



The Global Language of Business

GS1 Healthcare US

Implementation Guideline for RFID in Healthcare Manufacturing

Using GS1 Standard to Enable Visibility and Efficiency

Release 1.1, January 17, 2025



Table of Contents

1	Introduction	6
1.1	Background	6
1.2	Purpose of this Document	6
1.3	Who Will Use This Document	6
1.4	Document Scope	7
1.5	Participants	7
2	Foundational Information	10
2.1	Business Drivers	10
2.1.1	Patient Safety	10
2.1.2	Operational Efficiency	10
2.2	Type of Products in Scope	10
2.2.1	Pharmaceutical Products	10
2.2.2	Medical Devices	10
2.3	GS1 Identification Keys and Application Identifiers Used in This Document	11
2.3.1	Global Trade Item Number (GTIN)	11
2.3.2	Serial Shipping Container Code (SSCC)	11
2.3.3	Serial Number – AI (21)	11
2.3.4	Batch or Lot Number - AI (10)	11
2.3.5	Expiration Date - AI (17)	11
2.3.6	Production Date - AI (11)	11
2.3.7	Trade Items Contained in A Logistics Unit - AI (02)	11
2.3.8	Trade Item Pieces Contained in A Logistics Unit - AI (37)	12
3	RFID as a Secondary Data Carrier	13
3.1	Healthcare Packaging Level Definitions	13
3.2	Considerations for Serialization	14
3.3	Packaging Level Matrix	15
3.4	Planning an Encoding Program	16
3.4.1	Enhanced (SGTIN + Batch/Lot + Expiration Date)	16
3.4.2	Minimum (SGTIN Only)	16
3.4.3	Flow Chart	17
4	Encoding Procedure	18
4.1	Encoding/Decoding Methods	18
4.2	SGTIN+	18
4.3	SSCC+	18
4.4	Additional Attributes	19
5	Examples	21
5.1	SGTIN+	21
5.2	SSCC+	21

6	Glossary	22
----------	-----------------------	-----------

About GS1

GS1® is a neutral, not-for-profit, global organization that develops and maintains the most widely used supply chain standards system in the world. GS1 Standards improve the efficiency, safety, and visibility of supply chains across multiple sectors. With local Member Organizations in over 110 countries, GS1 engages with communities of trading partners, industry organizations, governments, and technology providers to understand and respond to their business needs through the adoption and implementation of global standards. GS1 is driven by over a million user companies, which execute more than six billion transactions daily in 150 countries using GS1 Standards.

About GS1 US

GS1 US®, a member of GS1 global, is a not-for-profit information standards organization that facilitates industry collaboration to help improve supply chain visibility and efficiency through the use of GS1 Standards, the most widely used supply chain standards system in the world. Nearly 300,000 businesses in 25 industries rely on GS1 US for trading partner collaboration that optimizes their supply chains, drives cost performance and revenue growth, while also enabling regulatory compliance. They achieve these benefits through solutions based on GS1 global unique numbering and identification systems, barcodes, Electronic Product Code (EPC®)-based RFID, data synchronization, and electronic information exchange.

About GS1 Healthcare

GS1 Healthcare is a global, voluntary healthcare user group developing global standards for the healthcare supply chain and advancing global harmonization. GS1 Healthcare consists of participants from all stakeholders of the healthcare supply chain: manufacturers, wholesalers, and distributors, as well as hospitals and pharmacy retailers. GS1 Healthcare also maintains close contacts with regulatory agencies and trade organizations worldwide. GS1 Healthcare drives the development of GS1 Standards and solutions to meet the needs of the global healthcare industry and promotes the effective utilization and implementation of global standards in the healthcare industry through local support initiatives like GS1 Healthcare US® in the United States.

About GS1 Healthcare US

GS1 Healthcare US® is an industry group that focuses on driving the adoption and implementation of GS1 Standards in the healthcare industry in the United States to help improve patient safety and supply chain efficiency. GS1 Healthcare US brings together members from all segments of the healthcare industry to address the supply chain issues that most impact healthcare in the United States. Facilitated by GS1 US, GS1 Healthcare US is one of over 30 local GS1 Healthcare user groups around the world that supports the adoption and implementation of global standards developed by GS1.

Document Summary

Document Item	Current Value
Document Title	Implementation Guideline for RFID in Healthcare Manufacturing - Using GS1 Standard to Enable Visibility and Efficiency
Date Last Modified	January 2025
Document Description	The purpose of this document is to provide the necessary information for healthcare manufacturers to encode RFID tags using GS1's Electronic Product Code (EPC®) schemes outlined in the <i>EPC Tag Data Standard (TDS)</i> .

Log of Changes

Release Number – Date	Changes
Release 1.0	Release/publication
Release 1.1 – January 2025	Error corrections, updated Fig 4-1 to align with the TDS. Updated links to point to the latest version of the TDS.

1 Introduction

1.1 Background

With benefits ranging from improved recall management, to enhanced inventory accuracy, interest in RAIN RFID¹ is increasing in the healthcare industry. Encoding attributes like the Global Trade Item Number® (GTIN®), Serial Number, Batch/Lot, and Date can help facilitate improved patient care.

To ensure all recipients of tagged products can decode and understand the product information, healthcare industry stakeholders worked together to identify how manufacturers should encode and provide a "roadmap" to assist the industry in adoption.

1.2 Purpose of this Document

The purpose of this document is to provide the necessary information for healthcare manufacturers to encode RFID tags using GS1's Electronic Product Code (EPC®) schemes outlined in the [EPC Tag Data Standard \(TDS\)](#). The information contained within this document is focused on the use of RFID as a secondary carrier, when it is appropriate to add RFID to a package, the encoding schemes to use, as well as the attribute data to be encoded at those levels.

