VDA	RFID for Container Management in the Supply Chain	5501

This non-binding recommendation by the German Association of the Automotive Industry (VDA) has the following objectives:

- Standardization of technical requirements for RTI-specific RFID application
- Standardization of RFID-specific data structures for identifying RTIs
- Complementary optical RTI identification with Barcodes and DataMatrix Codes

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Document Maintenance Summary

Date	Action	Description
Q4.2006	creation	Publication of the first version of the document
Q2.2008	modification	Revision of the remarks of the data structures in the memory of the RFID transponder
Q3.2012	addition	Integration of the Data Identifiers 25B, coding examples and the Global Transport Labels
Q1.2015	modification	Format adaptation to VDA 5500, elimination of process descriptions and integration of the Data Identifiers 26B-29B
Q2.2015	modification	Revision of the Coding example
Q3.2016	modification	Adaption to VDA-RFID-KLT specifications sheet and eliminationg the description of the read/write protection

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Abbreviations

AFI	Application Family Identifier
an	Alphanumeric
AutoID	Automatic Identification
CIN	Company Identification Number
CRC	Cyclic Redundancy Check
DI	Data Identifier
DUNS	Data Universal Numbering System
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
EOT	End of Transmission
EPC	Electronic Product Code
EPCIS	Electronic Product Code Information Services
ESD	Electrostatic Discharge
GS1	Global Standards One
HazMat	Hazardous Material
IAC	Issuing Agency Code
IEC	International Electronical Commission
IP	International Protection
ISO	International Organization for Standardization
IT	Information Technology
JAIF	Joint Automotive Industry Forum
LLC	Large Load Carrier
MB	Memory Bank
n	numeric
OT	Object Type
PC	Protocol Control
RFID	Radio Frequency Identification
RPI	Returnable Packaging Item
RTI	Returnable Transport Item
SLC	Small Load Carrier
SN	Serial Number
UHF	Ultra High Frequency
UII	Unique Item Identifier
UM	User Memory
VDA	German Association of the German Automotive Industry

1 Introduction

Radio Frequency Identification (RFID) provides for a high degree of automation and unique item identification. This particularly applies for Ultra High Frequency technology (UHF). RFID enables identifying multiple objects in very short time and without direct line of sight. Due to these characteristics, RFID is more effective and efficient than other Automatic Identification (AutoID) techniques such as Barcode and DataMatrix and improves object and information management in the automotive supply chain.

1.1 RFID in the Automotive Industry

RFID has been successfully applied in the automotive industry for many years. Typically, RFID is applied for Tracking & Tracing objects such as Vehicles, Parts and (Returnable) Transport Items (RTI). So far RFID projects focus on closed loop applications. In the last few years, RFID has also been applied in open loop applications. The latter requires standards and guidelines that provide for cross-company RFID application.

Therefore, the German Association of the German Automotive Industry (VDA) has published the following industry-specific recommendations for implementing RFID technology in cross-company environments:

- VDA 5500 – Basic Principles for RFID Application in the Automotive Industry
- VDA 5501 – RFID for Container Management in the Supply Chain
- VDA 5509 – AutoID/RFID-Application and Data Transfer for Tracking Parts and Components in the Vehicle Development Process
- VDA 5510 – RFID for Tracking Parts and Components in the Automotive Industry
- VDA 5520 – RFID in Vehicle Distribution

These recommendations highlight some of the most significant and well-known use cases for cross-company RFID implementations in the automotive industry.

VDA 5501 specifies RFID-specific requirements for the Tracking & Tracing of RTIs. VDA 5501 references VDA 5500 – Basic Principles for RFID Application in the automotive industry. VDA 5501 also references VDA 5007, which describes general guidelines for managing RTIs within the German automotive industry. Moreover, VDA incorporates the “Global Guideline for Returnable Transport Items (RTIs) Identification”, which has been published by the Joint Automotive Industry Forum (JAIF).

This document is organized as follows: Section 2 describes technical requirements for RFID transponders that are used for the Tracking & Tracing of RTIs. Section 3 covers

principles for application-specific data structures. Section 4 addresses the complementary optical identification of RTIs. Section 5 focuses on relevant requirements for RTI-specific data exchange.

