RFID from A to Z: Everything You Need to Know

October 11-14, 2021

Agenda for today

14.00-14.10
Looking back on what we've learned

14.10-14.40
Standards in the RFID industry - Cisc

14.40-15.10
Making RFID work for you

15.10-15.50
End-user Experience - Aalborg Airport

Standards in the RFID industry

October 11-14, 2021

ADDING TRUST
IN A CONNECTED WORLD
CISC.AT

ISO RFID Standards

Josef Preishuber-Pflügl

October 2021

We have a **PASSION** for providing trusted hardware and software communication solutions to empower our customers to develop excellent products for seamless connectivity.

SOME FACTS ABOUT US

700+ PROJECTS

120
COUNTRIES

70+
JOINED R&D PROJECTS

38
PATENTS

33
EMPLOYEES

21
YEARS OF EXPERIENCE

15
MEMBERSHIPS

8
AWARDS

OUR SOLUTIONS

WIRELESS TESTING

Covering concept, design, implementation, configuration, verification and testing

COMMUNICATION MODULES

Solutions for identification, authentication, and authorization of secure end-to-end communication.

TRUSTED CONNECTIVITY

Software cores for integrated hardware modules to improve product development.

20+ years in RFID standardization

Josef Preishuber-Pflügl

Convener ISO/IEC JTC1 SC31 **WG4** – Radio communications (RFID, RTLS, Security)

prior Project Editor **ISO/IEC 18000-63** - UHF RFID

Vice-Chairman **ETSI** ERM **TG34** RFID

Rapporteur ETSI **EN 302 208** UHF RFID

Chairman RAIN RFID **TWG** (Technical Work Group)

RAIN Air Interface
ISO/IEC 18000-63 | GS1 EPC Gen2

- ISO/IEC 18000-63:2015 Type C is equal to EPCglobal™ Class 1 Gen2 V2.1.0
  - Clause 1-6 are technically equal including referred annexes
  - Additional in ISO:
    - 7 Battery Assisted Passive (BAP) Interrogator Talks First Type C systems (optional)
    - 8 Sensor support (optional)
    - 8.1-8.4 General
    - 8.5 Simple Sensor
    - 8.6 Sensor Directory System and Full Function Sensors
- ISO/IEC 18000-63:2021 will contain
  - Technical corrigendum (already implemented in Gen2 V2.1.0)
  - More on sensors

Essential differences between ISO and GS1

- EPC/UII Memory – PC-Bits
  - NSI = 0xx EPCglobal™ identifier
  - NSI = 1xx ISO/IEC identifier
- TID memory
  - TID for NSI=0xx:
    AC = E2 according EPC™ Tag Data Standards
  - TID for NSI=1xx will be according ISO/IEC 15963
    AC = E0 … as e.g. in UID in 18000-6 A/B
    AC = E2 … for GS1 as above
  - GS1 committed to allow “E2”-tag manufacturer registration for free for EPCglobal members and non-members.

RAIN RFID Documents

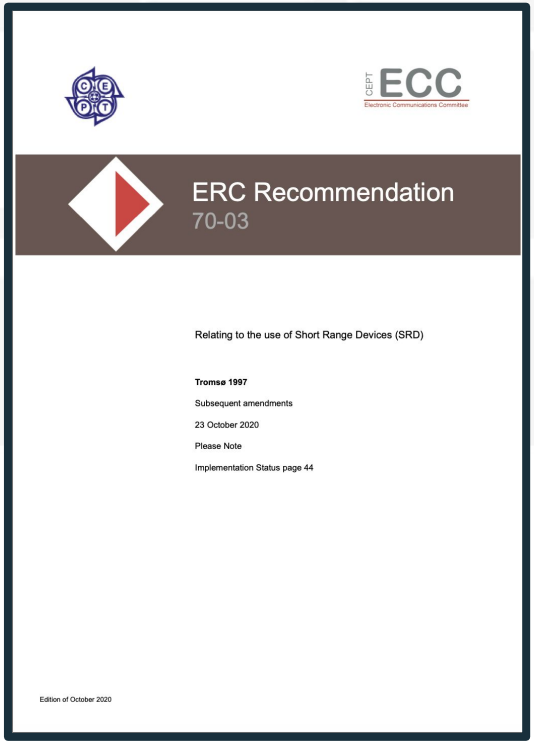
- RAIN Air Interface: RAIN uses the GS1 UHF Gen2 protocol which ISO/IEC has standardized as 18000-63. (https://rainrfid.org/about-rain/what-is-rain/)
- RAIN Communication Interface (RCI) (https://rainrfid.org/technology/rain-communication-interface-rci/)

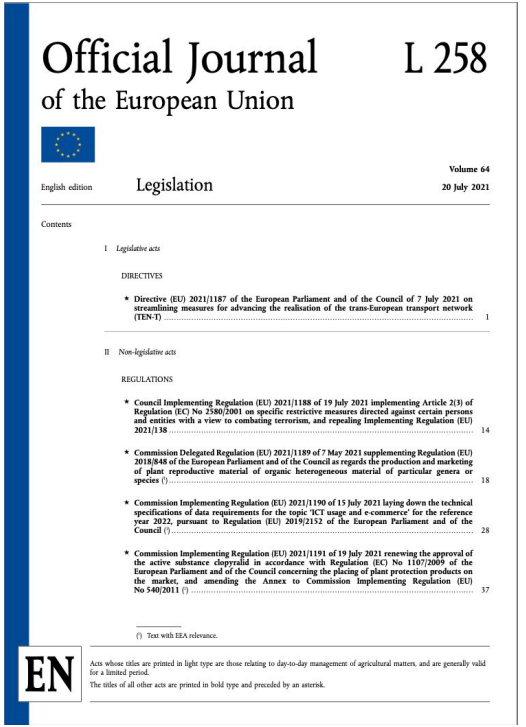
- RAIN Resouces (https://rainrfid.org/resources/)
  - RAIN RFID Lessons learned from the field
  - RAIN RFID Reader Sensitivity Testing v2
  - RAIN RFID Systen Design Guidelines
  - RAIN Item Numbering and Tag Data (Digital twin)
  - RAIN Item Numbering to Avoid Tag Interference (Acid RAIN)

EUROPEAN RADIO REGULATIONS

Sources: etsi.org, wikipedia.org, europe.eu

The documents





Source: cept.org, etsi.org, europa.eu

CEPT REC 70-03

- UHF RFID 865-868 MHz band
  - 4 Channels
  - 2 Werp transmit power
  - 200 kHz transmit channels
- UHF RFID 915-921 MHz band
  - 4 Channels
  - 4 Werp transmit power
  - 400 kHz transmit channels
  - Some countries have limitations in channel use
  - Some countries do not provide any channel
    - Germany 🇩🇪
    - The Netherlands 🇳🇱

DOUBLE IT

EN 302 208

- V3.3.1 is currently published and stated in the EU OJ 2021-07-20
- V3.3.1 has been developed to address the topic of measurement uncertainty
  - Measurement uncertainty became less important
  - EC set a new focus on efficient spectrum use
  - Several updates
- Required for RED approval

Reader – Relaxed spurios emmissions

- All spectrum down to 694 MHz the limit is –36 dBm

Table 2: Spurious emission limits in e.r.p. (according to [i.16])

State	87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 694 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Operating	4 nW (-54 dBm)	250 nW (-36 dBm)	1 µW (-30 dBm)
Standby	2 nW (-57 dBm)	2 nW (-57 dBm)	20 nW (-47 dBm)

Source: www.etsi.org/deliver/etsi_en/302200_302299/302208/03.03.01_60/en_302208v030301p.pdf

New test with focus on receiver tests

- Adjacent channel selectivity
- Blocking or desensitization
- Spurious emissions

- Receiver spurious response rejection
- Receiver sensitivity
- Receiver radio-frequency intermodulation

Reader receiver sensitivity

- Limits receiver sensitivity
- Setup

Table 2a: Receiver sensitivity limits

Category	Limit
Category I (> 30 dBm e.r.p.)	-60 dBm
Category II (> 13 to 30 dBm e.r.p.)	-55 dBm
Category III (≤ 13 dBm e.r.p.)	-45 dBm

Figure 15b: Conducted test set up for receiver sensitivity with (emulated) tag with variable backscatter

NOTE: For testing of ISO/IEC 18000-63 [i.20] compliant products it is recommended to use the protocol settings details as described for the ISO/IEC 18046-2 [i.17] reader sensitivity test. Values like Tari, RTcal, TRcal, BLF, DR and M should be recorded.

