

General Specifications Change Notification (GSCN)

WR #	GSCN Name	Effective Date
20-000044	GS1-128 Character Count – Code Set C	03-07-2020

Background:

The current wording within the GS1 General Specifications v.20 on data character limitation for the GS1-128 is causing confusion for how data characters are counted in Code Set C. This is resulting in data strings being created that are too long.

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GS1 General Specification Change:

Insert the actual changes to the Gen Spec here.



5.4 Linear barcodes - GS1-128 symbology specifications

The GS1-128 barcode has been carefully designed through joint co-operation between GS1 and AIM (Association for Automatic Identification and Mobility). Use of GS1-128 barcodes provides a high degree of security and distinguishes GS1 system element strings from extraneous non-standard barcodes.

The GS1-128 symbology is a subset of the more general Code 128 symbology. By agreement between AIM and GS1, use of the Function 1 Symbol Character (FNC1) in Code 128 symbols in the first symbol character position following the start character has been reserved exclusively for the GS1 system. Code 128 is fully described in *ISO/IEC 15417*, *Information Technology - Automatic Identification and Data Capture Techniques - Bar code Symbology Specification - Code 128*. The information covered in the *GS1 General Specifications* includes:

- Sections <u>5.4.1</u>, <u>5.4.2</u>, <u>5.4.3</u>, <u>5.4.4</u>, <u>5.4.5</u> and <u>5.4.6</u>: GS1-128 symbology subset (using *ISO/IEC* 15417 for reference).
- Section <u>5.4.7</u>: GS1-128 symbology application parameters.
- Section <u>7.8</u>: Processing of data from a GS1 symbology using GS1 Application Identifiers.

5.4.1 GS1-128 symbology characteristics

The characteristics of the GS1-128 symbology are:

- Encodable character set:
 - The GS1 system requires that only the subset of *ISO/IEC 646 International Reference Version* defined in these *GS1 General Specifications* be used for GS1 Application Identifier (AI) element strings. Refer to figure <u>7.11-1</u> for the allowed encodable character set.
 - Characters with ASCII values 128 to 255 may also be encoded in Code 128 symbols. Characters with ASCII values 128 to 255 accessed by Function 4 Symbol Character (FNC4) are reserved for future use and are not used in GS1-128 barcodes.
 - Four non-data function characters. FNC2 and FNC4 are not used in GS1-128 barcodes.
 - □ Four code set selection characters (including single character code set shift).
 - Three start characters.
 - One stop character.
- Continuous code type.
- Six elements per symbol character comprising three bars (dark bars) and three spaces (light bars), each one, two, three, or four modules in width. The stop character is made up of seven elements comprising four bars (dark bars) and three spaces (light bars).
- Character self-checking.
- Variable symbol length.
- Bi-directionally decodable.
- One mandatory symbol check character (see section <u>5.4.3.6</u>).
- Data character density is 11 modules per symbol character (5.5 modules per numeric character in code set C, 13 modules per stop character).
- Non-data overhead:
 - GS1-128 barcodes have a special double character start pattern consisting of the appropriate start character and immediately followed by a Function 1 Symbol Character Code (FNC1). The FNC1 adds to the symbol's non-data overhead. The total symbol overhead is 46 modules.
 - The FNC1 character may also be used as a separator character between element strings not contained in the predefined table shown in figure <u>7.8.4-2</u>.
- GS1-128 barcode size characteristics:

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- □ The maximum physical length is 165.10 millimetres (6.500 inch) including Quiet Zones.
- The maximum number of data characters in a single symbol is 48.
- For a given length of data, the symbol size is variable between limits in X-dimension to accommodate the ranges in quality achievable by the various printing processes.

5.4.2 GS1-128 barcode structure

The GS1-128 barcode is made up as follows, reading from left to right:

- Left Quiet Zone
- The double character start pattern:
 A start character (A, B, or C)
 The Function 1 Symbol Character (FNC1)
- Data (including the GS1 Application Identifier represented in character set A, B, or C).
- A symbol check character.
- The stop character.
- Right Quiet Zone.