For those receiving product that has been tagged and encoded in accordance with GS1 Standards as outlined within, this document provides an understanding of what product data to expect based on the packaging level. This information will allow trading partners to utilize product information to automate processes to gain operational efficiency and increase patient safety by reducing the need to scan barcodes to obtain data.

This document, the **Implementation Guideline for RFID in Healthcare Manufacturing**, is intended as a foundational document. Other healthcare-specific documents designed to provide guidance on RFID should refer to this document when referring to the topics contained herein.



Important: As with all GS1 Standards and solutions, this guideline is voluntary, not mandatory. It should be noted that use of the words "must" and "require" throughout this document relate exclusively to technical recommendations for the proper application of the standards to support the integrity of your implementation.

1.3 Who Will Use This Document

This guideline may be used by healthcare manufacturers, distributors, solution providers, end users and other stakeholders to understand the necessary steps required to implement RFID tags using GS1's EPC Standard. Healthcare manufacturers will be able to use this document as a guide for implementing open interoperable GS1 standards to enable more efficient tracking, management, and traceability of products throughout the supply chain. Distributors will benefit from understanding how to integrate RFID technology within their system to ensure compliance with new standards. Solution Providers can leverage this document's information to develop comprehensive solutions geared towards helping healthcare organizations achieve greater compliance and efficiency. Finally, end users can benefit from understanding the available data and access this enhanced method of data capture provides.

¹ What is RAIN RFID?

Radio frequency identification or RFID is a technology that enables the sharing of data encoded in RFID tags via RFID scanners. The term RAIN RFID specifies use of the UHF frequency band, which leverages the GS1 air interface protocol to communicate with tags.

GS1 refers to "RAIN RFID" tags in this document whenever making reference to UHF RFID tags. NOTE: Within the UHF RFID technology space, GS1 only endorses RAIN RFID implementations that are encoded per GS1's EPC standards (which is a subset of all RAIN RFID implementations).

1.4 Document Scope

This document defines the application of GS1 Standards to support the adoption of RFID by healthcare supply chain participants.

This document is designed to inform product manufacturers how to encode GS1 EPC-enabled RFID tags for automatic data capture to be utilized across the healthcare supply chain. This document also outlines what supply chain participants should expect when receiving a tagged product that is GS1 EPC enabled.

In scope for this document:

- Focusing on EPC-encoded RAIN RFID
- Describing how to determine which packaging levels should be tagged
- Outlining which packaging levels should be encoded and which data attributes should be included at each packaging level
- Informing as to which encoding schemes should be utilized when encoding data for use across the supply chain
- Offer considerations to think about when setting up an environment to encode/decode tags

Out of scope for this document:

- Provide any guidance or advice regarding regulatory compliance
- Address non-US market needs or considerations
- Outline the use of non-GS1 Standards
- Indicate how applications providing functionality interact with the decoded data
- Offer guidance for active RFID tags or other technologies
- Provide guidance for RFID tagging medical devices not suited for RAIN RFID

1.5 Participants

This guideline was developed through the commitment and dedication of the GS1 Healthcare US RFID Workgroup.

Name	Role	Company
Blair Korman	Co-Chair	Johnson & Johnson Services, Inc. / Johnson & Johnson Consumer Inc.
Gwen Volpe	Co-Chair	Fresenius Kabi
Gregg Gorniak	Co-Chair	AmerisourceBergen Corporation
Andrew Meyer	Co-Facilitator	GS1 US
Ned Mears	Co-Facilitator	GS1 US
Justine Freisleben		Accenture LLP
Sean Murphy		AmerisourceBergen Corporation
Greg Henthorn		Amgen
John Pitts		Antares Vision
Justin Patton		Auburn University

Name	Role	Company
Peter Bloch		Avery Dennison Retail Information Services, LLC
Jeanne Duckett		Avery Dennison Retail Information Services, LLC
Dennis Black		BD (Becton Dickinson & Co.)
Nicolas Deleuil		BD (Becton Dickinson & Co.)
Nilgun Fitoz		BD (Becton Dickinson & Co.)
Yacine Haddadi		BD (Becton Dickinson & Co.)
Herve Soukaissian		BD (Becton Dickinson & Co.)
Dennis Tribble		BD (Becton Dickinson & Co.)
Jeff Falardeau		Cardinal Health
Karl Hoelper		CCL Label Inc.
Wayne Taussig		CCL Label Inc.
Mike Isabell		eAgile, Inc.
Alejandro Flores-Caroll		Ecolab, Inc.
Jon Salazar		Excellis Health Solutions
Jeanne Sirovatka		Fresenius Kabi
Craig Alan Repec		GS1
Nicole Golestani		GS1 Canada
Liz Coan		GS1 US
Angela Fernandez		GS1 US
Jonathan Gregory		GS1 US
Patrick Javick		GS1 US
Gena Morgan		GS1 US
Tracy Nasarenko		GS1 US
Amber Walls		GS1 US
Beth Wells		GS1 US
Teresa Williams		GS1 US
Kurt Wolf		Health Care Logistics, Inc.
Felix Klebe		Impinj
Ayse Ozgun		Jacobs
Eric Shen		Jacobs
Ramsey Doany		BlueSight
Tim Kress Spatz		BlueSight
Jeff Li		LSPedia
Scott Mooney		McKesson Corporation

Name	Role	Company
Jay Williams		MEPS Real-Time, Inc
David Mason		Novartis Pharma
Mike Mazur		Pfizer, Inc
David Berkowitz		Omnicell
Jeffry Gibala		Omnicell
Erin Pezant		Pfizer, Inc
McLeod Williamson		Tageos
Michael Baucke		Tageos SAS
Bahar Aliakbarian		The Axia Institute – Michigan State University
Elizabeth Waldorf		TraceLink ,Inc
Chris Brown		TSC Printronix Auto ID
Jay Crowley		USDM Life Sciences
Cameron Hall		ValueCentric, LLC
Frank Guthrie		Vantage Solutions

2 Foundational Information

2.1 Business Drivers

2.1.1 Patient Safety

Using RFID, supply chain stakeholders can accurately capture and verify data related to the product's unique identity as well as production and expiration information. Automation enabled by RFID systems makes it possible to detect this data as trading partners send, receive or handle products. This process increases awareness of the product on-hand, what has been shipped, and who it's been sent to and enables immediate identification of products that are near to or have passed their expiration date. By having increased visibility by the supply chain participants, recall or disposal can be dealt with more efficiently and effectively at all levels, most importantly at the clinical level to protect patients from potential harm.