Source: www.etsi.org/deliver/etsi_en/302200_302299/302208/03.03.01_60/en_302208v030301p.pdf

Tag radiated power

- Reduction of ambiquities in tag radiated power (backscatter power)
- At tag position
  - 865 MHz band: -20 dBm
  - 915 MHz band: -10 dBm
- Tag for reader sensitivity: Both sidebands considered
- Tag as spectrum occupant: Single sideband considered

3 dB advantage

On-metal tags

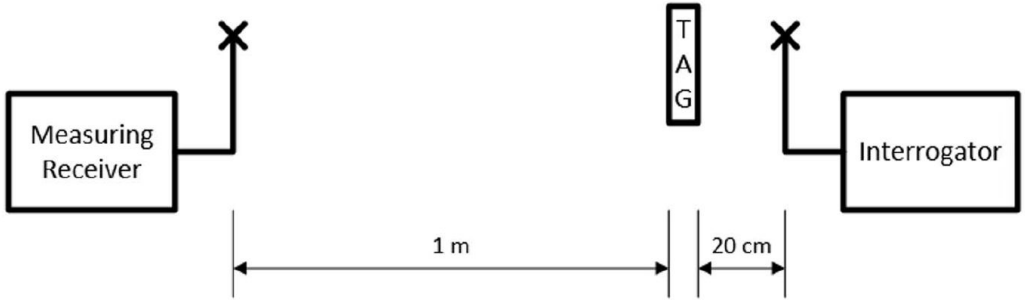
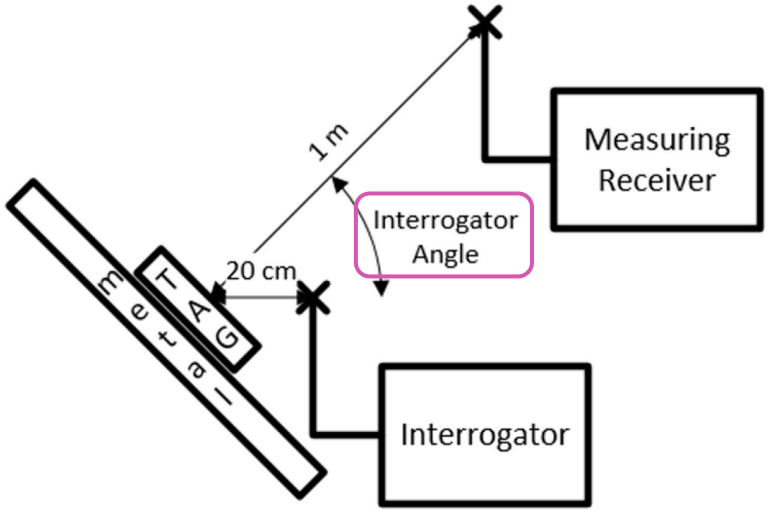
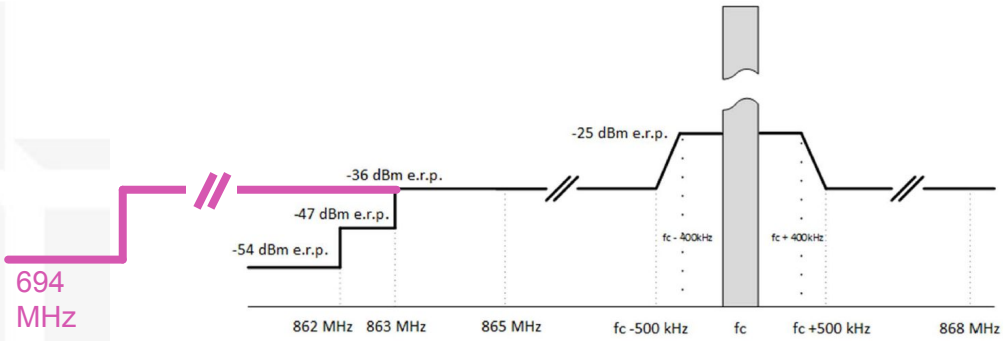


Figure 16: Measurement of tag emissions



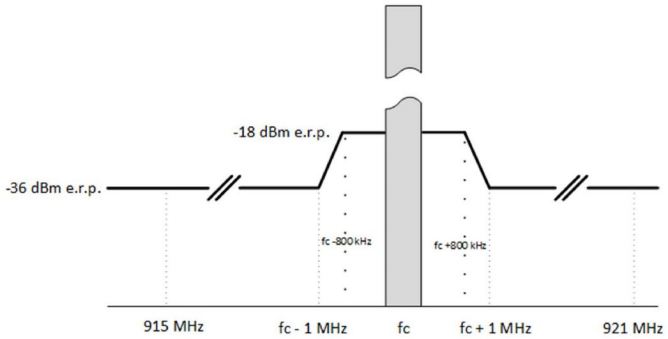
Source: www.etsi.org/deliver/etsi_en/302200_302299/302208/03.03.01_60/en_302208v030301p.pdf

Tag spurious emmisions



NOTE 1: fc is the centre frequency of the carrier transmitted by the interrogator.
NOTE 2: The transmit channel occupied by the interrogator is shown in grey.
NOTE 3: All power levels in the unwanted domain relate to the resolution bandwidths in figure 10.

Figure 8: Spectrum mask for tag for the lower band



NOTE 1: fc is the centre frequency of the carrier transmitted by the interrogator.
NOTE 2: The transmit channel occupied by the interrogator is shown in grey.
NOTE 3: All power levels in the unwanted domain relate to the resolution bandwidths in figure 11.

Figure 9: Spectrum mask for tag for the upper band

Source: www.etsi.org/deliver/etsi_en/302200_302299/302208/03.03.01_60/en_302208v030301p.pdf

ISO – ETSI aligned

ISO/IEC 18046-2:2020

Information technology — Radio frequency identification device performance test methods — Part 2: Test methods for interrogator performance

ABSTRACT

This document def
requirements and t
application. The su

GENERAL IN

Status : Publish

Edition : 2

ISO/IEC 18046-3:2020

Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance

ABSTRACT

This document defines test methods for performance characteristics of RFID tags for item management and specifies the general requirements and test requirements for tags which are applicable to the selection of devices for an application. The summary of the test reports forms a unified tag datasheet.

