General Specifications Change Notification (GSCN)

WR #	GSCN Name	Ratification Date
23-244	Correction of notation for prime number in check character calculation	Oct 2023

Associated Work Request (WR) Number:

Background:

Current notation in section 7.9.5 Check character calculation (for alphanumeric keys) is confusing because of the two usages of $P_{n.}$ Changes are proposed to differentiate the prime number from the position in the string of characters.

Disclaimer:

7.9.4 Check digit calculation for the five-digit price field

Figure 7.9.4-1. Assigned weighting factors

Assigned weighting factors					
Digit positions	1	2	3	4	5
Weighting factor	5+	2-	5-	5+	2-

- **Calculation step 1**: Determine the weighted product for each number in positions one to five according to the assigned weighting factors.
- **Calculation step 2**: Add the products of step 1.
- **Calculation step 3**: Subtract the result from the nearest equal or higher multiple of 10.
- **Calculation step 4**: Take the result and search for the same number in the weighted product row of figure 7.9.2–4. The check digit is the number in the digit row of the same column.

Figure 7.9.4-2. Example of a check digit calculation

Example of a check digit calculation						
Price field positions	1	2	3	4	5	
Assigned weighting factor	5+	2-	5-	5+	2-	
Amount	1	4	6	8	5	
Step 1: weighted product according to figure	5	8	7	4	9	
Step 2: sum	+	+	+	+	+	= 33
Step 3: result of subtraction (40 - 33)						= 7
Step 4: weighted product 7 in the figure weighting factor 5- shows number 6 to be the check digit.						

7.9.5 Check character calculation (for alphanumeric keys)

GS1's check character algorithm uses MOD 1021,32 to calculate the check character pair for use in alphanumeric data structures (GS1 AI encodable character set, see section 7.11). The check character pair utilises uppercase alpha and numeric characters (see figures below). The check character set reduces potential keying errors by removing 0, O and 1, I (similar looking numeric alpha characters) from the possible results. The check character pairing also becomes more readily recognised due to the uppercase alpha numeric character structure. The check character pair enables the detection of various keying and encoding errors, including but not limited to:

- Character substitution(s)
- Character transposition(s)
- Logical shifts
- Character addition(s)
- Character omission(s)

Check character calculation steps:

- **Calculation step 1:** For each character, retrieve the assigned reference value from table 7.9.5-1
- **Calculation step 2:** Each symbol character position is given a prime number weight. Beginning with the right most non-check character (X_j) and progressing left to first character (N_1) the prime weight increases 2, 3, 5, 7, 11, 13, to ~~PW_n~~ WP_n; "WP_n" denotes the n^{th} prime number where "n" is the number of characters representing data not including the check character pair.
- **Calculation step 3:** Multiply each assigned reference value (from step 1) by the weight (from step 2).
- **Calculation step 4:** Total the results of the calculations in step 3.

- **Calculation step 5:** Perform a MOD **1021** on the sum of the products (step 4).
- **Calculation step 6:** The result of step 5 is the check character's reference value.
- **Calculation step 7:** Based on the check character's reference value (Ck), determine the GMN check character using the following:

a. Ck = C1 * 32 + C2, (C1, C2 are the assigned reference values for table 7.9.5-2)
   i. C1 = INT (Ck / 32), (the whole number to the left of the decimal)
   ii. C2 = Ck MOD 32

b. Retrieve the alphanumeric characters for X_{j+1} and X_{j+2} using C1 and C2

Figure 7.9.5-1. GS1 AI encodable character reference values

Character set	Assigned value	Character set	Assigned value	Character set	Assigned value
!	0	B	30	e	60
"	1	C	31	f	61
%	2	D	32	g	62
&	3	E	33	h	63
'	4	F	34	i	64
(	5	G	35	j	65
)	6	H	36	k	66
*	7	I	37	l	67
+	8	J	38	m	68
,	9	K	39	n	69
-	10	L	40	o	70
.	11	M	41	p	71
/	12	N	42	q	72
0	13	O	43	r	73
1	14	P	44	s	74
2	15	Q	45	t	75
3	16	R	46	u	76
4	17	S	47	v	77
5	18	T	48	w	78
6	19	U	49	x	79
7	20	V	50	y	80
8	21	W	51	z	81
9	22	X	52		
:	23	Y	53		
;	24	Z	54		
<	25	_	55		
=	26	a	56		
>	27	b	57		
?	28	c	58		
A	29	d	59		

Figure 7.9.5-2. Check character reference values

Character set	Assigned value		Character set	Assigned value		Character set	Assigned value
2	0		D	11		Q	22
3	1		E	12		R	23
4	2		F	13		S	24
5	3		G	14		T	25
6	4		H	15		U	26
7	5		J	16		V	27
8	6		K	17		W	28
9	7		L	18		X	29
A	8		M	19		Y	30
B	9		N	20		Z	31
C	10		P	21			

Figure 7.9.5-3. Example of a check character calculation (based on 25 character Global Model Number)

Position	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}
GMN	1	9	8	7	6	5	4	A	d	4	X	4	b	L
Assigned value	14	22	21	20	19	18	17	29	59	17	52	17	57	40
Multiply by weighting factor (W_n)	X 83	X 79	X 73	X 71	X 67	X 61	X 59	X 53	X 47	X 43	X 41	X 37	X 31	X 29
Results to sum	1162	1738	1533	1420	1273	1098	1003	1537	2773	731	2132	629	1767	1160

Example of a check character calculation for 25-character GMN continued

Position	P_{15}	P_{16}	P_{17}	P_{18}	P_{19}	P_{20}	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}
GMN	5	t	t	r	2	3	1	0	c	**2**	**K**
Assigned value	18	75	75	73	15	16	14	13	58		
Multiply by weighting factor (W_n)	X 23	X 19	X 17	X 13	X 11	X 7	X 5	X 3	X 2		
Results to sum	414	1425	1275	949	165	112	70	39	116		

Summary totals	
Sum weighted assigned values	24521
MOD **1021** for the sum weighted assigned values	17
Integer Results of MOD **1021** Sum weighted assigned values divided by 32	**0**
Remainder of MOD **1021** Sum weighted assigned values multiplied by 32	**17**
Check character for position P_{24} referenced from Figure 7.9.5-2	**2**
Check character for position P_{25} referenced from Figure 7.9.5-2	**K**

7.10 GTIN-12 and RCN-12 in a UPC-E barcode

Some of the GTIN-12 and RCN-12 number ranges beginning with the U.P.C. Prefix 0 may be represented in a small symbol called the UPC-E barcode (see section 2.1).

The GTIN-12 or RCN-12 is condensed into a barcode consisting of six symbol character positions. For application processing, the GTIN-12 or RCN-12 must be transformed into its full length by the barcode reader software or by the application software. There is no six-digit UPC-E barcode.

It is possible to create false UPC-E barcodes if the encodation rules are not properly observed. Whether the digits represented in a UPC-E barcode can be expanded correctly to a GTIN-12 is verified by the following tests.