For human readable interpretation rules see section 4.15. For HRI rules specific to regulated healthcare retail consumer trade items, see section 4.15.1.

Figure 5.4.2-1. General format of a GS1-128 barcode



5.4.3 GS1-128 symbology character assignments

Figure <u>5.4.3.2-1</u> defines all the Code 128 character assignments. In the element width column, the numeric values represent the widths of the elements in modules or multiples of the X-dimension. GS1-128 barcode character assignments are identical to Code 128 symbol character assignments.

5.4.3.1 Symbol character structure

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

Figure 5.4.3.1-1. GS1-128 barcode start character A



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Figure <u>5.4.3.1-2</u> illustrates the encodation of <u>one the</u> symbol character <u>value 35</u>, which represents <u>the single</u> data character C in <u>both</u> code sets A or B or the <u>two distinct data character</u> digits 3 <u>and</u> 5 in code set C.





Figure 5.4.3.1-3. GS1-128 barcode stop character

	1	2	3	4	5	6	7	8	9	10	11	12	13
ſ	2	2		3			3		1	1	1	2	2

5.4.3.2 Data character encodation

Code 128 has three character sets, which are shown in figure 5.4.3.2-1 as code sets A, B, and C. GS1-128 symbology specifies a character subset of *ISO/IEC 646 International Reference Version* to ensure international compatibility. For more information see figure 7.11-1.

The symbol character bar (dark bar) and space (light bar) patterns shown in figure <u>5.4.3.2-1</u> represent the data characters listed under the columns for code set A, B, or C. <u>Each symbol</u> character in code set C encodes two data character digits or one of three auxiliary characters (code <u>A</u>, code <u>B</u> and <u>Function 1</u>). The choice of code set depends on the start character, 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 using code A, code B, and code C characters or the shift character (see section <u>5.4.3</u> for the use of special characters).

The same data may be represented by different Code 128 symbols through the use of different combinations of start character, code set, and shift characters. The individual applications do not specify code sets A, B, or C. section 5.4.7.65.4.7.7 contains rules to minimise the length of the symbol for any given data.

Each symbol character is assigned a numeric value listed in figure <u>5.4.3.2-1</u>. 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 section <u>5.4.7.65.4.7.7</u>).

Symbol character value	Code set A	ASCII value for code set A	Code set B	ASCII value for code set B	Code set C	Ele (Mi	men odule	t wic es)	iths			Eler	nent	patte	ern					
											S	1		3	4	5	6			1 1
0	space	32	space	32	00	2	1	2	2	2	2									
1	I	33	!	33	01	2	2	2	1	2	2									
2	"	34		34	02	2	2	2	2	2	1									

Figure 5.4.3.2-1. Code 128 character encodation

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Symbol character value	Code set A	ASCII value for code set A	Code set B	ASCII value for code set B	Code set C	Ele (M	emer odul	nt wie es)	dths			Ele	ment	patt	ern							
		Jeen		300 0		В	S	В	S	В	S	1	2	3	4	5	6	7	8	9	1	1
3	#	35	#	35	03	1	2	1	2	2	3										0	-
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					1						
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	comm a	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	1	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		ļ									
19	3	51	3	51	19	2	2	1	1	3	2											
20	4	52	4	52	20	2	2	1	2	3	1		ļ									
21	5	53	5	53	21	2	1	3	2	1	2		ļ									
22	6	54	6	54	22	2	2	3	1	1	2		ļ									
23	7	55	7	55	23	3	1	2	1	3	1		ļ									
24	8	56	8	56	24	3	1	1	2	2	2		ļ									
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		ļ									
29	=	61	=	61	29	3	2	2	2	1	1		ļ									
30	>	62	>	62	30	2	1	2	1	2	3		ļ									
31	?	63	?	63	31	2	1	2	3	2	1		ļ									
32	0	64	0	64	32	2	3	2	1	2	1											
33	А	65	А	65	33	1	1	1	3	2	3											
34	В	66	В	66	34	1	3	1	1	2	3											
35	С	67	С	67	35	1	3	1	3	2	1											
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		ļ									
40	н	72	н	72	40	2	3	1	1	1	3											