GENERAL INFORMATION

Status : Published	**Publication date :** 2020-10
Edition : 3	**Number of pages :** 51

Source: iso.org

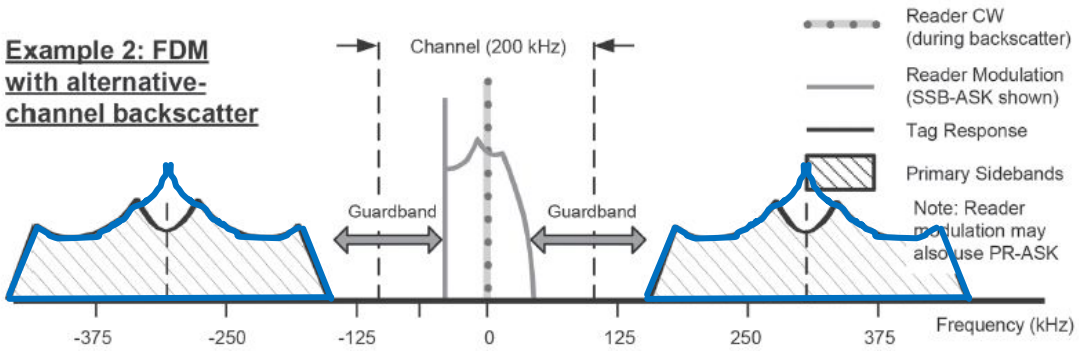
One method for each topic

- Aligned across global recognized standards from standards organizations
- International test standards for RAIN air interface
  (ISO/IEC 18000-63, GS1 EPC Gen2)
  - ISO/IEC 18046-2
  - ISO/IEC 18046-3
- Utilization for European standards
  - EN 302 208

The Value

- Standards define the globally reproducible test methods
- Traceable
- Globally reproducible
- Test equipment independent
- Meaningful in terms of physics
- Relevant to correlate test result with application performance

Backscatter power measurement

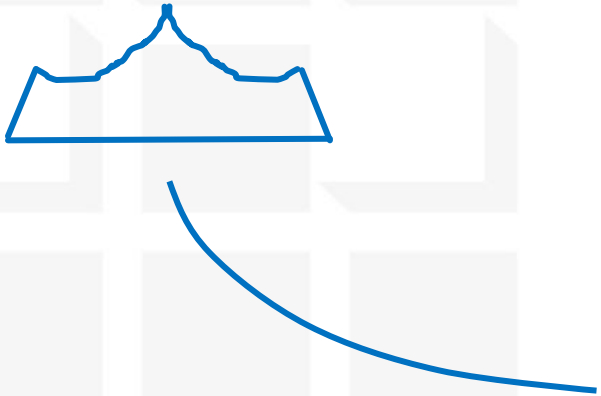


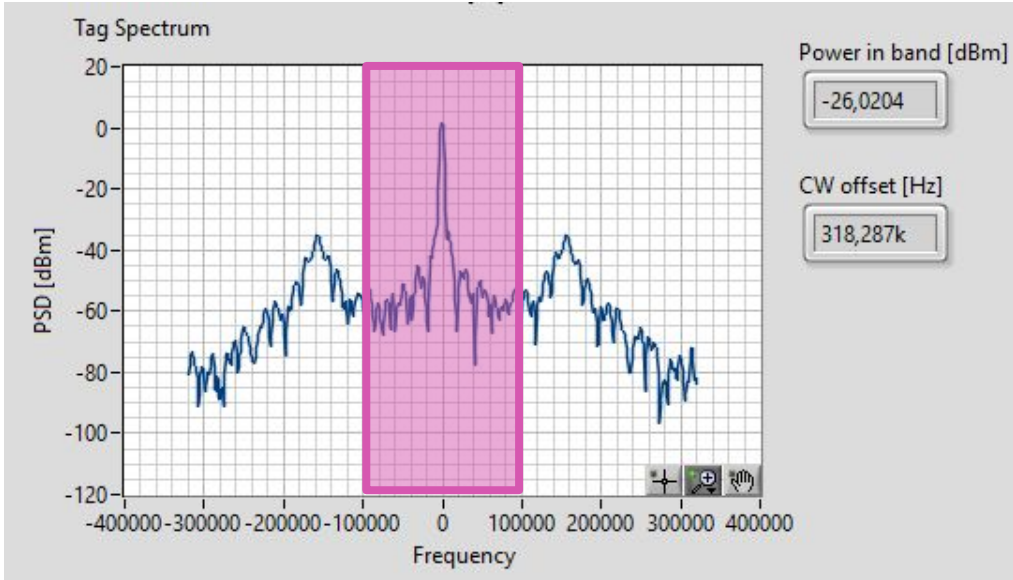
Tag Signal for reader

These values have been obtained by applying a guard band around the carrier to exclude the carrier including its phase noise. […]
Contribution of the tag harmonics to the measured backscatter is negligible.

Source: www.gs1.org/standards/epc-rfid/uhf-air-interface-protocol

Backscatter power measurement





Source: www.cisc.at/xplorer

- ISO/IEC 18046-2 – Annex A
- ISO/IEC 18046-3 – Annex E

RAIN RFID in tyres – Use cases

Most interesting uses cases

- Assembled tire portal
- On-vehicle tire inspection
- Tire manufacturing portal

Additional uses cases

- Manufacturer shipment
- Dealer
- Doublewheels
- Moving car on-vehicle inspection

REQUIREMENTS

Short distance (Near-Field)

Long distance (Far-Field)

Global use

- Suitable for all countries globally
- Fit for as many applications as possible

Requirements

- Minimum of 10 cm read range
- Preferable more than 50 cm read range
- More read range may make it easier – or not

Source: www.iso.org

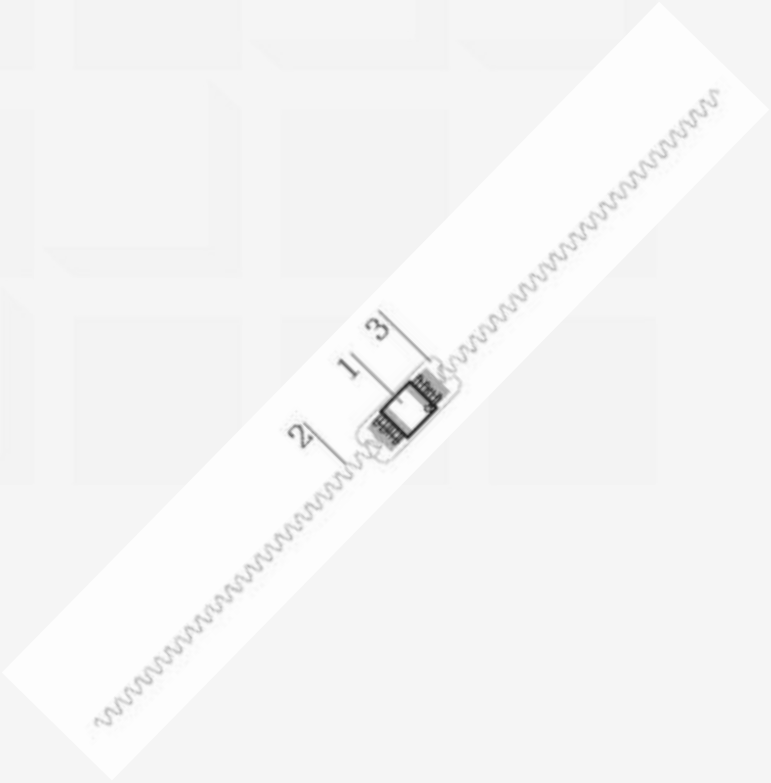
ISO Application Standards

ISO/TC 31 **Tyres, rims and valves**

ISO/TC 31/WG 10 **RFID tyre tags**

Dedicated standards for RFID tyre tags

- ISO 20909:2019
  Radio frequency identification (RFID) tyre tags
- ISO 20910:2019
  Coding for radio frequency identification (RFID) tyre tags
- ISO 20911:2020
  Radio frequency identification (RFID) tyre tags — Tyre attachment classification
- ISO 20912:2020
  Conformance test methods for RFID enabled tyres