1.2 RFID for Tracking & Tracing (Returnable) Transport Items

RFID has several technical advantages compared to other AutoID techniques such as Barcode and DataMatrix:

- Automatized identification without direct line of sight
- Identification of many RTIs at the same time (bulk reading)
- RFID transponders are very robust and resistant to harsh industrial environments

These technical characteristics and the unique identification of RTIs (serialization) enables use cases such as:

- Tracking & Tracing of RTIs
- Automatized reports on RTI movements (cycle information)
- Optimized planning and scheduling of RTI volumes
- Real-time cross-company RTI inventory
- Automatized material logistics (requires matching unique RTI reference IDs to specific RTI contents)
- Automatized control of machines and plants (production devices use unique RTI reference ID for control purposes)
- Automatized sequence control for staging material in production environments
- Better RTI design due to improved product life cycle information

2 Technical Requirements for RFID Transponders

The general requirements for RFID transponders that are used for the Tracking & Tracing of RTIs are based on VDA 5500. In the following, mainly application-specific details are described. Please review VDA 5500 for further information.

2.1 Passive RFID Transponders

Passive RFID transponders according to VDA 5500 are particular well-suited for Tracking & Tracing RTIs. The application of passive RFID transponders reduces costs related to the operation and maintenance of objects equipped with RFID. This is due to the fact that passive RFID transponders do not require additional power supply (i.e. batteries). Passive RFID transponders are resistant to harsh industrial environments. This assures that they can be operated throughout the entire life cycle of the RTI they are attached to.

2.2 Air Interface and Band Widths

The RFID transponders are compliant with Air Interface Protocol Standard ISO/IEC 18000-63/ EPC Class 1 Gen 2. Applicable band widths may differ according to the geographical zone the RFID transponder are operated in. Please review VDA 5500 for further information.

2.3 Structure and Size of Memory Banks

Compliant RFID transponders contain four different memory banks (MB):

- MB 00 „RESERVED“ – Kill- and Access-Password
- MB 01 „EPC“ – Unique Item Identifier (UII)
- MB 10 „TID“ – Tag Identification
- MB 11 „USER“ – User Memory (UM)

MB 01 contains the unique reference ID of the RTI (UII). MB 01 shall be protected with a password and a lock or perma-lock to avoid that the RTI reference ID is changed after it has been initially assigned (cf. Section 3.4).

The size of the different memory banks depends on the specific transponder type and the chip that is applied. The choice for a specific chip set also depends on the exact RFID data structure that is written to the chip of the RFID transponder (cf. Section 3.2). This includes the size and coding of the RFID data. Typically, data structures for RTI applications in the automotive industry require up to 40 alphanumeric (an) characters. Applying 6 bit encoding, 40 an characters result in an MB 01 size of 240 bit (not including Cyclic Redundancy Check (CRC) und Protocol Control (PC) bits).

2.4 Transponder Types, Positioning and Mounting

RTI applications may include various transponder types such as hard tags and smart labels. The choice for a specific RFID transponder mainly depends on the RTI type the RFID transponder is applied to. This is particularly important regarding metal RTIs or RTIs exposed to electrostatic discharge (ESD). Such applications may require special onMetal or ESD-resistant RFID transponders.

The type and positioning of the transponder significantly influence the performance of the whole RFID application. Therefore, the transponder type and the positioning shall be tested extensively before putting the RFID solution into practice. This also includes RTI sets as indicated in Figure 1. The RFID transponders shall point to the outside of the RTI sets and shall be shifted in order to assure that all RTIs can be captured. Note that RFID transponders, which are placed very close to each other, may negatively influence each other's performance:

