SIEMENS

SIMATIC Sensors

RFID systems SIMATIC RF300

System Manual

11/2009 - Zwischenstand 17.09.2009

A5E01642529-04

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E01642529-04
Ⓟ 11/2009

Table of contents

Introduction 1

1.1 Navigating in the system manual

Structure of contents	Contents
Table of contents	Organization of the documentation, including the index of pages and chapters
Introduction	Purpose, layout and description of the important topics.
Safety instructions	Refers to all the valid technical safety aspects which have to be adhered to while installing, commissioning and operating from the product/system view and with reference to statutory regulations.
System overview	Overview of all RF identification systems, system overview of SIMATIC RF300
RFID system planning	Information about possible applications of SIMATIC RF300, support for application planning, tools for finding suitable SIMATIC RF300 components.
Readers	Description of readers which can be used for SIMATIC RF300
RF300 transponder	Description of RF300 transponders which can be used for SIMATIC RF300
ISO transponder	Description of ISO transponders which can be used for SIMATIC RF300
System integration	Overview of the communication modules and function blocks that can be used for SIMATIC RF300
System diagnostics	Description of system diagnostics available for SIMATIC RF300
Appendix	• Certificates and approvals • Accessories • Connecting cable • Ordering data • Service & Support

1.2 Preface

Purpose of this document

This system manual contains all the information needed to plan and configure the system.

It is intended both for programming and testing/debugging personnel who commission the system themselves and connect it with other units (automation systems, further programming devices), as well as for service and maintenance personnel who install expansions or carry out fault/error analyses.

Scope of validity of this document

This documentation is valid for all supplied variations of the SIMATIC RF300 system and describes the state of delivery as of November 2009.

Conventions

The following terms/abbreviations are used synonymously in this document:

- Reader, read/write device, write/read device
- Tag, transponder, mobile data memory, data carrier, MDS
- Communication module, interface module, ASM

History

Currently released versions of the SIMATIC RF300 system manual:

Edition	Remark
05/2005	First Edition
11/2005	Revised edition, components added: RF310R with RS422 interface, RF350T and RF360T; ASM 452, ASM 456, ASM 473 and ASM 475
04/2006	Revised edition, components added: RF340R as well as RF350R with the antenna types ANT 1, ANT 18 and ANT 30
12/2006	Revised edition, components added: RF370T, RF380T and RF170C
07/2007	Revised edition, degrees of protection changed for the RF300 reader
09/2007	Revised edition, components added: RF380R and RF180C
06/2008	Revised edition
01/2009	Revised edition, expanded by the reader functions "RF300 Tags" and "ISO Tags" for the SIMATIC RF310R and SIMATIC RF380R readers
11/2009	Revised edition, expanded by the reader functions "RF300 Tags" and "ISO Tags" for the SIMATIC RF340R and SIMATIC RF350R readers Expanded by the following components: • ANT 12 (in conjunction with RF350R) • ISO transponders MDS D421, MDS D424, MDS D428, MDS D460

2 Safety information

SIMATIC RFID products comply with the salient safety specifications to IEC, VDE, EN, UL and CSA. If you have questions about the validity of the installation in the planned environment, please contact your service representative.

CAUTION
Alterations to the devices are not permitted. Failure to observe this requirement shall constitute a revocation of the radio equipment approval, CE approval and manufacturer's warranty.

Repairs

Repairs may only be carried out by authorized qualified personnel.

WARNING
Unauthorized opening of and improper repairs to the device may result in substantial damage to equipment or risk of personal injury to the user.

System expansion

Only install system expansion devices designed for this device. If you install other upgrades, you may damage the system or violate the safety requirements and regulations for radio frequency interference suppression. Contact your technical support team or your sales outlet to find out which system upgrades are suitable for installation.

CAUTION
If you cause system defects by installing or exchanging system expansion devices, the warranty becomes void.

System overview 3

3.1 RFID systems

RFID systems from Siemens control and optimize material flow. They identify reliably, quickly and economically, are insensitive to contamination and store data directly on the product.

Identification system	Frequency	Range, max.	Max. memory	Data transfer rate (maximum) in byte/s	Temperature, max.	Special features
RF300	13.56 MHz	0.2 m	20 byte EEPROM, 64 KB FRAM	**RF300 tags:** 8000 **ISO tags**: - Read: 600 - Write: 400	**Readers**: -25 °C to +70 °C **Transponder**: -40 °C to +85 °C +220 °C cyclic	IQ-Sense interface available; integrated diagnostic functions; battery-free data memory; additional ISO 15693 functionality (RF310R, 340R, RF350R, RF380R)
MOBY D	13.56 MHz	0.8 m	112 byte EEPROM	- Read: 600 - Write: 400	+ 85 °C or + 200 °C	SmartLabels based on ISO 15693 e.g. Tag-it/I-Code
MOBY E	13.56 MHz	0,1 m	752 byte EEPROM	- Read: 400 - Write: 350	+ 150 °C	Battery-free data memory
MOBY I	1.81 MHz	0.15 m	32 KB FRAM	1250	+ 85 °C or + 220 °C cyclic	Battery-free data memory

3.2 SIMATIC RF300

3.2.1 RF300 system overview

SIMATIC RF300 is an inductive identification system specially designed for use in industrial production for the control and optimization of material flow.

Thanks to its compact dimensions, RF300 is the obvious choice where installation conditions are restricted, especially for assembly lines, handling systems and workpiece carrier systems. RF300 is suitable for both simple and demanding RFID applications and it stands out for its persuasive price/performance ratio.

Low-performance applications

With the cost-effective IQ-Sense interface, RF300 provides an especially favorable solution concept for low-performance applications.

Medium-performance applications

RF300 in conjunction with ISO tags provides a cost-effective solution for medium-performance applications.

High-performance applications

The high-performance components of RF300 provide advantages in terms of high data transmission rates and storage capacities.

File handler functionality

In addition to standard addressing, the ASM 456 interface module in conjunction with the FC 56 offers a file handler functionality. The required parameters correspond to those of MOBY I which are described in the FC56 documentation (http://support.automation.siemens.com/WW/view/en/18690683).

Available ASMs can be found in an overview table in Chapter "System integration, Introduction (Page 209),Table 8-1).

Table 3- 1 Overview of RF300 low-, medium- and high-performance components

System components	RF300 for low-performance applications	RF300 for medium performance Applications with ISO 15693 tags	RF300 for high-performance applications
Communication modules	8xIQ-Sense for ET 200M (PROFIBUS) and for direct connection to an S7-300	• ASM 452 • ASM 456 • ASM 473 (PROFIBUS) • ASM 475 (S7 300/ET 200M) • RF170C • RF180C • RF182C	• ASM 452 • ASM 456 • ASM 473 (PROFIBUS) • ASM 475 (S7 300/ET 200M) • RF170C • RF180C • RF182C
Readers	• RF310R with IQ-Sense interface	• RF310R with RS422 interface • RF340R • RF350R • RF380R	• RF310R with RS422 interface • RF340R • RF350R • RF380R
Transponder	• RF320T • RF340T • RF350T • RF360T	• MDS D100 • MDS D124 • MDS D139[1)] • MDS D160[2)] • MDS D324 • MDS D421 • MDS D424 • MDS D428 • MDS D460	• RF320T • RF340T • RF350T • RF360T • RF370T • RF380T

1) only with the MLFB 6GT2600-0AA10

2) only with the MLFB 6GT2600-0AB10

3.2.2 RFID components and their function

System components overview

Component	Description
Communication module	A communication module (interface module) is used to integrate the RF identification system in controllers/automation systems.
Readers	The reader (read/write device) ensures inductive communication and power supply to the transponder, and handles the connection to the various controllers (e.g. SIMATIC S7) through the communication module (e.g. ASM 475).
Transponder	The transponder (data memory) stores all data relevant to the production process and is used, for example, instead of barcode.

RF300 system components for low- and high-performance applications

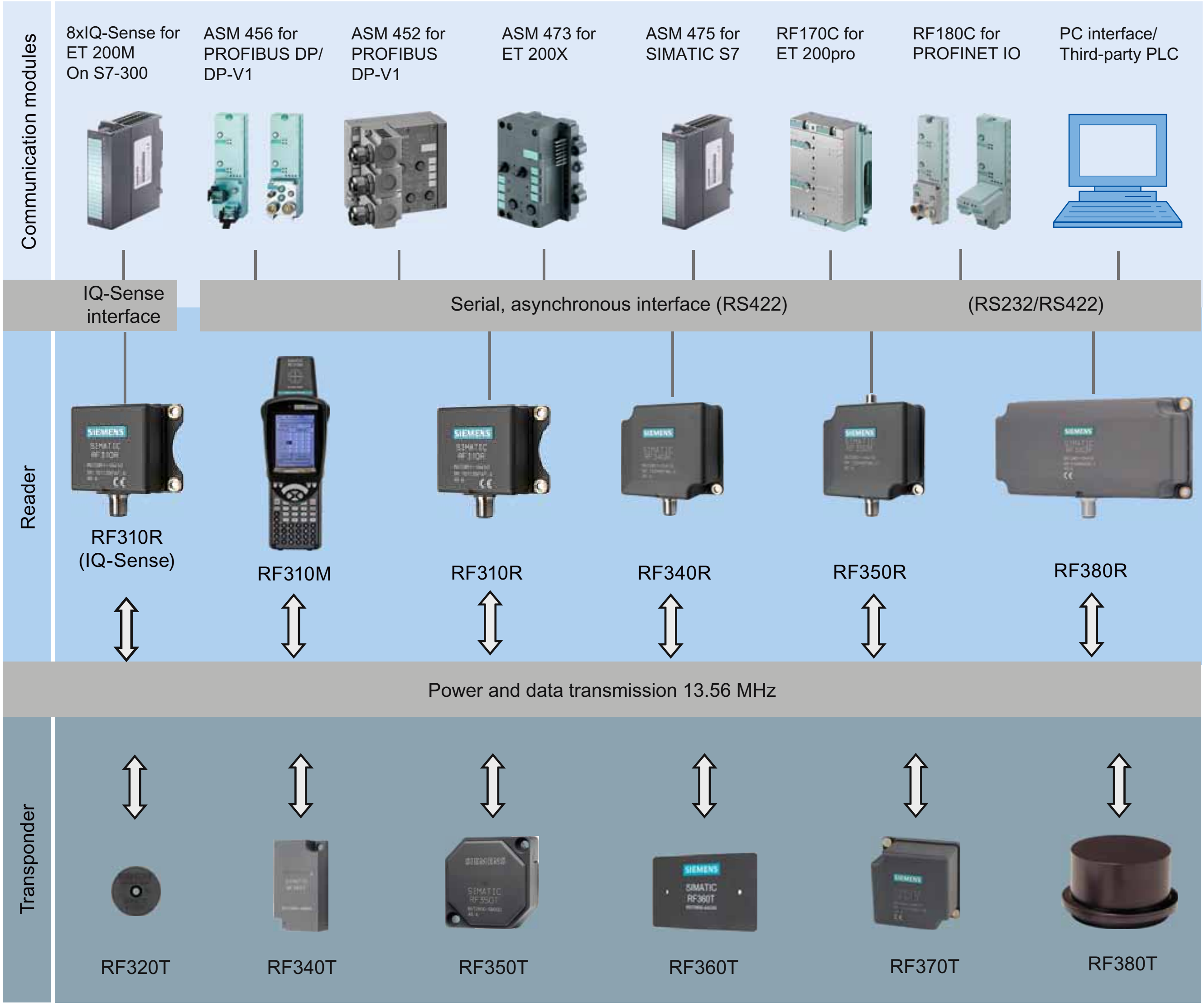


Figure 3-1 System overview low- and high-performance

Table 3- 2 Reader-tag combination options for low- and high-performance applications

Tags/ MDS	RF310R (IQ-Sense)	RF310R (RS422)	RF340R	RF350R with ANT 1	RF350R with ANT 18	RF350R with ANT 30	RF380R
RF320T	✓	✓	✓	✓	✓	✓	✓
RF340T	✓	✓	✓	✓	✓	✓	✓
RF350T	✓	✓	✓	✓	○	✓	✓
RF360T	✓	✓	✓	✓	--	○	✓
RF370T	○	○	✓	✓	--	○	✓
RF380T	○	○	✓	✓	--	--	✓

✓ Combination possible
-- Combination not possible
○ Combination possible, but not recommended

