STEP-BY-STEP WORKSHEET
EPC Encoding for Products

Use this worksheet to go step by step through the process of encoding product and serial data into the EPC using the SGTIN-96 identification key.

The use of the Electronic Product Code (EPC®) with RAIN RFID is an effective bridge from today's barcode-based systems to Radio Frequency Identification (RFID) while extending your current investment in GS1 Standards-based identification systems, transaction systems, or other information-sharing techniques.

Before you get started with EPC-enabled RFID, you will need to understand some terms.

What to Know

The UPC-A barcode, which identifies products at point-of-sale (POS), contains a GTIN-12. The GTIN-12 is comprised of a **UPC Company Prefix**, **Item Reference Number**, and **Check Digit**, for a total of 12 digits.

The SGTIN-96 is one of the EPC schemes. It is a combination of a Global Trade Item Number® (GTIN®) plus a Serial Number. Both the GTIN and Serial Number in the Serial Global Trade Item Number (SGTIN) are defined to be equivalent to specific application identifiers (AIs)—AI (01) and AI (21). See the GS1 General Specifications for more details.

Get Started →

To get started, find the product's Universal Product Code (UPC). If you already have your GTIN, check the "Note" on the worksheet for where to start.

UPC Company Prefix
This number can be found on your GS1 Company Prefix Certificate.

Check Digit
Calculated digit based on previous 11 digits to ensure the GTIN is created correctly. The Check Digit is always the last number.

6 14141 00734 9

Item Reference Number
Assigned by the owner of the UPC Company Prefix. These are the numbers that follow your UPC Company Prefix.

Getting Started

Follow This Example

Use this sheet to go step by step through the process, using our UPC-A barcode (GTIN-12) example as a reference guide. Check the "Note" sections throughout this document to see where to start if you already have your GTIN or SGTIN. Please see the EPC Tag Data Standard section named "Individually assigned GTINs" for guidance encoding a single issuance GTIN into an SGTIN.

Your Translation

Use these boxes to fill out your information as you read along with the example.

1. Separate Your UPC Into Its Component Parts

First, determine which numbers are your **UPC Company Prefix**, **Item Reference Number**, and **Check Digit**. You can confirm which digits represent your UPC Company Prefix by looking for them on your GS1 US Company Prefix Certificate. Alternatively, you can look this up using the Global Electronic Party Information Registry (GEPIR®). The final digit is your Check Digit. The digits in between are your Item Reference Number.

> **Note** *Your UPC Company Prefix can be as long as 10 digits.*

Our Example

UPC Company Prefix →						← Item Reference					Check Digit
N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}

Your Translation

UPC Company Prefix | Item Reference Number | Check Digit

2. Transform Your UPC Company Prefix Into a GS1 Company Prefix

To change your UPC Company Prefix into a **GS1 Company Prefix**, simply add a "0" in front. You should then have 13 digits.

> **Note** *GS1 Company Prefixes can be as long as 11 digits.*

Our Example

0	6	1	4	1	4	1	0	0	7	3	4	9

GS1 Company Prefix | Item Reference Number | Check Digit

Your Translation

0 | GS1 Company Prefix | Item Reference Number | Check Digit

3. Translate to a GTIN

To translate to a 14-digit GTIN, you need to add either "0" as a **Filler Digit** or a value ranging from "1" to "9" as an **Indicator Digit**. It must encode a fixed-length data string of 14 digits. The GTINs less than 14 digits in length must be prefixed by leading "0s" that simply act as **Filler Digits**. Place a "0" (more if needed) in front of your **GS1 Company Prefix**.

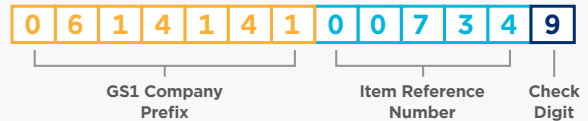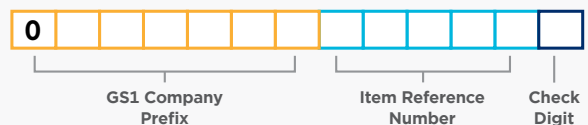> **Note** *If you already have a 14-digit GTIN, you can start at this step.*
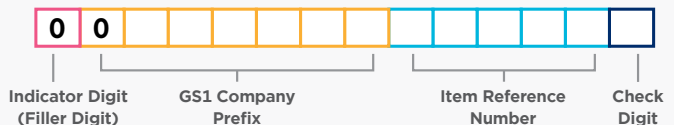
Our Example

0	0	6	1	4	1	4	1	0	0	7	3	4	9

Indicator Digit (Filler Digit) | GS1 Company Prefix | Item Reference Number | Check Digit

Your Translation

0 | 0 | ...