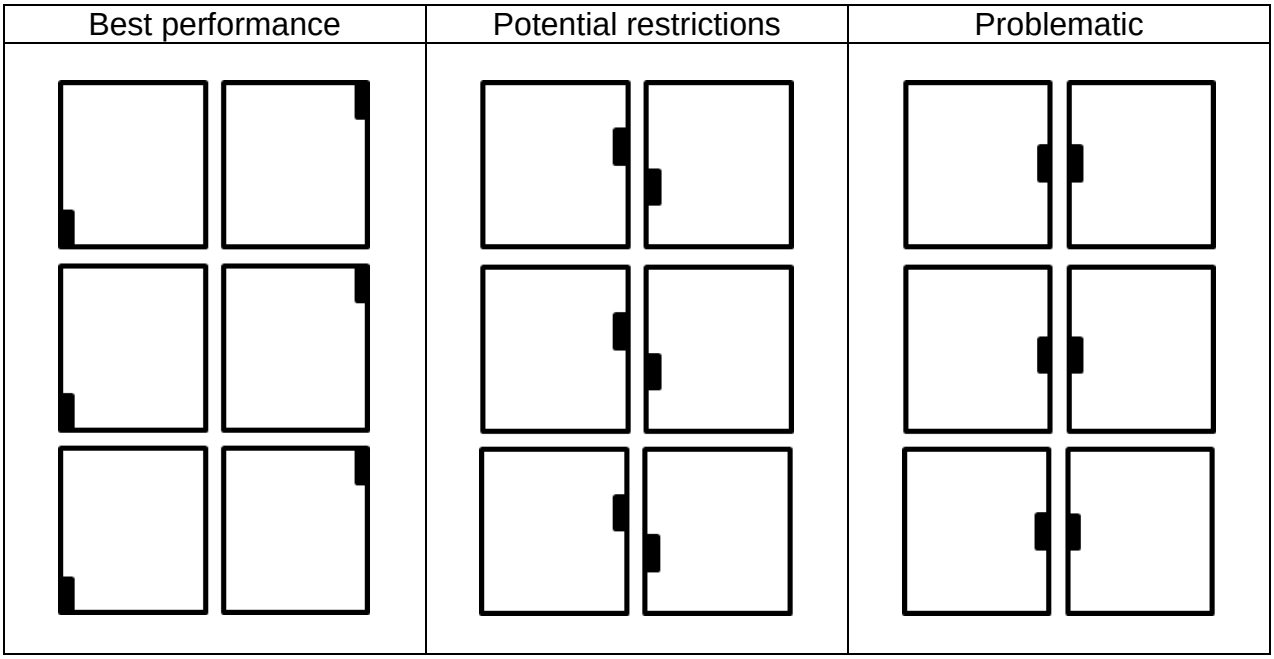


Figure 1: Positioning of RFID Transponders

It is recommended always to apply more than just one RFID transponder to the RTIs in order to provide for reliable RFID performance. Figure 2 shows two examples of appropriate RFID transponder positions. The illustrated mounting of the RFID transponders on the right of figure 2 are slightly moved out of the center to prevent a mutual negative influence. As an additional advantage of the right position, one RFID transponder is usually aligned parallel to the antenna of the RFID reader.

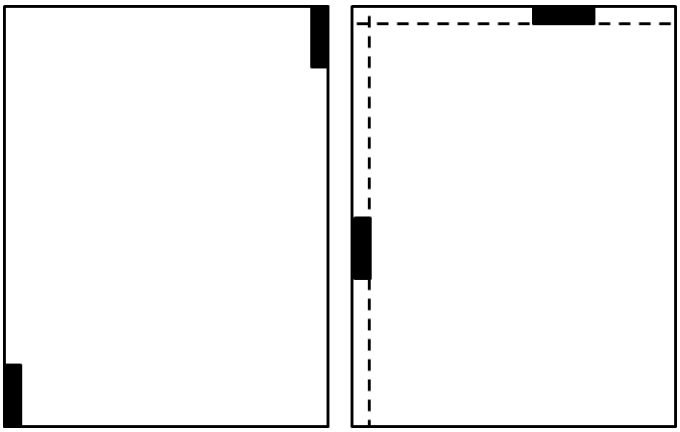


Figure 2: Positioning of multiple RFID Transponders

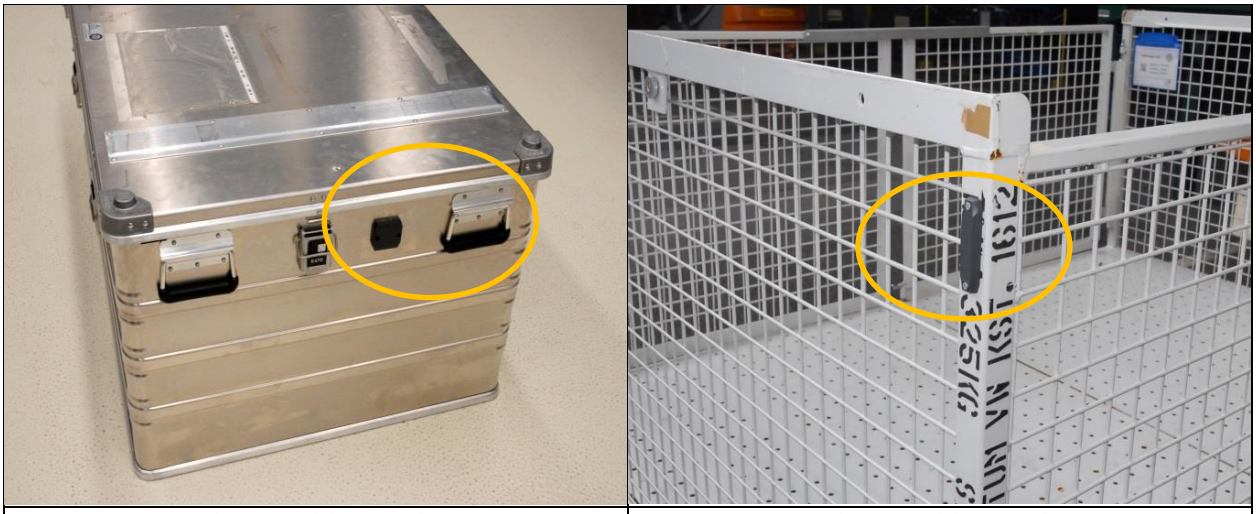
RFID transponders for RTI applications may be exposed to harsh industrial environments for a long period of time. This also implies to the mounting. Typically, the following mounting methods are applied:

