**Extended Encoding Scheme for Chipotle**

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This is a description of an encoding scheme for compressing traceability information into the 128-bit EPC memory of an RFID tag. The data contained includes an identifier, a GTIN, a date type, a date value, and an alphanumeric lot number. The following describes the purpose of each field and how it is created.

Note: Throughout this document, the notation 0xHH is used to represent a hexadecimal value. For example, 0x12 would be the hex representation of the binary number 0001 0010 which would be 18 in decimal. The asterisk character, “\*”, is used to represent multiplication. The arrow, “🡪”, means “yields” or “results in.” Thus, 0x12 \* 0xA 🡪 18 \* 10 🡪 180.

**Structure:**

**Id**

8 bits. identifies the tag encoding in order to distinguish it from other tags.

**GTIN**

46 bits. The Global Trade Identification Number with the check digit.

**Date**

Type – 2 bits, a value identifying the type of date represented

Value – 13 bits, a compressed date containing the last digit of the year (4 bits), the month (4 bits), and day of month (5 bits)

**Lot Number**

59 bits. Up to 11 uppercase alphanumeric characters or three symbols (“-“, “.”, or “:”).

**Serial Number**

The serial number is not encoded in the standard rfid memory. The TID is used as a serial number to separate individual items.

**Encoding:**

**Id** – 8 bits - The Id is chosen to distinguish this tag encoding scheme from other schemes. No value has been assigned yet.

**GTIN** – 46 bits – The GTIN value (less the check digit) is a 14-digit number encoded as a binary value. (Max value 70368744177663)

**Date** – 15 bits total – The date field consists of a date type and a date value.

**Type** -2 bits – The date type is derived from the following table:

|  |  |
| --- | --- |
| Value | Meaning |
| 0 | Production/harvest date (AI 11) |
| 1 | Packaging date (AI 13) |
| 2 | Best-before date (AI 15) |
| 3 | Expiry date (AI 17) |

**Value** – 13 bits – The date value is calculated as follows and expressed as a binary value:

Value = (512 \* (last digit of year)) + (32 \* month) + day-of-month

This can also be visualized as the last digit of the year in binary followed by the month in binary followed by the day in binary. (yyyymmmmddddd)

**Lot number** – 59 bits total – Up to 11 uppercase alphanumeric characters or three symbols (“-“, “.”, or “:”). The encoding is done using the index of the characters in Table 1 at the end of this document. The first two characters are encoded together, followed by the remaining characters in groups of three. If there are fewer than 11 characters, the pad character (0) is used for the remaining characters. The radix-40 calculation is as follows:

Value1 = 40\*A1 + A2

Value2 = 40\*40\*A3 + 40\*A4 + A5

Value3 = 40\*40\*A6 + 40\*A7 + A8

Value2 = 40\*40\*A9 + 40\*A10 + A11

Where the A values are taken from Table 1 at the end of this document. The values, in binary, are concatenated to form the 59-bit stream representing the lot number.

**Serial Number** – There is no serial number included in the rfid stream. Instead, the TID is used to uniquely identify each item.

