

RFID from A to Z: Everything You Need to Know

RFID - From key players
to choosing inlays

October 11-14, 2021



Agenda

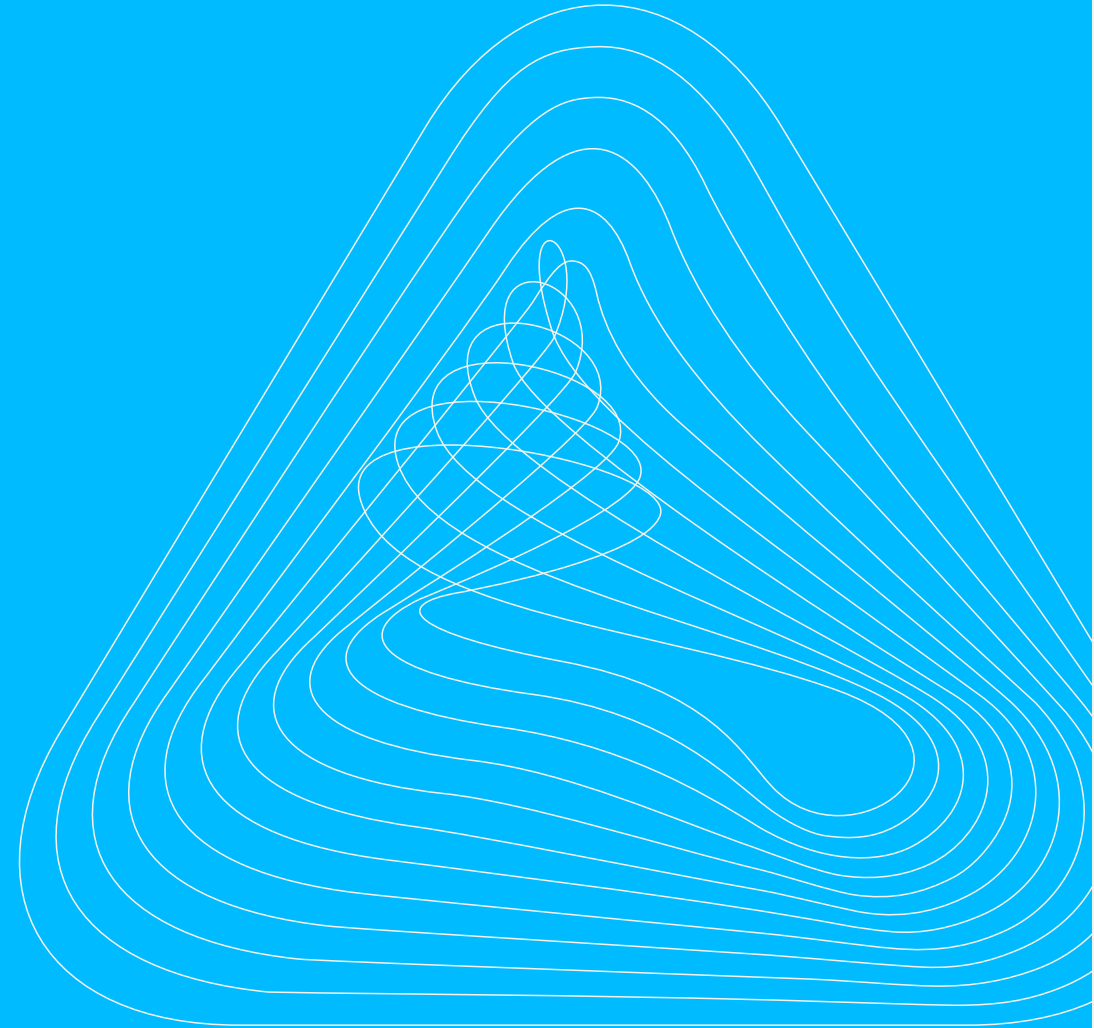
- RFID System Key Components & Market Model
- RFID Across Industries
- NFC Introduction
- NFC vs UHF
- Selecting the Right Inlay
- NFC & ARC Certifications
- Product Datasheet Deep Dive



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RFID System Key Components & Market Model



RFID System

Key Components

RFID systems requires three components

Tag, hardware, software

Each tag contains a **unique identification number** that is then linked to additional product data on a secure database. RFID tags and tickets can therefore identify each individual item.

RFID tags allow you to:

- Read the RFID tag without line of sight
- Read multiple items hanging on a rack or stacked on a shelf very quickly
- Read multiple items in a box without opening the packaging