@ in Grafik fehlt noch MDS D424 und die Fotos von MDS D460/MDS D424

RF300 system components for medium-performance applications

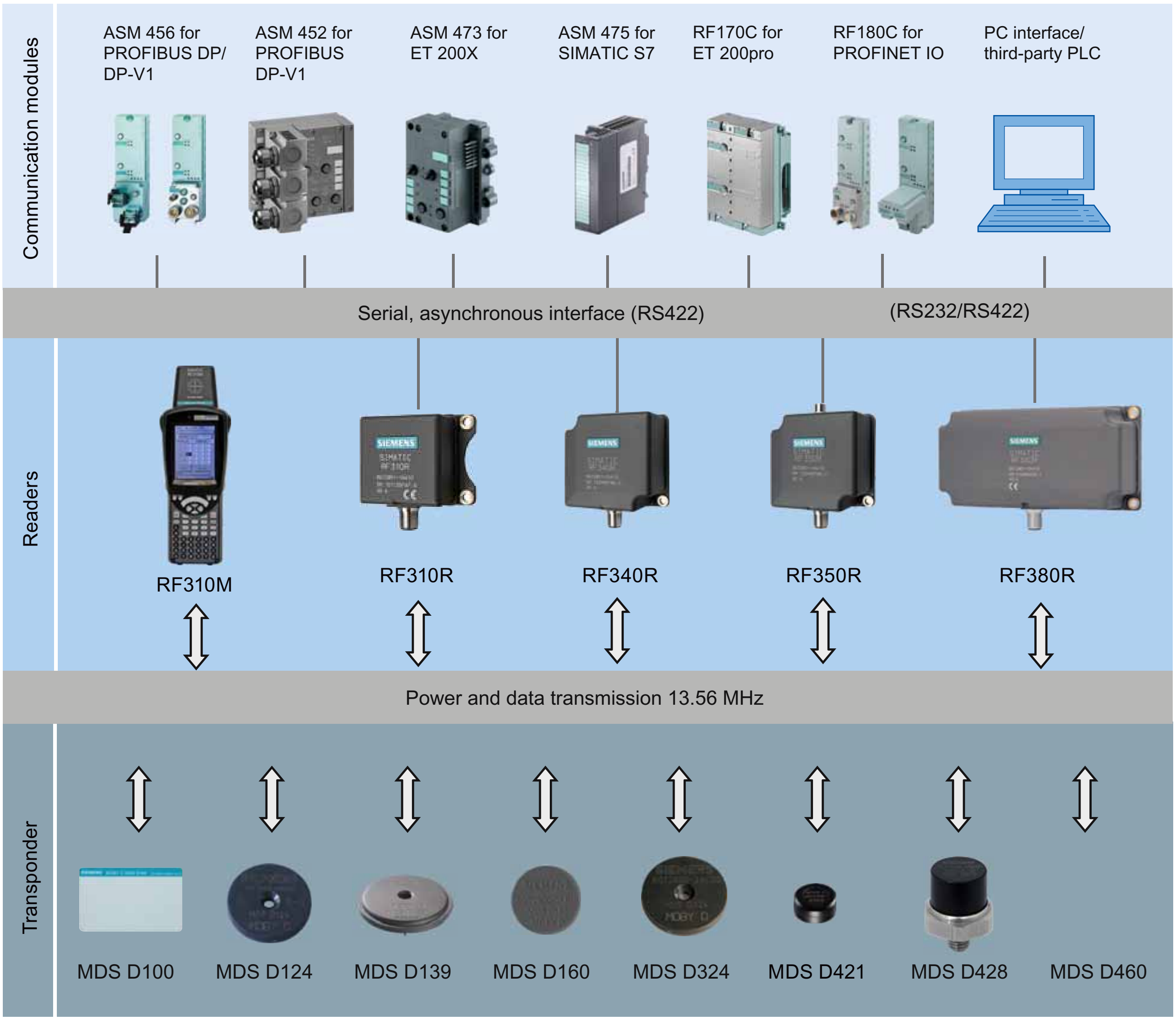


Figure 3-2 System overview medium-performance

Table 3- 3 Reader-tag combination options for medium-performance applications

Tags/ MDS	RF310R (IQ-Sense)	RF310R (RS422)	RF340R	RF350R with ANT 1	RF350R with ANT 12	RF350R with ANT 18	RF350R with ANT 30	RF380R
MDS D100	--	✓	✓	✓	--	--	○	✓
MDS D124	--	✓	✓	✓	○	✓	✓	✓
MDS D139	--	○	✓	✓	--	--	○	✓
MDS D160	--	✓	✓	✓	✓	✓	✓	✓
MDS D324	--	✓	✓	✓	○	✓	✓	✓
MDS D421	--	--	--	--	✓	✓	--	--
MDS D424	--	✓	✓	✓	○	✓	✓	✓
MDS D428	--	✓	✓	✓	✓	✓	✓	✓
MDS D460	--	✓	✓	✓	✓	✓	✓	✓

✓ Combination possible

-- Combination not possible

○ Combination possible, but not recommended

Note

ISO15693 is only possible with MLFB 6GT2801-xxBxx readers.

Conventions

The RF310R, RF340R and RF380R readers are equipped with an integral antenna, whereas the RF350R reader is operated over an external antenna. In this system manual, the term "Reader" is used throughout even where it is actually referring to the antenna of the reader.

3.2.3 Application areas of RF300

SIMATIC RF300 is primarily used for non-contact identification of containers, palettes and workpiece holders in a closed production circuit. The data carriers (transponders) remain in the production chain and are not supplied with the products. SIMATIC RF300, with its compact transponder and reader enclosure dimensions, is particularly suitable in confined spaces.

Main applications

- Mechanical engineering, automation systems, conveyor systems
- Ancillary assembly lines in the automotive industry, component suppliers
- Small assembly lines

Application examples

- Production lines for engines, gearboxes, axles, etc.
- Assembly lines for ABS systems, airbags, brake systems, doors, cockpits, etc.
- Assembly lines for household electrical appliances, consumer electronics and electronic communication equipment
- Assembly lines for PCs, small-power motors, contactors, switches

Advantages

- Reading and writing of large data volumes within a short time results in shorter production cycle times and thus help to boost productivity
- Can be used in harsh environments thanks to rugged components with high degree of protection
- Simple and low-cost system integration into SIMATIC S7 and PROFIBUS (TIA)
- Shorter commissioning times and fewer plant failures and downtimes thanks to integral diagnostic functionalities
- Cost savings thanks to maintenance-free components

3.3 System configuration

3.3.1 Overview

The SIMATIC RF300 system is characterized by a high level of standardization of its components. This means that the system follows the TIA principle throughout: Totally Integrated Automation. It provides maximum transparency at all levels with its reduced interface overhead. This ensures optimum interaction between all system components.

The RF300 system with its flexible components offers many possibilities for system configuration. This chapter shows you how you can use the RF300 components on the basis of various example scenarios.

3.3.2 Assembly line example: Use of RF300 tags

In assembly lines, such as in engine manufacturing, many work steps are completed in succession. Automated or manual assembly work is carried out at the individual workstations in relatively short periods of time. The special features of the RF300 tags, which stand out for their large data memory and high transmission speeds, bring about many advantages in regard to the production unit numbers of such plants.

The possibility of saving large volumes of data means savings in terms of data management on the HOST system and considerably contributes to data security. (redundant data management, e.g. HOST database, or controller and data carrier)

Advantages at a glance:

- Redundant data storage on the basis of large memory, availability of decentralized data
- High data rate
- Data management savings on the host system

Characteristics of the scenario

In this example scenario, engine blocks that are placed on metal pallets are conveyed on an assembly line. The engines are assembled piece-by-piece at the individual workstations. The SIMATIC RF340T RFID tag is securely affixed on the underside of the pallet. The transport speed is approx. 0.5 m/s.

In this scenario, it is an advantage that the tag can be directly secured to metal on the metal pallets. The small-dimensioned SIMATIC RF310R reader is integrated in the conveyor elements in such a manner that it can communicate with the tags from below. Thus, it is not necessary to align the pallets or to attach several tags.

The data of the entire production order (5000 bytes) is stored on the tag. This data is read at each workstation and changed or supplemented depending on the workstation, and then written back again. Thus, the status of the engine block assembly can be determined at any point in time, even if there is a failure at the HOST level.

Thanks to the extremely high data rate, a very short cycle time for the work steps can be factored in, which results in high end product unit numbers (engines).

The entire production order that is saved on the tag can also be manually read via the WIN-LC terminal located at each workstation. This means that virtually no additional data management is required on the control PC.

The production order data can also be read for servicing purposes via the mobile SIMATIC RF310M handheld terminal.

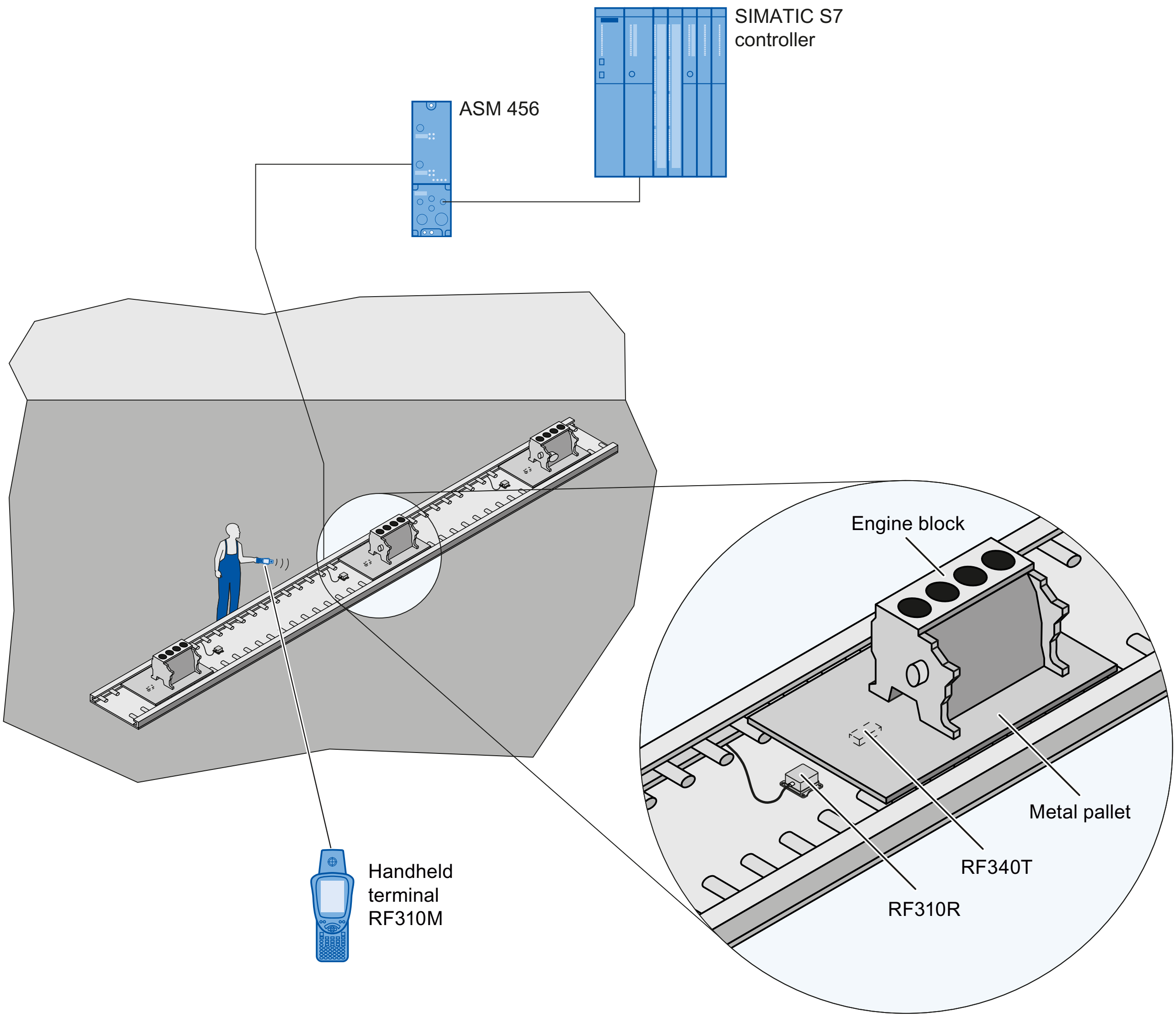


Figure 3-3 Example of engine block production

3.3.3 Example of container and paper board container handling: Use of ISO tags

Containers of varying sizes are conveyed to picking workstations in a delivery center. There, the individual goods are removed and packed in cartons according to the delivery note. These cartons are marked with low-cost transponder labels and sorted to small or large packaging workstations (according to the delivery note) by being guided or transported via the corresponding conveyor system. The containers are marked using the MDS D100 ISO tag.

