VOLKSWAGEN
AKTIENGESELLSCHAFT

Group standard

VW 01067

Issue 2017-11

Class. No.: 01152

Descriptors: coding, coding method, marking, RFID, Radio Frequency Identification, component marking, vehicle marking, tool marking, reusable container marking, packaged item marking

Use of Auto ID for Unique Object Marking

Serialization Using Optical Coding Methods and/or Radio Frequency Identification (RFID)

Preface

The aim of this Volkswagen standard (VW) is to ensure the unique marking (serialization) and automated identification of objects using optical coding methods and/or Radio Frequency Identification (RFID). For this purpose, unique data structures (reference numbers) are defined that can be stored using normal optical coding methods as well as on RFID tags, enabling the hybrid use of the technologies. In this way, it is possible to use established processes such as optical coding (bar code, 2-D code, data matrix code) and plain text as a back-up to advanced RFID technology.

Previous issues

VW 01067: 2012-10, 2013-06, 2014-09, 2015-10, 2016-11

Changes

The following changes have been made to VW 01067: 2016-11:

– Section 2, abbreviations: BZD, DMC, DPM, CSD, TLD, and ASSY added
– Section 4.2 added
– Section 4.5.1 "Layout of number ranges", last paragraph changed
– Section 4.7.1 "Layout of number ranges", warning information added

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Contents

1 Scope

This standard describes unique object marking (serialization) using an optical coding method and/or RFID. It is used for components, vehicles, tools, reusable containers, and packaged items.

The marking as per this standard does not replace part marking as per VW 10500 and VW 01064 or the marking of tools, auxiliary tools, test equipment, and gages (identification plate) as per VW 34022.

NOTE 1: This marking does not apply to components that are diagnostics-enabled. The markings for electronic control units are described in workshop sketch WSK.013.290°E, "Identification plate for electronic control units."

This standard is intended for:

– Developers specifying a unique object marking
– Quality Assurance staff inspecting samples of a unique object marking
– Vehicle part suppliers in charge of implementing a unique object marking

The contents of this standard are based on German Association of the Automotive Industry (VDA) standards VDA 5500, VDA 5501, VDA 5509, VDA 5510, and VDA 5520, and take into account the current status of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) standardization.

2 Symbols and abbreviations

AFI	Application family identifier
ASSY	Assembly
BZD	Build status documentation
CC	Company code
CIN	Company identification number
CSD	Classification System for Documents
D&B	Dun & Bradstreet
DI	Data identifier
DMC	Data matrix code
DPM	Direct part marking
DSFID	Data structure format identifier
DUNS	Data universal numbering system
EOT	End of transmission
FZN	Vehicle number
GS	Group separator
GTL	Global transport label
IAC	Issuing agency code
ITU	International Telecommunications Union
JIS	Just in sequence
KBP	Group Business Platform
OID	Object identifier
PN	Part number
PSN	Part serial number
RFID	Radio frequency identification
RS	Record separator
SN	Serial number
TLD	Technical Guideline for Documentation
UHF	Ultra high-frequency
UII	Unique item identifier
UM	User memory
UPIK	Unique partner identification key
URL	Uniform Resource Locator
VFF	Pre-production approval testing vehicle
VIN	Vehicle identification number
an	alphanumeric
n	numeric

3 Fundamentals of unique object marking (serialization)

3.1 RFID technology

This document describes the use of passive UHF tags (frequency range: 860 MHz to 960 MHz) for the purpose of unique object marking (serialization) and automatic tracking. The air interface corresponds to ISO/IEC 18000-63/EPC class 1 generation 2. When selecting the tag, the different frequency ranges defined by the ITU for UHF communication must be considered: Europe (865 MHz to 868 MHz), USA (902 MHz to 928 MHz), and Japan (950 MHz to 960 MHz).

RFID tags have four logical memory areas/memory banks (MB) as per ISO/IEC 18000-63/EPC class 1 generation 2.

MB00	Kill and password
MB01	UII
MB10	Tag identification (TID)
MB11	UM

The memory areas are specified and described in detail in the underlying standards.

The MB01 and MB11 areas are used for saving data relating to the object. The UII is stored in the MB01 area along with mandatory control information. The UII contains an exclusively assigned, unique reference number. After the initial write access, the MB01 memory area can be protected (locked) to prevent any further write access. The MB11 area contains the UM. Optionally, additional payload can be stored in the UM. It must be noted that using the UM instead of the UII results in a lower read/write performance.

The memory size of each area depends on the specific application. Table 1 shows the preferred sizes of the UII and the additional UM. To ensure sufficient flexibility, the additional UM must be between 128 bits and 512 bits. The nominal values are rounded up and adjusted to available memory sizes to ensure that the respective application-specific storage requirements are fulfilled.

Table 1 – Storage requirements per use case

Use case	Minimum storage requirement
Prototype parts	240-bit UII
Vehicles (distribution)	128-bit UII
Vehicles (pre-production)	128-bit UII + 128-bit UM
Tools	240-bit UII
Containers	240-bit UII
Packaged items	240-bit UII

The structure and layout of the data contents is based on ISO/IEC standards. A key feature of implementing RFID data structures as per ISO/IEC standards is that it conforms to and complies with established bar code/DMC standards. This ensures the coexistence of bar code/DMC and RFID, and the step-by-step migration to RFID.

An AFI, which can be used for filtering data, is stored in the tag's control information (ISO/IEC 15961-1). The AFIs are defined in ISO 17363, ISO 17364, ISO 17365, ISO 17366, and ISO 17367 as specific to the application. The complete structure of the control information, including referencing of the AFIs, is described in the underlying standards and recommendations (including VDA 5500, VDA 5501, VDA 5509, VDA 5510, and VDA 5520) and is therefore not explained in more detail here.

A unique reference number is stored in the UII. The syntax and data structure of the reference number is based on the JAIF Global Radio Frequency Identification (RFID) Item Level Standard, ISO/IEC 15418, ISO 17363, ISO 17364, ISO 17365, ISO 17366, and ISO 17367. The layout specific to the application can be taken from section 4. The UII concludes with the EOT. The EOT can be removed if the UII's data structure uses the entire memory area available (MB01). Free bits are padded with fill characters until the current 16-bit word is reached. For this, a fixed bit string (monomorphic) is used as per ISO/IEC 15962. Details on this can be taken from table 2, which describes the generic layout of the RFID data structure (MB01) conforming to ISO/IEC standards, including the prefixed protocol control bits (PC header).