1 Tag
An RFID enabled tag, ticket or label



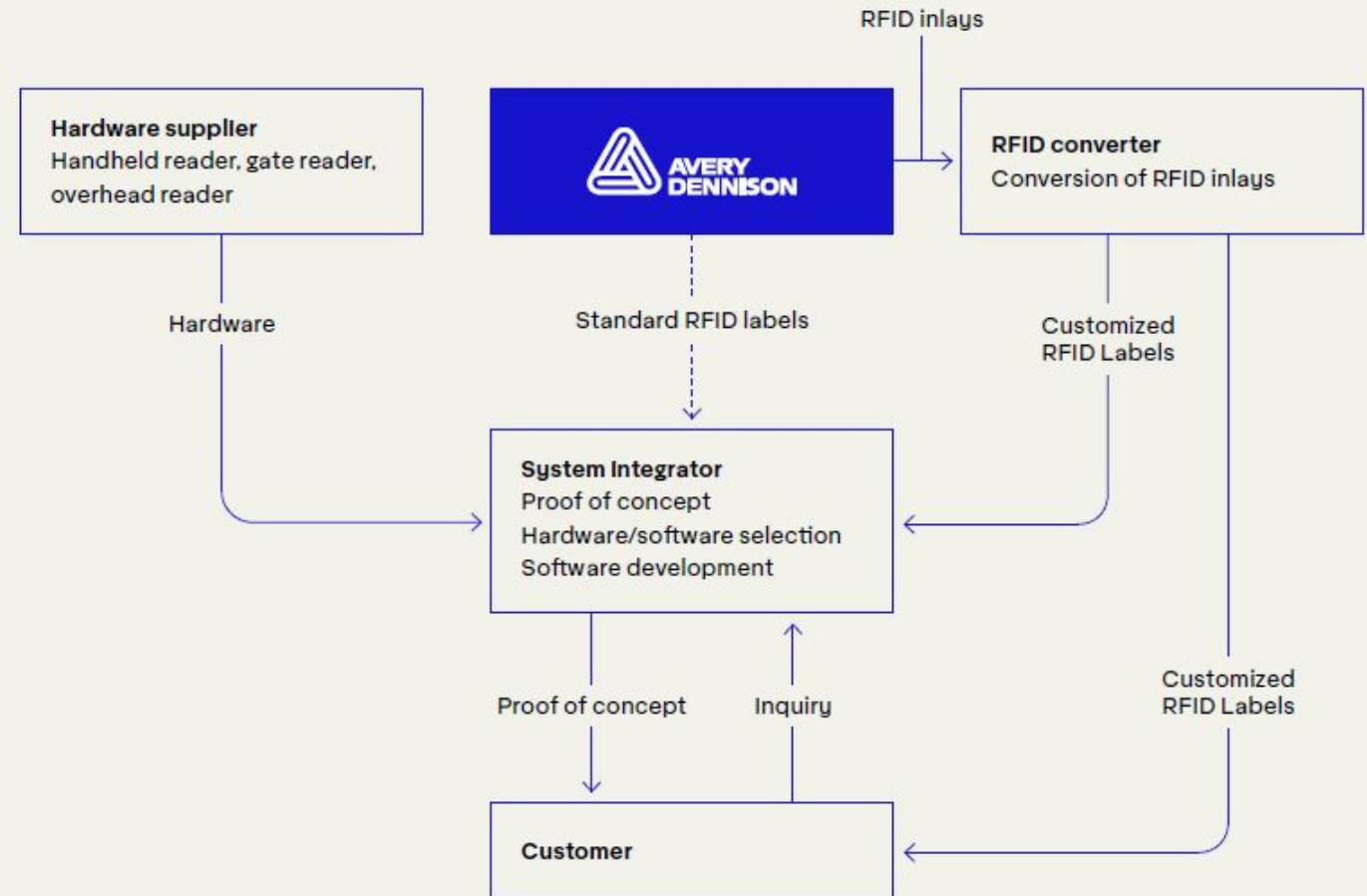
2 Hardware
RFID reader (fixed or mobile)



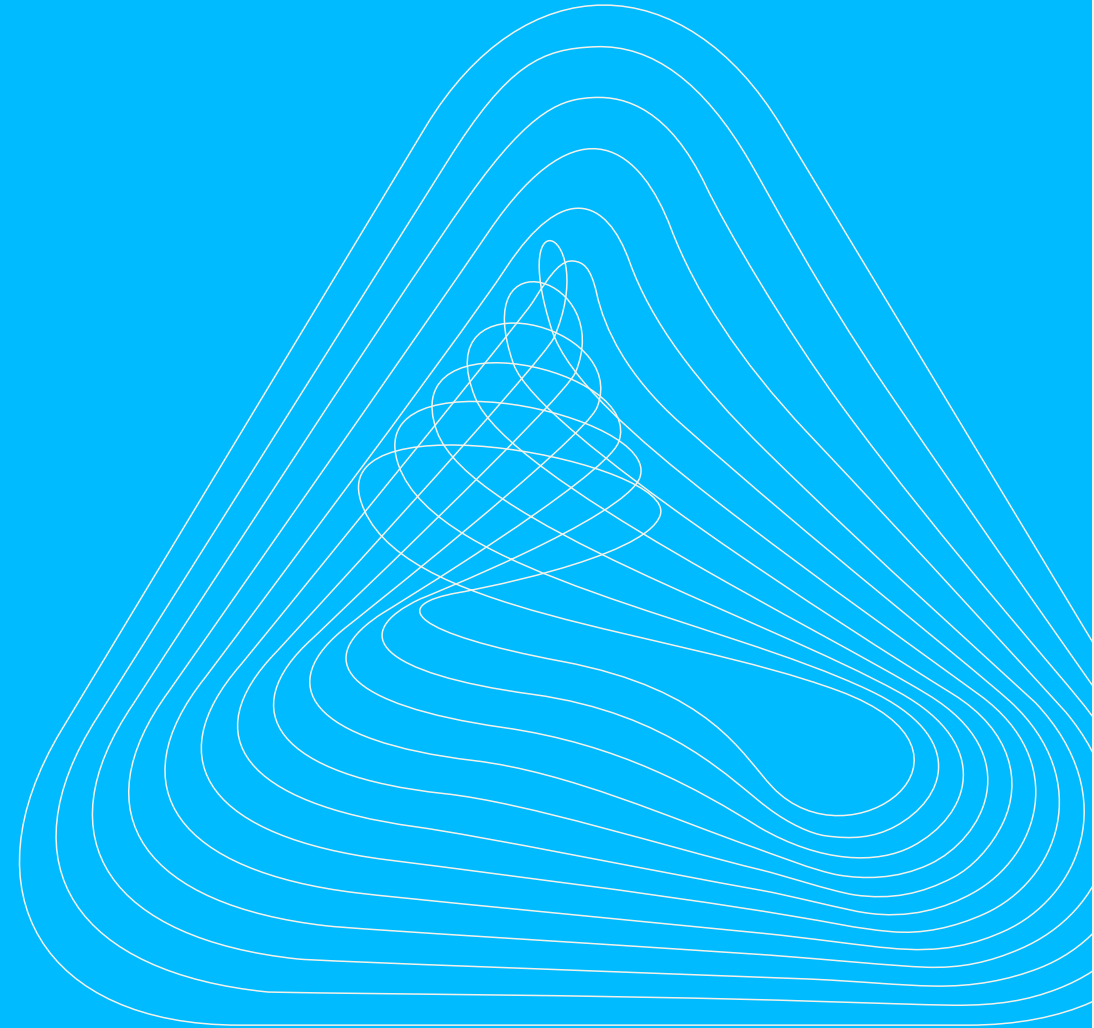
3 Software
On premise or cloud based

Market Model

Integrating RFID into the converting process requires investing time and resources, but it's worth the effort. Before taking the first steps, it is important to understand the key players you will interact with in the RFID market.