- Adhesive bonding
- Screws, rivets
- Embedded transponders

Note that there are different types of embedded transponders. The RFID transponders may be directly embedded into the RTI material (i.e. plastics). The RFID transponders may also be integrated into metal RTIs (slot antennas). This method implies that the material of the RTI itself acts as an antenna.

Comment: Make sure that the applied mounting method reduces the possibility of accumulating humidity (condensation, rain, snow etc.) between the RFID transponders and the actual RTI surface. Humidity may compromise RFID performance.

In summary, the mounting method shall comply with the specific RFID application environments. Figure 3 shows appropriate mounting methods for different RTI applications:



Metal RTI with Hard Tag	Metal RTI with Hard Tag

Figure 3: RTIs equipped with RFID Transponders

2.5 Determining Factors for RFID Applications

The choice for appropriate RFID transponders, the positioning and the mounting method also depends on the objects that are shipped or stored within the RTIs. Objects made out of metal may cause performance issues. This particularly applies for bulk materials (e. g. screws). The performance may also be affected by other RTIs. This particularly applies to RTI sets that contain multiple RTI units. Figure 4 shows an example: RFID transponders that point to the outside of the RTI set can be read successfully. The other transponders may possibly be “blocked” by surrounding RTIs and their contents. Such circumstances negatively influence RFID performance.

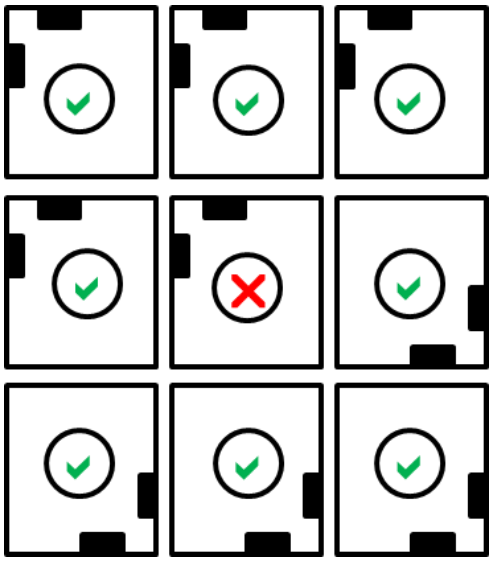


Figure 4: Capturing RTI Sets

Solution: Assign individual RTIs (children) to the applicable master units (parents) – such as carrier pallets. Post these aggregations to support Information Technology (IT) systems using appropriate data exchange formats (cf. Section 5). Whenever the master unit is captured, the RFID system draws from the aggregation data and resolves the child-parent relations to identify the individual RTI units that have been loaded to the carrier pallet.

2.6 Environmental Influences and Durability

RTIs are subject to heavy industrial and environmental influences and often are exposed to regular cleaning procedures that apply aggressive cleansers and temperatures up to +80° Celsius. These circumstances shall be considered when choosing appropriate RFID transponders and mounting methods.

Due to the heavy industrial and environmental influences that may occur, the RFID transponders shall comply with protection class International Protection (IP) 68 according to IEC 60529:

- No ingress of dust, complete protection against contact (dust tight)
- Protected against continuous submersion in water

RTIs are usually operated in diverse climate zones and therefore shall resist temperatures between -40° and +60° Celsius. In general, RTIs are operated for long periods of time. Therefore, RFID transponders for RTI applications shall be designed to last for approximately >10 years.

3 Data Structures for RFID Application

Appropriate and well-defined data structures are essential for successfully tracking & tracing RTIs in cross-company environments. Basic principles for defining RFID-specific data structures are described in VDA 5500. In the following, we focus on RTI-specific details.