Advantages at a glance:

- Decision points in the conveyor system can be installed in a more favorable way (mechanically)
- Different sizes of containers with different depths can be identified due to the range

- In contrast to bar codes, tags can also be written to
- Different types of tags can be processed using one and the same reader

Characteristics of the scenario

In this example scenario, containers of varying sizes are conveyed on a conveyor system. Only the unique identification number (8 bytes) is read. The containers to be picked are sorted to the corresponding workstations. The maximum transport speed is 1.0 m/s.

In this scenario, it is an advantage that the RF380R reader can read and write the tags at different distances on the containers without a great deal of mechanical or control system effort due to the reading range.

During the picking process, the goods are immediately placed in different containers or packed in cartons depending on the destination (small packaging or large packaging station). The containers are equipped with the MDS D100 ISO tag. The low-cost "one-way tag" (label) is used on the cartons: it is simply glued onto the carton. Thus the goods can be identified at any time. Again, one and the same reader is used for this. The maximum transport speed is 0.8 m/s.

In addition, flexible identification is possible at each location and at any time using the mobile SIMATIC RF310M handheld terminal.

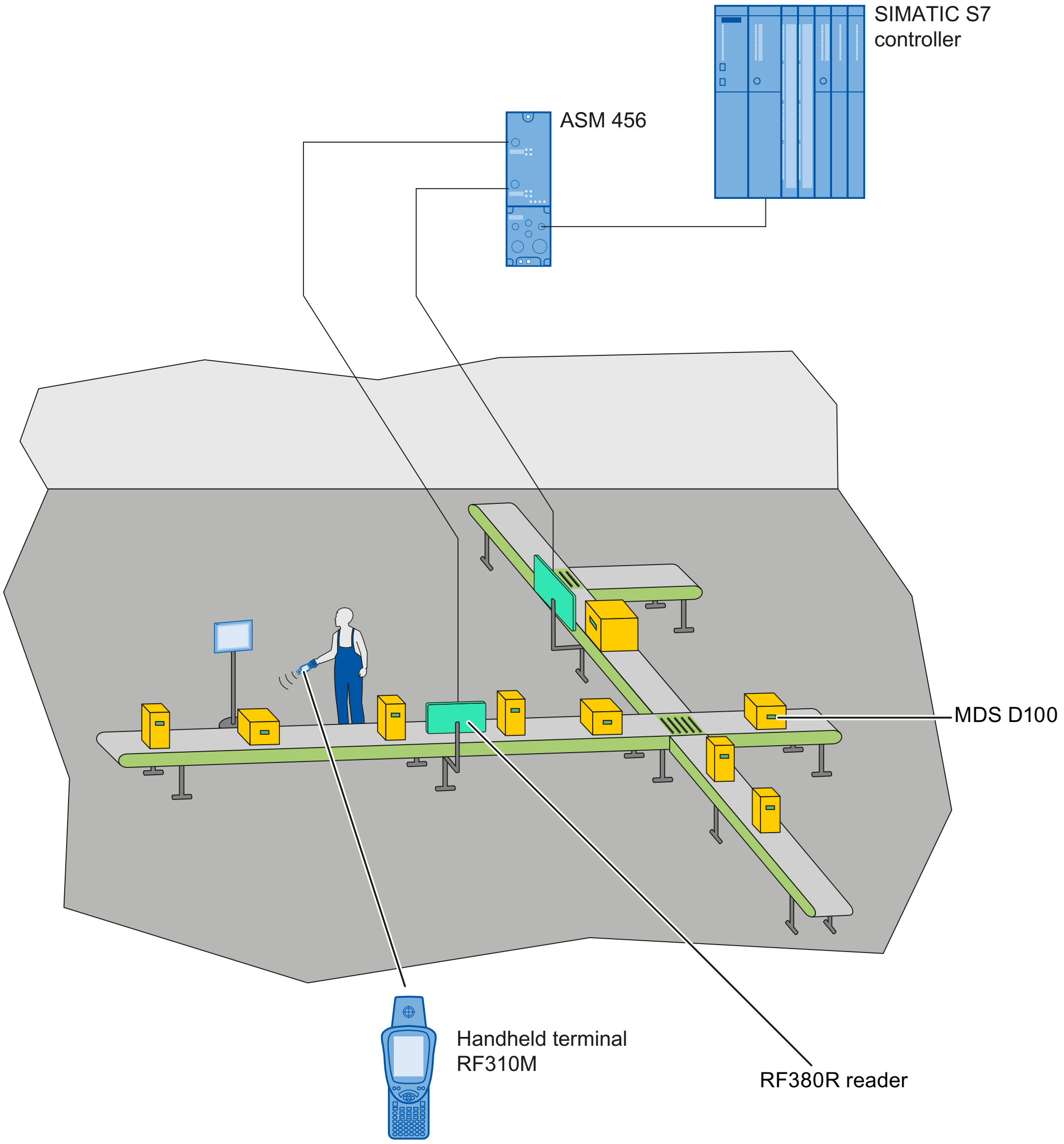


Figure 3-4 Example of container and paper board container handling

3.4 System data

Type	Inductive identification system for industrial applications
Transmission frequency data/energy	13.56 MHz
Memory capacity	• 20 bytes to 64 KB user memory (r/w) • 4 bytes fixed code as serial number (ro)
Memory type	EEPROM / FRAM
Write cycles	• EEPROM: > 200 000 • FRAM: Unlimited

Read cycles	Unlimited		
Data management	Byte-by-byte access		
Data transmission rate Transponder reader		RF300 tags	ISO tags
	Read (maximum values)	8000 byte/s	approx. 600 byte/s
	Write (maximum values)	approx. 8000 byte/s	approx. 400 byte/s
Read/write distance (system limit; depends on reader and transponder)	• RF300 tags: up to 0.15 m • ISO tags: up to 0.2 m		
Operating temperature	**Readers:**	-25°C to +70°C	
	Transponder:	-40 to +125 °C +220 °C cyclically	
Degree of protection	Reader: IP 67 [2)] Transponder: > IP 67		
Can be connected to	• SIMATIC S7-300 • PROFIBUS DP V1 • PROFINET • PC [1)] • Third-party control [1)]		
Special features	• Very high data transfer rate • High noise immunity • Compact components • Extensive diagnostic options • A reader with IQ-Sense interface • ISO 15693 functionality can be parameterized		
Approvals	• ETS 300 330 (Europe) • FCC Part 15 (USA), • UL/CSA CE, • operating license for Japan		

1) By means of RS422 interface and 3964R protocol

2) Exception RF350R: IP 65

RF300 system planning 4

4.1 Fundamentals of application planning

4.1.1 Selection criteria for SIMATIC RF300 components

Assess your application according to the following criteria, in order to choose the right SIMATIC RF300 components:

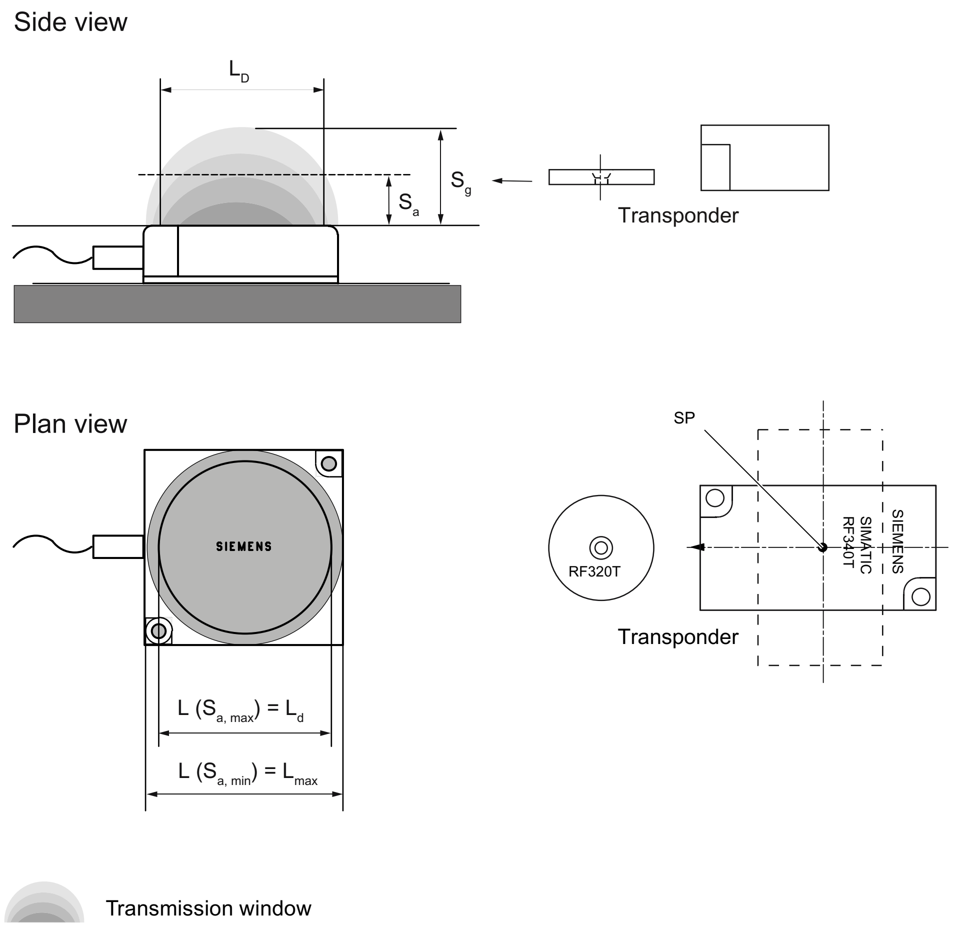
- Transmission distance (read/write distance)
- Tracking tolerances
- Static or dynamic data transfer
- Data volume to be transferred
- Speed in case of dynamic transfer
- Metal-free rooms for transponders and readers
- Ambient conditions such as relative humidity, temperature, chemical impacts, etc.

4.1.2 Transmission window and read/write distance

The reader generates an inductive alternating field. The field is strongest near to the reader. The strength of the field decreases in proportion to the distance from the reader. The distribution of the field depends on the structure and geometry of the antennas in the reader and transponder.