2.1.2 Operational Efficiency

RFID technology enables rapid and reliable data capture without direct line of site. Readers at shipping and receiving points can be used to automate the capture of data and trigger other automated processes to verify product information, share event data or update records required for regulatory compliance. This process can eliminate the need for manual data collection that may be less efficient, less accurate or prone to error. This allows industry to shift resources from procedural logistics to more advanced exception handling and quality control processes while providing better quality data more quickly.

2.2 Type of Products in Scope

2.2.1 Pharmaceutical Products

A pharmaceutical product is a medicinal drug or medication that is formulated, manufactured, and marketed for use in the treatment, prevention, or diagnosis of various diseases or medical conditions. Pharmaceutical products are typically developed by pharmaceutical companies, and they are subject to rigorous testing and regulation to ensure their safety, efficacy, and quality. This document is concerned with two classes of pharmaceuticals Over the Counter (OTC), and Prescription (Rx) drugs.

- Over the Counter (OTC)

An OTC is a pharmaceutical product, drug, or medicinal specialty whose dispensing, or administration does not require medical authorization.

- Medical Prescription (Rx)

A Medical Prescription Product (Rx) (often referred to as a Pharmaceutical) is a drug, medical device, or medicinal specialty that requires a medical prescription or direct medical intervention.

2.2.2 Medical Devices

A medical device is any instrument, apparatus, implement, machine, appliance, implant, in vitro reagent or calibrator, software, material, or other similar or related article intended by the manufacturer to be used, alone or in combination for human beings for several purposes. This document only intends to address products that are suitable for tagging with RAIN RFID tags.

2.3 GS1 Identification Keys and Application Identifiers Used in This Document

2.3.1 Global Trade Item Number (GTIN)

The Key for unique product identification is the GTIN which is assigned AI (01). GTINs are used to identify “trade items” (i.e., products and services that may be priced, ordered, or invoiced at any point in the supply chain). They are assigned by the responsible entity who is normally responsible for the allocation of the GTIN.

A company may license a GS1 Company Prefix by joining a GS1 Member Organization. This gives the company the ability to create GTINs.

Note: Refer to the GS1 General Specifications and GS1 Healthcare GTIN Allocation Rules ([GS1 Healthcare GTIN Allocation Rules Standard](#)) for the GTIN Structure.

2.3.2 Serial Shipping Container Code (SSCC)

The Key for uniquely identifying a logistic unit is the SSCC, which is assigned AI (00). In the context of this document SSCC will be used to identify homogenous partial cases created during production of a specific trade item.

Note: Refer to [GS1 General Specifications](#) for the SSCC structure and rules of use.

2.3.3 Serial Number – AI (21)

If Healthcare products are to be individually tracked and traced using a Serial Number, the Application Identifier (21) can be used. This additional data is alphanumeric with a variable length of up to 20 characters.

2.3.4 Batch or Lot Number - AI (10)

If you require additional data to identify Batch or Lot Number, the GS1 Application Identifier (10) is used and typically assigned at the point of manufacture. This additional data is alphanumeric with a variable length of up to 20 characters.

2.3.5 Expiration Date - AI (17)

If you require additional data to identify an Expiration Date, often referred to as expiry date, use by date or maximum durability date, the GS1 Application Identifier (17) can be used. This indicates the limit of consumption or use of a product (e.g., for pharmaceutical products it can indicate the possibility of an indirect health risk resulting from the ineffectiveness of the product after the date). It is expressed as year, month, and day (YYMMDD).

2.3.6 Production Date - AI (11)

If you require additional data to identify a Production Date the GS1 Application Identifier (11) can be used. The production date is the production or assembly date determined by the manufacturer. The date may refer to the trade item itself or to items contained). It is expressed as year, month, and day (YYMMDD).

2.3.7 Trade Items Contained in A Logistics Unit - AI (02)

To identify the items contained in a homogenous partial case that has been assigned an SSCC, use GS1 Application Identifier (02) The GTIN of the trade items contained is the GTIN of the highest level of trade item contained in the logistic unit.

Note: Refer to [GS1 General Specifications](#) for the rules of use and mandatory association to other element strings.

2.3.8 Trade Item Pieces Contained in A Logistics Unit - AI (37)

To identify the number of trade items contained in a logistic unit use Application Identifier (37). This element string is a mandatory completion of AI (02). The count of items field contains the number of trade items or number of trade item pieces contained in the respective logistic unit. This information refers to the identification number of the contained items.

Note: Refer to [GS1 General Specifications](#) for the rules of use and mandatory association to other element strings.

3 RFID as a Secondary Data Carrier

Healthcare regulations have been put in place to increase supply chain security and ensure patient safety. To achieve these objectives, many regulations require the use of barcodes capable of carrying the required data elements. As a data carrier, EPC-encoded RFID is able to meet this demand while enabling greater efficiency and speed to data collection processes. However, adoption of RFID technology and infrastructure is not universal nor is it specifically referenced by regulation. Therefore, the use of RFID in this application should be considered additive and secondary to the barcode. In instances where the regulations do not require a barcode, or the packaging or labeling is too small to include the human-readable interpretation of the encoded information, RFID may be an appropriate data carrier. However, in this scenario it should be noted that there is no fail-safe option to retrieve the data if the RFID tag becomes unreadable or reader systems are not available.