RFID Across Industries



RFID Across Industries

Beauty: Grupo Boticário



Goal: Seeking end-to-end traceability across its increasingly complex supply chain.

- Stockouts dropped by up to 97%,
- Identification of hidden stockouts increased by more than 50%,
- Revenue climbed

Logistics: Suar Group



Goal: Keep detailed inventory of every unique item being used in a project

- Speedier inventory checks
- More accurate inventory taking
- Lower cost per inventory check through fewer work hours
- Reduced health and safety risks

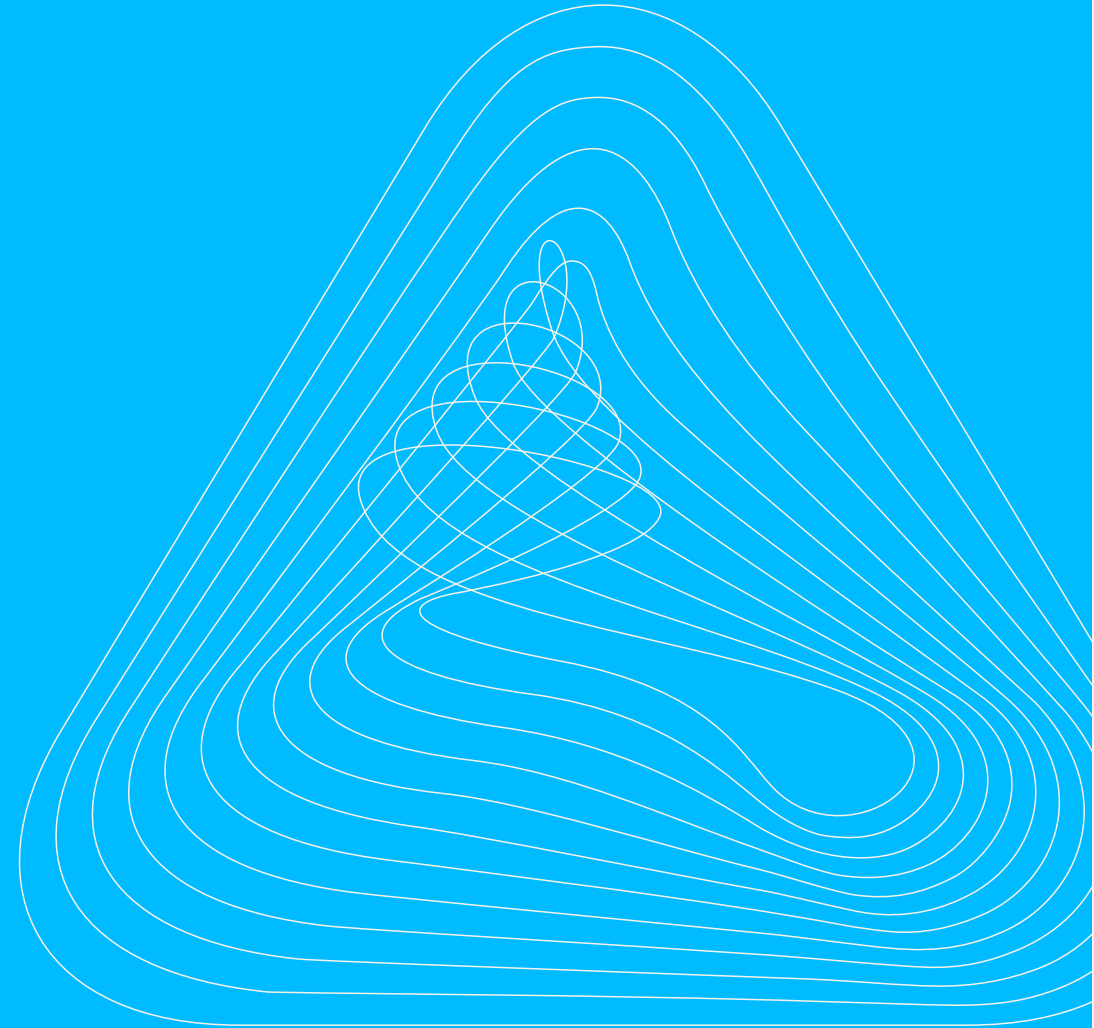
Food: Sodexo



Goal: Enable automated self-service vending machine + microwave save inlays.