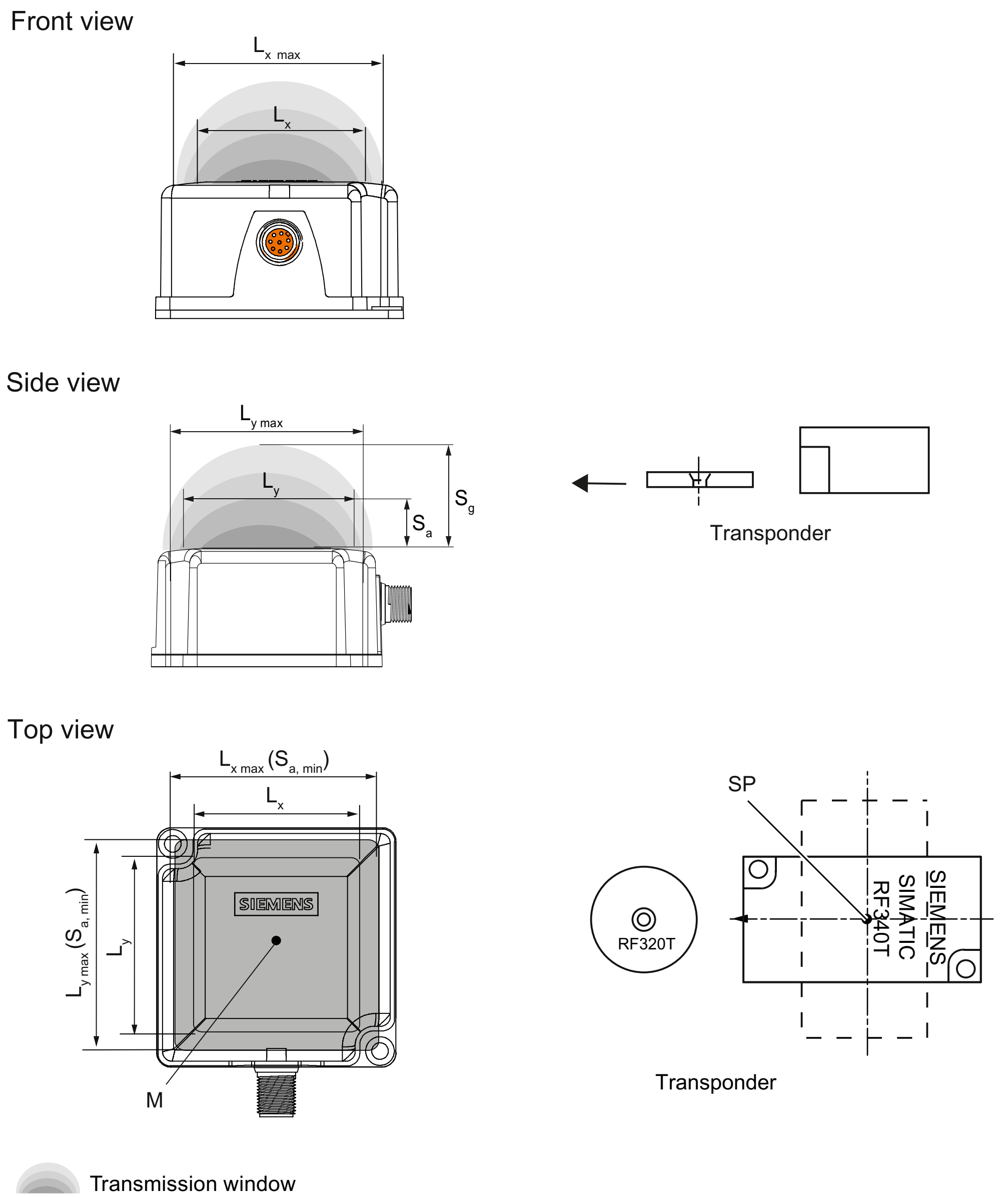
A prerequisite for the function of the transponder is a minimum field strength at the transponder achieved at a distance S_g from the reader or the ANT1. The picture below shows the transmission window between transponder and reader or ANT1:

Table 4- 1 RF310R reader and ANT 1 (RF350R) transmission window and read/write distance



S_a:	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still function under normal conditions)
L	Length of a transmission window The length L_d is valid for the calculation. At $S_{a,min}$, the field length increases from L_d to L_{max}.
SP	Intersection of the axes of symmetry of the transponder

Table 4- 2 RF340R reader transmission window and read/write distance

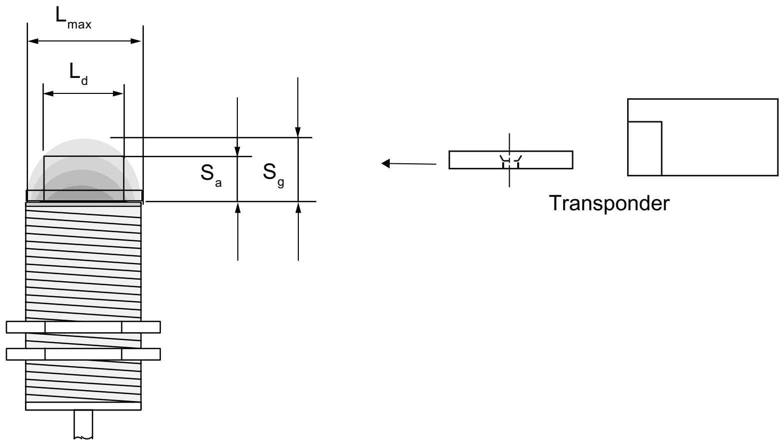


All dimensions in mm.

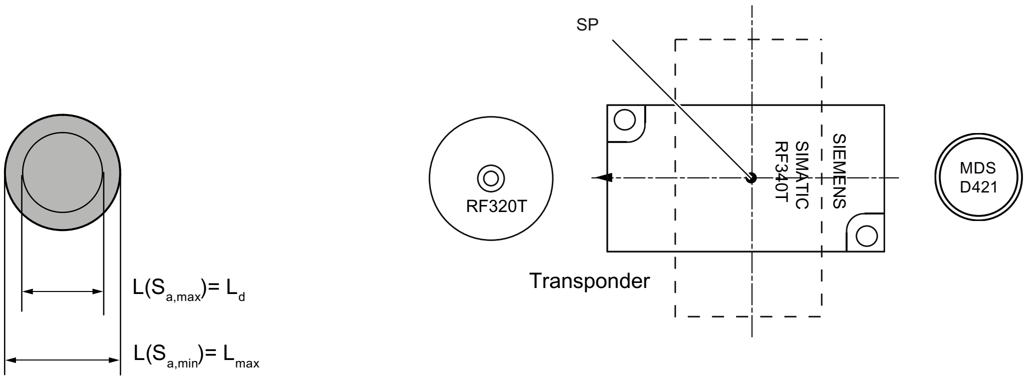
S_a:	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still function under normal conditions)
L_x	Length of a transmission window in the x-direction ($L_x = L_y$ with RF340R) The length L_x is valid for the calculation. At $S_{a,min}$, the field length increases from L_x to L_{max}.
L_y	Length of a transmission window in the y-direction ($L_x = L_y$ with RF340R) The length L_y is valid for the calculation. At $S_{a,min}$, the field length increases from L_y to $L_{y\,max}$.
M	Field centerpoint

Table 4- 3 ANT 12, ANT 18 and ANT 30 (RF350R) transmission window and read/write distance

Side view



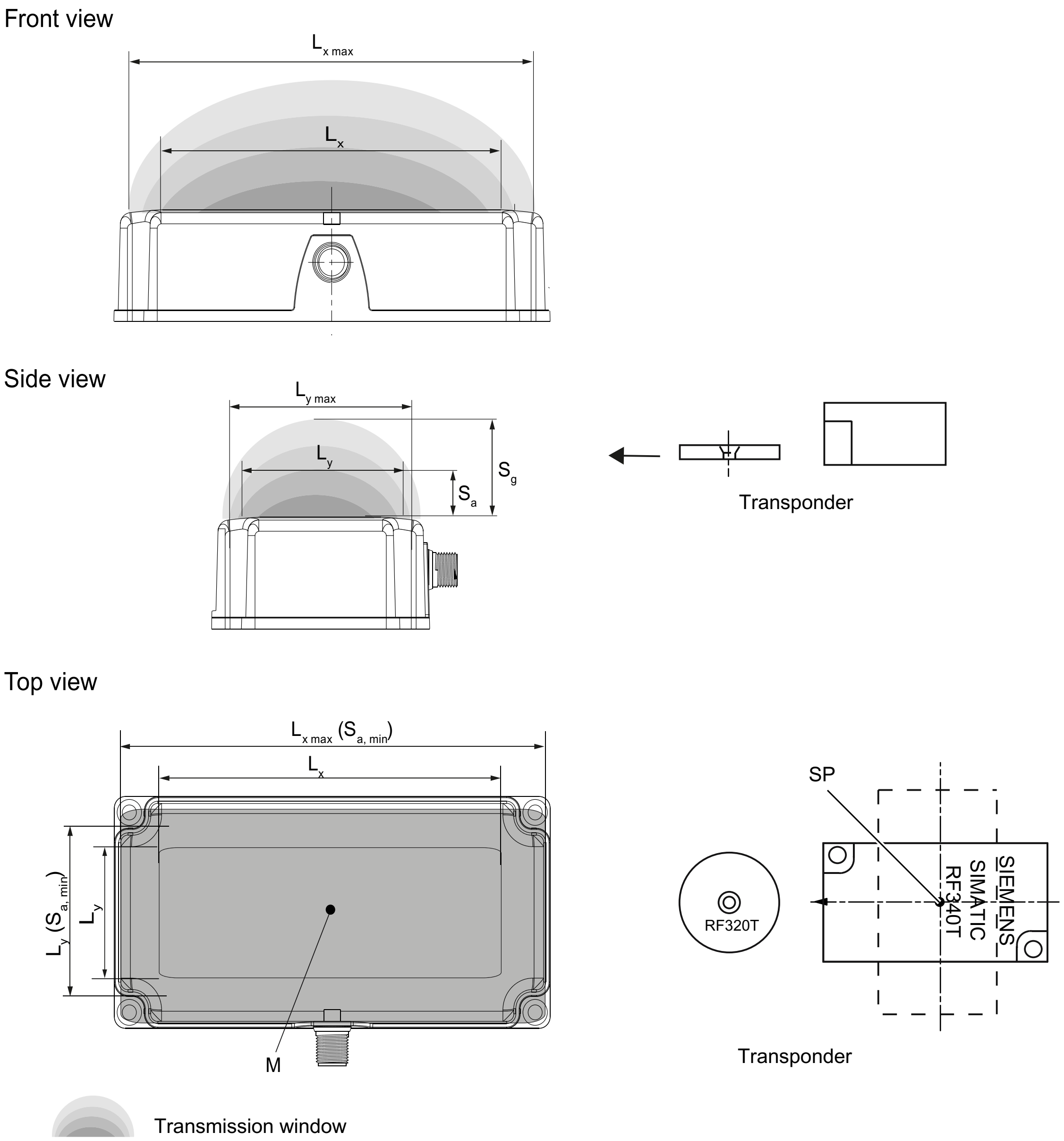
Top view




Transmission window

S_a:	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still function under normal conditions)
L	Diameter of a transmission window The length L_d is valid for the calculation. At $S_{a,min}$, the field length increases from L_d to L_{max}.
SP	Intersection of the axes of symmetry of the transponder

Table 4- 4 RF380R reader transmission window and read/write distance



S_a:	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still function under normal conditions)
L_x	Length of a transmission window in the x direction The length L_x is valid for the calculation. At $S_{a,min}$, the field length increases from L_x to L_{max}.
L_y	Length of a transmission window in the y direction The length L_y is valid for the calculation. At $S_{a,min}$, the field length increases from L_y to $L_{y\ max}$.
M	Field centerpoint

The transponder can be used as soon as the intersection (SP) of the transponder enters the area of the transmission window.

From the diagrams above, it can also be seen that operation is possible within the area between S_a and S_g. The active operating area reduces as the distance increases, and shrinks to a single point at distance S_g. Only static mode should thus be used in the area between S_a and S_g.

4.1.3 Width of the transmission window

Determining the width of the transmission window

The following approximation formula can be used for practical applications:

$$B = 0.4 \cdot L$$

B:	Width of the transmission window
L:	Length of the transmission window

Tracking tolerances

The width of the transmission window (B) is particularly important for the mechanical tracking tolerance. The formula for the dwell time is valid without restriction when B is observed.

4.1.4 Impact of secondary fields

Secondary fields in the range from 0 to 20 mm always exist.
They should only be applied during planning in exceptional cases, however, since the read/write distances are very limited. Exact details of the secondary field geometry cannot be given, since these values depend heavily on the operating distance and the application.

Secondary fields without shielding

The following graphic shows typical primary and secondary fields, if no shielding measures are taken.