3.1 Principles for Storing Data to RFID Transponders

Memory Bank (MB) 01 contains the UII consisting of a reference ID that uniquely identifies the RTI. The reference ID includes Data Identifiers (DI) that supports distinguishing between various RFID types. Moreover, DI support in filtering and preprocessing RFID event at the reader level. This accelerates data capture and reduces network traffic that occurs when communicating (unfiltered) RFID reads to backend IT systems (cf. VDA 5500).

MB 11 contains the UM which is used to store additional object and application data. The usage of MB 11 has not been standardized so far and therefore requires bilateral agreements between participating supply chain partners.

3.2 Alternative Data Standards (ISO/IEC, GS1)

Within the automotive industry two alternative standards for structuring data on RFID transponders have been established:

- ISO/IEC
- GS1

The VDA recommends the application of ISO/IEC standards cross-company applications (cf. VDA 5500). In the following, we describe how to apply ISO/IEC standards for structuring MB 01 accordingly.

3.3 Storing Data to Memory Bank 01 (ISO/IEC)

The reference ID which uniquely identifies the RTI is stored in MB 01. The reference ID may contain up to 40 an characters. Applying 6 bit encoding, this requires a memory size of 240 bit (plus Cyclic Redundancy Check (CRC) and Protocol Control (PC) bits).

ISO/IEC provides two options for filtering RFID data: Application Family Identifiers (AFI) and DI. In the following, we address these concepts in more detail.

3.3.1 Application Family Identifier (AFI)

ISO/IEC provides two AFIs for identifying RTIs:

AFI	Standards
A3	ISO 17364 – Supply chain applications of RFID – Returnable transport item
A8	ISO 17364 – Supply chain applications of RFID – Returnable transport item Hazardous Material (HazMat)

Table 1: Application Family Identifiers

3.3.2 Data Identifier (DI)

The choice for appropriate DIs depends on application-specific details. In general, there are two different application types:

- Reference ID does not explicitly declare the RTI type (DI 25B, 55B)
- Reference ID explicitly declares the RTI type (DI 26B-29B)

Common automotive RTI applications require distinguishing between RTI types. Therefore, the following sections focus on RFID data structures that explicitly declare the RTI type. Table 2 shows how to compose ISO/IEC-compliant data structures accordingly:

DI	IAC	CIN	OT	+	SN
Data Identifier	Issuing Agency Code	Company Identification Number	Object Type	Separator	Serial Number
26B-29B	UN or OD	Variable	Variable	Fix	Variable
3 char (an)	2 char (an)	9 or 4 char (numeric (n) / an)	x char (an)	1 char (an)	y char (an)

Table 2: Implementation of Data Identifiers

Choosing the right DI depends on the operated RTI types. Table 3 indicates several RTI types and appropriate DIs:

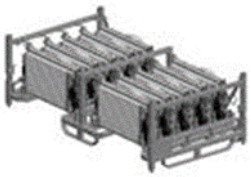
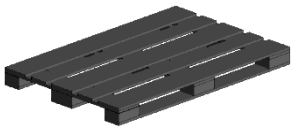
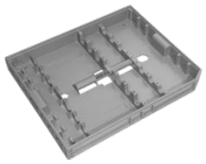
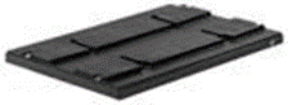
DI	Description	Examples	
26B	Generic Identifier for RTIs (including sets)		
27B	Large RTIs (Large Load Carriers (LLC), Racks, Pallets)		
			
28B	Small RTIs (Small Load Carrier (SLC), self-supporting packaging)		
			
29B	Returnable Packaging Item (RPI) (Lid, Blister Intermediate Layers Inlays)		

Table 3: Applicable Data Identifiers

3.3.3 Issuing Agency Code (IAC)

The IAC identifies the authorized and registered agency (cf. ISO/IEC 15459-2) that has issued the CIN. The length of the IAC may be between one and three characters where the characters can be both numerical and alphanumeric. Table 4 indicates common IACs that are applied in the European and international automotive industry.

Agency	Description	IAC	Characters
Dun & Bradstreet	Data Universal Numbering System (DUNS)	UN	2 (an)
Odette Europe	Odette Numbering System	OD	2 (an)

Table 4: Issuing Agency Codes

DUNS numbers are applied worldwide. However, many European vehicle manufacturers and suppliers also use Odette numbers. The German automotive industry prefers DUNS numbers (cf. VDA 5006). This particularly applies to RTI applications in international, cross-company environments.