- Lower labor costs
- Reduce food waste,
- Better inventory management

HF / NFC Intro



HF / NFC Everywhere

Unleashed by ubiquitous NFC-enabled mobile phones

Consumer experience



- Product authentication
- Product information
- Shopping experience

Closed-loop applications



- Social media
- Customer loyalty
- Instant sales

Brand protection



- Tamper detection
- Anti-counterfeiting / diversion

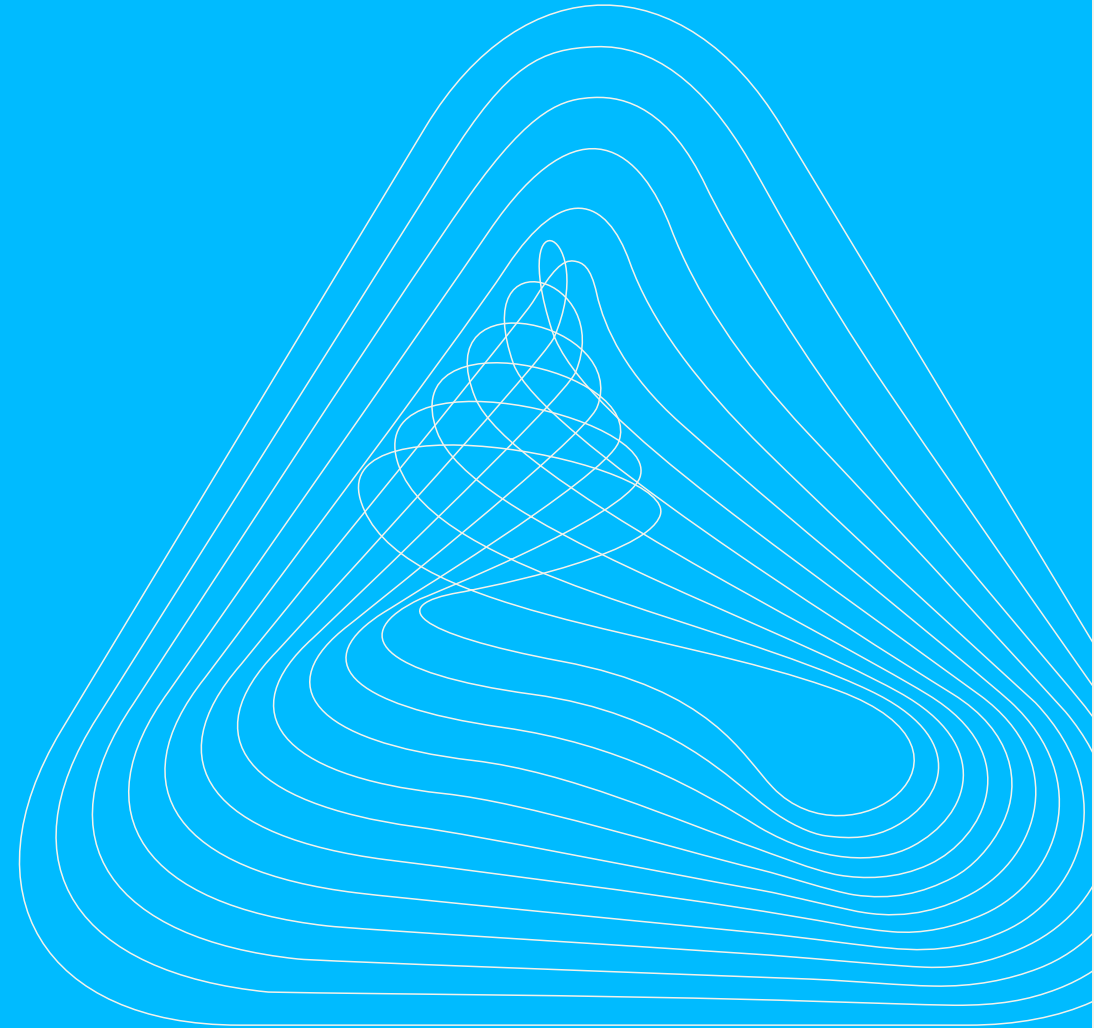
HF / NFC Chip Capabilities (13.56 MHz)

Global standard		Chip memory	Security	Read distance	Example chips	Type of applications
HF	ISO/IEC 15693 ISO/IEC 18000-3 NFC Forum T5T	2000+ bits	Password	Vicinity (<1.2 m)	NXP ICODE SLIX/2 MYD 2K	Library, Ticketing, WIP
NFC	ISO/IEC 14443A NFC Forum T2T	48+ bytes	Password	Proximity (< 10 cm)	NXP NTAG 210-u/213/216 MiFARE Ultralight	URLs, Bus cards, VCARDS
NFC High security	ISO/IEC 14443A NFC Forum T4T	400+ bytes	AES 128		NXP NTAG 424 DNA NXP 213/424 TT SIC 43NT em linq (4332)	Brand authentication

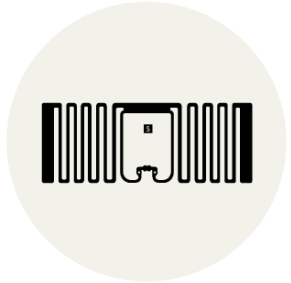
NXP Chips (13.56 MHz)

	ICODE SLIX2	NTAG 210 μ	NTAG 210	NTAG 213	NTAG 216
Primary applications	Library, ticketing	Lowest cost	Simple URLs	Long URLs/ SMS	All purpose/ VCARD
Global standard	ISO 15693 / ISO 18000-3M1 NFC Forum T5T	ISO 14443 NFC Forum T2T or T4T			
Read distance	Vicinity (<1.2 m)	Proximity (< 10 cm)			
Memory	2528 bits	48 bytes	48 bytes	144 bytes	888 bytes
Security	Pswd 32 bit		Pswd 32 bit	Pswd 32 bit	Pswd 32 bit
UID mirror			✓	✓	✓
Originality signature	✓	Re-programmable ✓	✓	✓	✓
Fast read			✓	✓	✓
Counter	✓			✓	✓

UHF vs HF / NFC

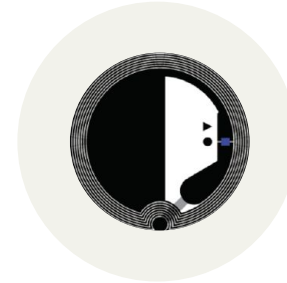


UHF vs NFC



UHF (Ultra High Frequency) RFID One to Many

- Propagating radio signal: Reads several meters
- Typical memory 96 bits
- Challenges near metal and liquid solved by tag engineering



