNC1 in the first or second data position should require the transmission of symbology identifiers to be enabled. When FNC1 is used in the first or second position it shall not be represented in the transmitted message, although its presence is indicated by the use of modifier values 1 or 2 respectively in the symbology identifier.

When FNC1 is used in the second data position the symbol characters immediately preceding and following it shall be transmitted exactly as though the FNC1 character were not present.

FNC1 in the third or subsequent character position is transmitted as the ASCII character GS (ASCII value 29).

Annex C
(normative)

Symbology identifiers

Symbology identifiers provide a uniform methodology for reporting the symbology read, options set in the reader and any special features of the symbology encountered. The symbology identifier for Code 128 is:

]Cm

where] represents ASCII character 93, C is the code character assigned to the Code 128 symbology and m is a modifier value from Table C.1 below:

Table C.1 — Modifier values for Code 128

m	Option
0	Standard data packet. No function code 1 in first or second symbol character position after Start character
1	UCC/EAN-128 data packet — function code 1 in first symbol character position after Start character
2	Function code 1 in second symbol character position after Start character
4	Concatenation according to International Society for Blood Transfusion ISBT-128 specifications has been performed — concatenated data follows

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 D
(informative)

Relationship of symbol character value to ASCII value

In order to convert symbol character value (S) to ASCII decimal value or vice versa, the following relationships are applicable for Code Set A and Code Set B.

Code Set A

If $S \leqslant 63$,
ASCII value = S + 32

If $64 \leqslant S \leqslant 95$,
ASCII value = S – 64

Code Set B

If $S \leqslant 95$,
ASCII value = S + 32

The resulting values are shown in Table 1.

NOTE As described in 4.3.4.3.d, the presence of the FNC4 character has the effect of adding 128 to the ASCII value of the following data character or characters derived from the rules given above.