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Symbol character value	Code set A	ASCII value for code	Code set B	ASCII value for code	Code set C	Ele (M	men odule	t wic es)	iths			Eler	nent	patte	ern							
		set A		SET B		В	S	В	S	В	S	1	2	3	4	5	6	7	8	9	1	1
41	I	73	I	73	41	2	3	1	3	1	1										0	-
42	J	74	J	74	42	1	1	2	1	3	3											
43	к	75	к	75	43	1	1	2	3	3	1											
44	L	76	L	76	44	1	3	2	1	3	1											
45	М	77	м	77	45	1	1	3	1	2	3											
46	N	78	N	78	46	1	1	3	3	2	1											
47	0	79	0	79	47	1	3	3	1	2	1											
48	Р	80	Р	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	т	84	т	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	Х	88	х	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	١	92	١	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	а	97	65	1	2	1	1	2	4											
66	STX	02	b	98	66	1	2	1	4	2	1											
67	ETX	03	с	99	67	1	4	1	1	2	2											
68	EOT	04	d	100	68	1	4	1	2	2	1											
69	ENQ	05	е	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											
75	VT	11	k	107	75	2	4	1	2	1	1											
76	FF	12	I	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	0	111	79	1	3	4	1	1	1											
80	DLE	16	р	112	80	1	1	1	2	4	2											

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Symbol character value	Code set A	ASCII value for code set A	Code set B	ASCII value for code set B	Code set C	Ele (M	emen odul	it wic es)	iths			Eler	nent	patte	ern				
								В				1		3			7	9	1 1
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	У	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	2	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 character values	Code set A	Code set B	Code set C	Ele	men	t wio	iths	(Moo	dules	5)	Ele	mer	nt pa	itter	n					
	Chan					В				В							9	11	12	13
	Stop			2	3	З	1	1	1	2										

Note: The stop character comprises 13 modules in four bars (dark bars) and three spaces (light bars). Every other character comprises 11 modules, starts with a bar (dark bar), ends with a space (light bar), 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 (dark bar) or space (light bar) element respectively in the symbol characters.

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5.4.3.3 Code sets

This section contains information on code sets.

5.4.3.3.1 Code set A

Code set A includes all of the standard upper case alphanumeric characters and punctuation characters together with the symbology elements (e.g., characters with ASCII values from 00 to 95) and seven special characters.

5.4.3.3.2 Code set B

Code set B includes all of the standard upper case alphanumeric characters and punctuation characters together with the lowercase alphabetic characters (e.g., ASCII characters 32 to 127 inclusive) and seven special characters.

5.4.3.3.3 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.

5.4.3.4 Special characters

The last seven characters of code sets A and B (character values 96 to 102) and the last three characters of code set C (character values 100 to 102) are special non-data characters that, though they have particular significance to the barcode reader, have no ASCII character equivalents.

5.4.3.4.1 Code set and shift characters

Code set and shift characters SHALL be used to change from one code set to another within a symbol. The decoder SHALL NOT transmit them.

- Code set characters: Code A, B, or C characters change the symbol code set from the code set previously defined to the new code set, which is 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.
- 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.

5.4.3.4.2 Function characters

Function characters (FNC) provide special operations and application instructions to the barcode reading device.