NFC (Near Field Communication) One to One

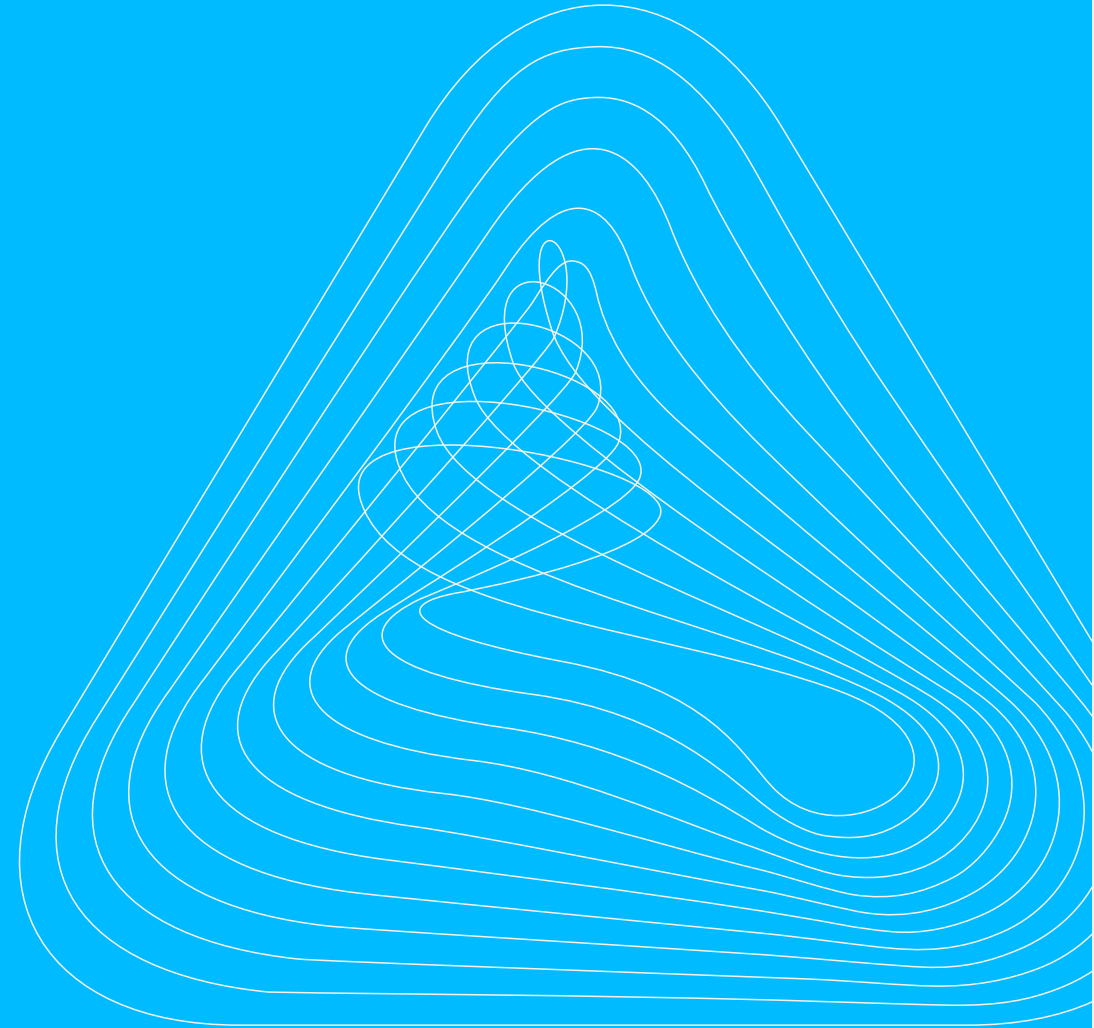
- Coupling technology – short read ranges
- Larger memory
- Minor challenges with liquids and metals
- Standard reader in Android and new iPhones

Comparing HF (NFC) and UHF



	Ultra High Frequency, UHF, 868-915MHz	High Frequency, HF(NFC), 13.56MHz
Read distance	1-20m (passive) “Non-line of site”	10cm-1m (passive) “Near field” or “Tap”
Reader hardware	RFID reader	RFID reader, Smartphone Android and iOS 6+
Communication	1 reader to many tags at once	1 device to 1 tag at once
Cost of tags	Low	Medium to low
Applications	Supply chain connectivity Logistics, pallet and case tracking Baggage tracking Item-level retail	Consumer engagement (NFC) Smart cards (traditional HF)

Selecting the Right Inlay



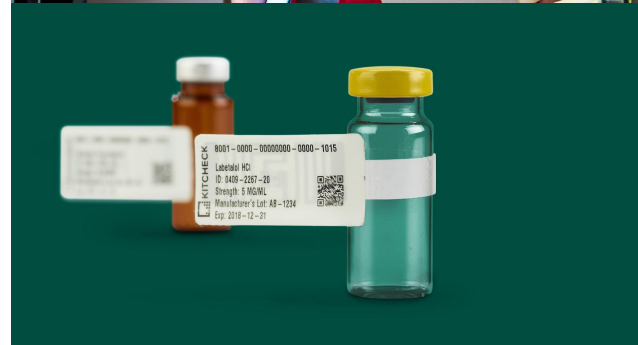
Item Size Drives Inlay Size...

...item material will select inlay.