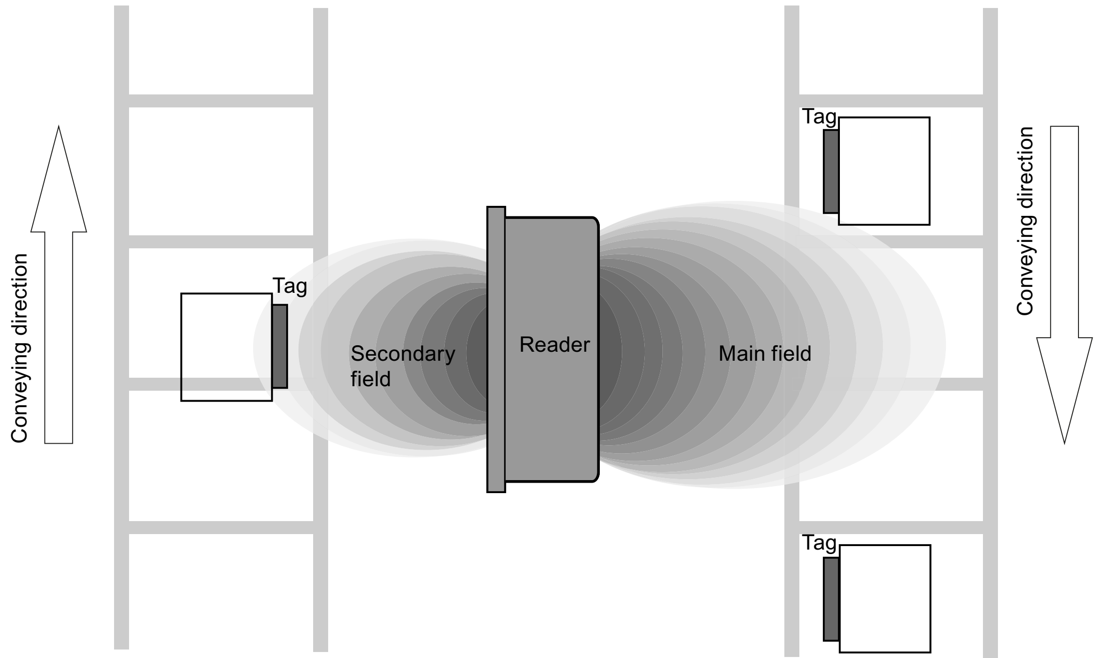


Figure 4-1 Secondary field without shielding

In this arrangement, the reader can also read tags via the secondary field. Shielding is required in order to prevent unwanted reading via the secondary field, as shown and described in the following.

Secondary fields with shielding

The following graphic shows typical primary and secondary fields, with metal shielding this time.

The metal shielding prevents the reader from detecting tags via the secondary field.

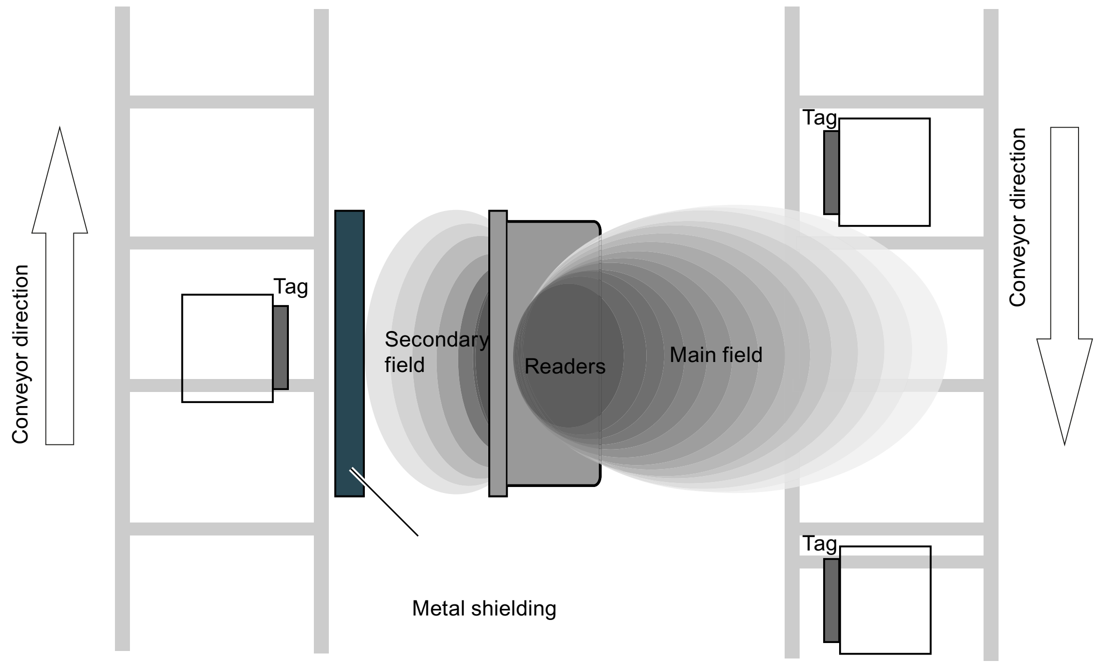


Figure 4-2 Secondary field with shielding

4.1.5 Permissible directions of motion of the transponder

Detection area and direction of motion of the transponder

The transponder and reader have **no** polarization axis, i.e. the transponder can come in from any direction, be placed at any position, and cross the transmission window. The figure below shows the active area for various directions of transponder motion:

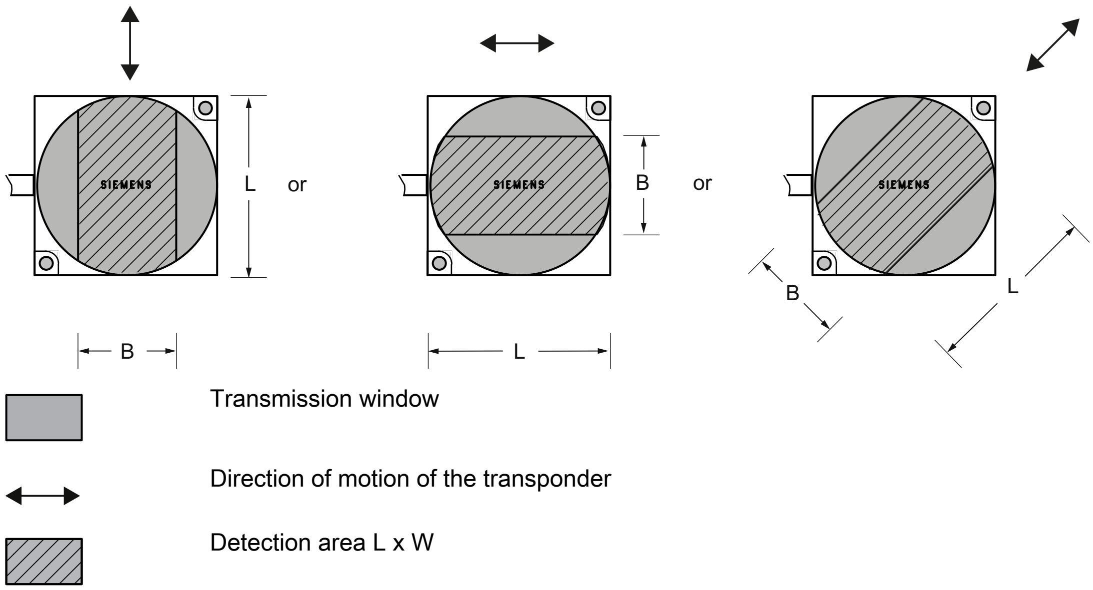


Figure 4-3 Detection areas of the reader for different directions of transponder motion

4.1.6 Operation in static and dynamic mode

Operation in static mode

If working in static mode, the transponder can be operated up to the limit distance (S_g). The transponder must then be positioned exactly over the reader:

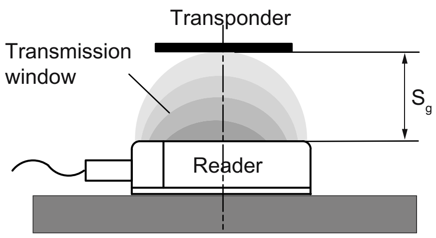


Figure 4-4 Operation in static mode

Operation in dynamic mode

When working in dynamic mode, the transponder moves past the reader. The transponder can be used as soon as the intersection (SP) of the transponder enters the circle of the transmission window. In dynamic mode, the operating distance (S_a) is of primary importance. [Operating distances, see Chapter Field data for transponders, readers and antennas (Page 41)]

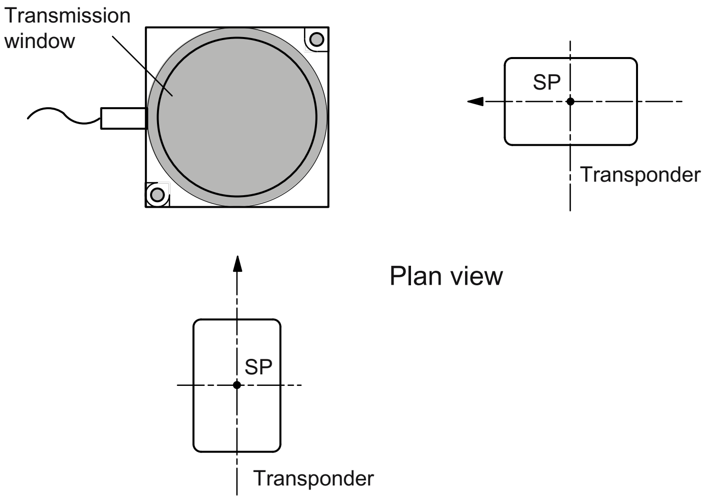


Figure 4-5 Operation in dynamic mode

4.1.7 Dwell time of the transponder

The dwell time is the time in which the transponder remains within the transmission window of a reader. The reader can exchange data with the transponder during this time.

The dwell time is calculated thus:

$$t_v = \frac{L \cdot 0{,}8\,[m]}{v_{Tag}\,[m/s]}$$

t_V: Dwell time of the transponder

L: Length of the transmission window

v_{Tag}: Speed of the transponder (tag) in dynamic mode

0,8: Constant factor used to compensate for temperature impacts and production tolerances

The dwell time can be of any duration in static mode. The dwell time must be sufficiently long to allow communication with the transponder.

The dwell time is defined by the system environment in dynamic mode. The volume of data to be transferred must be matched to the dwell time or vice versa. In general:

$$t_V \geq t_K$$

t_V:	Dwell time of the data memory within the field of the reader
t_K:	Communication time between transponder and communication module

4.1.8 Communication between communication module, reader and transponder

Communication between the communication module, reader and transponder takes place asynchronously through the RS422 interface. Depending on the communication module (ASM) used, transfer rates of 19200 baud, 57600 baud or 115200 baud can be selected.

Calculation of the communication time for interference-free transfer

The communication time for fault-free data transfer is calculated as follows:

$$t_K = K + t_{Byte} \cdot n \qquad (n \geq 1)$$

If the transmission is interrupted briefly due to external interference, the communication module automatically continues the command.

Calculation of the maximum amount of user data

The maximum amount of user data is calculated as follows:

$$n_{\max} = \frac{t_V - K}{t_{Byte}}$$

t_k:	Communication time between communication module, reader and transponder
t_v:	Dwell time
n:	Amount of user data in bytes
n_{max}:	Max. amount of user data in bytes in dynamic mode
t_{byte}:	Transmission time for 1 byte
K:	Constant; the constant is an internal system time. This contains the time for power buildup on the transponder and for command transfer

Time constants K and t_{byte} for medium and high-performance applications

Table 4- 5 Static mode

Transfer rate [baud]	RF300 mode FRAM				ISO mode					
	Read/write				Read				Write	
	Data volume ≤ 233 bytes		Data volume >233 bytes		Data volume ≤ 233 bytes		Data volume >233 bytes		Independent of data volume	
	K [ms]	t_{byte} [ms]	K [ms]	t_{byte} [ms]	K [ms]	t_{byte} [ms]	K [ms]	t_{byte} [ms]	K [ms]	t_{byte} [ms]
19200	28	0.67	28	0.67	35	1.08	64	0.75	41	2.66
57600	15	0.30	25	0.22	34	0.59	34	0.59	28	2.28
115200	11	0.21	30	0.12	26	0.56	26	0.56	26	2.17

The values for K and t_{byte} include the overall time that is required for communication in static mode. It is built up from several different times:

- Serial communication between communication module, reader and
- Processing time between reader and transponder and their internal processing time.

The values shown in the table must be used when calculating the maximum quantity of user data in static mode. They are applicable for both reading and writing in the FRAM area.

For writing in the EEPROM area (max. 20 bytes), the byte time t_{Byte} is approx. 11 ms.

Table 4- 6 Dynamic mode

Transfer rate [baud]	Memory area	RF300 tags		ISO tags	
		K [ms]	t_{byte} [ms]	K [ms]	t_{byte} [ms]
Independent	FRAM	8	0.13	-	-
Independent	EEPROM				
Write		8	12.20	15	1.99
Read		8	0.13	12	0.56

In dynamic mode, the values for K and t_{byte} are independent of the transmission speed. The communication time only includes the processing time between the reader and the transponder and the internal system processing time of these components. The communication times between the communication module and the reader do not have to be taken into account because the command for reading or writing is already active when the transponder enters the transmission field of the reader.

The values shown above must be used when calculating the maximum quantity of user data in dynamic mode. They are applicable for both writing and reading.