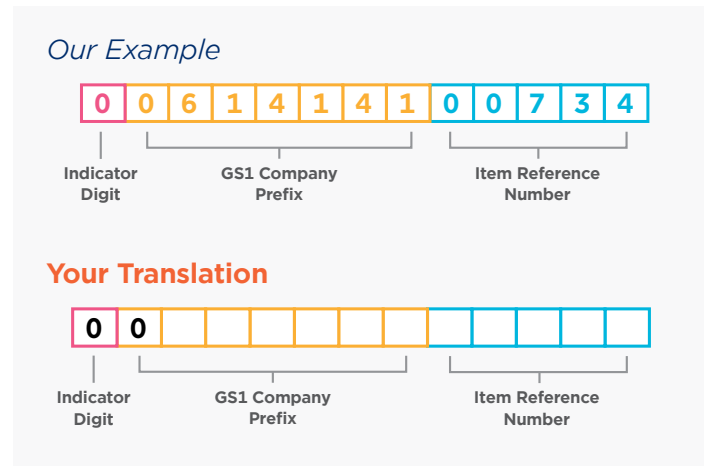Indicator Digit (Filler Digit) | GS1 Company Prefix | Item Reference Number | Check Digit

4. Drop Your Check Digit

Check Digits are a way for you to manually ensure you have the right sequence of numbers for your UPC-A barcode (GTIN-12), but EPC technology uses other forms of checking. Simply drop your last digit.

Our Example

| 0 | 0 | 6 | 1 | 4 | 1 | 4 | 1 | 0 | 0 | 7 | 3 | 4 |

Indicator Digit | GS1 Company Prefix | Item Reference Number

Your Translation

| 0 | 0 | | | | | | | | | | |

Indicator Digit | GS1 Company Prefix | Item Reference Number

5. Move Your Indicator Digit

To speed up the RFID reader performance in finding products from a particular brand owner, we move the **Indicator Digit** to join the **Item Reference Number** as its first digit.
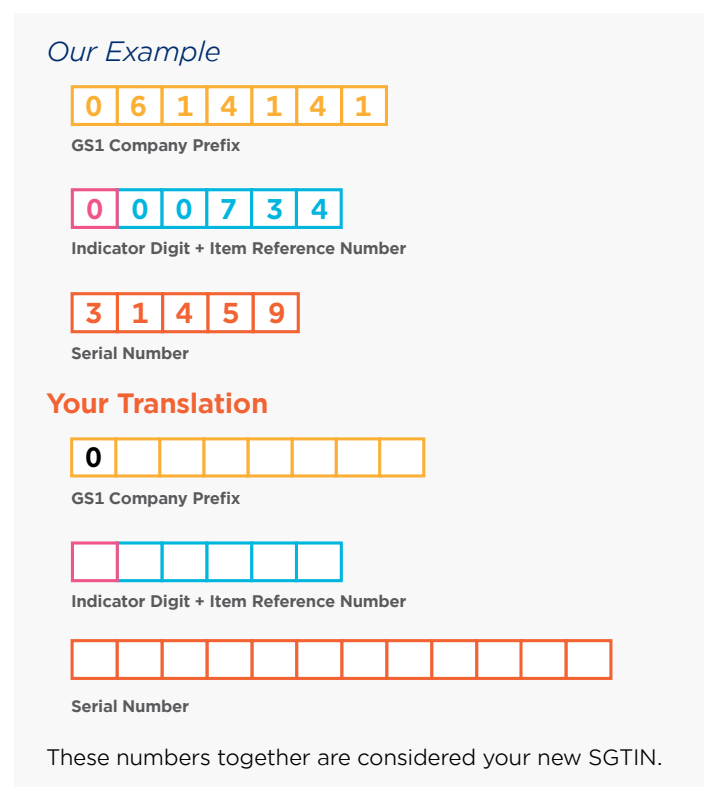
Our Example