3.1 Healthcare Packaging Level Definitions

Healthcare primary packaging - The first level of packaging for the product marked with an Automatic Identification and Data Capture (AIDC) data carrier either on the packaging or on a label affixed to the packaging. For non-sterile packaging, the first level of packaging can be the packaging in direct contact with the product. For sterile packaging, the first level of packaging can be any combination of the sterile packaging system, may consist of a single item or group of items for a single therapy such as a kit. For packaging configurations that include a retail consumer trade item, primary packaging is a packaging level below the retail consumer trade item.

Healthcare secondary packaging - A level of packaging marked with an AIDC carrier that may contain one or more primary packages or a group of primary packages containing a single item.

Important: The above are GS1 General Specifications definitions. "Primary packaging" may also be "unit of use". As shown here "Tertiary" refers to "Trade Items" only and not "Logistic Units". (See the GS1 General Specifications for more detail.)

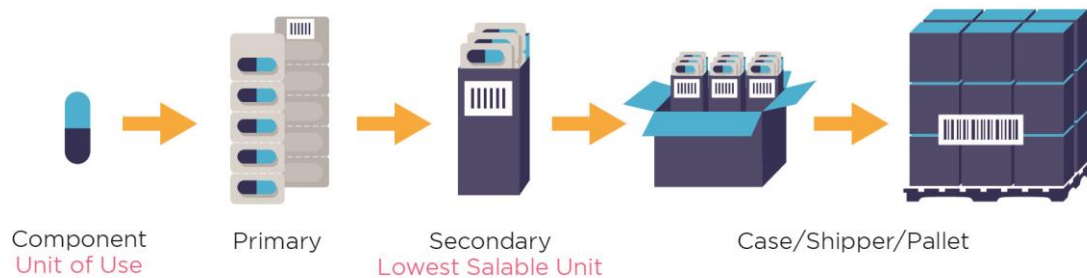
Figure 3-1 Examples of the packaging level hierarchies and the corresponding terminology for that level.



3.2 Considerations for Serialization

Serialization at secondary packaging level in the pharma sector is increasingly required by regulations. While serialization at primary packaging level is typically out of scope for regulators, it is needed for RFID tagging, regardless of packaging level. The terms Unit of Use and Lowest Saleable Unit are also common to describe items or levels in the packaging hierarchy based on their real-world application. These terms may be necessary to interpret an item's function or to align with other regulations but may not align to packaging level definitions. The guidance in this section is intended to illustrate some of the considerations and decisions that must be made to add an RFID data carrier at any level of the hierarchy.

Figure 3-2 Example of possible product packaging hierarchy for pharmaceutical capsules and the corresponding terminology for that level.



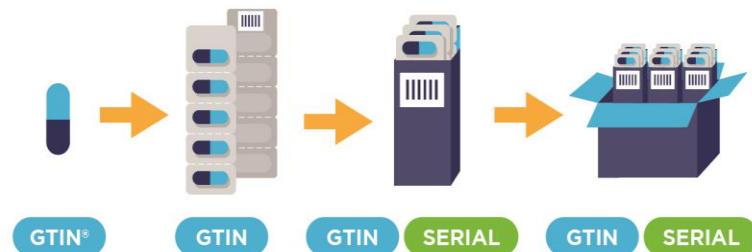
Trade Items in the packaging hierarchy have a unique GTIN assigned at each level by the product brand owner. If the product brand owner has assigned a Serial Number to items in any given packaging level, these represent the minimum required elements that can be encoded in RFID as an SGTIN EPC.

Figure 3-3 Example of packaging hierarchy in which all levels have been assigned both a GTIN and Serial Number.



If the product brand owner has not assigned a Serial Number at a given level an SGTIN EPC may not be used.



















Figure 3-4 Example of a packaging hierarchy where all levels have been assigned a GTIN, but only some have been assigned a Serial Number.




3.3 Packaging Level Matrix


The matrix below illustrates several possible medical product packaging hierarchies. The green check denotes that the packaging level has been assigned both a GTIN and Serial number by the brand owner and meets the criteria for the application of RFID as outlined in this guideline. It is important to understand that not all products will be serialized by brand owner in the matrix, those packaging levels are marked with the red "X" do not meet the criteria outlined and should not be considered for RFID. In addition, logistics units that are primarily identified using an SSCC and contain multiple GTINS will not be outlined in this document.

Figure 3-5 Examples of possible medical product packaging hierarchies.

Component	Primary Packaging			Secondary/Tertiary Packaging			Logistics Units	
	Unit of Use (UoU)		Each (Lowest Saleable Unit)	Inner Pack	Case		Pallet	Partial Case
Packaging Example: OTC Capsule								
Packaging Example: Glucose Test Strip								
Packaging Example: Pharmaceutical Vial								



- **Trade Items:** Product packaging level has been assigned a GTIN® and serial number by the brand owner and meets the minimum requirements for RFID tagging.
- **Logistics Units:** Item is a collection of homogenous GTINs with an SSCC assigned by the brand owner.



- **Trade Items:** Product packaging level has been assigned a GTIN but not a serial number and does meet the minimum requirements.
- **Logistics Units:** Item contains products of multiple GTINs and is for logistics tracking only.

The use of RFID as an additive technology in this application is not limited to or defined by the specific packaging level or specific practical use of an item. It is however dependent on availability of required data elements and may be limited by the physical practicality of tagging certain items.

3.4 Planning an Encoding Program

When launching an RFID encoding plan for a product or packaging level it is necessary that they have been assigned a GTIN and serial number or SSCC by the brand owner. If additional data elements such as expiration date and batch/lot are to be included this data must be available at the time of encoding. It should be noted that the serial number and batch/lot each may allow up to twenty alphanumeric characters, so it is important to check the number of bits required to encode the EPC prior to selecting an RFID tag. If the encoded EPC requires more memory than what the selected tag can store, either change to a higher memory tag or simplify the data elements as needed.