**Encoding Example 1:**

**Id** – FE 🡪 0xFE

**GTIN** – 01234567890128 🡪 0x011F71FB04D0

**Date Type** – Expiry date, AI 17 🡪 3 🡪 0x3

**Date Value** - '06/11/2020 🡪 (0x200 \* 0) + (0x20 \* 6) + 11 🡪 0x00CB

**Lot** – A1B23C45D67 🡪

A1 🡪 40\*1 + 31 🡪 71 🡪 0x47

B23 🡪 40\*40\*2 + 40\*32 + 33 🡪 4153 🡪 0x11A1

C45 🡪 40\*40\*3 + 40\*34 + 35 🡪 6195 🡪 0x1833

D67 🡪 40\*40\*4 + 40\*36 + 37 🡪 7877 🡪 0x1EC5

Lot result: 0x04711A118331EC5

**Shift and combine values:**

Id 0xFE

GTIN 047DC7EC1340 🡨 Shifted 2 bits left

Date Type 3

Date Value 0658 🡨 Shifted 3 bits left

Lot 04711A118331EC5

**Final 0xFE047DC7EC134306584711A118331EC5**

**Encoding Example 2** (less than 11-character lot number)**:**

**Lot** – XR-7 🡪

XR 🡪 40\*24 + 18 🡪 978 🡪 0x3D2

-7 🡪 40\*40\*27 + 40\*37 + 0 🡪 44680 🡪 0xAE88

[Pad] 🡪 40\*40\*0 + 40\*0 + 0 🡪 0 🡪 0x0000

[Pad] 🡪 40\*40\*0 + 40\*0 + 0 🡪 0 🡪 0x0000

**Lot result: 0x3D2AE8800000000**

**Decoding Example:**

**Input 0x** **FE001A1A658B09079847CD43E0600000**

**Separate fields:**

Id 0xFE

GTIN 001A1A658B08

Date Type 1

Date Value 0798

Lot 047CD43E0600000

**Shift values:**

GTIN 0x001A1A658B08 🡪 0x0006869962C2

Date Value 0x0798 🡪 0x00F3

**Id** - 0xFE identifies the encoding used.

**GTIN** – 0x0006869962C2 🡪 00028028003010

**Date Type** – 0x1 🡪 1 🡪 AI 13, packing date

**Date Value** - 0x00F3 🡪 00719 🡪 07/19/2020

**Lot** – 0x047CD43E0600000 🡪 047 CD43 E060 0000

Calculate first two characters: 0x047 🡪 71

Calculate first and second character value: 71/40 = 1 with a remainder of 31

Look up characters in Table 1: 1 🡪 A, 31 🡪 1

Calculate next three characters: 0xCD43 🡪 52,547

Calculate first value: 52547/(40\*40) = 32 with a remainder of 1347

Calculate first value: 1347/40 = 33 with a remainder of 27

Look up characters in Table 1: 32 🡪 2, 33 🡪 3, 27 🡪 “-“

Repeat for next two sets of three characters

…

**Lot combined** – A123-56

**Table 1 – Radix-40 Character Set**

Symbol Name ASCII Binary Code

PAD 0

A Capital letter A 0x41 01000001 1

B Capital letter B 42 01000010 2

C Capital letter C 43 01000011 3

D Capital letter D 44 01000100 4

E Capital letter E 45 01000101 5

F Capital letter F 46 01000110 6

G Capital letter G 47 01000111 7

H Capital letter H 48 01001000 8

I Capital letter I 49 01001001 9

J Capital letter J 4A 01001010 10

K Capital letter K 4B 01001011 11

L Capital letter L 4C 01001100 12

M Capital letter M 4D 01001101 13

N Capital letter N 4E 01001110 14

O Capital letter O 4F 01001111 15

P Capital letter P 50 01010000 16

Q Capital letter Q 51 01010001 17

R Capital letter R 52 01010010 18

S Capital letter S 53 01010011 19

T Capital letter T 54 01010100 20

U Capital letter U 55 01010101 21

V Capital letter V 56 01010110 22

W Capital letter W 57 01010111 23

X Capital letter X 58 01011000 24

Y Capital letter Y 59 01011001 25

Z Capital letter Z 5A 01011011 26

– Hyphen-Minus 2D 00101101 27

. Full stop 2E 00101110 28

: Colon 3A 00101110 29

0 Digit zero 30 00110000 30

1 Digit one 31 00110001 31

2 Digit two 32 00110010 32

3 Digit three 33 00110011 33

4 Digit four 34 00110100 34

5 Digit five 35 00110101 35

6 Digit six 36 00110110 36

7 Digit seven 37 00110111 37

8 Digit eight 38 00111000 38

9 Digit nine 39 00111001 39