Time constants K and t_{byte} for low-performance applications (IQ-Sense)

Table 4- 7 Static mode

K (ms)	t_{byte} (ms)	Command
15	15	Read (FRAM/EEPROM area)
15	15	Write (FRAM area)
30	30	Write (EEPROM area)

The table of time constants applies to every command. If a user command consists of several subcommands, the above t_K formula must be applied to each subcommand.

4.1.9 Calculation example (RS422)

A transport system moves pallets with transponders at a maximum velocity of V_{Tag} = 1.0 m/s (dynamic mode). The following RFID components were selected:

- ASM 475 communication module
- RF310R reader with RS422 interface
- Transponder RF340T

Task

a) The designer of the plant is to be given mechanical specifications.

b) The programmer should be given the maximum number of bytes in dynamic mode.

Refer to the tables in the "Field data of transponders and readers" section for the technical data.

Determine tolerance of pallet transport height

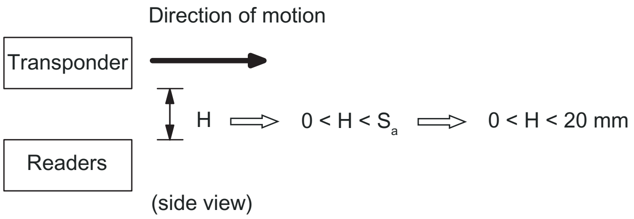


Figure 4-6 Tolerance of pallet transport height

Determine tolerance of pallet side transport

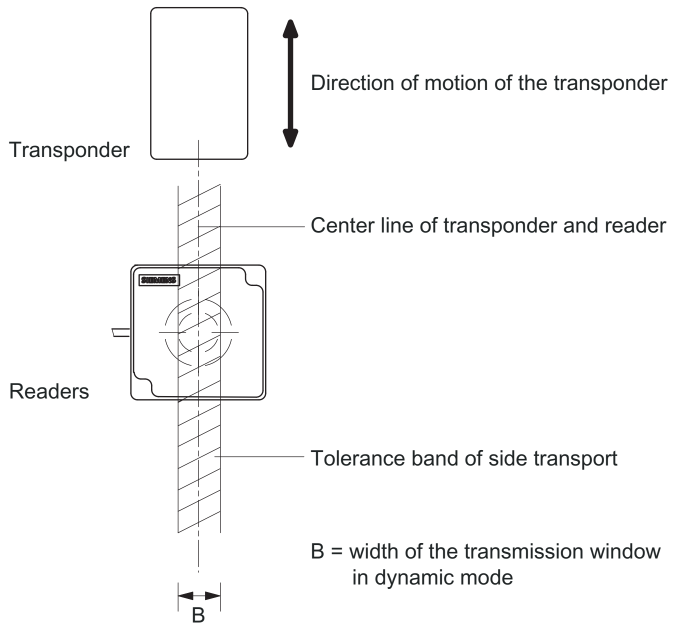


Figure 4-7 Tolerance of pallet side transport

Minimum distance from reader to reader

Refer to the field data of the reader for this value.

Minimum distance from transponder to transponder

Refer to the field data of the transponder for this value.

Calculation of the maximum amount of user data in dynamic mode

Step		Formula/calculation
1.	Calculate dwell time of the transponder	Refer to the "Field data of all transponders and readers" table for value L. Value v_{Tag} = 1.00 m/s $t_v = \frac{L \cdot 0,8}{v_{Tag}} = \frac{0,038\ m \cdot 0,8}{1,0\ m/s} = 0,0304\ s = 30,4\ ms$
2.	Calculate maximum user data (n_{max}) for reading or writing (FRAM area)	Take value t_v from Step 1. Take values K and t_{Byte} from Table "Time constants K and t_{Byte}". Read / write: $\frac{t_v - K}{t_{bytes}} = \frac{30.4\ ms - 8\ ms}{0.13\ ms} = 172.3\ bytes \Rightarrow n_{max} \approx 172\ bytes$

Result

A maximum of 172 bytes can be read or written when the transponder passes by.

4.2 Field data for transponders, readers and antennas

The following table shows the field data for all SIMATIC RF300 components of transponders and readers. It facilitates the correct selection of a transponder and reader.

All the technical specifications listed are typical data and are applicable for an ambient temperature of between 0 C and +50 °C, a supply voltage of between 22 V and 27 V DC and a metal-free environment. **Tolerances of ±20 % are admissible due to production or temperature conditions.**

If the entire voltage range at the reader of 20 V DC to 30 V DC and/or the entire temperature range of transponders and readers is used, the field data are subject to further tolerances.

Note

Transmission gaps

If the minimum operating distance (S_a) is not observed, a transmission gap can occur in the center of the field. Communication with the transponder is not possible in the transmission gap.

4.2.1 Field data of RF300 transponders

Observe the following information for field data of RF300 transponders:

- A maximum median deviation of ±2 mm is possible in static mode (without affecting the field data)
- The field data are reduced by approx. 15% if the transponder enters the transmission window laterally (see also "Transmission window" figure)

RF310R reader

Table 4- 8 RF310R reader

	Length of transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	30	2...10	16
RF340T	38	2...20	26
RF350T	45	5...22 [26]	30 [35]
RF360T	45	5...26	35

All values are in mm

Values in brackets [ ] refer to RF310R with the MLFB 6GT2801-1AB10

RF340R reader

Table 4- 9 RF340R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	45	2...20	25
RF340T	60	5...25	35
RF350T	60	5...35	50
RF360T	70	8...40	60
RF370T	75	15...36	52
RF380T	85	15...47	55

All values are in mm

RF350R reader / ANT 1

Table 4- 10 RF350R reader / ANT 1

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	45	2...20	25
RF340T	60	5...25	35
RF350T	60	5...35	50
RF360T	70	8...40	60
RF370T	70	15...45	65
RF380T	88	15...53	65

All values are in mm

RF350R reader / ANT 18

Table 4- 11 RF350R reader / ANT 18

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
RF320T	10	2...8	10
RF340T	20	2...10	13

All values are in mm

RF350R reader / ANT 30

Table 4- 12 RF350R reader / ANT 30

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
RF320T	15	2...11	15
RF340T	25	5...15	20
RF350T	25	5...16	22

RF380R reader

Table 4- 13 RF380R reader

	Length of the transmission window		Operating distance (S_a)	Limit distance (S_g)
	in the x-direction (L_x)	in the y-direction (L_y)		
RF320T	100	40	2...30 [40]	47 [55]
RF340T	115	50	20...70 [80]	90 [100]
RF350T	120	60	35...70 [100]	105 [130]
RF360T	120	70	40...120	140 [150]
RF370T	135	65	35...85 [100]	125 [135]
RF380T	155	75	25...85 [110]	125 [140]

All values are in mm

Values in brackets [ ] refer to RF380R with the MLFB 6GT2801-3AB10

The RF380R with MLFB 6GT2801-3AB10 enables the user to set the transmission output power with the aid of the "distance_limiting" input parameter. For this, values from approx. 0.5 W to approx. 2.0 W can be set in 0.25 W increments. Depending on the setting, the change to the transmission output power increases the performance in the lower operating distance (low performance) or in the upper limit distance (high performance).

The "dili" value range goes from

02 (= 0.5 W) and

05 (default value: 1.25 W) to

08 (= 2 W).

Note

A dili value setting outside of the value range of 02 to 08 leads to the default setting (05) and does not generate an error message.

Also see Chapter Minimum clearances (Page 47) Section "Minimum distance from reader to reader".

You can find exact information regarding the parameters in the Product Information "FB 45 and FC 45 input parameters for RF300 and ISO transponders" (http://support.automation.siemens.com/WW/view/en/33315697).

4.2.2 Field data of ISO transponders

Observe the following information for field data of ISO transponders:

- A maximum median deviation of ±2 mm is possible in static mode (without affecting the field data)
- The field data are reduced by approx. 15% if the transponder enters the transmission window laterally (see also "Transmission window" figure)

RF310R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D100	50	2...78	90
MDS D124	30	2...22	30
MDS D160	36	2...25	37
MDS D324	40	2...30	38
MDS D424			
MDS D428			
MDS D460			

1) Combination with the RF310R is basically possible, but is not recommended because the antenna geometries for the reader and transponder are not ideally matched.

All values are in mm

RF340R reader

Table 4- 14 RF340R reader

	Length of the transmission window (L_x)	Operating distance (S_a)	Limit distance (S_g)
MDS D100			
MDS D124			
MDS D139			
MDS D160			
MDS D324			
MDS D421			
MDS D424			
MDS D428			
MDS D460			

All values are in mm

RF350R reader / ANT 1

Table 4- 15 RF340R reader / ANT 1

	Length of the transmission window (L)	Operating distance (S_a)	Operating distance (S_a)
MDS D100			
MDS D124			
MDS D139			
MDS D160			
MDS D324			
MDS D424			
MDS D428			
MDS D460			

All values are in mm

RF350R reader with ANT 12

Table 4- 16 RF340R reader / ANT 12

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D160			
MDS D421			
MDS D428			
MDS D460			

RF350R reader with ANT 18

Table 4- 17 RF340R reader / ANT 18

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D124			
MDS D160			
MDS D324			
MDS D421			
MDS D424			
MDS D428			
MDS D460			

RF350R reader with ANT 30

Table 4- 18 RF340R reader / ANT 30

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D124			
MDS D160			
MDS D324			
MDS D424			
MDS D428			
MDS D460			

RF380R reader

Table 4- 19 RF380R reader

	Length of the transmission window		Operating distance (S_a)	Limit distance (S_g)
	in the x-direction (L_x)	in the y-direction (L_y)		
MDS D100	160	100	15…170	210
MDS D124	100	80	0…72	90
MDS D139	155	90	15...160	200
MDS D160	120	40	0…64	80
MDS D324	130	60	0…96	120
MDS D424				
MDS D428				
MDS D460				

All values are in mm

Note

Only the MDS D139 with MLFB 6GT2600-0AA10 is compatible with SIMATIC RF300.

4.2.3 Minimum clearances

Minimum distance from transponder to transponder

The specified distances refer to a metal-free environment. For a metallic environment, the specified minimum distances must be multiplied by a factor of 1.5.

Table 4- 20 RF300 tags

	RF310R	RF340R	RF350R / ANT 1	RF350R / ANT 12	RF350R / ANT 18	RF350R / ANT 30	RF380R
RF320T	≥ 50	≥ 70	≥ 70		≥ 20	≥ 40	≥ 120
RF340T	≥ 60	≥ 80	≥ 80		≥ 40	≥ 40	≥ 140
RF350T	≥ 60	≥ 80	≥ 80		__	≥ 50	≥ 150
RF360T	≥ 60	≥ 80	≥ 80		__	__	≥ 120
RF370T	__	≥ 80	≥ 80		__	__	≥ 130
RF380T	__	≥ 80	≥ 80		__	__	≥ 150

The values are all in mm, relative to the operating distance (S_a) between reader and tag

Table 4- 21 ISO tags

	RF310R	RF340R	RF350R / ANT 1	RF350R / ANT 12	RF350R / ANT 18	RF350R / ANT 30	RF380R
MDS D100	≥ 120						≥ 300
MDS D124	≥ 100						≥ 170
MDS D139	≥ 120						≥ 230
MDS D160	≥ 120						≥ 150
MDS D324	≥ 120						≥ 250
MDS D421							
MDS D424							
MDS D428							
MDS D460							

The values are all in mm, relative to the operating distance (S_a) between reader and tag

Minimum distance from reader to reader

RF310R to RF310R	RF340R to RF340R	RF380R to RF380R[1)]
≥ 100	≥ 100	≥ 400

All values are in mm

1) The permissible minimum distance between two RF380Rs depends on the transmission output power that is set. The specified minimum distance must be multiplied by the following factor, depending on the output:

DILI byte	Factor
02; 03	0,8
04; 05; 06	1,0
07; 08	1,2

Minimum distance from antenna to antenna

ANT1	ANT18	ANT30
≥ 100	≥ 100	≥ 100

All values are in mm

See also Minimum distance between antennas (Page 121)

NOTICE

Effect on inductive fields by not maintaining the minimum distances of the readers

When the values specified in the "minimum distance from reader to reader" table are not met, there is a risk of affecting inductive fields. In this case, the data transfer time would increase unpredictably or a command would be aborted with an error.

Adherence to the values specified in the "Minimum distance from reader to reader" table is therefore essential.