Table 2 – Schematic layout of RFID data structures conforming to ISO/IEC standards

Bit location (HEX)	Data type	Value	Size	Description
MB01: CRC + protocol control word				
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 1 = Valid user data in MB11
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	e.g., 0x90, 0xA1, 0xA2, 0xA3	8 bits	AFI used as per ISO/IEC 15961-1, ISO 17363, ISO 17364, ISO 17365, ISO 17366, and ISO 17367
	Subtotal		**32 bits**	
MB01: UII				
Start at location 20 Go to end of data/end of available memory	**Unique reference number (placeholder). For data contents specific to the application, see section 4.**			
	End of transmission	EOT	1 (alphanumeric)	$^{E}O_{T}$(!)
	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	Padding as per ISO/IEC 15962 (monomorphic)
	Subtotal		**Variable**	**Up to 240 bits**
	Total MB01 bits:		**Variable**	**Up to 272 bits**

The data contents are coded in 6-bit. Only the letters, numbers, and select special characters highlighted in appendix A may be used.

3.2 Optical coding and plain text (labels)

The DMC is used for the unique identification of objects. Depending on the application, code 128 can also be used (e.g., GTL, reusable container). The data contents of the bar codes and DMCs correspond to the RFID principle. Identical reference IDs are stored on both the 1-D/2-D code and the RFID tag. The aim of this approach is to use optical and radio-frequency Auto ID methods in a hybrid manner.

The bar code is structured as per ISO/IEC 15417 and is not described in further detail here. The DMC is structured as per ISO/IEC 15418 and ISO/IEC 15434. The syntax consists of the message header, followed by a format header for designating the embedded data structure, and finally the format trailer, which is used as a final character. The individual data elements are identified by DIs and separated by GSs.

Table 3 shows the generic layout of DMCs conforming to standards:

Table 3 – Schematic layout of DMCs conforming to ISO/IEC standards

Start sequence	[]>
RS	$^{R}_{S}$
Format identifier	06
Group separator	$^{G}_{S}$
Unique reference number	..
Group separator	$^{G}_{S}$
Additional data element	..
RS	$^{R}_{S}$
EOT	$^{E}O_{T}$

The syntax is structured in such a way that there is an option to code further data elements in addition to the unique reference ID. The precondition is that the additional payload is marked using standardized DIs (cf. ISO/IEC 15418), ensuring that these additional data contents are correctly interpreted across the Group. This is also intended to avoid or reduce proprietary solutions.

The data contents are coded in 8-bit. However, in order to ensure the synchronizing of bar code/data matrix and RFID data structures, only the letters, numbers, and select special characters used in 6-bit coding (see appendix A) may be used.

The bar codes/DMCs are printed on suitable labels. The code types, the design of the labels and their contents must comply with the specifications of VW 01064 and VW 10500. If possible, the data contents of the codes are presented in plain text on the labels. In the event that, in addition to the optical codes, RFID is used, it is also recommended to print the RFID emblem as per ISO/IEC 29160 for the purpose of optical marking. The generic variant (cf. Figure 1) or one of the following application-specific variants can be used for this (cf. ISO/IEC 29160):

– B1 (reusable container)
– B3 (transport unit, packaged items)
– B5 (product packaging)
– B7 (product)
– B8 (freight container)

The label must be suitably dimensioned for printing the RFID emblem.

Figure 1 – RFID emblem (generic)

4 Representation of the data contents for unique object marking

4.1 Marking of prototype parts including notes in Component Performance Specifications and drawings

The electronic marking as per this standard (VW 01067) is mandatory for all prototype parts until the start of the VFF. Deviations specific to a vehicle project and/or component are possible.

This standard describes the use of DMCs and RFID. Prototype parts are marked using DMCs as standard. The RFID marking is explicitly mandatory for all prototype parts that are listed in the RFID reference list. Further components may also be marked with RFID because of vehicle project-specific requirements. The RFID reference list is available on the KBP http://vwgroupsupply.com under the path: Information > Divisions > Research and Development > TE-Logistik > RFID.

Direct access:

Internally	Radio Frequency Identification
Externally	Radio Frequency Identification

Standard VW 01064 applies to the marking of production components for installation testing and BZD.

Component Performance Specification and drawing notes

For information in the drawings and Component Performance Specifications for the RFID marking, see figure 2 (text macro NO-E4 from VW 01014):

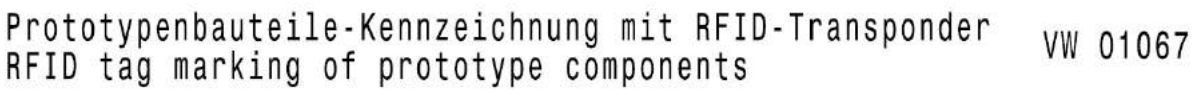

Figure 2 – Text macro NO-E4 (RFID marking)

4.1.1 Layout of number ranges

The layout of the reference number for marking prototype parts is based on three number ranges, which ensure that the number is unique; see table 4:

Table 4 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	PN/Group	max. 20 characters (alphanumeric)
3	PSN	max. 9 characters (alphanumeric)
	Total number of characters	max. 40 characters (alphanumeric)

The number of characters for the CIN, PN, and PSN must not exceed 33 characters (alphanumeric) in total. Including additional characters required for representing suitable RFID data structures (cf. Section 4.1.2), this adds up to a data string of max. 40 characters (alphanumeric). This character length can be covered using established memory sizes (240-bit UII) so that the hybrid marking of parts can be ensured using RFID and DMC.

The layout of the CIN depends on whether the prototype parts are marked by a contractor or within the Group; see table 5:

Table 5 – Marking variants

	Marking	CIN	Number of characters
1	By the contractor	Supplier DUNS (D&B)	9 characters (numeric)
2	Within the Group	Brand code + plant + cost center	2 characters (alphanumeric) + 2 characters (alphanumeric) + 5 characters (numeric)

The owner of the CIN assigns the reference number and ensures that it is unique.

The structure of the PN corresponds to VW 01098. PNs can have leading spaces. Leading spaces must be given special consideration when implementing optical and RFID-based Auto ID systems. It is absolutely mandatory that they are also coded to ensure that the completely coded character string or parts thereof can be used as a reference to additional information stored by the IT system.

The PSN consists exclusively of uppercase letters and numbers.

4.1.2 RFID marking of prototype parts

The following AFI is used within the control information (MB01): A1 (product reference).

4.1.2.1 Marking by suppliers

Table 6 shows the layout of the unique reference number within the UII (MB01):

Table 6 – Example of RFID data structure (contractor)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	37S
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (numeric)	123456789
4	PN	max. 20 characters (alphanumeric)	_5G9945093A
5	Separator	1 character	+
6	PSN	max. 9 characters (alphanumeric)	BA7654321
7	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 40 characters (alphanumeric)	240 bit

Alphanumeric representation:

37SUN123456789 5G9945093+BA7654321!