| 0 | 6 | 1 | 4 | 1 | 4 | 1 | 0 | 0 | 0 | 7 | 3 | 4 |

GS1 Company Prefix | Indicator Digit | Item Reference Number

Your Translation

| 0 | | | | | | | | | | | |

GS1 Company Prefix | Indicator Digit | Item Reference Number
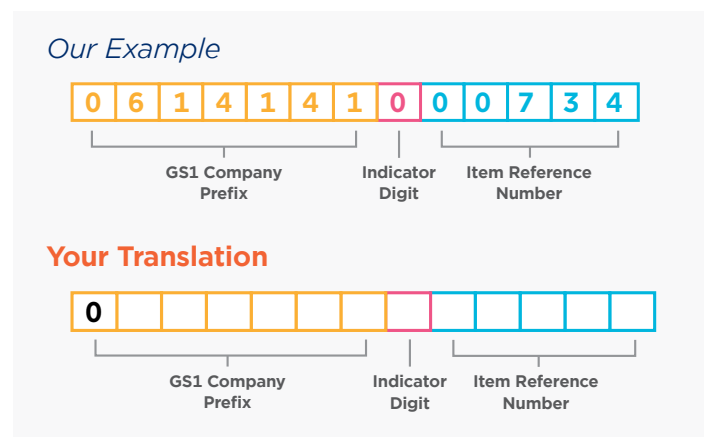
6. Add a Unique Serial Number

Serial Numbers are unique numeric strings that can be up to 12 digits (for a 96-bit RFID tag). These numbers are brand-owner driven, so you choose the way you'd like to number them. We advise you to keep it simple and not add logic to the Serial Number itself. GS1 US® has published guidelines to help you choose an appropriate method for allocating and assigning Serial Numbers for EPCs.

EPCs are represented in an internet-friendly format that separates the fields in your EPC with dots, so set your sequence up as follows:

| Note | *For use in a 96-bit RFID tag, the Serial Number may be from one to 12 digits. It must be less than or equal to 274,877,906,943, and the first digit may not be a 0. You might not fill out all of the boxes on the right, depending on the length of your GS1 Company Prefix and Serial Number.* |

Our Example

| 0 | 6 | 1 | 4 | 1 | 4 | 1 |

GS1 Company Prefix

| 0 | 0 | 0 | 7 | 3 | 4 |

Indicator Digit + Item Reference Number

| 3 | 1 | 4 | 5 | 9 |

Serial Number

Your Translation

| 0 | | | | | | |

GS1 Company Prefix

| | | | | | |

Indicator Digit + Item Reference Number

| | | | | | | | | | | |

Serial Number

These numbers together are considered your new SGTIN.
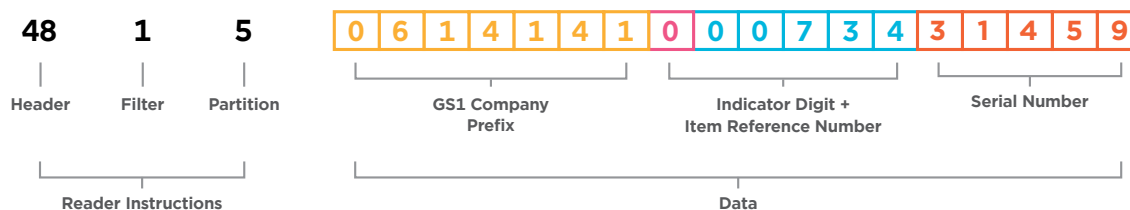
EPC Structure

Understanding EPC Structure

EPCs are structured into six blocks of information that help the reader understand how to read your code. In this instruction, all values will be decimal and binary numbers.

48	1	5	0 6 1 4 1 4 1	0 0 0 7 3 4	3 1 4 5 9
Header	Filter	Partition	GS1 Company Prefix	Indicator Digit + Item Reference Number	Serial Number

Reader Instructions — Data

Header: Per the EPC Tag Data Standard, for an SGTIN-96 RFID tag, this value is always the 8-bit binary value corresponding to decimal number 48, which is equivalent to hexadecimal number 30.

Filter: The filter value lets the reader filter out certain types of RFID tags, allowing you to identify which tags you want to read and which to ignore. As shown in the example below, the filter value of "1" is used to describe a POS item. Reference the EPC Tag Data Standard for additional information regarding these values.

Partition: The partition value identifies how many digits are in the GS1 Company Prefix.

GS1 Company Prefix: Reference Step 2.

Indicator Digit + Item Reference Number: Reference Steps 3 and 5.

7. Determine Your Header Value

For this example, we use the header value for a 96-bit SGTIN EPC format, which are the decimal values "48" (hexadecimal value 30). All GS1 Application Identifiers have EPC formats, each with a unique header value that can be found in the EPC Tag Data Standard. Reference this to find your EPC-format header value.