- The Function 1 Symbol Character (FNC1) SHALL be subject to the special considerations defined in section <u>5.4.3.6</u>. An FNC1 in the first position following the start character of a Code-128 symbol is at all times a reserved use, which identifies the GS1 system.
- The Function 2 Character (FNC2) (Message Append) is not used in the GS1 system. It instructs the barcode reader to temporarily store the data from the symbol containing the FNC2 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.
- The Function 3 Character (FNC3) (Initialise) instructs the barcode reader to interpret the data from the symbol containing the FNC3 as instructions for initialisation or reprogramming of the barcode reader. The data from the symbol SHALL NOT be transmitted by the barcode reader. This character may occur anywhere in the symbol.
- The Function 4 Character (FNC4) is not used in the GS1 system. In Code 128 symbols, FNC4 is
 used to represent an extended ASCII character set (byte values 128 to 255) as specified in ISO

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8859-1: Information technology; 8-bit single-byte coded graphical character sets; Part 1: Latin alphabet No.1, or otherwise in an application specification. If a single FNC4 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 if it is necessary to change the code set for the following data character. Subsequent data characters revert to the standard ASCII set. If two consecutive FNC4s are used, the value 128 is added to the ASCII value of the following data characters until two further consecutive FNC4s are encountered or the end of the symbol is reached. If, during this sequence of extended ASCII encodation, a single FNC4 is encountered, it is used to revert to standard ASCII encodation for the next data character only. Shift and code set for extended ASCII values 128 to 255 is the corresponding half of *ISO 8859-1, Latin alphabet 1,* but application specifications may define or reference alternative sets corresponding to byte values 128 to 255.

5.4.3.5 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.
- The decoder SHALL NOT transmit start and stop characters.

5.4.3.6 Symbol check character

The symbol check character SHALL be included as the last symbol character before the stop character. Section <u>5.4.7.5.15.4.7.6.1</u> 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.

5.4.3.7 GS1-128 symbology start pattern

The GS1-128 symbology has special double character start patterns consisting of start (A, B, or C) and FNC1. These special start characters differentiate GS1-128 barcodes from the more generalised Code 128 symbols.

In other words, a Code 128 symbol, which begins with one of the GS1-128 symbology double character start patterns, is always a GS1-128 barcode; a Code 128 symbol, which does not begin with this start pattern, is never a GS1-128 barcode.

A Function 1 Symbol Character (FNC1) may be the symbol check character (in less than 1 percent of cases). It is also used as a separator character, when appropriate, if element strings are concatenated into a single barcode.

- Start A begins the GS1-128 symbol data encodation according to character set A.
- Start B begins the GS1-128 symbol data encodation according to character set B.

Start C begins the GS1-128 symbol data encodation according to character set C. Start character C SHOULD always be used when the data inclusive of the AI begins with four or more numeric characters.

5.4.3.8 Relationship of symbol character value to ASCII value (informative)

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 ≤ 63

Then: ASCII value = S + 32

If: $64 \le S \le 95$

Then: ASCII value = S - 64

Code set B

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If: S ≤ 95,

Then: ASCII value = S + 32

The resulting values are shown in figure 5.4.3.2-1.

Note: As described in section <u>5.4.3</u>, the Function 4 Character (FNC4) is not used in the GS1 system. However, the presence of FNC4 in Code 128 symbols has the effect of adding 128 to the ASCII value of the subsequent data character or characters derived from the rules given above.

5.4.4 Dimensional requirements

GS1-128 barcodes SHALL conform to the dimensions in the subsections that follow.

5.4.4.1 Minimum width of a module (X-dimension)

The minimum X-dimension is defined by the application specification and requirements (see section <u>5.10</u>), while considering the equipment available for symbol production and scanning. Application specifications stipulate a target and minimum and maximum width of the X-dimension, see the symbol specifications in section <u>5.10.3</u>

The X-dimension SHALL be constant throughout a given symbol.

5.4.4.2 Quiet Zone

The minimum width of the Quiet Zone to the left and right of the GS1-128 barcode is 10x.

5.4.4.3 Maximum symbol length

The maximum length of any GS1-128 barcode must be within the following limits:

- The physical length, including Quiet Zones, cannot exceed 165.10 millimetres (6.500 inches).
- The maximum number of encoded data characters <u>SHALL NOT exceedis</u> 48., <u>Data characters</u> include including the GS1 Application Identifier(s) and <u>the</u> Function 1 Symbol Character (FNC1) when used as a separator character., <u>The start</u>, <u>leading Function 1</u>, <u>symbol check and stop</u> characters are not data characters. The total number of transmitted data characters following the symbol of the symbol check character.