The Audi and Porsche brands require, in addition, the representation of the color code (if applicable) and the component-specific technical version (if applicable). The composition of the pertinent data structures must be taken from appendix B.

NOTE 2: Representing color codes and technical versions results in a longer PN. At the same time, the combination of DUNS number, PN, and SN, including AutoID-specific control characters, may have max. 40 characters (alphanumeric), i.e., the number of remaining characters for representing the SN is limited to max. 5 to 6 characters (alphanumeric).

4.1.2.2 Marking within the Volkswagen Group

Table 7 shows the layout of the unique reference number within the UII (MB01):

Table 7 – Example of RFID data structure (within the Group)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	37S
2	IAC	2 characters (alphanumeric)	SC (marking within the Group)
3	CIN	9 characters (alphanumeric)	VW1116120
4	PN	max. 20 characters (alphanumeric)	_5G9945093A
5	Separator	1 character	+
6	PSN	max. 9 characters (alphanumeric)	BA7654321
7	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 40 characters (alphanumeric)	240 bit

Alphanumeric representation:

37SSCVW1116120 5G9945093A+BA7654321!

The Audi and Porsche brands require, in addition, the representation of the color code (if applicable) and the component-specific technical version (if applicable). The composition of the pertinent data structures must be taken from appendix B.

NOTE 3: Representing color codes and technical versions results in a longer PN. At the same time, the combination of DUNS number, PN, and SN, including AutoID-specific control characters, may have max. 40 characters (alphanumeric), i.e., the number of remaining characters for representing the SN is limited to max. 5 to 6 characters (alphanumeric).

4.1.3 Optical marking of prototype parts

DMCs are used for marking prototype parts.

4.1.3.1 Marking by suppliers

Table 8 shows how data matrix contents are represented conforming to ISO/IEC standards (incl. control characters).

Table 8 – Optical coding of prototype parts (contractor)

Description	Data content
Start sequence	[]>
RS	$^{R}_{S}$ (ASCII)
Format identifier	06
GS	$^{G}_{S}$ (ASCII)
DI	37S
IAC	UN (DUNS)
CIN	123456789
PN/Group	_5Q9945093A
Separator	+
PSN	BA7654321
RS	$^{R}_{S}$ (ASCII)
EOT	$^{E}O_{T}$ (ASCII)

Example: []>$^{R}_{S}$06$^{G}_{S}$37SUN123456789 5Q9945093A+BA7654321$^{R}_{S}{}^{E}O_{T}$

Figure 3 shows an example of a data matrix label structured accordingly:

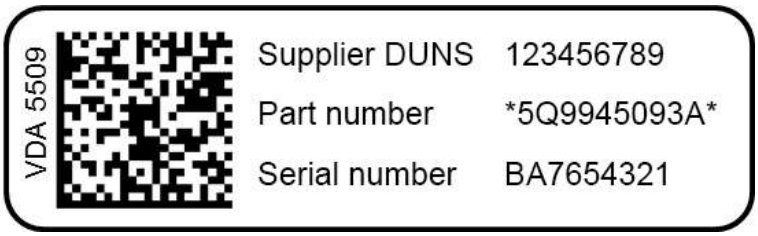

Figure 3 – Example of data matrix label

NOTE 4: Sample labels are shown under the link for Volkswagen employees VW 01067 – Sample Labels for Prototype Parts v1.0 or for contractors VW 01067 – Sample Labels for Prototype Parts v1.0.

If the example from table 8 is expanded to include a specific technical version (cf. Section 4.1.1), the data content would look like this:

Generation "02H": []>$^{R}_{S}$06$^{G}_{S}$37SUN123456789 5Q9945093A -02H+BA7654321$^{R}_{S}{}^{E}O_{T}$

Model phase "AS03": []>$^{R}_{S}$06$^{G}_{S}$37SUN123456789 5Q9945093A -AS03+BA7654321$^{R}_{S}{}^{E}O_{T}$

4.1.3.2 Marking within the Volkswagen Group

Table 9 shows how data matrix contents are represented conforming to ISO/IEC standards (incl. control characters).

Table 9 – Optical coding of prototype parts (within the Group)

Description	Data content
Start sequence	[]>
RS	$^{R}_{S}$ (ASCII)
Format identifier	06
GS	$^{G}_{S}$ (ASCII)
DI	37S
IAC	SC (marking within the Group)
Brand code + plant + cost center	VW1116120
PN/Group	_5Q9945093
Separator	+
PSN	BA7654321
RS	$^{R}_{S}$ (ASCII)
EOT	$^{E}O_{T}$ (ASCII)

Example: []>$^{R}_{S}$06$^{G}_{S}$37SSCVW1116120 5Q9945093A+BA7654321$^{R}_{S}{}^{E}O_{T}$

Figure 4 shows an example of a data matrix label structured accordingly:

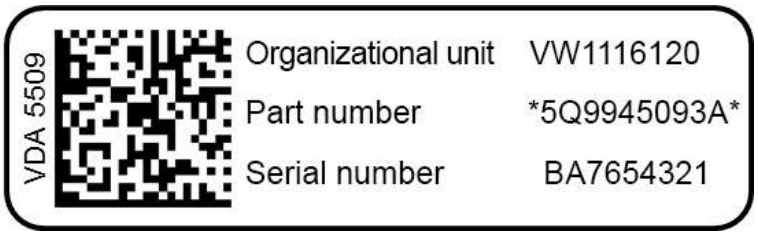

Figure 4 – Example of data matrix label

NOTE 5: Sample labels are shown under the link for Volkswagen employees VW 01067 – Sample Labels for Prototype Parts v1.0 or for contractors VW 01067 – Sample Labels for Prototype Parts v1.0.

If the example from table 8 is expanded to include a specific technical version (cf. Section 4.1.1), the data content would look like this:

Generation "02H": []>$^{R}_{S}$06$^{G}_{S}$37SUN123456789 5Q9945093A -02H+BA7654321$^{R}_{S}{}^{E}O_{T}$

Model phase "AS03": []>$^{R}_{S}$06$^{G}_{S}$37SUN123456789 5Q9945093A -AS03+BA7654321$^{R}_{S}{}^{E}O_{T}$

4.2 RFID use for BZD in production

The electronic marking of production parts for the purpose of legally required BZD and/or installation testing is realized using a DMC and/or RFID. The type of marking and the location of the marking on the component are defined in the component drawing; for ASSYs without a PN, they are defined in the Product Description Manual (PDM) sheet.

BZD: Each component is provided with a marking (DMC/RFID). Thus, the components can be allocated to VINs defined during the production process. This allows the vehicle components to be documented and tracked, so that, in the event of a warranty claim (recall), the number of affected vehicles can be narrowed down.