Application Drives Inlay Selection

- Item level vs pallet level track and trace workflows
- Item size
- Item material and directionality
- RFID environment read points



Inlay Selection

Select an inlay fit for purpose:

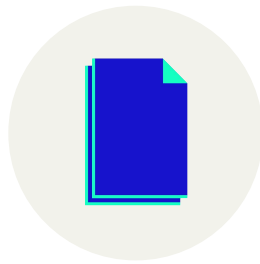


Step 1

Application drives requirements

Gather tag requirements

- Item to tag
- Read point performance required
- IC features needed
- Converted / delivery formats
- Encoding requirements



Step 2

Requirements drive capabilities

Align requirements with inlay capabilities

- Review Inlay certifications (ARC, NFC Forum,)
- Review RFID inlay data sheets



Step 3

Test and validate

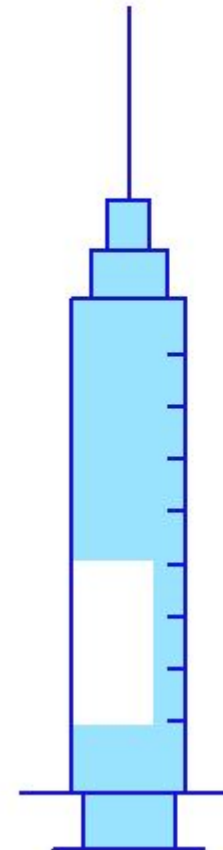
Select, test, deliver!

- Simulate 'real-world' scenario
- Ensure performance meets the requirements
- Confirm production and scale capabilities

Common Application Questions

- Q1** What is the product made of?
(e.g. glass, plastic, metal)
- Q2** Where will the tag be placed?
(e.g. On the syringe, flagged, on the cap)
- Q3** Will the product go through any process?
(e.g. Sterilization, extreme temperatures)
- Q4** How will the RFID inlay be read?
(e.g. handheld or fixed reader)

Example decision-making process:



- A1** Made of glass but will contain liquids
- A2** Tag will be applied directly on the syringe
- A3** No special process, storage temperatures up to -40°C
- A4** Near field fixed reader

Inlay selection considerations:

- 1** RFID tag that performs well near liquid
- 2** Small enough for the diameter of the syringe
- 3** Operating temperatures from -40°C to 85°C
- 4** Good shape for readability of fixed reader

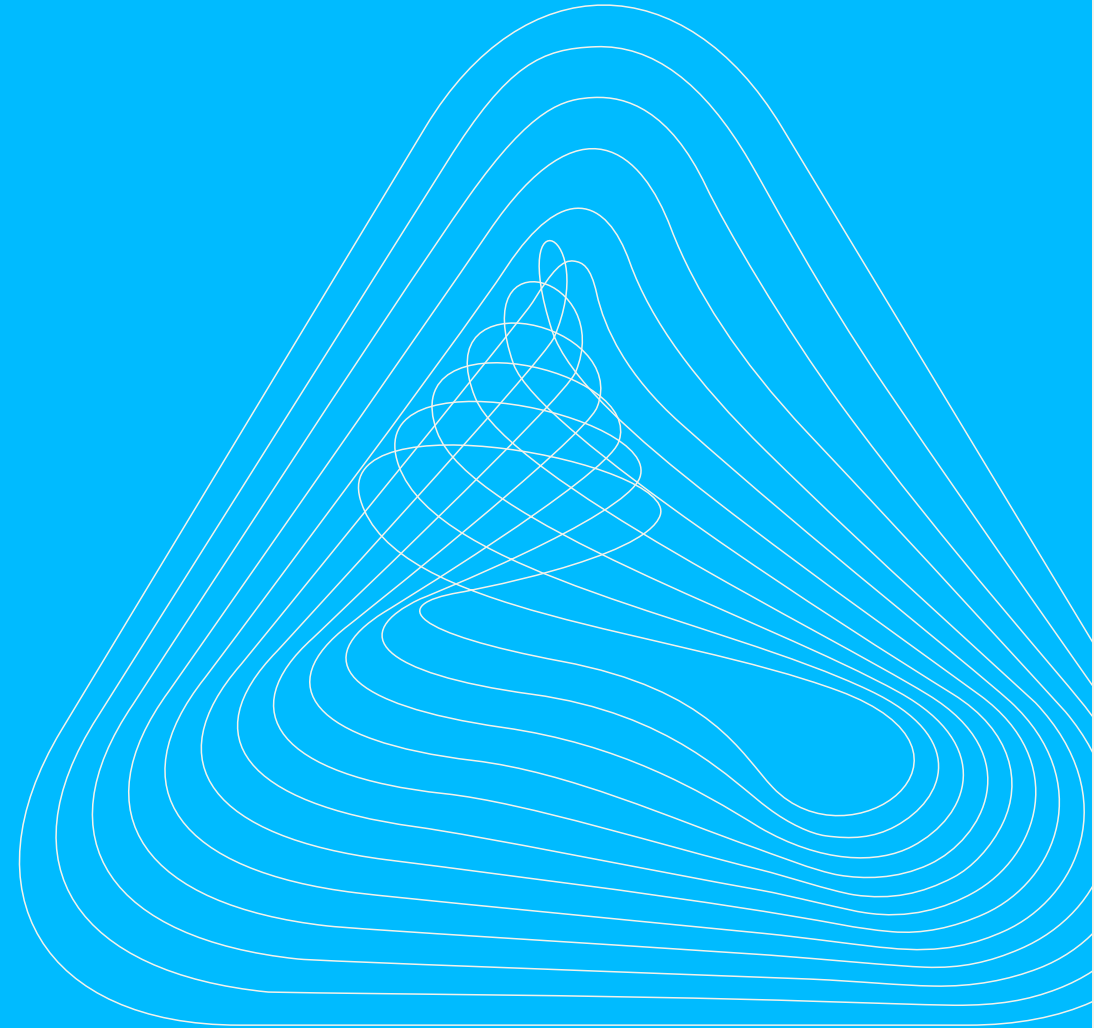
Solution: "Minidose" inlay

Tag Selection Quick Tips

- In general, larger inlay means larger antennas and better RF performance; also, newer ICs generally perform better.
- However, the target application and use cases ultimately drive inlay requirements.
- Select inlays/ICs by aligning inlay capabilities with application requirements using certification programs, inlay manufacturers data sheets or application notes, pilot programs.
- Validate that inlays/tags meet application requirements by testing.