5.4.5 Reference decode algorithm

Barcode 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 character:

Calculate eight width measurements p, e1, e2, e3, e4, b1, b2, and b3 (see figure below).

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Figure 5.4.5-1. Decode measurements



- Convert measurements e₁, e₂, e₃, and e₄ to normalised values E₁, E₂, E₃, and E₄, which will
 represent the integral module width (E_i) of these measurements. The following method is used
 for the i-th value:
 - $\label{eq:interm} \Box \quad \mbox{If $1,5p/11 \le e_i < 2,5p/11$, then $E_i = 2$}$
 - If 2,5p/11 \leq e_i < 3,5p/11, then E_i = 3
 - If $3,5p/11 \le e_i < 4,5p/11$, then $E_i = 4$
 - If $4,5p/11 \le e_i < 5,5p/11$, then $E_i = 5$
 - If $5,5p/11 \le e_i < 6,5p/11$, then $E_i = 6$
 - □ If $6,5p/11 \le e_i < 7,5p/11$, then $E_i = 7$

Otherwise the character is in error.

- Look up the character in the decode table using the four values E1, E2, E3, and E4 as the key (see figure <u>5.4.5-2</u>).
- Retrieve the self-checking symbol character 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 (dark bars) as defined for that character.
- 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 nonsystematic 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 is 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 other secondary checks on Quiet Zones, beam acceleration, absolute timing, and dimensions that are 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) and an additional measurement of the sum of the three bar (dark bar) widths.

Figure 5.4.5-2. Edge differences for decoding code 128 symbols

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

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Char. value	E1	E2	E3	E4	V	Char. value	E1	E2	E3	E4	V
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	/	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	5	5	2	6
29	2	4	4	3	6	83	2	5	0 E	3	6
30	3	3	5	5	6	04 95	3	6	5	2	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

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Char. value	E1	E2	E3	E4	V	Char. value	E1	E2	E3	E4	V
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	Stop₄	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 a forward direction. Stop_B values apply to the first six elements of the stop character starting at the rightmost side when scanned in a reverse direction.

5.4.6 Symbol quality

5.4.6.1 General

ISO/IEC 15416 defines a standardised methodology for measuring and grading barcodes. Code 128 symbols SHALL be evaluated according to that standard. The reference decode algorithm defined in section 5.3.2.3 SHALL be used for the assessment of the decode and decodability parameters under ISO/IEC 15416.



Note: For GS1-128 barcode minimum quality levels, refer to section <u>5.4.7</u>.

5.4.6.2 Decodability

Decodability is a measure of how closely the decode algorithm measurement values approach those in a theoretically perfect symbol. Thus, decodability is a parameter that measures how closely the Scan Reflectance Profile is to approaching decode failure for a given printed symbol.

For the calculation of the decodability value V, the following provisions apply, which supplement those described in ISO/IEC 15416 for edge to similar edge decodable symbologies:

Substitute V1 for VC in the formula VC = K / (S / 2n)

- Where: \mathbf{K} = the smallest difference between a measurement and a reference threshold.
 - **N** = 11 (number of modules in a symbol character).
 - \mathbf{S} = total width of the character.

Calculate V2

$$V2 = \frac{1,75 - \left(ABS\left(\left(Wb \ x\frac{11}{S}\right) \cdot M\right)\right)}{1,75}$$

Where: \mathbf{M} = number of dark modules in the character.

- \mathbf{S} = total width of the character.
- **Wb** = sum of the bar (dark bar) widths in the character.

ABS = mathematical term for taking the absolute of the calculation that follows.

VC is the lesser of V1 and V2.

The stop character includes an additional terminating bar (dark bar). For the purpose of measuring decodability, the stop character SHOULD be checked twice: first using the six leftmost elements and then using the six rightmost elements from right to left. Both sets of six elements are equivalent in width to a standard character.

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5.4.6.3 Quiet Zone measurement

The Quiet Zones to the right and left of the GS1-128 barcode are compulsory. Both Quiet Zones have a minimum width of 10x.