The documentation here relates to ASSYs. ASSYs here are understood to be vehicle components or parts that are built together to form assemblies, which are subject to mandatory marking in the sense of the present standard and are marked by means of a unique ASSY number. The accompanying ASSY data is defined in the BG-ONLINE system. Instructions on mandatory marking can be found in engineering drawings and TLD sheets.

The decision on which components are subject to mandatory BZD for each vehicle project is made in the Product Team/Model Series Team based on the Process Standard 1.4_K-GQZ/I_01_PS "Definition and Implementation of the BZD Scope in the Product Team." The status of the decision on BZD is published by means of a special form of the TLD sheets TLD.011.xxx.B0 in the Engineering Data Management System (KVS).

The marking is a release-relevant component property and must be taken into account during the sample inspection process. The following must be checked:

– That the data can be recorded under production conditions
– The contents of the applied data sequence
– The type of marking on the component and its application
– Retention period ≥ 15 years

The marking is checked during the sample inspection process. For this purpose, the supplier/manufacturer provides components that are marked the same way as they are during production. The supplier/manufacturer ensures that the marking requirements described here are met during ongoing production (e.g., through random sample testing).

The retention period is at least 15 years from the moment the data is created (equivalent to CSD class 7.2) The data must document important, quality-relevant individual information concerning the marked vehicle component (e.g., batch of raw materials used, manufacturers of purchase parts used, testing and setting values, place of manufacture and system), establish a clear link that makes it possible to identify the correspondence between this information and the corresponding reference data, and archive the information. If necessary, this will then make it possible to obtain clear information on qualities with respect to function, manufacturing, and materials.

If the supplier manufactures an ASSY containing a component subject to mandatory BZD (e.g., fuel pump inside the fuel tank ASSY), the supplier must record the data for the component subject to mandatory BZD, add the data to the ASSY's data, and retain this data in its documentation for at least 15 years. This also applies to ASSYs made up of an electronic control unit and mechanical components (e.g., headlamp with control module). If the requirements on the marking are not fulfilled, the affected components are considered faulty and might not be usable.

Installation testing: Each component is provided with a marking (DMC/RFID). The coded data is used in the ongoing production process to check the correct installation of a vehicle component (technical design, age, manufacturer).

4.2.1 Layout of number ranges

The layout of the reference number for marking production parts is based on 4 number ranges, which ensure that the number is unique; see table 10:

Table 10 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	PN/Group	max. 14 characters (alphanumeric)
3	ASSY	max. 3 characters (alphanumeric)
4	PSN	max. 7 characters (alphanumeric)
	Total number of characters	max. 40 characters (alphanumeric)

The number of characters for the CIN, PN, ASSY, and PSN must not exceed 32 characters (alphanumeric) in total. Including additional characters required for representing suitable RFID data structures (cf. section 4.2.2), this adds up to a data string of max. 40 characters (alphanumeric). This character length corresponds to common memory sizes (240-bit UII) so that the hybrid marking of parts can be ensured using RFID and DMC.

The owner of the CIN assigns the reference number and ensures that it is unique. The structure of the PN corresponds to VW 01098. The PSN consists exclusively of uppercase letters and numbers.

Note: The PSN must be formed independently from the PN and must be unique in combination with the ASSY throughout the archival time period of 15 years.

An additional parameter is also stored on the RFID tag, see table 11.

Table 11 – Layout of number ranges

	Number range	Number of characters
1	Manufacturer’s code	max. 4 characters (alphanumeric)

4.2.2 RFID marking of production parts (BZD)

The following AFI is used within the control information (MB01): A1 (product reference). Table 3 shows the layout of the unique reference number within the UII (MB01).

Note: The layout of the BZD data sequence is described in the Group assembly catalog "BG-ONLINE," cf. VW 01064, section 4.1 (contact via baugruppeninfo@volkswagen.de). In the present case, BZD data with a 7-digit production number is assumed.

Table 12 – Example of RFID data structure

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	37S
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (numeric)	123456789
4	PN including PN suffix + color code	max. 14 characters (alphanumeric)	5G4857705M RRA
5	Separator	1 character	*
6	ASSY	3 characters (alphanumeric)	Example: 209
7	Separator	1 character	+
8	PSN	max. 7 characters (alphanumeric)	4516616
	Number of characters	max. 40 characters (alphanumeric)	240 bit

Alphanumeric representation:

37SUN1234567895G4857705M RRA*209+4516616

Note: If the color code is not used, the resulting empty spots are not filled in, i.e., the contents of the data structure are as follows:

37SUN1234567895G4857705M*209+4516616!

After omitting the color code, sufficient memory is available in the UII area, i.e., the data structure is terminated with EOT.

Table 13 shows the layout of the data in the UM:

Table 13 – Data content and structure for RFID

	Data content UM (MB11)	Number of characters	Value
1	*DSFID*	$2_{(hex)}$	$03_{(hex)}$
2	*Pre-Cursor (compaction code + rel. OID)*	$2_{(hex)}$	$46_{(hex)}$
3a	*Byte count indicator switch*	$0_{(2)}$	
3b	*Number of following bytes*	$5_{(10)}$	$0+5 = 05_{(hex)}$
	Data content UM (MB11)	**Number of characters**	**Value**
1	DI	1 character (alphanumeric)	V
2	Manufacturer’s code	3 – 4 characters (alphanumeric)	ABC
3	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 6 characters (alphanumeric)	36 bit

4.2.3 Optical marking of production parts (BZD)

The DMC as per VW 01064 is used for marking production parts. In addition to the classical labeling, DPM is also possible. The DMC can have a square or also a rectangular design. For examples, see table 14.

Table 14

Design	Square code symbol	Rectangular code symbol
Code symbol		
Size in dots	24 x 24 dots	16 x 48 dots
Size in mm without quiet zone	12.24 x 12.24	8.16 x 24.48
Size in mm with quiet zone	16.24 x 16.24	12.16 x 28.48

The following quality requirements apply to the DMC:

- Symbol quality as per ISO/IEC 15415 class B or 2 (label)
- Symbol quality as per ISO/IEC TR 29158 is ≥ 3 (DPM)
- ECC 200 error correction
- Module size at least 0.50 mm
- Printer resolution 300 dpi or higher
- Quiet zone is at least 2 mm on each side

Note: Deviations from the quality standards specified above are permissible only in agreement with all parties involved in the process. The supplier must verify compliance with the quality standards and legibility of the DMC.

Table 15 – Example data content for DMC as per VW 01064

PN including PN suffix and color code	5G4857705M RRA
DUNS	123456789
ASSY	209
Manufacturer's code	ABC
SN	4516616
Check digit	P (check digit)

Basic layout of the character string as per VW 01064:

#Part number#Part type#DUNS#Manufacture date*ASSY data*=Additional data

DMC coding of the example specified above:

#5G4857705M RRA##123456789#*209 ABC4516616P*=

For an example SmartLabel, see figure 5.