NFC & ARC Certifications



Consider NFC Inlay / Tag Certifications

NFC Forum Tag Certification

NFC Forum Certification Program confirms that your device, tag or reader is compliant with NFC Forum specifications.

Conformance to the specifications provides consistency of behavior across NFC implementations and sets the foundation for interoperability.



For more information, please see nfc-forum.org

NFC Tag Spec	Summary
Type 1	Simplest, least expensive, may lack functionality required for some applications, slowest, e.g. response may lag.
Type 2	Right functionality at the right price to meet a wide range of needs.
Type 3	Based on Sony's FeliCa tag widely use in Asia and provides a wide range of functionality at a relatively high price.
Type 4	Offers flexibility and more memory while providing support for ISO/IEC 7816 security and ability to perform true authentication. Also allows for self-modification of NDEF content.
Type 5	Provides a longest read range with low power in accordance with ISO/IEC 15693. Combined with tamper-detection, Type 5 tags can be used effectively for supply chain applications.

Consider UHF Inlay / Tag Certifications

Auburn University RFID Lab / ARC product certifications for retail and key RFID segments

ARC RFID tag manufacturer quality certification

Ensures that an RFID tag manufacturer will design and manufacture reliable, high quality RFID tags.

Manufacturers may be required to be ARC Quality Certified before they can submit tags for performance certification, especially for new ARC specs such as Spec V.



For more information, please see rfid.auburn.edu/arc/

ARC RFID inlay / tag performance certification

ARC works with end users in key segments identify performance and quality requirements for their use cases and deployment:

- Retail, Logistics, Manufacturing, Healthcare / Pharma, Aviation

These requirements are the basis of ARC specifications or specs that an RFID tag must meet to perform reliably in the deployment.

ARC maintains a database of comprehensive performance and quality data of market available RFID tags.

ARC Spec	Context
F	Home Goods
G	Apparel
H	Brand Proprietary
I	Euro Home Goods
K	Euro Apparel
L	Brand Proprietary
M	Brand Proprietary
N	Fixed Infrastructure
Q	Accessory
U	Aviation Baggage
V	Universal (draft)
W1-W6	Brand Proprietary
X	Cargo / Freight (draft)

Consider Inlay Data Sheets

Avery Dennison Smartrac Product Data Sheet Inlays and Tags AD-324u8-FCC/03/21/DS

AD-324u8 FCC

Overview

Frequency Band
UHF 860 - 960 MHz

Chip
NXP UCODE 8


Antenna Dimensions
41 x 16 mm / 1.63 x 0.63 in

International Standard
ISO/IEC 18000-63 Type C

Industry Segments
Apparel
Logistics
Healthcare

Applications
Supply Chain Management
Home Essentials
Inventory and Logistics

RoHS
EU Directive 2011/65/EU and 2015/863 Compliant



Excellent read range and versatility

AD-324u8 FCC inlays from Avery Dennison are ideally suited for a wide variety of RFID tagging applications, particularly those related to the areas of supply chain, inventory & logistics, apparel, and pharmaceutical & healthcare

The Gen2 UHF RFID inlay's 41.4 x 16mm design is optimized for outstanding performance in the FCC frequency band (902-928 MHz) and features the UCODE 8 IC by NXP. An ETSI-specific design with identical footprint is available as well.

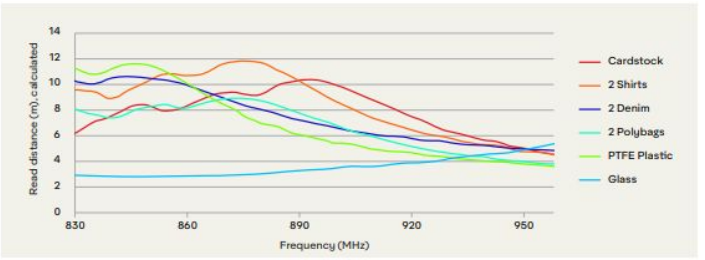
AD-324u8 FCC's UCODE 8 chip features 128-bit of EPC memory and 96-bit unique factory-locked TID number. A 48-bit unique serial number is factory-encoded into the TID. UCODE 8 supports all mandatory commands of EPC global specification V.2.0.1 including (Perma) LOCK and Kill Command. Delivery formats include dry, wet and paper label.

Like all RFID products from Avery Dennison, AD-324u8 FCC inlays are manufactured according to the industry's highest quality standards, as confirmed by the RFID Lab at Auburn University; The inspection body awarded Avery Dennison its first comprehensive and significant ARC accreditation for quality.

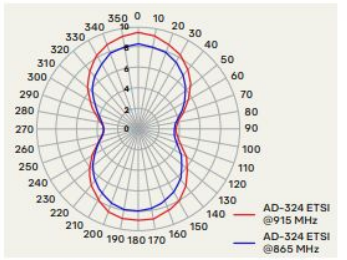
Look for description similar to your use case: item or material type