During your planning it is also crucial to understand the role of your line converter in the process. In some instances, to meet the speeds needed to encode products on the manufacturing line, the line encoder will encode data that can be assigned before the manufacturing process, this commonly includes the GTIN and serial number. Then during the manufacturing process when batch/lot and expiration date have been assigned to the production run, the manufacturer will encode those additional attributes to the tag.

3.4.1 Enhanced (SGTIN + Batch/Lot + Expiration Date)

Due to the lack of maturity of data exchange across the supply chain currently, it is recommended that manufacturers who wish to implement RFID encode not only the SGTIN but the Batch/Lot, and Expiration Date as well. These elements will ensure that any supply chain participant who decodes your tags will be able to act on many of the most common functions in the supply chain. Having the data "on-tag" means that warehouse operators and clinicians will not need to rely upon back-end systems to determine if the product needs to be removed from circulation or to determine the order in which it should be used. It should be noted that for some functionality it may still be necessary for back-end systems to consume the tag information to determine if the tag meets the specific criteria for a given function.

3.4.1.1 Medical Devices (Production Date)

Medical devices may not use expiration dates to drive processes but may rely on another date like a production date to drive these actions. The manufacturer should determine which date to use in those scenarios. The correct Application Identifier, AI (11), should be encoded to indicate the date type that is being utilized so that supply chain participants do not misinterpret the meaning of the date.

3.4.2 Minimum (SGTIN Only)

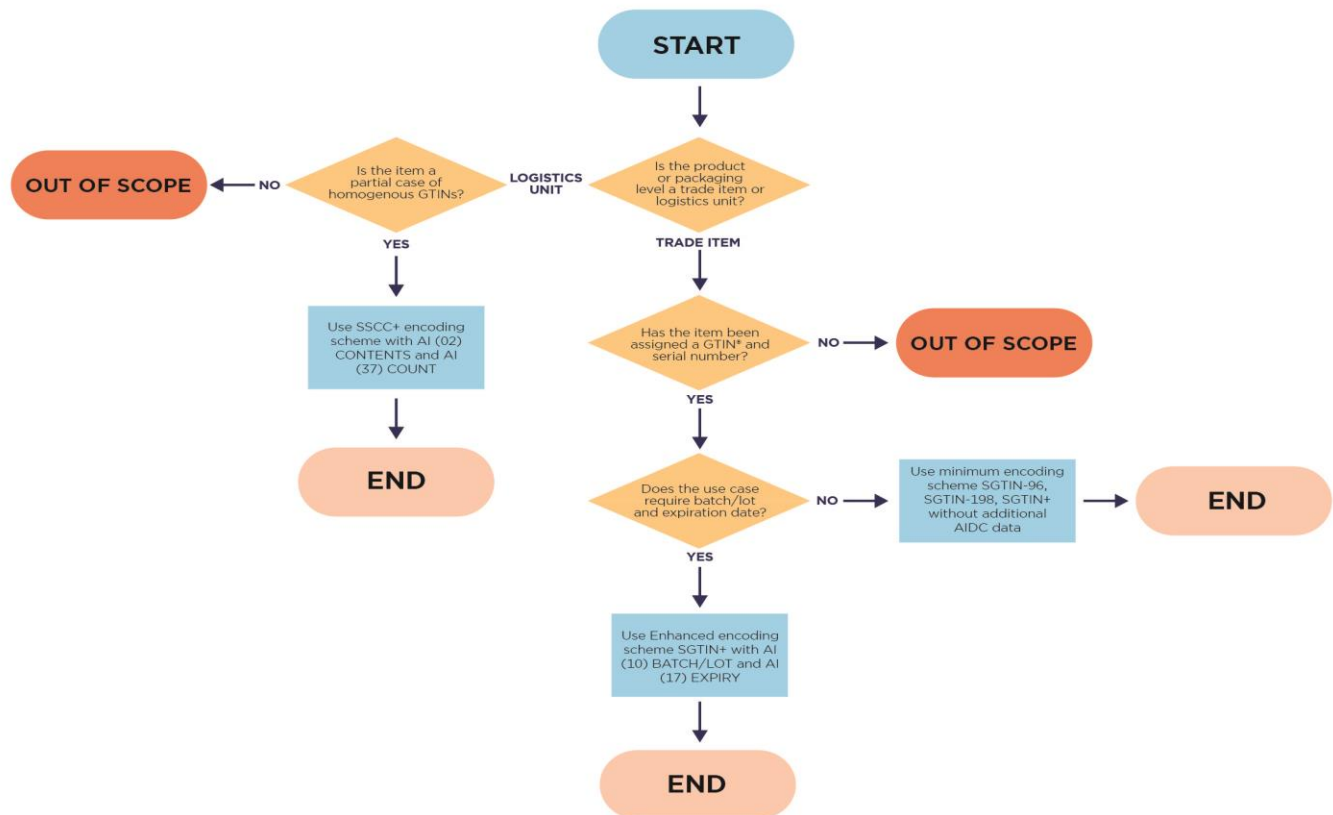
There may be scenarios where it is preferable to start with a minimum encoded data approach to implementing RFID. In these scenarios, the encoding of a GTIN and Serial Number at minimum is required when following GS1 standards to encode an RFID tag for a product packaging level. If your company decides to follow this route, without a robust data-sharing program throughout your supply chain, the value of the added visibility provided by the tag will be reduced as many business applications require knowledge of the batch/lot or expiration dates to carryout routine processes such as recalls or monitoring for expiration.

If your company is utilizing a serial number that is 12 digits or less, consists of a value less than 274,877,906,944, and you do not intend to add +AIDC in the future, it may make sense for efficiency to use an SGTIN-96 encoding structure with a 96-bit tag. However, if you plan to add +AIDC data or do not meet the other criteria, it is more efficient to utilize an SGTIN+ encoding strategy.