If the specified minimum distance cannot be complied with due to the physical configuration, the SET-ANT command can be used to activate and deactivate the HF field of the reader. The application software must be used to ensure that only one reader is active (antenna is switched on) at a time.

Note

Please also observe the graphic representations of the minimum distances in the respective chapters on readers.

4.3 Dependence of the volume of data on the transponder speed with RF300 tags

The curves seen here show the relation between speed and data transfer volume for each transponder. They should make it easier to preselect the transponders for dynamic use.

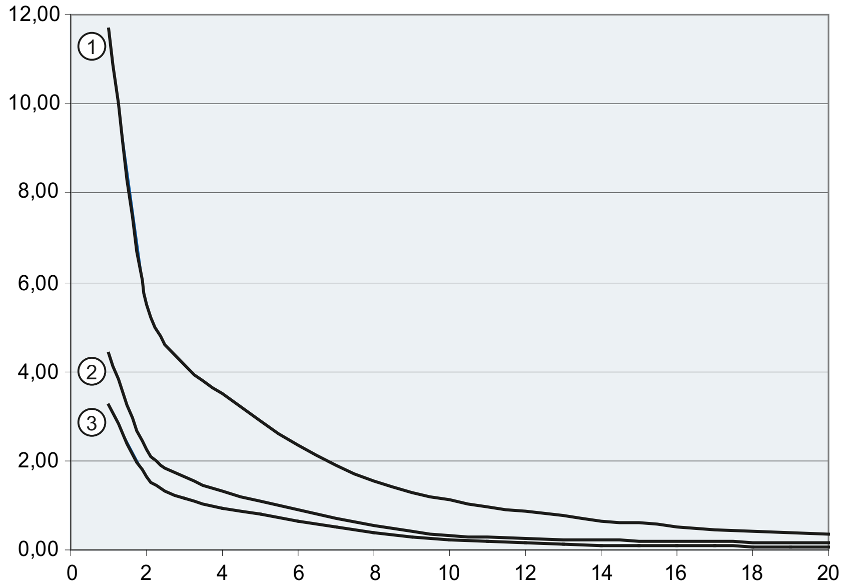
4.3.1 RF320T with RF310R, RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/ RF350R	RF380R
Operating distance (S_a)	10 mm	10 mm	40 mm

RF320T: Display of speed relative to data volume (write)



① RF380R
② RF340R / RF350R + ANT 1
③ RF310R

Figure 4-8 RF320T with RF310R, RF340R/RF350R, RF380R

4.3.2 RF340T with RF310R, RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/ RF350R	RF380R
Operating distance (S_a)	20 mm	20 mm	40 mm

RF340T: Display of speed relative to data volume (read/write)

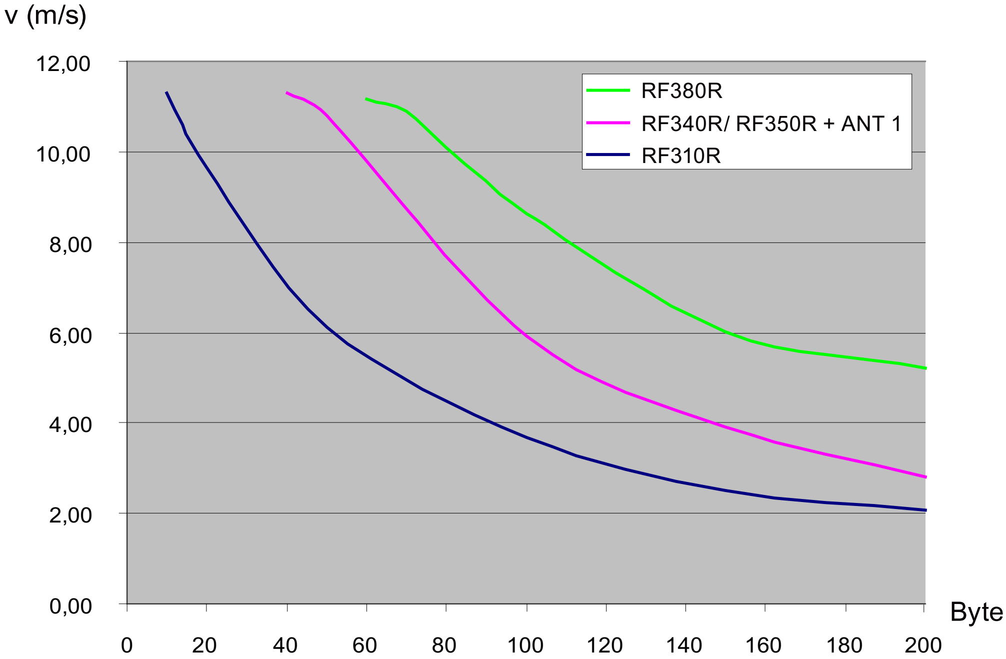


Figure 4-9 RF340T with RF310R, RF340R/RF350R and RF380R

4.3.3 RF350T with RF310R, RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/ RF350R	RF380R
Operating distance (S_a)	22 mm	22 mm	40 mm

RF350T: Display of speed relative to data volume (read/write)

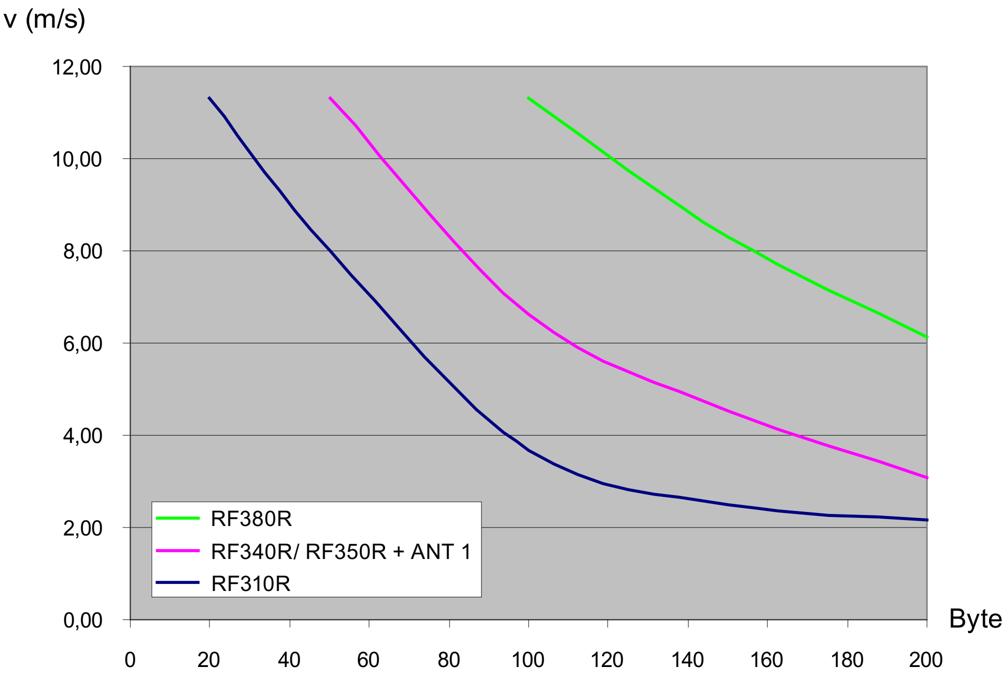


Figure 4-10 RF350T with RF310R, RF340R/RF350R and RF380R

4.3.4 RF360T with RF310R, RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/ RF350R	RF380R
Operating distance (S_a)	26 mm	26 mm	60 mm

RF360T: Display of speed relative to data volume (read/write)

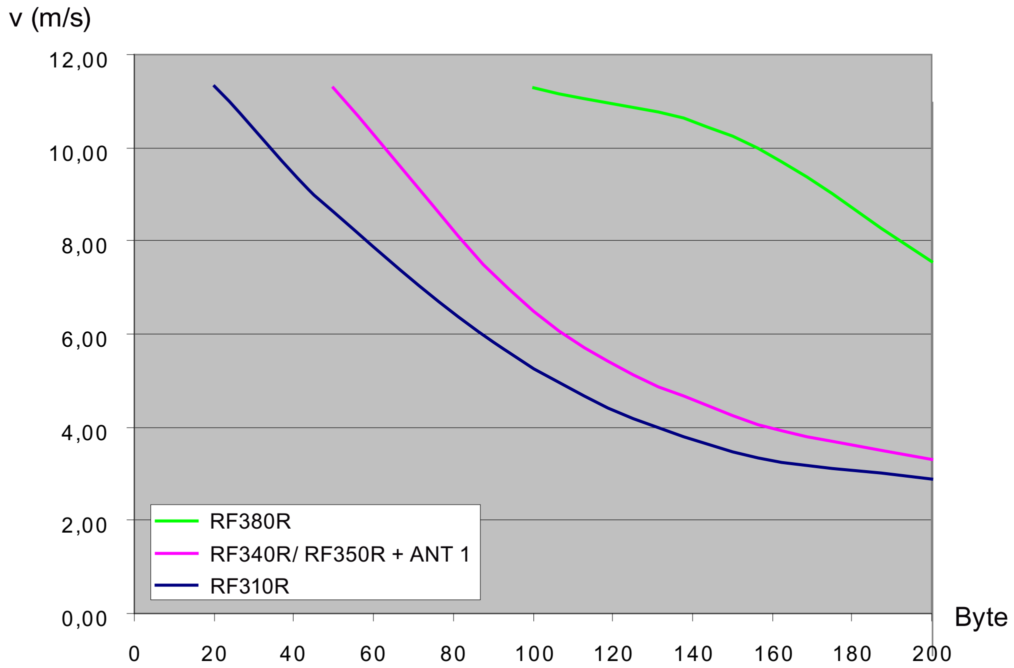


Figure 4-11 RF360T with RF310R, RF340R/RF350R and RF380R

4.3.5 RF370T with RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF340R/ RF350R	RF380R
Operating distance (S_a)	22 mm	60 mm

RF370T: Display of speed relative to data volume (read/write)

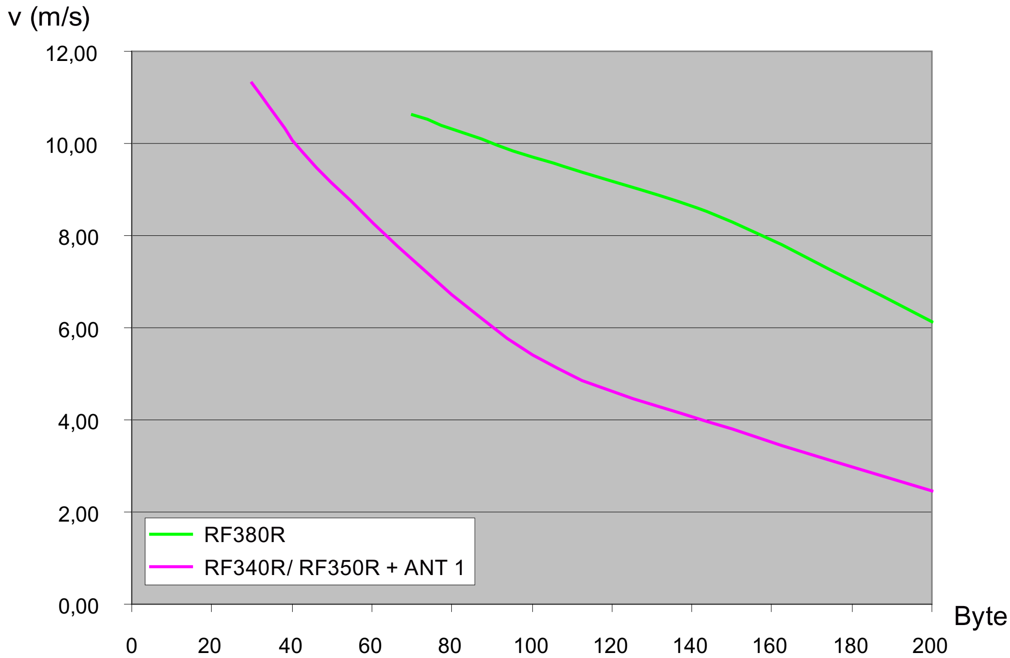


Figure 4-12 RF370T with RF340R/RF350R and RF380R

4.3.6 RF380T with RF340R, RF350R, RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF340R/ RF350R	RF380R
Operating distance (S_a)	22 mm	60 mm