3.3.4 Company Identification Number (CIN)

The CIN is issued by registered and authorized agencies and uniquely identifies companies and other organizational units. Regarding RTI applications, the CIN usually defines the owner of the RTIs. However, the CIN may also describe the producer of the RTIs or associations such as the VDA, which support the automotive industry in organizing cross-company RTI applications. According to DUNS the CIN consists of nine numeric (n) digits. CINs issued by Odette consist of four an characters. The owner of the CIN guarantees, that the reference ID uniquely identifies the RTI (worldwide).

3.3.5 Object Type (OT) + Serial Number (SN)

The RTIs are identified by the Object Type (OT) and a Serial Number (SN) which are separated by a “+”. The OT describes the RTI type. The serial number provides unique object identification (serialization). The length of the OT and SN are variable (cf. Section 6.1) as long as the overall length of the RTI reference ID does not exceed the available memory size of the RFID transponder (cf. Section 2.3). When using the DIs 26B through 29B, the combined length of OT + SN according to the standard ANSI MH10.8.2 is limited to 50 alphanumeric characters. Table 5 shows an example for an ISO/IEC-compliant reference ID.

DI	IAC	CIN	OT	Separator	SN
26B	UN	123456789	RKLT3215	+	ABC123456
3 char (an)	2 char (an)	9 char (n)	x char (an)	1 char (an)	y char (an)

Table 5: Sample Data Structure according to DI 26B

Comment: By using the separator "+" between the OT and SN the OT may be used as an additional filter. This is particularly useful for managing cross-company RTI accounts, which are usually based on overall RTI volumes rather than on individual RTI identification.

3.3.6 Coding Sample for RTI Application

In the following, we indicate how to arrange a complete ISO/IEC-compliant data structure for RTI applications:

Bit Location (HEX)	Data Type	Value	Size	Description
MB 01: CRC + Protocol Control Word (Header)				
00 –0F	CRC-16	Hardware assigned	16 bits	Cyclic Redundancy Check
10 – 14	Length	Variable	5 bits	Represents the number of 16-bit words excluding the PC field and the Attribute/AFI field.
15	PC bit 0x15	0b0 or 0b1	1 bit	0 = No valid User Data, or no $MB11_2$ 1 = Valid User Data in $MB11_2$
16	PC bit 0x16	0b0	1 bit	0 = "Extended PC word" not used
17	PC bit 0x17	0b1	1 bit	1 = Data interpretation rules based on ISO
18 – 1F	AFI	**0xA3 or 0xA8**	8 bits	Application Family Identifier used according to ISO/IEC 15961 and ISO 17364. For hazardous RTI use A8.
	Subtotal		***32 bits***	

MB 01: Unique Item Identifier (UII) with 6 bit encoding				
Start at location 20 Go to end of data / end of	DI	**"26B" – "29B"**	3 an	Data Identifier for RTI Identification
	Issuing Agency Code (IAC)	"OD" or "UN"	2 an	Issuing Agency Code, i.e. Odette, DUNS

available memory	Company Code (CIN)	As defined by the IAC	4 an (OD) or 9 n (UN)	Company Identification Number
	Object Type (OT)	RTI Type	1...x an	x alphanumeric characters
	Separator between OT and SN	+	1 an	+ sign separator ($2B_h$)
	Serial Number (SN)	RTI Serial Number	1...y an	y alphanumeric characters
	<EoT>	0b100001	6 bit	End of Transmission ISO 17364 Table B1
	Padding until the end of the last 16-bit word	0b10, 0b1000, 0b100000, 0b10000010, 0b1000001000, 0b100000100000, or 0b10000010000010	2, 4, 6, 8, 10, 12 or 14 bits	Bit Padding Schema according to ISO/IEC 15962 chapter 13.1
	Subtotal		***Variable***	***Up to 240 bits***
	TOTAL $MB01_2$ BITS:		**VARIABLE**	**UP TO 272 BITS**

Table 6: Coding Scheme

Comment: <EoT> and padding bits are used for control purposes and padding. They are not part of the reference ID in the UII (MB 01) and the data that is stored to the UM (MB 11), i.e. both <EoT> and the padding bits are removed when decoding the data and sending it to IT backend systems.

Chapter 6.3 contains a step-by-step tutorial. Please also review VDA 5500 for additional information.

3.4 Read-/Write Protection and Kill-Command

RTIs often circulate in open-loop environments which imply that RFID transponders are subject to potential misuse and therefore require protection. This particularly applies to MB 01 which contains the unique RTI reference ID. Corrupting the unique RTI reference ID may cause severe application errors and handling errors. Therefore, it is recommended to protect the MB 01 against write access. Additionally, the RFID transponder shall be protected against deactivation.
Please review VDA 5500 for further information on how to apply read-/write protection to RFID transponders.