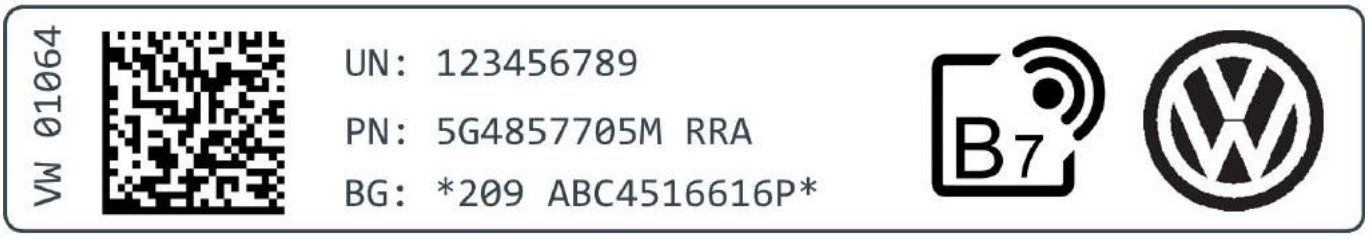

Figure 5 – RFID SmartLabel with plain text and 2-D code

Additional details on the layout of the label and additional examples can be found in the document "VW 01064 SampleLabels DE. Arbeitsstand.pptx."

The document can be found on the supplier platform http://www.vwgroupsupply.com >> Login >> Information >> Divisions >> Production >> Radio Frequency Identification (RFID).

4.3 Marking of tools

4.3.1 Layout of number ranges

The layout of the unique reference number for marking tools complies with VW 34022 (based on DIN 66277), and is based on two number ranges; see table 16:

Table 16 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	Inventory/tool number	max. 18 characters (alphanumeric)

The layout of the CIN depends on whether the tools are marked by a contractor or within the Group; see table 17:

Table 17 – Marking variants

		Number range	Number of characters
1	By the con-tractor	Supplier DUNS (D&B)	9 characters (numeric)
2	Within the Group	Brand code + plant + cost center	2 characters (alphanumeric) + 2 characters (alphanumeric) + 5 characters (numeric)

The CIN owner assigns the inventory/tool number. The owner ensures that the reference number is unique.

Optionally, the UM can be used to store additional payload; see VW 34022.

4.3.2 RFID marking of tools

The following AFI is used within the control information (MB01): A1 (product reference).

4.3.2.1 Marking by suppliers

Table 18 shows the layout of the unique reference number within the UII (MB01):

Table 18 – Example of RFID data structure (contractor)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	25S
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (numeric)	123456789
4	SN	max. 18 characters (alphanumeric)	ABC123456789012345
5	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 33 characters (alphanumeric)	198 bit

.

Alphanumeric representation:

25SUN123456789ABC123456789012345!

4.3.3 Marking within the Volkswagen Group

Table 19 shows the layout of the unique reference number within the UII (MB01):

Table 19 – Example of RFID data structure (within the Group)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	25S
2	IAC	2 characters (alphanumeric)	SC (marking within the Group)
3	CIN	9 characters (alphanumeric)	VW1116120
4	SN	18 characters (alphanumeric)	ABC123456789012345
5	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 33 characters (alphanumeric)	198 bit

Alphanumeric representation:

25SSCVW1116120ABC123456789012345!

4.3.4 Optical marking of tools

The DMC is used for marking tools.

4.3.4.1 Marking by suppliers

Table 20 shows how data matrix contents are represented conforming to ISO/IEC standards (incl. control characters).

Table 20 – Optical coding of tools (contractor)

Description	Data content
Start sequence	[]>
RS	$^{R}_{S}$ (ASCII)
Format identifier	06
GS	$^{G}_{S}$ (ASCII)
DI	25S
IAC	UN (DUNS)
CIN	123456789
SN	ABC123456789012345
RS	$^{R}_{S}$ (ASCII)
EOT	$^{E}O_{T}$ (ASCII)

Example: []>$^{R}_{S}$06$^{G}_{S}$25SUN123456789ABC123456789012345$^{R}_{S}{}^{E}O_{T}$

Figure 6 shows an example of a data matrix label structured accordingly:

Figure 6 – Example of data matrix label

4.3.4.2 Marking within the Volkswagen Group

Table 21 shows how data matrix contents are represented conforming to ISO/IEC standards (incl. control characters).

Table 21 – Optical coding of tools (within the Group)

Description	Data content
Start sequence	[]>
RS	$^{R}_{S}$ (ASCII)
Format identifier	06
GS	$^{G}_{S}$ (ASCII)
DI	25S
IAC	SC (marking within the Group)
CIN	VW1116120
SN	ABC123456789012345

Description	Data content
RS	$^{R}_{S}$ (ASCII)
EOT	$^{E}O_{T}$ (ASCII)

Example: [)>$^{R}_{S}$06$^{G}_{S}$25SSCVW1116120ABC123456789012345$^{R}_{S}{}^{E}O_{T}$

Figure 7 shows an example of a data matrix label structured accordingly:

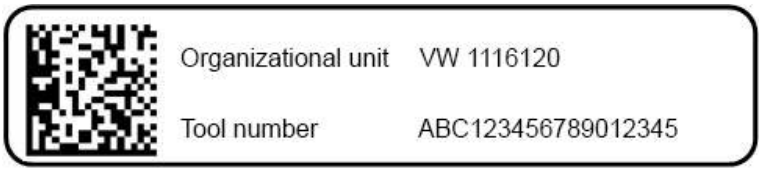

Figure 7 – Example of data matrix label

4.4 Marking of reusable containers

4.4.1 Layout of number ranges

The layout of the reference number for marking reusable containers is based on three number ranges, which ensure that the number is unique; see table 22:

Table 22 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	Container type	6 to 7 characters (alphanumeric)[a)]
3	SN	max. 9 characters (alphanumeric)

a) Continuous text string, contains no spaces

The layout of the CIN depends on whether the reusable containers are marked by a contractor or within the Group; see table 23:

Table 23 – Marking variants

	Marking	CIN	Number of characters
1	By the contractor	Supplier DUNS (D&B)	9 characters (numeric)
2	Within the Group	Brand code + plant + cost center	2 characters (alphanumeric) + 2 characters (alphanumeric) + 5 characters (numeric)

The owner of the CIN assigns the reference number and ensures that it is unique.

4.4.2 RFID marking of reusable containers

The following AFI is used within the control information (MB01): A3 (reusable container).