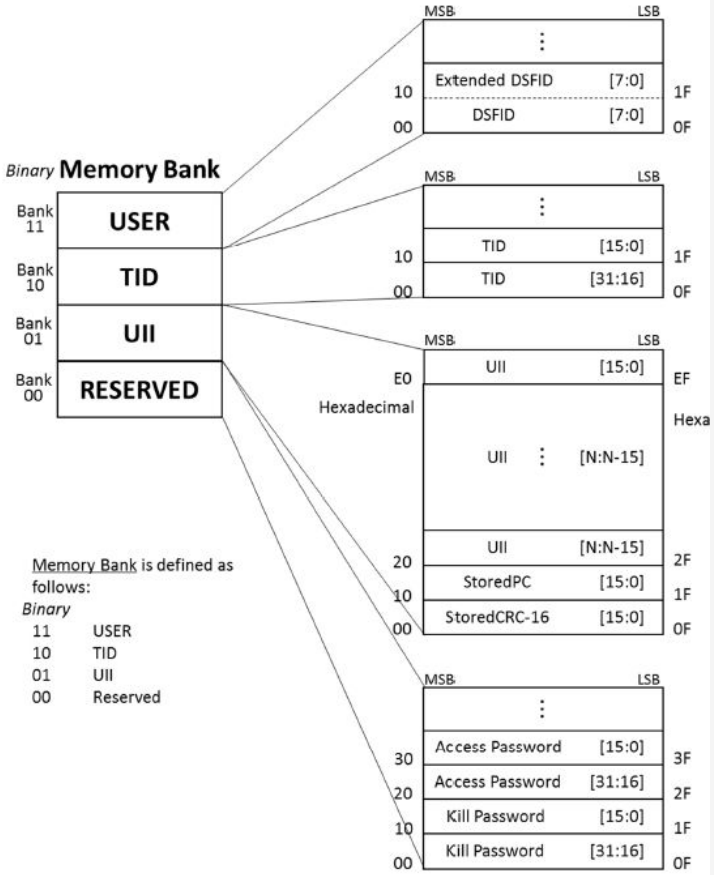


ISO 20909:2019

Radio frequency identification (RFID) tyre tags

Elements

- Reference to ISO/IEC 18000-63 / GS1 EPC Gen 2 (= RAIN RFID Air interface)
- 860 – 930 MHz band
- 3 techologies of RFID enabled tyre
  - Embedded (-25 °C to 80 °C, 5 MPa/200 °C, lifetime)
  - Patch (as embedded, may be removed)
  - Sticker (-25 °C to 60 °C)
- SGTIN-96 encoding / permalocked
- 15 cm reading distance
- Kill must be disabled



ISO 20910:2019

Coding for radio frequency identification (RFID) tyre tags

Elements

- Memory bank use
- Command support
- SGTIN-96 encoding / permalocked
- GS1 coding (T=0)
- Kill must be disabled

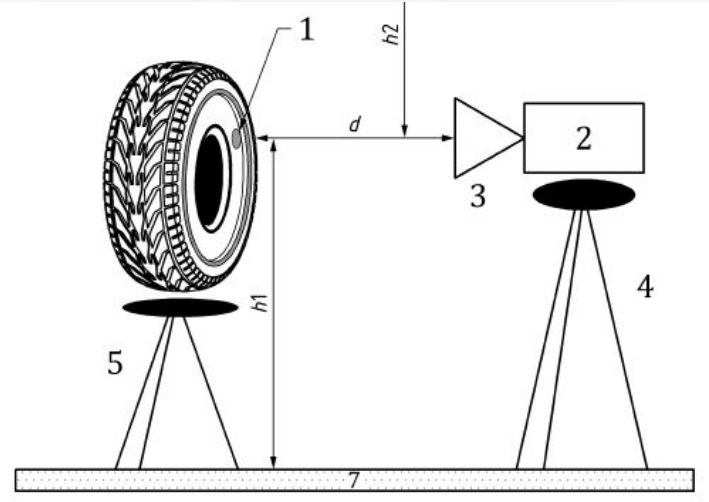
ISO 7000-3010
Registed ISO Symbol
Registration date: 2010-03-12

ISO 20911:2020

Radio frequency identification (RFID) tyre tags — Tyre attachment classification

Technolofy and requirements

- Embedded
- Patch
- Sticker



ISO 20912:2020

Conformance test methods for RFID enabled tyres

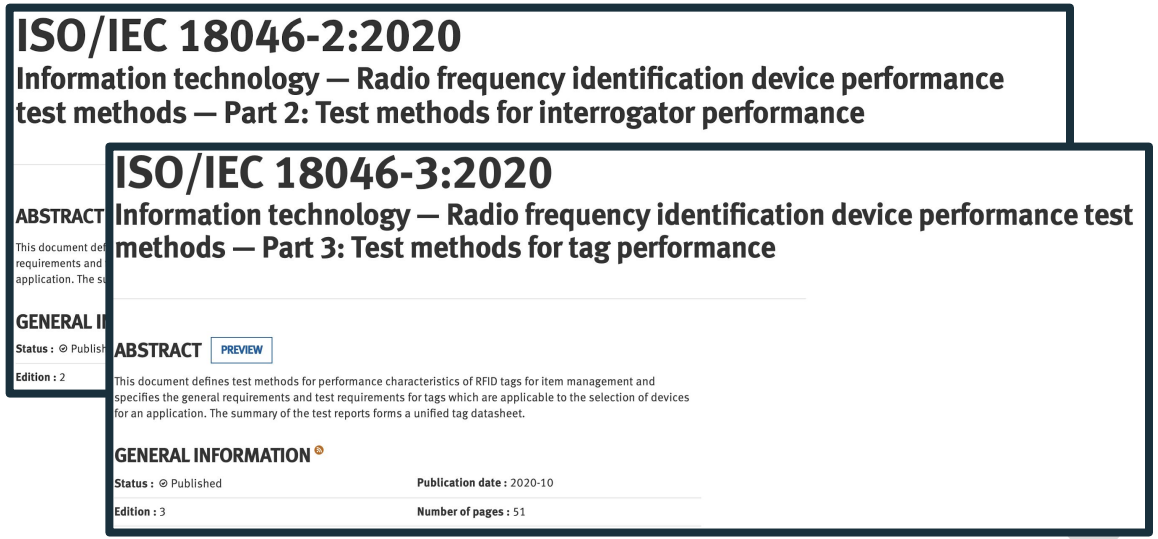
Elements

- Measurement methods
  - Open space
  - Semi-anechoic chamber
- Measurement equipment
  - Handheld reader
  - Dedicated high-end RFID test equipment

REVISION

Relevant standards

- RAIN RFID Air interface
  - ISO/IEC 18000-63 / GS1 EPC™ Gen2 UHF RFID
- Conformance standards
  - ISO/IEC 18047-6 / GS1 EPC Gen2 UHF RFID Devices Conformance Requirements
- Performance standards
  - ISO/IEC 18046-2, Interrogator tests
  - ISO/IEC 18046-3, Tag tests
- Radio regulations
  - CEPT REC 70-03 / ETSI EN 302 208
    - Reader requirements
    - Tag requirements
  - FCC part 15 / part 90
    - Reader requirements



Source: www.iso.org

Conclusions

ISO does great work on RFID standards

ISO/IEC JTC1 SC 31 AIDC

- Well developed and mature technology standards
- Fitting set of test standards
- Data standards

Commitees refering to technology standards/

- ISO application standards referring to
  - SC31 technology standards
  - SC31 test standards
- RAIN RFID standards are using SC31 standards as basis
- GS1 standards refer or align with SC31 standards

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QUESTIONS?

…. ask me at
j.preishuber-pfluegl@cisc.at

How to Merge the Physical and Digital World with NFC

October 11-14, 2021

AVERY DENNISON

Agenda

- Learn more about latest contactless trends and what it means for your business
- Explore NFC solution offerings that will help you jumpstart your digital transformation

Tony Fazhev

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NFC Business Development Manager, EMEA

Avery Dennison Smartrac

What is Near Field Communication?

Near Field Communication (NFC) tags are small passive devices, that can be embedded into nearly anything

It enables:
verification, product- authentication, product exclusivity and tamper detection

Compatible with Android and iOS

Source: 2018 data from McKinsey

NFC Market Applications

Consumer Engagement

Brand storytelling and exclusive brand experiences

Reviews / ratings and loyalty programs

Contests, promotions and gamification

Brand Protection

Tamper protection

Authentication against counterfeits and parallel trading

Provenance through blockchain

Consumers Are Going Digital. Are Your Products?