3.4.3 Flow Chart

The chart below displays the decision making that may be required to plan an encoding program and may be used in addition to the context provided in the preceding sections.

Figure 3-6 Selecting and Encoding Scheme Flowchart.



4 Encoding Procedure

Following the GS1 EPC modernization efforts several new EPC binary encoding schemes have been released. These encoding schemes allow encoders to align the data encoded into an RFID tag with the data currently encoded into barcodes on the product. This alignment simplifies the encoding process and the expertise required to understand the data on the tags. Additionally, +AIDC data can be stored following the EPC in Bank 01 (EPC memory bank) allowing a more efficient decoding operation that only requires the tag to be interrogated once.



Important: It is recognized that existing implementations utilize the SGTIN-96 or SGTIN-198 binary encoding schemes and are currently leveraged in the supply chain. It is not the intent of this document to curtail or sunset those activities. This document is focused on future implementations and providing the information needed to implement GS1 standards in pursuit of an open and interoperable supply chain.

4.1 Encoding/Decoding Methods

This document focuses on the following EPC binary encoding schemes: SGTIN+, and SSCC+ described in [the section EPC Tag URI and EPC Raw URI – EPC Binary Encoding Schemes](#) of the TDS. These EPC binary encoding schemes are identified by the tag's EPC binary header value which is found in the first 8 bits of the EPC binary encoding. The section EPC Binary Encoding Schemes of the TDS focuses on the encoding and decoding of the element strings (GS1 Application Identifiers and their values). [The subsection Encoding/Decoding Methods Introduced in TDS 2.0](#) outlines the newly introduced binary encoding and decoding methods. As well as how to express additional data (+AIDC) beyond the EPC identifier. This section should be carefully followed when setting up your tagging program.

Table 4-1 Encoding/decoding methods.

EPC Binary Encoding Type	8-bit Encoding Value
SGTIN+	1111 0111
SSCC+	1111 1001



Note: For more information on the encoding schemes and the requirements around those please refer to the [EPC Tag Data Standard \(TDS\)](#).

4.2 SGTIN+

The SGTIN+ EPC Binary encoding scheme allows the encoder to encode the GTIN and Serial Number as they would appear in a barcode. This encoding scheme allows +AIDC data to be added directly after the EPC in the EPC memory block. [See TDS section EPC Binary Encoding - SGTIN+ for more information](#).

4.3 SSCC+

One of two coding schemes for the SSCC. The SSCC+ has a fixed length of 84 bits before +AIDC data. Because it is not partitioned it supports simplified interoperability with the full range of SSCCs in their GS1 element string form. [See the TDS section EPC Binary Encoding - SSCC+ for more information](#).