4.4.2.1 Marking by suppliers

Table 24 shows the layout of the unique reference number within the UII (MB01):

Table 24 – Example of RFID data structure (contractor)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	26B to 29B
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (numeric)	123456789
4	Container type	6 to 7 characters (alphanumeric)	A153097
5	Separator	1 character	+
6	SN	max. 9 characters (alphanumeric)	CS7148945
7	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 40 characters (alphanumeric)	240 bit

.

Alphanumeric representation:

26BUN123456789A153097+CS7148945!

The DI serves to differentiate between different types of containers; see table 25:

Table 25 – DI for reusable containers

	DI	Container type
1	26B	Generic designation for reusable containers
2	27B	Large load carriers, pallets
3	28B	Small load carriers, self-supporting special packaging
4	29B	Auxiliary packaging (covers, separating layers, internal packaging)

4.4.2.2 Marking within the Volkswagen Group

Table 26 shows the layout of the unique reference number within the UII (MB01):

Table 26 – Example of RFID data structure (within the Group)

	Data content UII (MB01)	Number of characters	Value
1	DI	3 characters (alphanumeric)	26B to 29B
2	IAC	2 characters (alphanumeric)	SC (marking within the Group)
3	CIN	9 characters (alphanumeric)	VW1116120
4	Container type	6 to 7 characters (alphanumeric)	A153097
5	Separator	1 character	+
6	SN	max. 9 characters (alphanumeric)	CS7148945
7	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 40 characters (alphanumeric)	240 bit

.

Alphanumeric representation:

26BSCVW1116120A153097+CS7148945!

The DI serves to differentiate between different types of containers; see table 27:

Table 27 – DI for reusable containers

	DI	Container type
1	26B	Generic designation for reusable containers
2	27B	Large load carriers, pallets
3	28B	Small load carriers, self-supporting special packaging
4	29B	Auxiliary packaging (covers, separating layers, internal packaging)

4.4.3 Optical marking of reusable containers

The optical coding of reusable containers depends on the respective application scenario. Code 128 is recommended for marking reusable containers, since it can achieve very large read ranges. It is permissible to use DMCs for marking.

4.4.3.1 Marking by suppliers

Table 28 shows how code contents are represented conforming to ISO/IEC standards:

Table 28 – Optical coding of reusable containers (contractor)

Description	Data content
DI	26B
IAC	UN (DUNS)
CIN	123456789
Container type	A153097
Separator	+
SN	CS7148945

Example: 26BUN123456789A153097+CS7148945

Figure 8 shows an example of a bar code label structured accordingly:

Figure 8 – Example of a bar code label

4.4.3.2 Marking within the Volkswagen Group

Table 29 shows how code 128 is represented conforming to ISO/IEC standards:

Table 29 – Optical coding of reusable containers (within the Group)

Description	Data content
DI	26B
IAC	SC (marking within the Group)
CIN	VW1116120
Container type	A153097
Separator	+
SN	CS7148945

Example: 26BSCVW1116120A153097+CS7148945

Figure 9 shows an example of a bar code label:

Figure 9 – Example of a bar code label

4.5 Marking of packaged items

4.5.1 Layout of number ranges

The layout of the reference number for marking packaged items is based on two number ranges, which ensure that the number is unique; see table 30:

Table 30 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	Packaged item ID	9 characters (numeric)

The layout of the CIN depends on whether the packaged items are marked by a contractor or within the Group; see table 31:

Table 31 – Marking variants

	Marking	Number range	Number of characters
1	By the contractor	Supplier DUNS (D&B)	9 characters (numeric)
2	Within the Group	Brand code + plant + cost center	2 characters (alphanumeric) + 2 characters (alphanumeric) + 5 characters (numeric)

The CIN owner assigns the packaged item ID. The packaged item ID must not be repeated until the number range from 000000001 to 999999999 has been used up for all Group plants. Within the Group, the owner ensures that the reference number is unique by adding the delivery slip date.

4.5.2 RFID marking of packaged items

The following AFI is used within the control information (MB01): A2 (transport units).

Among other things, the following variants are available for marking packaged items in MB01 as per ISO 17365 (cf. ISO/IEC 15418):

– 1J (packaged item)
– 5J (mixed container)
– 6J (single-type container)

Implementation is described below using a simple packaged item as an example.

4.5.2.1 Marking by suppliers

Table 32 shows the layout of the unique reference number within the UII (MB01):

Table 32 – Example of RFID data structure (contractor)

	Data content UII (MB01)	Number of characters	Value
1	DI	2 characters (alphanumeric)	1J
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (numeric)	049977473
4	Packaged item ID	9 characters (numeric)	123456789
5	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 23 characters (alphanumeric)	138 bit

Alphanumeric representation:

1JUN049977473123456789!

4.5.2.2 Marking within the Volkswagen Group

Table 33 shows the layout of the unique reference number within the UII (MB01):

Table 33 – Example of RFID data structure (within the Group)

	Data content UII (MB01)	Number of characters	Value
1	DI	2 characters (alphanumeric)	1J
2	IAC	2 characters (alphanumeric)	SC (marking within the Group)
3	Brand code + plant + cost center	9 characters (alphanumeric)	VW111620
4	Packaged item ID	9 characters (numeric)	123456789
5	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 23 characters (alphanumeric)	138 bit

Alphanumeric representation:

1JSCVW1116120123456789!

4.5.3 Optical marking of packaged items

Code 128 is used for the optical marking of packaged items.

4.5.3.1 Marking by suppliers

The layout of the unique reference number and the representation of additional data contents is based on the specifications contained in the Volkswagen Implementation Guideline Global Transport Label (GTL). Table 34 shows how code contents for the license plate are represented conforming to ISO/IEC stands.

Table 34 – Optical coding of packaged items (contractor)

Description	Data content
DI	1J
IAC	UN (DUNS)
CIN	049977473
Packaged item ID	123456789

Example: 1JUN049977473123456789

Figure 10 shows an example of a GTL label structured accordingly:

Figure 10 – Example of GTL

4.5.3.2 Marking within the Volkswagen Group

Table 35 shows how code contents are represented conforming to ISO/IEC standards:

Table 35 – Optical coding of packaged items (within the Group)

Description	Data content
DI	1J
IAC	SC (marking within the Group)
Brand code + plant + cost center	VW1116120
Packaged item ID	123456789

Example: 1JSCVW1116120123456789

Figure 11 shows a Group bar code label structured accordingly:

Figure 11 – Example of a bar code label

4.6 Marking of JIS packaged items

JIS packaged items are used for sequence processes and vehicle-based delivery processes. The marking of these JIS packaged items is different from standard packaged items (see above). The packaged items are marked using packaged item IDs. The packaged item IDs are transferred to advanced ship notices (ASNs) in parallel (VDA 4987), and printed on the shipment documents (VDA 4939).