Millennials: 18-35 years old

4 mobile devices personally used

17.5 hrs spent on the internet weekly

98% social media usage

Baby Boomers:

> 50 years old

3.5 mobile devices personally used

16.4 hrs spent on the internet weekly

75% social media usage

Trends of Consumers Buying Habits

70%

sales influenced by online

8%

online sales

22%

offline sales

Source: 2018 data from McKinsey

Advantage of NFC Compared to QR and Visual Codes

NFC

Image recognition

QR code

Bar code

NFC is the easiest way for consumers to engage with products...

Quick and easy-to-use; simply tap phone to product

Compatible with all mobile devices, with no necessity to download an app

No unsolicited advertising or annoying pop-ups

Direct 1-to-1 communication: Pull technology

Doesn't take up branding "real estate" on label or package

Anti-counterfeit through tamper evident and encryption security

NFC market size projected to reach $47.43 billion by 2024*

*Source: Grandview Research

Packaging Solutions Enabled with NFC

Behind the Decorated Label

Bottle Neck Label

Over the Closure

In the Closure

Consumer Experience with NFC

Tangle Tequila

Behind the decorated label

Brand Awareness

Consumer Engagements

Product Authentication


PURO AGAVE AZUL
TEQUILA
REPOSADO
ESTATE
BOTTLED
SAMSUNG

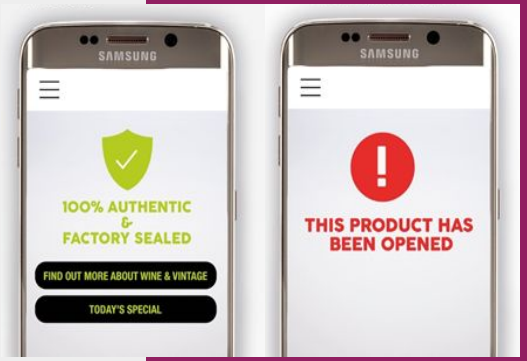
Product Authentication with NFC

A simple, easy-to-use solution that does not require a new device.

Higher-security IC's
Equipped with AES cryptography can support advanced authentication schemes – tag, message and/or mutual authentications.

NFC tamper evident tags
Provide digital seal functionality. When seal broken the RFID antenna breaks sending a signal to the Microchip (IC)

Secure NFC technology
Quickly confirm the originality and provenance of important documents, such as product certificates



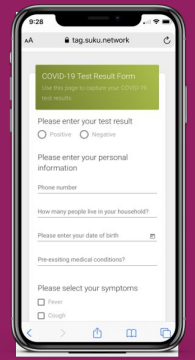
Images courtesy of OREV

Packaging Solutions Enabled with NFC

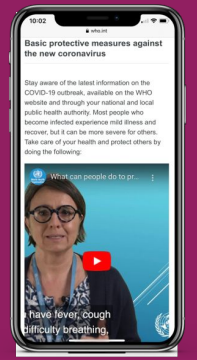
Authenticity via NFC + blockchain

- NFC tags combined with blockchain provenance
- Can be attached to any test kit
- Allowing organizations to source secure, immutable, confidential, and real time data from test results

Patient takes at-home test kit and gets results



Patient scans secure NFC tag and receives diagnostic information



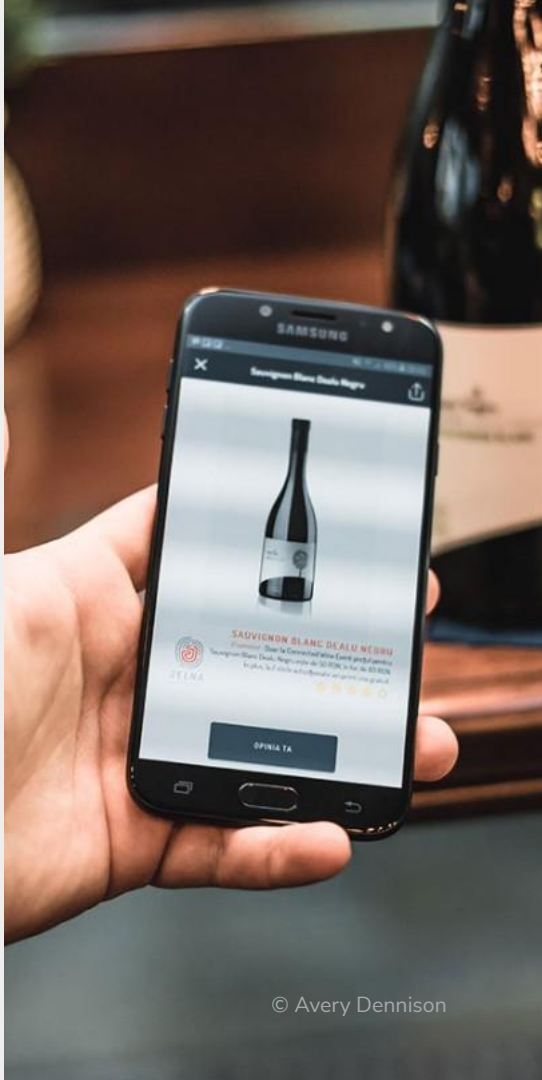
Patient receives customized health guidance on diagnosis

NFC Benefits Recap

Anti-counterfeiting through tamper evidence and encryption security

Gain visibility and control of gray markets by accessing real-time data from consumer interactions

Create more meaningful, personalized digital interactions with consumers at the point of sale and at home



Q & A

Thank you.

RFID in Logistics & Industrial Applications

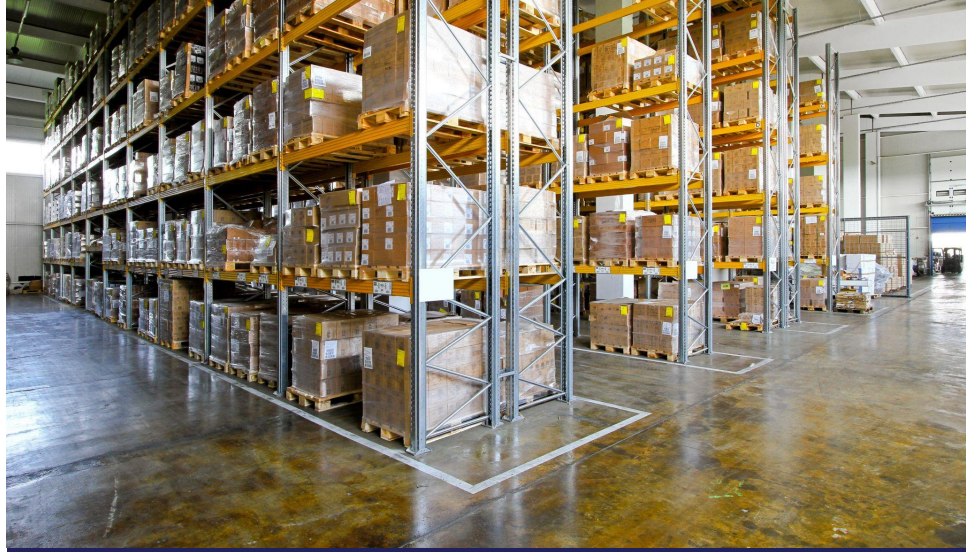
October 11-14, 2021

AVERY DENNISON

smartrac
an Avery Dennison company

Agenda

- Passive UHF RFID - perfect for track/trace and automation?
- Connected logistics - building value
- Supply Chain Management - Visibility/transparency and Internet of Things
- Logistic use cases
- RFID on challenging materials
- Q&A



Urban Söderberg

Business Development Manager

Avery Dennison Intelligent Labels

RFID vs. Barcode

Barcode Scanning

- Needs a line of sight
- One to One communication
- Limited amount of information
- Reads at close proximity