4 Additional Optical Identification

RTI applications shall imply complementary optical object identification.

4.1 Application of 1D/2D Labels

The RFID-equipped RTIs shall carry additional optical identification such as plain writing and 1D/2D-Codes. The use of optical codes is restricted to Code 128 (1D) or DataMatrix (2D) and depends on the specific use case of the RTI application. The data of the 1D/2D-Codes matches the data that is written to the RFID transponders and provides for appropriate backup. Please review VDA 5500 for further information.

4.2 Application of the RFID Emblem

The RTIs shall be marked with RFID emblems as described in ISO/IEC 29160 (cf. VDA 5500):

Figure 5: RFID Symbol for RTIs

5 RFID-specific Data Exchange

Cross-company data exchange is based on established Electronic Data Interchange (EDI) messaging formats (e.g. Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT)).

Additionally, supply chain partners may implement messages based on Electronic Product Code Information Services (EPCIS) for internal and cross-company data exchange. The implementation of EPCIS messages provides for more accurate object and process information. Please review VDA 5500 for further information.

References

- ANSI MH10.8.2-2013 - Data Identifier and Application Identifier Standard
- EPC™ Radio-Frequency Identity Protocols Generation-2 UHF RFID Specification for RFID Air Interface Protocol for Communications at 860 MHz - 960 MHz Version 2.0.1
- IEC 60529 - Degrees of protection provided by enclosures (IP Code)
- ISO/IEC 15459-2 Information technology - Unique identifiers - Part 2: Registration procedures
- ISO/IEC 15961-1 Information technology - Radio frequency identification (RFID) for item management - Data protocol: application interface
- ISO/IEC 15962 - Information technology - Radio frequency identification (RFID) for item management - Data protocol: data encoding rules and logical memory functions
- ISO 17364 - Supply Chain Applications of RFID - Returnable Transport Items
- ISO 17365 - Supply Chain Applications of RFID - Transport Units
- ISO/IEC 18000-63 - Information technology - Radio frequency identification for item management - Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C
- ISO/IEC 29160 - Information Technology - Radio Frequency Identification for Item Management - RFID Emblem
- JAIF Global Radio Frequency Identification (RFID) Returnable Transport Item (RTI) Identification
- JAIF Global Radio Frequency Identification (RFID) Item Level Standard
- VDA 5500 - Basic Principles for RFID Application in the Automotive Industry
- VDA 5501 - RFID for Container Management in the Supply Chain
- VDA 5006 - Unique Identification of Business Partners
- VDA 5007 - Guideline for Container Management
- VDA 5509 - AutoID/RFID-Application and Data Transfer for Tracking Parts and Components in the Vehicle Development Process
- VDA 5510 - RFID for Tracking Parts and Components in the Automotive Industry
- VDA 5520 - RFID in Vehicle Distribution

6 Attachments

6.1 Data Identifier for RTI Identification (ISO/IEC)

Characters	Data Identifier	Description
an3+an1...35	25B	Identification of a party to a transaction as defined in ISO 17364, assigned by a holder of a Company Identification Number (CIN) and including the related Issuing Agency Code (IAC) in accordance with ISO/IEC 15459 and its registry, structured as a sequence of 3 concatenated data elements: IAC, followed by CIN, followed by the RTI serial number that is unique within the CIN holder's domain.
an3+an1... <undefined>	26B	Unique Returnable Transport Item identifier comprised of a sequence of 5 data elements: “IAC”, followed by “CIN”, followed by “RTI Number” (RTIN), followed by the “+” character, followed by the supplier assigned (or managed) “RTI Serial Number” (RTISN) that is globally unique within the CIN holder’s domain; in the format IAC CIN RTIN + RTISN (spaces added for visual clarity only; they are not part of the data). See Annex C.11.
an3+an20...50	27B	Globally unique asset identifier of a Large Load Carrier (LLC) Returnable Transport Item (RTI) with a side base of ≥ 1000 mm, as defined in ISO 17365:2013, tertiary packaging, layer 3 comprised of a sequence of 5 data elements: “IAC”, followed by “CIN”, followed by RTI Type Code “RTITC”, followed by the “+” character, followed by the owner assigned (or managed) RTI Serial Number “RTISN” that is globally unique within the CIN holder´s domain in the format IAC CIN RTITC + RTUSN (spaces added for visual clarity only; they are not part of the data).