4.6.1 Layout of number ranges

The layout of the reference number for marking packaged items is based on the following characters, which ensure that the number is unique; see table 36:

Table 36 – Layout of number ranges

	Number range	Number of characters
1	CIN	9 characters (alphanumeric)
2	Packaged item acronym	3 characters (alphanumeric)
3	Packaged item assembly line	2 characters (numeric)
4	Packaged item number	6 characters (numeric)

The CIN consists of the DUNS number (D&B) of the vehicle assembly plant. The packaged item acronym is assigned by the vehicle assembly plant. The assembly line is transferred to the supplier in the course of the call-offs in sync with production (DELJIT/Syncro or VDA 4986). The supplier assigns the packaged item number, which establishes the uniqueness of the reference number (000001 – 999999). After reaching 999999, the counting sequence starts again at 000001.

4.6.2 RFID marking of JIS packaged items

In addition to others, the following variants are available for marking packaged items as per ISO 17365 (cf. ISO/IEC 15418):

– 3J (JIS packaged item, single)
– 4J (JIS packaged item, container)

Implementation is described below using a simple packaged item as an example. Table 37 shows the layout of the unique reference number within the UII (MB01):

Table 37 – Example of RFID data structure (contractor)

	Data content UII (MB01)	Number of characters	Value
1	DI	2 characters (alphanumeric)	3J
2	IAC	2 characters (alphanumeric)	UN (DUNS)
3	CIN	9 characters (alphanumeric)	315016295
4	Packaged item acro-nym	3 characters (alphanumeric)	SIL
5	Packaged item assem-bly line	2 characters (alphanumeric)	03
6	Packaged item number	6 characters (alphanumeric)	001756
7	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 25 characters (alphanumeric)	150 bit

Alphanumeric representation:

3JUN315016295SIL01001536!

4.6.3 Optical marking of JIS packaged items

Code 128 is used for the optical marking of packaged items.

Example: 3JUN315016295SIL01001536

Figure 12 shows a bar code label structured accordingly:

Figure 12 – Example of a bar code label

4.7 Marking of vehicles

4.7.1 Layout of number ranges

The layout of the reference number for marking vehicles is based on two number ranges, which ensure that the number is unique; see table 38:

Table 38 – Layout of number ranges

	Number range	Number of characters
1	VIN	17 characters (alphanumeric)
2	FZN	11 characters (alphanumeric)

The layout of the reference number depends on whether the vehicles are marked as part of pre-production tracking or as part of vehicle distribution (production); see table 39:

Table 39 – Marking variants

	Marking	Vehicle marking	Number of characters
1	Vehicle distribution	VIN	17 characters (numeric)
2	Pre-production	FZN + VIN	11 characters (alphanumeric) + 17 characters (alphanumeric)

The layout of the VIN for marking within vehicle distribution (production) corresponds to ISO 3779 and is assigned by the vehicle manufacturer.

Warning information

The VIN is considered personal information within the European Union (EU) and is thus subject to the General Data Protection Regulation (EU-DSGVO), i.e., using the VIN requires a legal basis.

Therefore, the legal necessity or other need for the electronic read-out of the VIN on the vehicle must be described, e.g., from the viewpoint of the manufacturer and retailer processes, and documented in agreement with those responsible for data protection.

Within pre-production, vehicles (test mules) are marked with the FZN within the Group. The VIN is not universally used within pre-production, meaning it is only employed as an additional, optional attribute within vehicle marking. The vehicle manufacturer is responsible for ensuring that the reference numbers are unique.

The data structures for vehicle marking are shown below.

4.7.2 RFID marking of vehicles

The following AFI is used within the control information (MB01): 90 (vehicle-based).

4.7.2.1 RFID marking of vehicles (vehicle distribution)

Table 40 shows the layout of the unique reference number within the UII (MB01). The layout corresponds to VDA 5520.

Table 40 – Generic RFID data structure (vehicle distribution)

	Data content UII (MB01)	Number of characters	Value
1	DI	1 character (alphanumeric)	I
2	VIN	17 characters (alphanumeric)	WVWZZZ1JZ3W123456
3	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 19 characters (alphanumeric)	114 bit

Alphanumeric representation:

IWVWZZZ1JZ3W123456!

4.7.2.2 RFID marking of prototype vehicles (pre-production)

Table 41 shows the layout of the unique reference number within the UII (MB01) and the additional use of UM (MB11):

Table 41 – Example of RFID data structure (pre-production)

	Data content UII (MB01)	Number of characters	Value
1	DI	2 characters (alphanumeric)	1Y
2	FZN	11 characters (alphanumeric)	VW462480574
3	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 14 characters (alphanumeric)	84 bit
	Data content UM (MB11)	**Number of characters**	**Value**
1	*DSFID*	$2_{(hex)}$	$03_{(hex)}$
2	*Pre-cursor (compaction code + rel. OID)*	$2_{(hex)}$	$46_{(hex)}$
3	*Byte count indicator switch*	$1_{(2)}$	$'0'_{(2)}$
4	*Number of following bytes*	$7_{(2)}$	$N_{(2)}$
	Data content UM (MB11)	**Number of characters**	**Value**
1	DI	1 character (alphanumeric)	I
2	VIN	17 characters (alphanumeric)	WVWZZZ1JZ3W123456
3	EOT	1 character (alphanumeric)	$^{E}O_{T}$ (!)
	Number of characters	max. 19 characters (alphanumeric)	114 bit

Alphanumeric representation:

Unique item identifier (UII): 1YVW462480574!

UM: IWVWZZZ1JZ3W123456!

4.7.3 Optical marking of vehicles

4.7.3.1 Optical marking of vehicles (vehicle distribution)

The optical coding and structure of labels for vehicle marking is based on VDA 5520.

4.7.3.2 Optical marking of prototype vehicles (pre-production)

Table 42 shows how data matrix contents are represented conforming to ISO/IEC standards (incl. control characters).

Table 42 – Optical coding of vehicles (pre-production)

Description	Data content
Start sequence	[)>
RS	$^{R}_{S}$ (ASCII)
Format identifier	06
GS	$^{G}_{S}$ (ASCII)
DI	1Y
FZN	VW462480574
GS	$^{G}_{S}$ (ASCII)
DI	I
VIN	WVWZZZ1JZ3W123456
RS	$^{R}_{S}$ (ASCII)
EOT	$^{E}O_{T}$ (ASCII)

Example: [)>$^{R}_{S}$06$^{G}_{S}$1YVW462480574$^{G}_{S}$IWVWZZZ1JZ3W123456$^{R}_{S}{}^{E}O_{T}$

Figure 13 shows an example of a data matrix label structured accordingly:

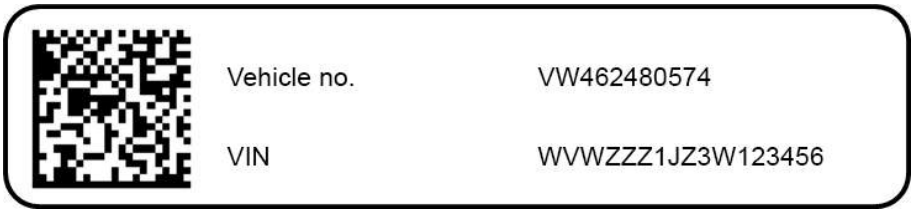

Figure 13 – Example of data matrix label

5 Applicable documents

The following documents cited in this standard are necessary to its application.