RFID Scanning

+ No line of sight needed
+ One to Many communication
+ Extended amount of information, unique per product
+ Readability of several meters

Connected Logistics: Building Value

End to End Supply Chain, Analytics Platform, WMS, TMS

Use Cases

Barcoded Warehouse Operations

Shipment Verification

Inventory Management

Workflow Optimization

RFID

Building Value

92% Accurate
1 Minute

- Requires Line-of-Sight
- Labor Intensive
- Error-Prone
- Delayed Visibility

- Mis-Shipment Prevention
- Labor Efficient
- Increased Velocity
- Truckload Optimization
- Floorspace Efficient

99.9% Accurate
5 Seconds

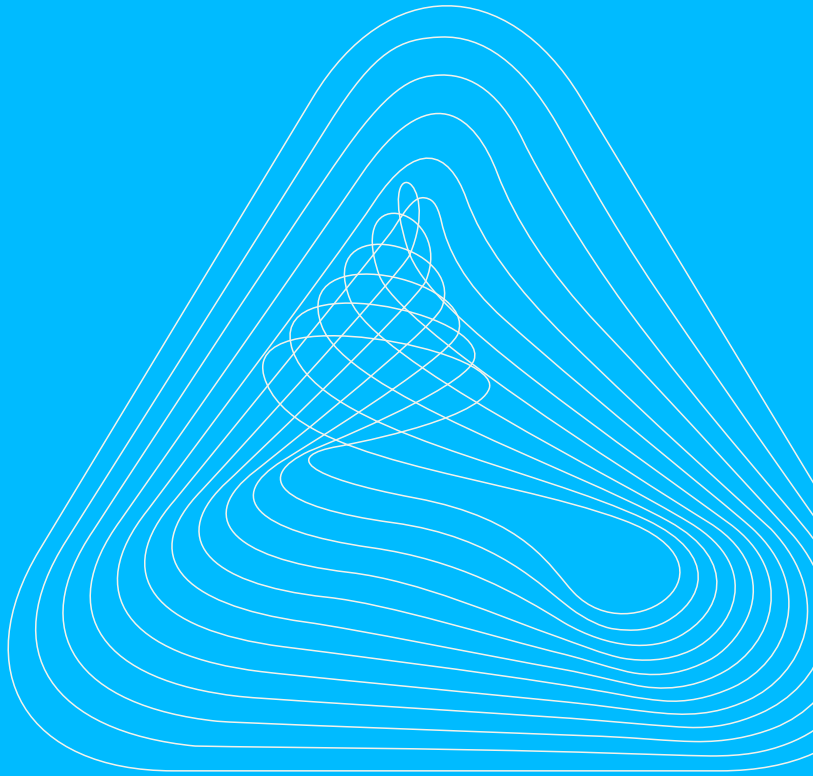
- Mis-Stock Prevention
- Reduced Inventory Levels
- Automated Cycle Counting
- Labor Efficient
- Increased Velocity

- Order Verification
- Forklift Uberization
- Pallet Build Verification
- Dangerous Goods Sortation
- Parcel Sortation

Visibility & Transparency

The supply chain and Internet Of Things

How to collect and share accurate, granular and timely data



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Supply Chain Transparency:
End-To-End Visibility, Traceability and Accuracy

Suppliers

Raw materials
Spare parts
Semi finished goods

Incoming

Goods receipt
Warehousing
Inventory

Processes

Work in progress
Inventory / part tracking
Asset management

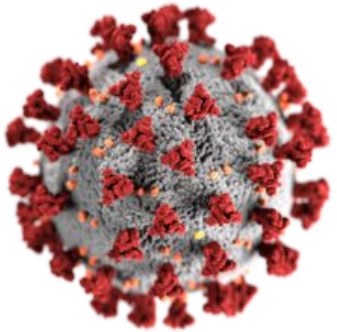
Outgoing

Warehousing
Inventory
Shipment preparation
Loading verification
Return logistics

Customers

Finished goods

Supply Chains Were Not Designed for 2020/2021



eCommerce

- Same day shipping expectation
- Shift from retail to eCom
- eCom logistics space = 3X retail
- Reverse logistics

Globalization

- Increased sensitivity to shocks
- Labor shortages
- Trade wars
- Emissions and waste

The unexpected

- Highest highs, lowest lows
- Safety-stock
- Inability to react
- Huge changes in demand

Four Major Pressures

Increase capacity

Move more products through the current facility footprint – delay expansion capex.

Accuracy

Heightened inventory accuracy/integrity and tracking - Flawless delivery – correct item(s) to the correct destination.

Velocity / Speed

The need to move products faster and more efficiently in order to meet today's consumer demands.

Labour efficiency

Growth drives increases in demand, resulting in labor and logistical challenges. Highly efficient pick, pack, ship processes are required.

Do more. Be accurate. Do it faster. Be lean.

The Supply Chain IoT Gap

The supply chain

Raw material → Supplier → Manufacturer → Distributor → Local dist → Consumer

Internet (Logistics systems)

ORACLE · infor · SAP · EPICOR · BlueYonder · Softeon · Manhattan Associates

Manual connectivity layer

1 

2 

3 

=

Error
Delay
Inefficiency

"IoT Gap"

Things (Physical goods)

The Supply Chain IoT Solution

The supply chain

Internet (Logistics systems)

ORACLE infor SAP EPICOR BlueYonder Softeon Manhattan Associates

Automated connectivity layer

RFID labels

+

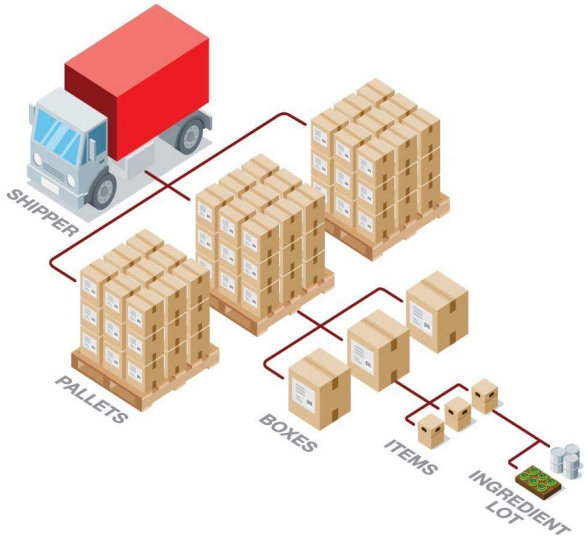
RFID readers

=

Real-time
Accuracy
Automation

Things (Physical goods)

Where to Tag?