Check expected performance

Read range



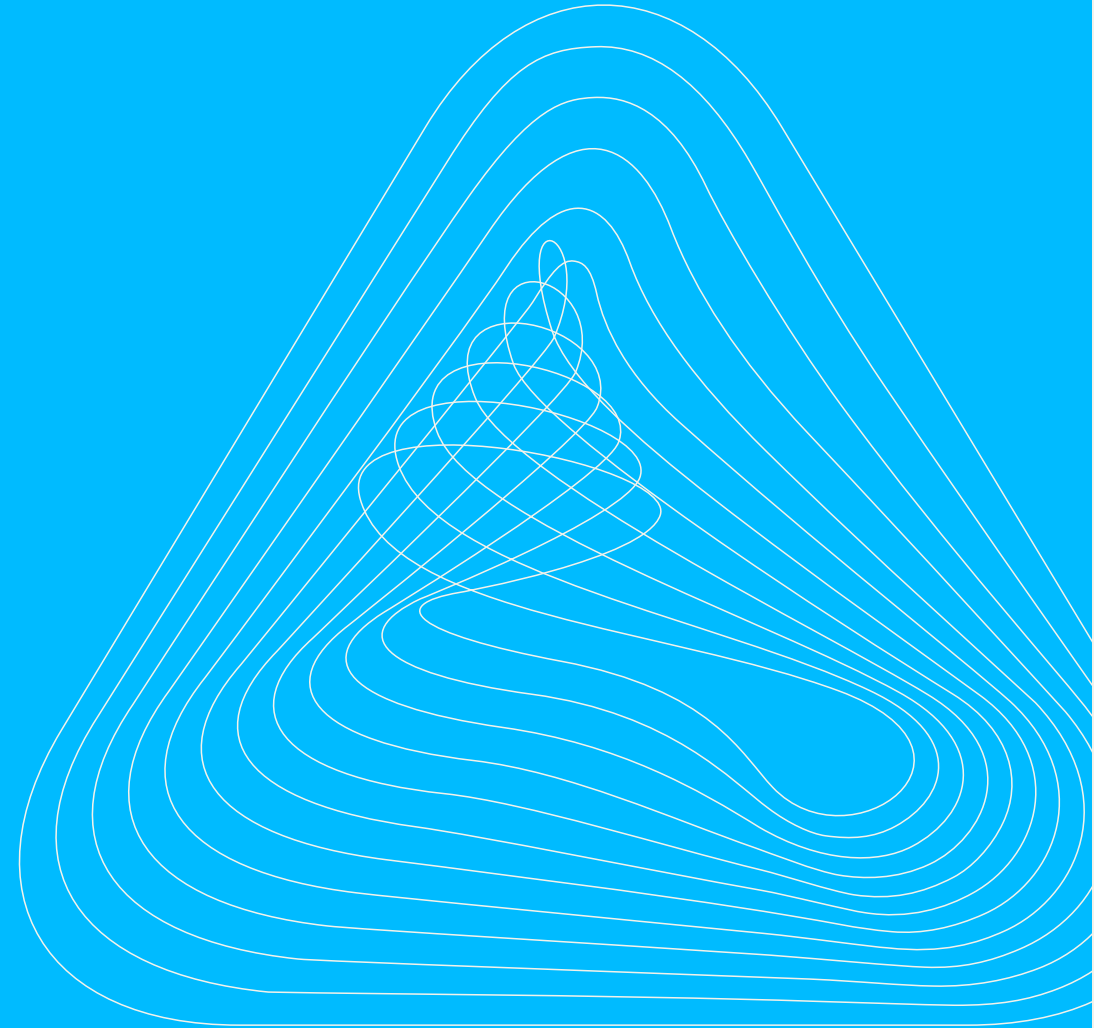
Orientation sensitivity



All graphs are indicative; performance in real life applications may vary.

Find more at rfid.averydennison.com

Product Datasheet Deep Dive

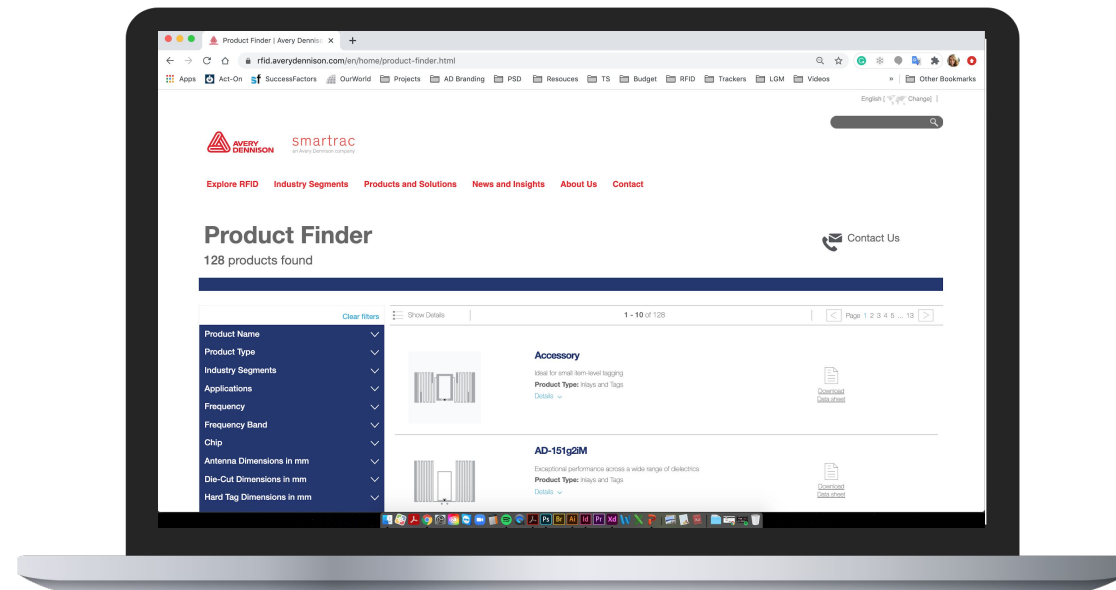


Our RFID Portfolio



Explore our progressive portfolio of digital ID technologies to choose the product or solution that fits your business needs.

Visit rfid.averydennison.com/product-finder for more information.



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&

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Thank you

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