an3+an20...50	28B	Globally unique asset identifier of a Small Load Carrier (SLC) Returnable Transport Item with a side base of < 1000 mm, as defined in ISO 17364:2013 (RTI), tertiary packaging, layer 2 comprised of a sequence of 5 data elements: “IAC”, followed by “CIN”, followed by RTI Type Code “RTITC”, followed by the “+” character, followed by the owner assigned (or managed) RTI Serial Number “RTISN” that is globally unique within the CIN holder´s domain in the format IAC CIN RTITC + RTISN (spaces added for visual clarity only; they are not part of the data).
an3+an1… 50	29B	RPI No. + SN. Globally Unique Returnable Packaging Item (RPI) identifier of the category packaging aid (lid, blister, inlay, …) comprised of a sequence of 5 data elements: “IAC”, followed by “CIN”, followed by “RPI Number” RPIN, followed by the “+” character, followed by the owner assigned (or managed) “RPI Serial Number” RPISN that is globally unique within the CIN holder´s domain in the format IAC CIN RPIN + RPISN (spaces added for visual clarity only; they are not part of the data).
an3+an1...50	55B	Global Unique Returnable Packaging Item (RPI) as defined in ISO 17364, assigned by a holder of a Company Identification Number (CIN) and including the related Issuing Agency Code (IAC) in accordance with ISO/IEC 15459 and its registry, structured as a sequence of 3 concatenated data elements: IAC, followed by CIN, followed by the RPI serial number that is unique within the CIN holder's domain.

Table 7: Data Identifiers according to ANSI MH10.8.2

6.2 Coding Table (6-bit)

Character	Binary Value	Character	Binary Value	Character	Binary Value	Character	Binary Value
Space	100000	0	110000	@	000000	P	010000
<EoT>	100001	1	110001	A	000001	Q	010001
<Reserved>	100010	2	110010	B	000010	R	010010
<FS>	100011	3	110011	C	000011	S	010011
<US>	100100	4	110100	D	000100	T	010100
<Reserved>	100101	5	110101	E	000101	U	010101
<Reserved>	100110	6	110110	F	000110	V	010110
<Reserved>	100111	7	110111	G	000111	W	010111
(	101000	8	111000	H	001000	X	011000
)	101001	9	111001	I	001001	Y	011001
*	101010	:	111010	J	001010	Z	011010
+	101011	;	111011	K	001011	[	011011
,	101100	<	111100	L	001100	\	011100
-	101101	=	111101	M	001101	]	011101
.	101110	>	111110	N	001110	<GS>	011110
/	101111	?	111111	O	001111	<RS>	011111

Table 8: 6-Bit-Character-Encoding compliant to ISO 17367 Table C.1

6.3 Coding Example (ISO 17364)

The reference ID is 6-bit encoded (cf. Table 8). The string is padded until an even number of bytes is reached. This way, in the PC area (*header*) the UII length may be declared in 16-bit words (2 bytes).

Reference ID (plain text)
26BUN123456789A153097+CS71489453

Compaction 6-bit code in binary code including <EoT>					
110010	110110	000010	010101	001110	110001
110010	110011	110100	110101	110110	110111
111000	111001	000001	110001	110101	110011
110000	111001	110111	101011	000011	010011
110111	110001	110100	111000	111001	110100
110101	110011	100001			

Split into 8-bit fragments including padding bits					
11001011	01100000	10010101	00111011	00011100	10110011
11010011	01011101	10110111	11100011	10010000	01110001
11010111	00111100	00111001	11011110	10110000	11010011
11011111	00011101	00111000	11100111	01001101	01110011
10000110	00001000				

Hex code representation					
CB	60	95	3B	1C	B3
D3	5D	B7	E3	90	71
D7	3C	39	DE	B0	D3
DF	1D	38	E7	4D	73
86	08				

PC data (cf. section 3.3):

UII-length of 16-bit words:	0b	***0110 1***	(26 bytes → #13 words)
Valid User Memory:	0b	***0***	(*no* user memory)
XPC:	0b	***0***	(not used – reserved)
EPC or ISO code:	0b	***1***	*(ISO)*
All PC bits:	0b	***0110 1001***	(hex 69)

Protocol Control	AFI
69	A3

Coded UII content (including header):

PC	AFI	UII Reference ID																							
69	A3	CB	60	95	3B	1C	B3	D3	5D	B7	E3	90	71	D7	3C	39	DE	B0	D3	DF	1D	38	E7	4D	73	86	08