Some of the cited documents are translations from the German original. The translations of German terms in such documents may differ from those used in this standard, resulting in terminological inconsistency.

Standards whose titles are given in German may be available only in German. Editions in other languages may be available from the institution issuing the standard.

VW 01014	Drawings; Drawing Frames and Text Macros
VW 01064	Module Marking on Production Vehicles; Build Status Documentation - Codes on Mechanical Vehicle Parts
VW 01098	Part Number System
VW 10500	Company Designation, Marking of Parts; Guidelines for Use
VW 34022	Marking of Tools, Auxiliary Tools, Test Equipment, and Gages (Identification Plate); Requirements
DIN 66277	Information technology - Automatic identifcation and data capture techniques - Electronic identification plate
ISO/IEC 15415	Information technology - Automatic identification and data capture techniques - Bar code symbol print quality test specification - Two-dimensional symbols
ISO/IEC 15417	Information technology - Automatic identification and data capture techniques - Code 128 bar code symbology specification
ISO/IEC 15418	Information technology - Automatic identification and data capture techniques - GS1 Application Identifiers and ASC MH10 Data Identifiers and maintenance
ISO/IEC 15434	Information technology - Automatic identification and data capture techniques - Syntax for high-capacity ADC media
ISO/IEC 15961-1	Information technology - Radio frequency identification (RFID) for item management: Data protocol - Part 1: Application interface
ISO/IEC 15962	Information technology - Radio frequency identification (RFID) for item management - Data protocol: data encoding rules and logical memory functions
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
ISO/IEC TR 29158	Information technology - Automatic identification and data capture techniques - Direct Part Mark (DPM) Quality Guideline
ISO 17363	Supply chain applications of RFID - Freight containers
ISO 17364	Supply chain applications of RFID - Returnable transport items (RTIs) and returnable packaging items (RPIs)

ISO 17365	Supply chain applications of RFID - Transport units
ISO 17366	Supply chain applications of RFID - Product packaging
ISO 17367	Supply chain applications of RFID - Product tagging
ISO 3779	Road vehicles - Vehicle identification number (VIN) - Content and structure
VDA 4939	Shipment Documents; Version 3.1
VDA 4986	Datenübertragung von Produktionssynchronen Abrufen - Verfahrensbeschreibung - Übertragung von Produktionssynchronen Lieferabrufdaten per EDI mit EDIFACT und XML von Kunden an Lieferanten; Version 1.2
VDA 4987	Data Transfer of Despatch Advices - Process description - Transfer of despatch advices by EDI with EDIFACT and XML; Version 1.3
VDA 5500	Basic Principles for RFID Application in the Automotive Industry; Version 1.2
VDA 5501	RFID for Container Management in the Supply Chain; Version 2.2
VDA 5509	AutoID/RFID-Application and Data Transfer for Tracking Parts and Components in the Vehicle Development Process; Version 2.4
VDA 5510	RFID for Tracking Parts and Components in the Automotive Industry; Version 2.0
VDA 5520	RFID for vehicle identification in production, logistics and for service purposes; Version 2.0

Appendix A (normative) 6-bit coding

Table A.1 – 6-bit coding table

Character	Binary value	Charac-ter	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

The following characters may be used to represent data content:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z. Additional use of " " (space), + (plus), - (minus), * (asterisk), <EOT>, <RS>, <GS> as per specification.

Appendix B (informative) Examples (reference number for prototype parts)

The following different valid variants are shown as examples (see figure B.1) to illustrate the structure of the reference number, in particular the PN and the PSN:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	Variants
GENERAL (without engineering version)																																								
Basic data content on transponder																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	+	1	2	3	4	5	6	7	8	9	!						Basic, no suffix, no color code, no generation
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	+	1	2	3	4	5	6	7	8	9	!				Like basic, including suffix (two letters)
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	+	1	2	3	4	5	6	7	8	9	!					Like basic, including suffix (one letter)
Content on transponder including color code																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6			6	B	6	+	1	2	3	4	5	6	7	8	9	!	Like basic, no suffix, including color code
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	6	B	6	+	1	2	3	4	5	6	7	8	9	!	Like basic, including suffix (two letters) and color code
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A		6	B	6	+	1	2	3	4	5	6	7	8	9	!	Like basic, including only color code
Audi-specific engineering version (3 characters)																																								
Content on transponder including generation																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	-	0	1	K	+	1	2	3	4	5	6	!				Like basic, no suffix, including generation
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	-	0	1	K	+	1	2	3	4	5	6	!			Including suffix (two letters) and generation
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A		-	0	1	K	+	1	2	3	4	5	6	!			Including suffix (one letter) and generation
Content on transponder including color code and generation																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6			6	B	6	-	0	1	K	+	1	2	3	4	5	6	Like basic, no suffix, including color code and generation
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	6	B	6	-	0	1	K	+	1	2	3	4	5	6	Like basic, including suffix (two letters), color code, and generation
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A		6	B	6	-	0	1	K	+	1	2	3	4	5	6	Like basic, including suffix (one letter), color code, and generation
Porsche-specific engineering version (4 characters)																																								
Content on transponder including engineering version																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	-	E	M	0	5	+	1	2	3	4	5	!				Like basic, no suffix, including engineering version
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	-	E	M	0	5	+	1	2	3	4	5	!			Including suffix (two letters) and engineering version
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A		-	E	M	0	5	+	1	2	3	4	5	!			Including suffix (one letter) and engineering version
Content on transponder including color code and engineering version																																								
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6			6	B	6	-	E	M	0	5	+	1	2	3	4	!	Like basic, no suffix, including color code and engineering version
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A	B	6	B	6	-	E	M	0	5	+	1	2	3	4	!	Like basic, including suffix (two letters), color code, and engineering version
3	7	S	U	N	1	2	3	4	5	6	7	8	9		1	K	0	1	2	3	4	5	6	A		6	B	6	-	E	M	0	5	+	1	2	3	4	!	Like basic, including suffix (one letter), color code, and engineering version

Figure B.1 – Structure of the reference number