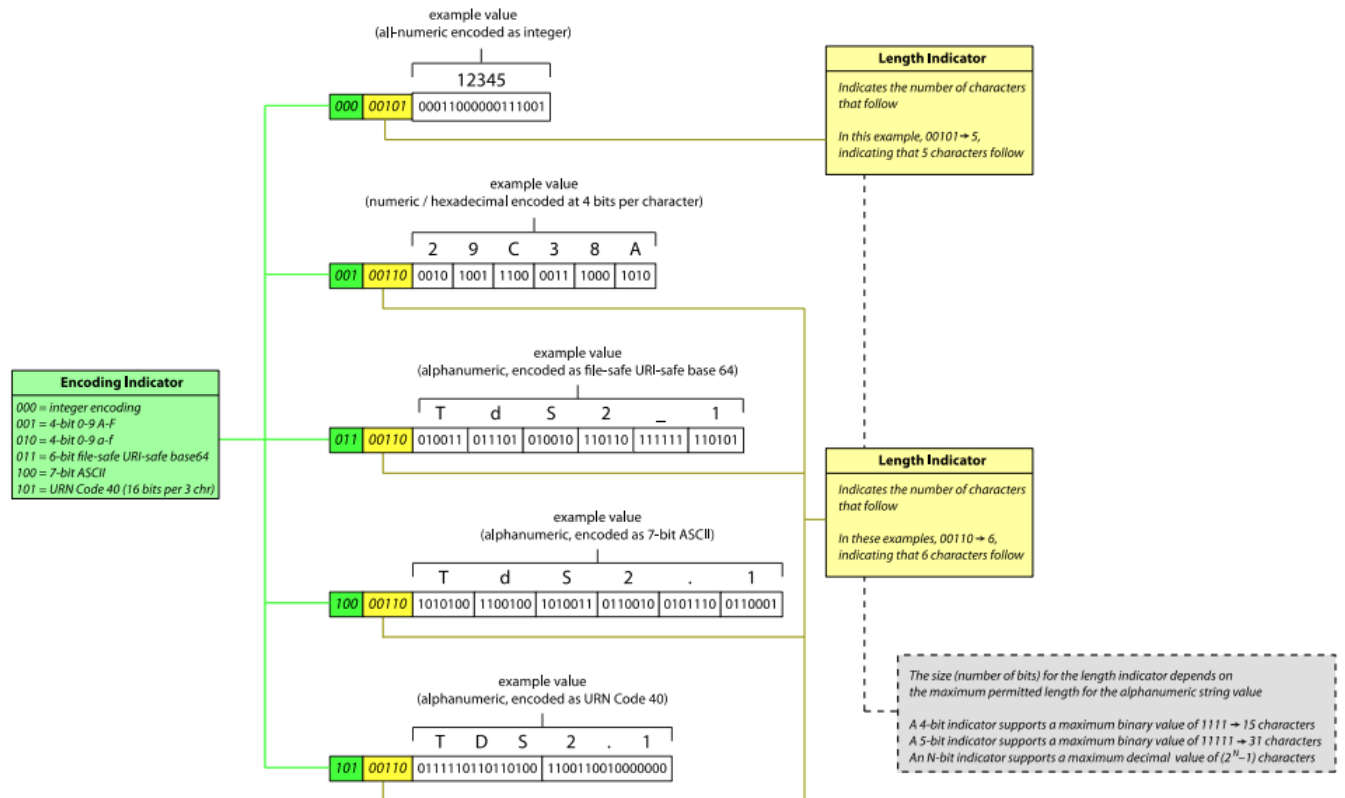
4.4 Additional Attributes

When encoding attributes beyond the EPC, it is necessary to set the bit immediately following the EPC Header to "1". This bit is the +AIDC data toggle bit and tells the reader to expect additional data after the EPC encoding. When encoding the additional attribute data, it is important to always include the GS1 AI for the attribute you are encoding. In some scenarios like the batch/lot where there can be multiple ways to encode the data, and the data can be variable length you must also include a 3-bit Encoding Indicator and a 5-bit Length Indicator. The Encoding Indicator denotes what type of encoding is used and the Length Indicator tells the reader how long the attribute is. [See the section *Delimited/Terminated Numeric in the TDS*](#) for the decision tree to assist you in choosing the most efficient encoding method for your application.

Table 4-2 Additional attributes and their associated AIs.

Application Identifier (AI)	Attribute	Encoding Indicator Required	Length Indicator Required	Required AI Pairing
10	Batch/Lot	Y	Y	01 or 02
11	Production Date	N	N	01 or 02
17	Expiration Date	N	N	01 or 02
02	Trade Items Contained in Logistic Unit	N	N	01,37
37	Count of Contained Trade Items	N	Y	01,02

Figure 4-1 Excerpt from EPC and Tag Data Standard (TDS) Section “Variable-length alphanumeric.”

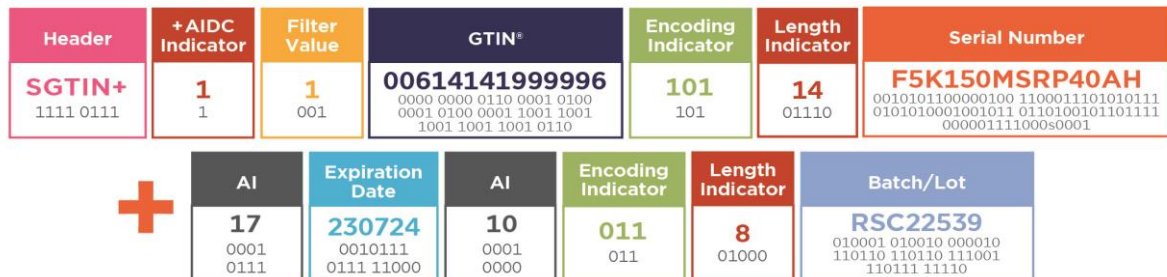


5 Examples

5.1 SGTIN+

This binary encoding scheme allows the encoder to add +AIDC data immediately following the EPC in the EPC memory block. The addition of +AIDC data can be useful when robust event or transactional data is not present across your supply chain. Please refer to the [EPC and Tag Data Standard \(TDS\)](#) for full information on when and how to encode the Indicator Digit and Length Indicator.

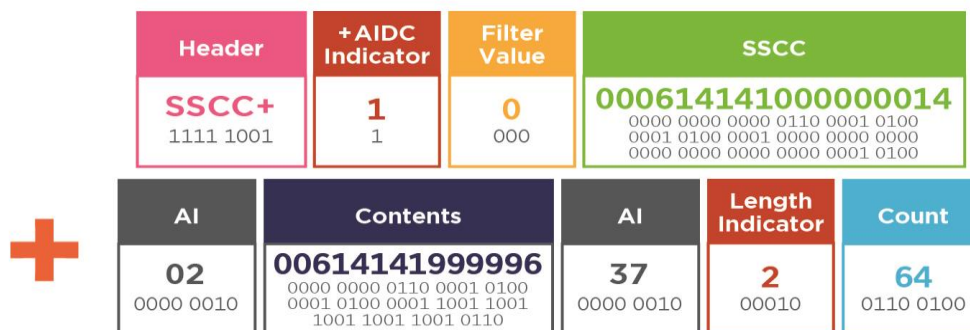
Figure 5-1 SGTIN+ encoding example including +AIDC data.



5.2 SSCC+

This binary encoding scheme allows the encoder to add +AIDC data immediately following the EPC in the EPC memory block. For partial cases it can be useful to include the +AIDC data for the Identification of trade items contained in a logistic unit AI (02), and the Count of trade items contained in a logistic unit AI (37) as the SSCC does not identify the contents of the logistic container, just the container itself. Please refer to the [EPC and Tag Data Standard \(TDS\)](#) for full information on when and how to encode the Indicator Digit and Length Indicator.