Pallet Level

- Remove manual scanning
- Automated validation of right pallet, right truck

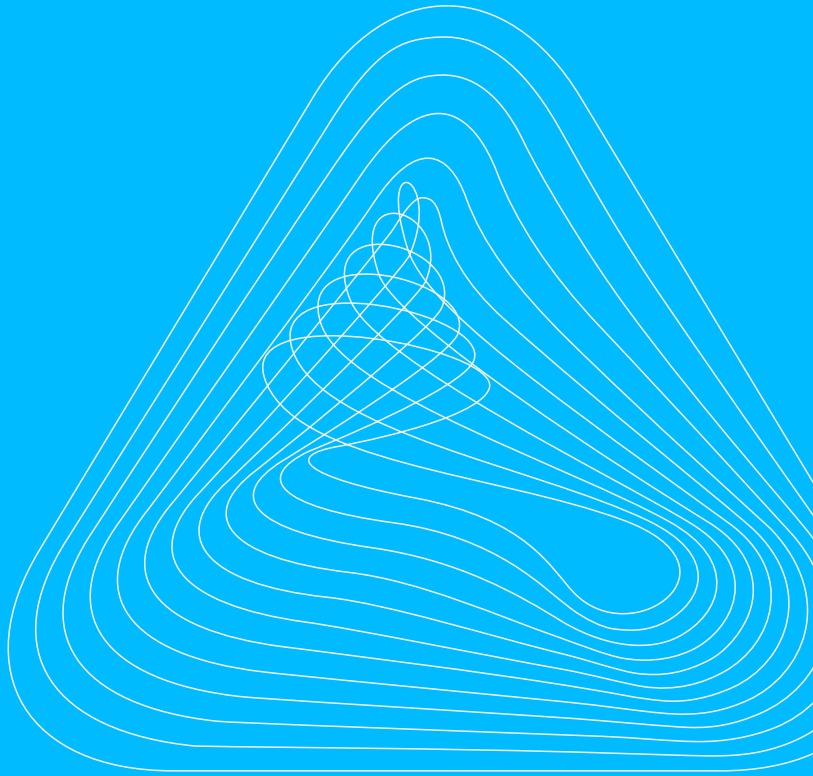
Carton Level

- Inventory management
- Automation
- Traceability / Recalls

Item Levels

- Inventory automation
- Expiry management
- Omnichannel / New models

Automation & Visibility



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Automated Processes

Efficiency

Visibility

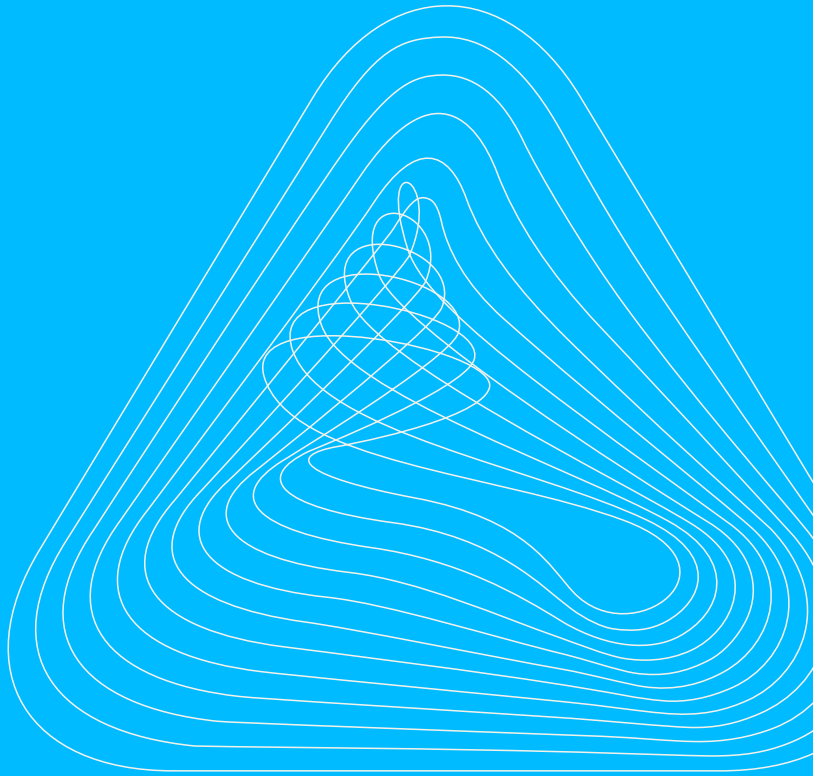
Accuracy

Automated Processes

Shipping zones and dock doors being covered by RFID readers for full visibility

Use Cases

Connected logistics



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Connected Logistics: Resolving Key Challenges

Increase Capacity
Move more product through the current facility footprint – delay expansion capex.

Accuracy
Heightened inventory accuracy/integrity and tracking - Flawless delivery – correct item(s) to the correct destination.

Velocity / Speed
The need to move products faster and more efficiently in order to meet today's consumer demands.

Labor Efficiency
As growth drives increased demand, labor, and drivers becomes tight. Highly efficient pick, pack, ship processes.

Warehouse Management Use Cases
Shipment Verification

Shipment Verification

- Avoid costly mis-shipments
- Reduce unload/load time
- Improve dock schedules
- Increase truckload volume and weight
- Improve inventory accuracy

Avery Dennison solutions enable:

- Mis-shipment prevention
- Automated inbound/stage/outbound data capture
- Increased productivity of dock/cross-dock operations
- Reduced freight dwell time of current operations
- Operator interaction (red/green light scenario)

Warehouse Management Use Cases
Inventory Tracking

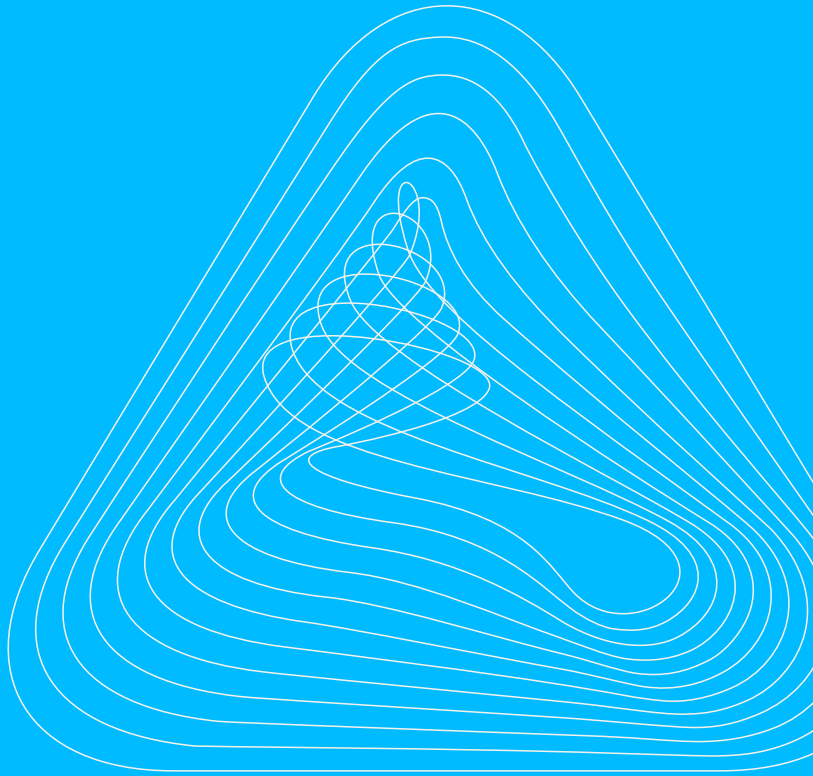
In-facility Item Tracking

- Inventory verification
- Misplaced item prevention
- Enhanced inventory visibility (with real-time product tracking) as products route through the facility
- Maximized efficiencies with inventory processes
- Reduced labor and associated costs

Avery Dennison solutions enable:

- One to many scanning of items
- No line-of-sight scanning required
- Quick accurate inventory verification without opening cartons
- Item-level carton scanning on fast moving conveyor
- Routine RFID scans done automatically as pallets, cartons, products flow through the warehouse
- Elimination of slow, error-prone, manual labeling and scanning processes.