Note	*If you already have an SGTIN, start at this step.*

Our Example

48
Header

0	6	1	4	1	4	1

GS1 Company Prefix

0	0	0	7	3	4

Indicator Digit + Item Reference Number

3	1	4	5	9

Serial Number

Your Translation

48
Header

0						

GS1 Company Prefix

Indicator Digit + Item Reference Number

Serial Number

8. Determine Your Filter Value

Reference the table from the EPC Tag Data Standard (*shown below*). Find which type of filter matches your EPC need. Insert this number after your header.

Filter Value Table		
Type	**Filter Value**	**Binary Value**
All Others (see Section 10.1)	0	000
Point-of-Sale (POS) Trade Item	①	001
Full Case for Transport	2	010
Reserved (see Section 10.1)	3	011
Inner Pack Trade Item Grouping for Handling	4	100
Reserved (see Section 10.1)	5	101
Unit Load	6	110
Unit Inside Item or Component Inside a Product Not Intended for Individual Sale	7	111

(From EPC Tag Data Standard, "SGTIN Filter Values" table)

48   **1**

Header   Filter

Your Translation

48   [ ]

Header   Filter

0 [ ][ ][ ][ ][ ][ ][ ]

GS1 Company Prefix

[ ][ ][ ][ ][ ][ ]

Indicator Digit + Item Reference Number

[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Serial Number

> **Note**
> *Note: In most cases, if you have started with a UPC-A barcode (GTIN-12), you will be using the POS filter value of "1."*

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9. Determine Your Partition Value

Reference the table from the EPC Tag Data Standard (*shown below*). Find the row where the (L) column matches the number of digits in your **GS1 Company Prefix**. The value of the partition is what is listed in the first column of that row. Insert this number after your Filter Value.

SGTIN Partition Table				
Partition Value	**GS1 Company Prefix**		**Indicator/Pad Digit + Item Reference**	
	Bits (M)	**Digits (L)**	**Bits (N)**	**Digits**
0	40	12	4	1
1	37	11	7	2
2	34	10	10	3
3	30	9	14	4
4	27	8	17	5
⑤	24	7	20	6
6	20	6	24	7

(From EPC Tag Data Standard, "SGTIN Partition" table)

48   **1**   **5**

Header   Filter   Partition

Your Translation

48   [ ]   [ ]

Header   Filter   Partition

0 [ ][ ][ ][ ][ ][ ][ ]

GS1 Company Prefix

[ ][ ][ ][ ][ ][ ]

Indicator Digit + Item Reference Number

[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Serial Number

> **Note**
> *Note: It's important that you start with the length (in digits) of your GS1 Company Prefix; remember that the leading 0 we added back in Step 2 counts as a digit.*

At this point, you can use software to finish the rest of the process, but for your reference, please continue to Step 10.

10. Translate From Decimal to Binary

RFID readers only read in binary code, so you must translate your decimal value to binary bits.

This step is key to correctly encode the EPC into the RFID tag. This is the key piece of information that makes it possible for you to work with the software to develop the binary string.

Binary Translation

00110000
Header (8 bits)

001
Filter (3 bits)

101
Partition (3 bits)

000010010101111011111101
GS1 Company Prefix (24 bits)

00000000001011011110
Indicator Digit + Item Reference Number (20 bits)

00000000000000000000000111101011100011
Serial Number (38 bits)

Binary Translation

_____
Header (8 bits)

_____
Filter (3 bits)

_____
Partition (3 bits)

_____
GS1 Company Prefix (24 bits)

_____
Indicator Digit + Item Reference Number (20 bits)

_____
Serial Number (38 bits)

Note | *Reference your set of numbers from the previous page to translate. Be sure to fill the binary values from the right, adding leading 0s as needed.*

11. Create a Single String

Compose your numbers back into a single string. Often, this number is expressed in a hexadecimal. Reference the EPC Tag Data Standard for more information on hexadecimals.

00110000 001 101 000010010101111011111101 00000000001011011110 000000000000000 0000000001111101011100011
Binary

3034257BF400B78000007AE3
Hexadecimal

Your Translation

_____

_____

_____
Binary

_____
Hexadecimal

Note | *We are providing this for your reference. It will be mostly invisible to you. This is the part where the software takes over, preparing the binary string to be programmed into the RFID tag.*

You're done!

If you have any questions about translating a UPC to an EPC, visit www.gs1us.org

EPC Encoder/Decoder Tool

Use this to translate between different forms of barcode-based identification and corresponding EPC/RFID data. This is helpful in translating identification keys encoded in a barcode into an EPC representing the same identifier, or vice versa (i.e., UPC barcode GTINs translated into EPC form and back). Try the EPC Encoder/Decoder today!