ISO/IEC 15416 allows for additional pass/fail criteria to be stipulated by a symbology specification. In the case of a GS1-128 barcode, a minimum Quiet Zone of 10Z is specified. Both left and right Quiet Zones on each Scan Reflectance Profile (SRP) under ISO/IEC 15416 SHALL be measured and graded as follows:

- Quiet Zone \geq 10Z: Grade 4 (A).
- Quiet Zone < 10Z: Grade 0 (F).

Where Z = the average measured width of the narrow bars (dark bars) and spaces (light bars) (one module) in the symbol.

5.4.6.4 Transmitted data

Transmitted data from a decoded GS1-128 barcode SHALL comprise the byte values of the data characters. It is prefixed by the symbology identifier **]C1**, 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.



Note: For GS1-128 symbology implementation, see section <u>5.4.7</u>.

5.4.7 GS1-128 symbology application parameters

5.4.7.1 Symbol height

The symbol height of a GS1-128 symbol depends on the specific application requirements. Please see section 5.10.3 for minimum symbol height specifications.

5.4.7.2 Symbol length

The dimensions of the GS1-128 barcode depend on the number of characters encoded:

- 1 start character x 11 modules = 11
- Function 1 Symbol Character (FNC1) x 11 modules = 11
- 1 symbol check character x 11 modules = 11
- 1 stop character x 13 modules = 13

N symbol characters x 11 modules = 11N

(11N + 46) modules

Where N is the number of symbol characters, any auxiliary characters (shift and code characters) embedded in the data are included.

A module is equal to the X-dimension of the symbol.

Character set C allows two digits to be encoded in one symbol character. Thus, numeric data can be encoded with twice the density of other data when using character set C.

In addition, Quiet Zones to the right and left of the barcode are compulsory and both have widths of 10 modules.

Thus total symbol length, including Quiet Zones, is: **(11N + 66) modules = (11N + 66) X** <u>Please see section 5.4.4.3 for maximum symbol length specifications</u>

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5.4.7.3 Maximum symbol length

Two parameters have to be taken into consideration for defining the maximum length of a GS1-128 barcode: the physical length, which depends on the number of characters encoded and the module width (or X-dimension) used, and the number of data characters encoded excluding the auxiliary characters.

The maximum length of any GS1-128 barcode must be within the following limits:

The physical length, including Quiet Zones, cannot exceed 165.10 millimetres (6.500 inches).

The maximum number of encoded data characters is 48, including the GS1 Application Identifier(s) and Function 1 Symbol Character (FNC1) when used as a separator character, but excluding the auxiliary characters and the symbol check character.

5.4.7.45.4.7.3 Human readable interpretation

For human readable interpretation rules see section <u>4.15</u>. For HRI rules specific to regulated healthcare retail consumer trade items, see section <u>4.15.1</u>.

5.4.7.5 5.4.7.4 Transmitted data (FNC1)

The following GS1-128 symbology implementation specifications are in accordance with ISO/IEC 15417 Appendix 2 for transmitted data:

- The Function 1 Symbol Character (FNC1) may validly occur as the symbol check character.
- FNC1 in the third or subsequent character position is transmitted as the control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)).
- For symbols using FNC1 in the first data position scanners SHOULD have symbology identifiers enabled.

When FNC1 is used in the first position, it SHALL NOT be represented in the transmitted message, although its presence is indicated by the use of modifier value 1 in the symbology identifier.

5.4.7.65.4.7.5 Additional features of GS1-128 (normative)

5.4.7.6.15.4.7.5.1 Symbol check character

- The GS1-128 symbol check character SHALL be calculated according to the following rules.
- 1. Retrieve the symbol character value from figure <u>5.4.3.2-1</u>.
- 2. Each symbol character position is given a weight. 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, and 4 to...n for all subsequent 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 and stop characters and symbol check character.



- 3. Each symbol character value is multiplied by its weight.
- 4. The products of the calculations in step 3 are totalled.
- 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.

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