RFID On Challenging Materials



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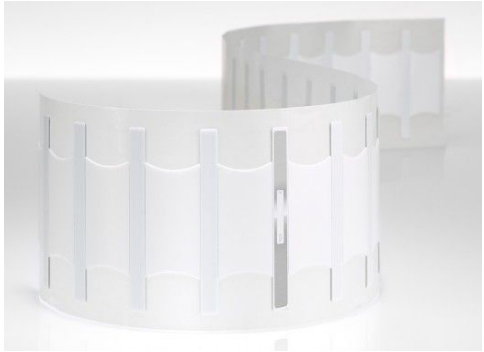
RFID works on metal and liquids using specific designs

Midas Flagtag (72 x 21 mm)

- Flag design creates distance and uses metal material tagged as amplifying antenna

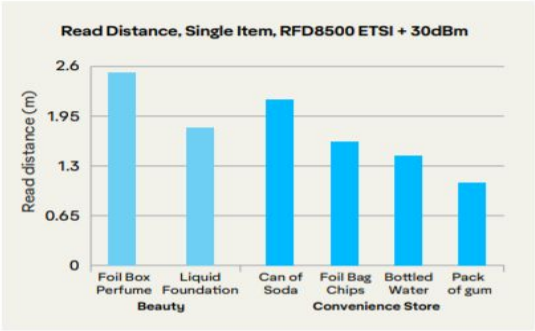
Construction material with Midas Flagtag
Achieving up to 10m readrange

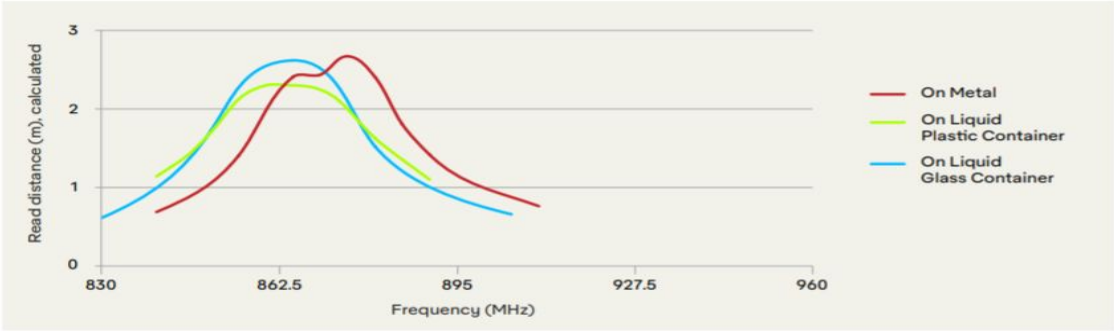
RFID works on metal and liquids using specific designs



AD-456 U8 (64 x 6 mm)

Read range





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

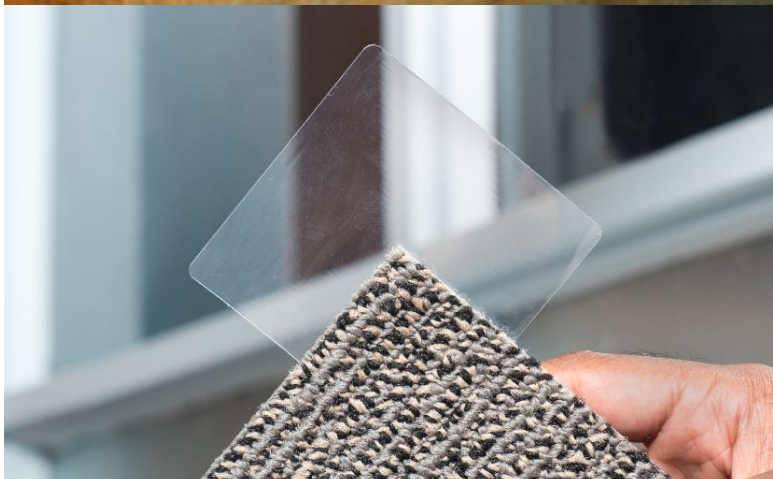
Adhesive experts - enablers for OEM specification

- For more than 85 years we've been developing new adhesives and adhesive technologies
- With over 400 adhesive scientists working in seven R&D centers globally, we solve the challenges faced by our global customers in real time, offering bespoke adhesive performance to every corner of the world

Adhesive coating technology	Emulsion		Hotmelt		Solvent			
Adhesive chemical composition	Acrylic	Rubber	Acrylic	Rubber	Acrylic	Rubber	Hybrid	Silicon

- R&D leading partner in adhesive technology with 8 different platforms
- Offering more than 50.000 material combinations for any application
- With our deep technical understanding and support we will find the right material for your application

Logistic labels for difficult surfaces



Wooden pallet, carpet use case

- High coatweight hotmelt adhesive
  - e.g. TS8000, TS79
- Durable face material (PET, HDPE)
  - High scratch resistance
  - High smudge resistance
  - Excellent printability
- RFID inlays with suitable performance
  - Omni-directional
  - Sufficient read range

Tyre labeling

Avery Dennison tyre labeling portfolio:

- Different face materials with barrier technologies to prevent chemical migration to the front side
  - PP Tyre Top White -> Chemical barrier
  - PP Light Top Silver -> Aluminium barrier
  - PPNG Top White Plus -> Polyester barrier
- Application specific coat weights (40gr to 80gr) (winter/summer, hairy/shaved)
- Production-friendly gum patterns to eliminate bleeding
- Back-side siliconization (BSS) liners

Adhesive experts - enablers for OEM specification

Factors influencing adhesion

- Surface tension
- Surface texture (rough, etc.)
- Chemical resistance
- Environmental stability (UV, temperature, humidity, salt spray)
- Compliance requirements, including flammability, specifications, ...

Meeting the challenging requirements - Automotive Durable Label Solutions RFID enabled

Applications

- Interior, exterior, under-the-hood
- Lightweight, difficult-to-label automotive components, etc.

Components

- Battery, engine block, seat, sunvisor, tires, airbag, cables / wire harness, fuel cap, bumper, A/C, etc.

Main purposes

- Tracking, warning, handling and in-process labels, functional, serial & VIN labels, instruction, identification, warning, compliance, security/anti-counterfeit, etc.

Q & A

Thank you

Urban Söderberg

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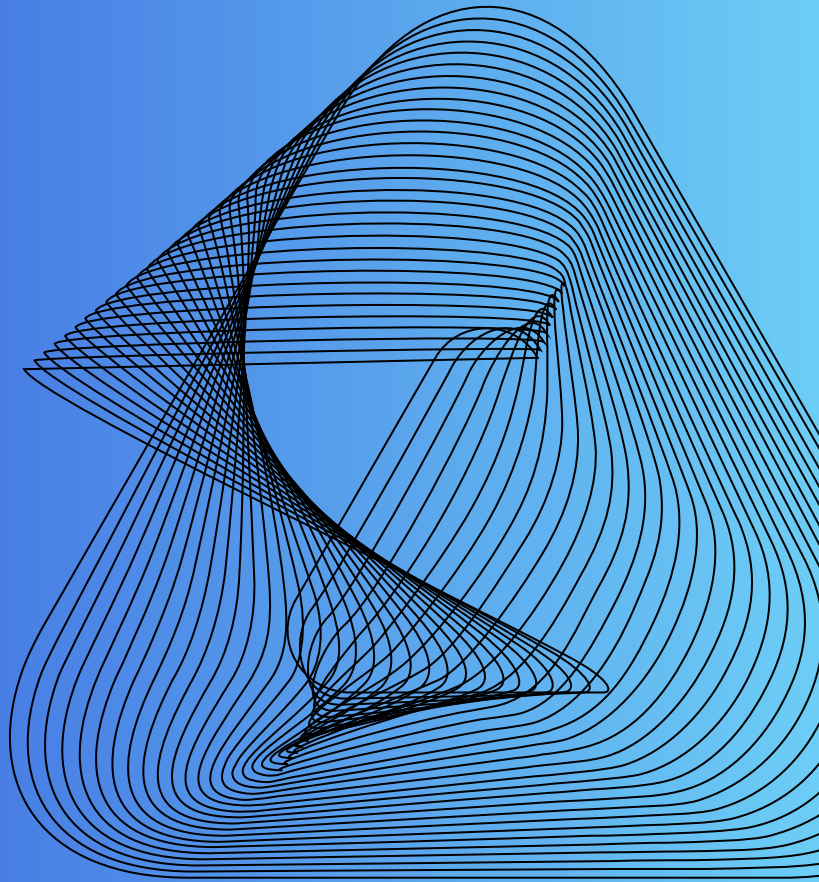

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