Figure 5-2 SSCC+ encoding example including +AIDC data



6 Glossary

Term	Definition	Also Known As
Attribute Data	Product information beyond item unique identity, that defines the items characteristics. For the purposes of this document, Attribute Data refers to data such as Batch/Lot, Expiration Date, and Production Date.	+AIDC
Electronic Product Code	An identification scheme for universally identifying physical objects (e.g., trade items, assets, and locations) via RFID tags and other means. The standardized EPC data consists of an EPC (or EPC Identifier) that uniquely identifies an individual object, as well as an optional filter value when judged to be necessary to enable effective and efficient reading of the EPC tags.	EPC®
Global Trade Item Number	The GS1 identification key is used to identify trade items. The key comprises a GS1 Company Prefix, an item reference, and check digit.	GTIN
GS1 Application Identifier	GS1 Application Identifiers (AIs) are prefixes used in barcodes and RAIN RFID tags to define the meaning and format of data attributes.	AI
Radio Frequency Identification	A technology that uses radiofrequency electromagnetic fields or waves to automatically identify and track tags attached to objects. An RFID system consists of RFID tags and readers. When triggered by a radio frequency electromagnetic interrogation signal from a nearby RFID reader, the RFID tag transmits digital data, usually a unique identifier like an EPC, back to the reader.	RFID
RAIN RFID	The RAIN RFID alliance is a global alliance promoting the universal adoption of passive UHF RFID (called RAIN RFID) technology. GS1 refers to "RAIN RFID" tags in this document whenever making reference to passive UHF RFID tags. NOTE: Within the UHF RFID technology space, GS1 only endorses RAIN RFID implementations that are encoded per GS1's EPC standards (which is a subset of all RAIN RFID implementations).	UHF passive RFID
Serialized Global Trade Item Number	The Serialized Global Trade Item Number EPC scheme is used to assign a unique identity to an instance of a trade item, such as a specific instance of a product or SKU.	SGTIN
SGTIN-198	The SGTIN-198 is an encoding scheme that encodes the SGTIN with 198 bits of data. Within that encoding scheme, 140 bits are allocated for the Serial Number value. (The SGTIN-198 requires more RFID tag memory than the SGTIN-96.)	SGTIN-198
SGTIN-96	The SGTIN-96 is an encoding scheme that encodes the SGTIN with 96 bits of data. Within that encoding scheme, 38 bits are allocated for the Serial Number value.	SGTIN-96
Serial Shipping Container Code	The Serial Shipping Container Code can be used by companies to identify a logistic unit, comprised of any combination of trade items packaged together for storage and/or transport purposes.	SSCC

Proprietary Statement

This document contains proprietary information of GS1 US. Such proprietary information may not be changed for use with any other parties for any other purpose without the expressed written permission of GS1 US.

Improvements

Improvements and changes are periodically made to publications by GS1 US. All material is subject to change without notice. Please refer to GS1 US website for the most current publication available.

Disclaimer

Except as may be otherwise indicated in specific documents within this publication, you are authorized to view documents within this publication, subject to the following:

1. You agree to retain all copyright and other proprietary notices on every copy you make.
2. Some documents may contain other proprietary notices and copyright information relating to that document. You agree that GS1 US has not conferred by implication, estoppels, or otherwise any license or right under any patent, trademark, or copyright (except as expressly provided above) of GS1 US or of any third party.

This publication is provided "as is" without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Any GS1 US publication may include technical inaccuracies or typographical errors. GS1 US assumes no responsibility for and disclaims all liability for any errors or omissions in this publication or in other documents which are referred to within or linked to this publication. Some jurisdictions do not allow the exclusion of implied warranties, so the above exclusion may not apply to you.

Several products and company names mentioned herein may be trademarks and/or registered trademarks of their respective companies. GS1 US does not, by promulgating this document on behalf of the parties involved in the creation of this document, represent that any methods, products, and/or systems discussed or recommended in the document do not violate the intellectual property rights of any third party. GS1 US has not performed a search to determine what intellectual property may be infringed by an implementation of any strategies or suggestions included in this document. GS1 US hereby disclaims any liability for any party's infringement of intellectual property rights that arise as a result of any implementation of strategies or suggestions included in this document.

This publication may be distributed internationally and may contain references to GS1 US products, programs, and services that have not been announced in your country. These references do not imply that GS1 US intends to announce such products, programs, or services in your country.

No Liability for Consequential Damage

In no event shall GS1 US or anyone else involved in the creation, production, or delivery of the accompanying documentation be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other loss) under any theory of liability arising out of the use of or the results of use of or inability to use this publication or any content herein, even if GS1 US has been advised of the possibility of such damages or if such loss or damage could have been reasonably foreseen.

GS1 US HEREBY DISCLAIMS, AND YOU HEREBY EXPRESSLY RELEASE GS1 US FROM, ANY AND ALL LIABILITY RELATING TO YOUR COMPLIANCE WITH REGULATORY STANDARDS AND LAWS, INCLUDING ALL RULES AND REGULATIONS PROMULGATED THEREUNDER. GS1 US MAKES NO WARRANTIES OF ANY KIND RELATING TO THE SUITABILITY OF THE GS1 STANDARDS AND THE SPECIFIC DOCUMENTS WITHIN THIS PUBLICATION TO COMPLY WITH ANY REGULATORY STANDARDS, LAWS, RULES AND REGULATIONS. ALL INFORMATION AND SERVICES ARE PROVIDED "AS IS."

GS1 US recommends that any organization developing an implementation designed to be in conformance with any GS1 Specification, Guideline or Recommendation, should consult with their own counsel to determine the compliance of such an implementation with any relevant intellectual property or other rights of third parties.

Portions of the following publication may have been generated using AI. GS1 US does not provide any warranty or guarantee regarding the reliability or accuracy of its content, nor does it assume legal liability or responsibility regarding the same. Instead, we encourage

you to independently verify and cross-reference the content provided with other reliable sources before making any decisions or taking any actions based on the information.

GS1 US employees are not representatives or agents of the U.S. FDA, and the content of this publication has not been reviewed, approved, or authorized by the U.S. FDA.

Trademark Notices

DataBar®, EPC®, EPCglobal®, GDSN®, GS1 Global Registry®, GTIN®, and Global Trade Item Number® are registered trademarks of GS1 AISBL.

GS1 US® and design is a registered trademark of GS1 US, Inc. Trademarks appearing in this presentation are owned by GS1 US, Inc. unless otherwise noted, and may not be used without the permission of GS1 US, Inc.

The letters "UPC" are used solely as an abbreviation for the "Universal Product Code," which is a product identification system. They do not refer to the UPC, which is a federally registered certification mark of the International Association of Plumbing and Mechanical Officials (IAPMO) to certify compliance with a Uniform Plumbing Code as authorized by IAPMO.

*If applicable

GS1 US Corporate Headquarters

Princeton South Corporate Center, 300 Charles Ewing Boulevard
Ewing, NJ 08628 USA

T +1 937.435.3870 | **E** info@gs1us.org

www.gs1us.org

Connect With Us