RF380T: Display of speed relative to data volume (read/write)

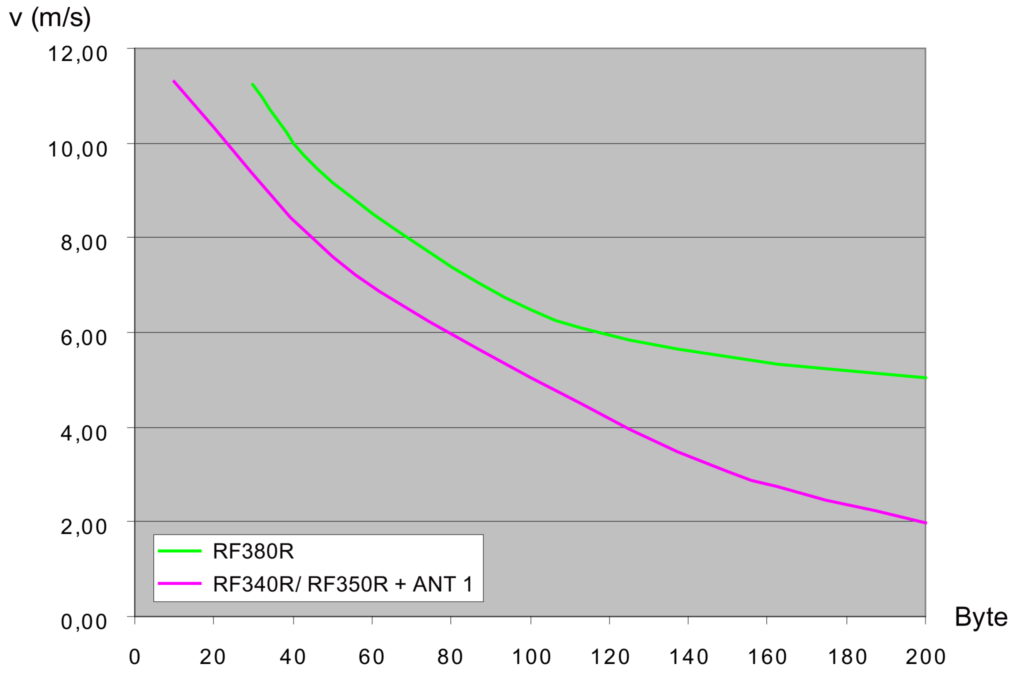


Figure 4-13 RF380T with RF340R/RF350R and RF380R

4.4 Dependence of the volume of data on the transponder speed with ISO tags

The curves seen here show the relation between speed and data transfer volume for each transponder. They should make it easier to preselect the transponders for dynamic use.

4.4.1 MDS D100 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/ RF350R	RF380R
Operating distance (S_a)	30 mm	@	30 mm

MDS D100: Display of speed relative to data volume (read/write)

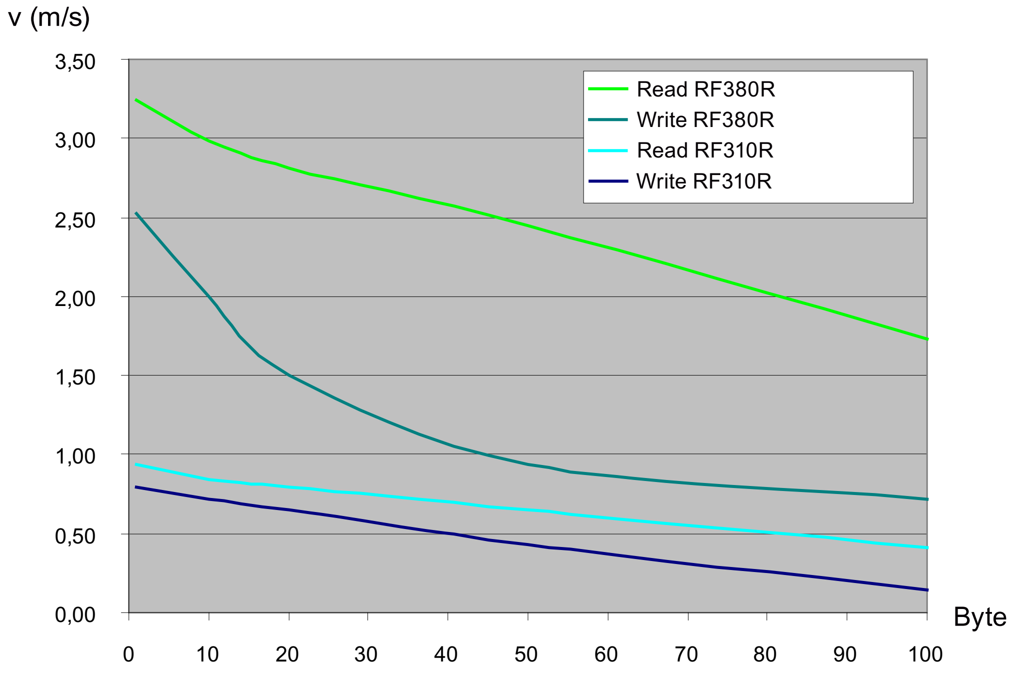


Figure 4-14 MDS D100 with RF310R, RF340R/RF350R/ANT 12 and RF380R

4.4.2 MDS D124 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	25 mm		40 mm

MDS D124: Display of speed relative to data volume (read/write)

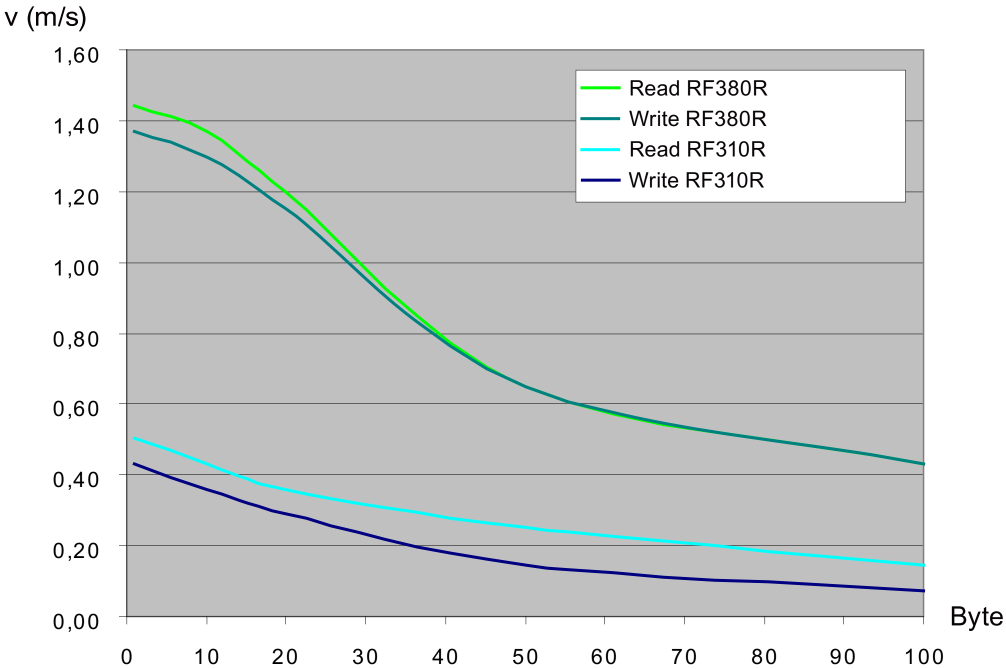


Figure 4-15 MDS D124 with RF310R, RF340R/RF350R and RF380R

4.4.3 MDS D139 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF340R/RF350R	RF380R
Operating distance (S_a)		60 mm

MDS D139: Display of speed relative to data volume (read/write)

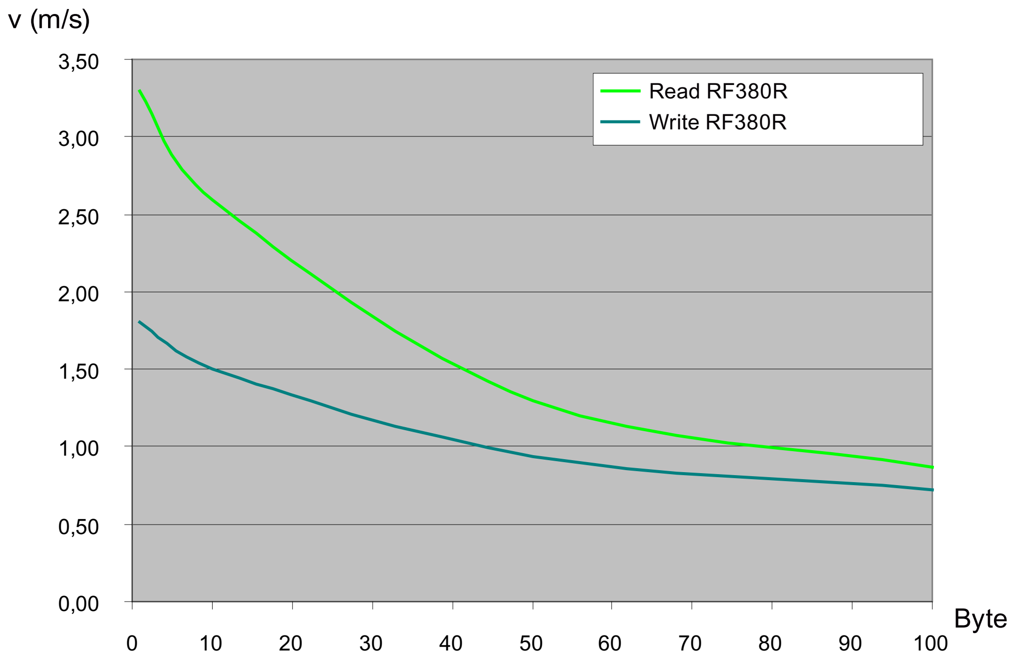


Figure 4-16 MDS D139 with RF310R, RF340R/RF350R and RF380R

4.4.4 MDS D160 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	20 mm		40 mm

MDS D160: Display of speed relative to data volume (read/write)

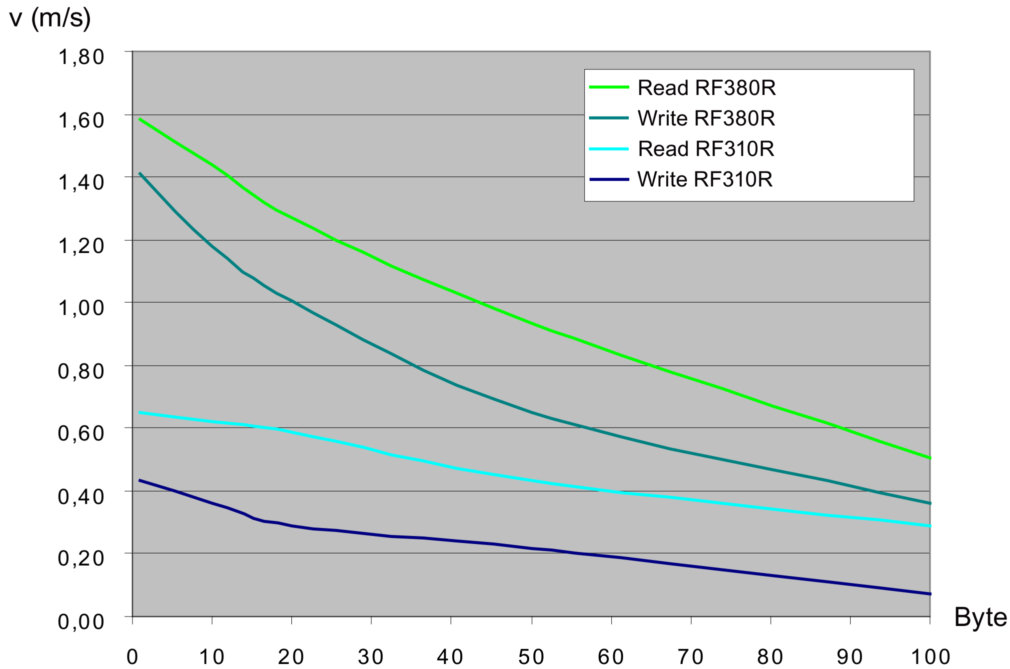


Figure 4-17 MDS D160 with RF310R, RF340R/RF350R and RF380R

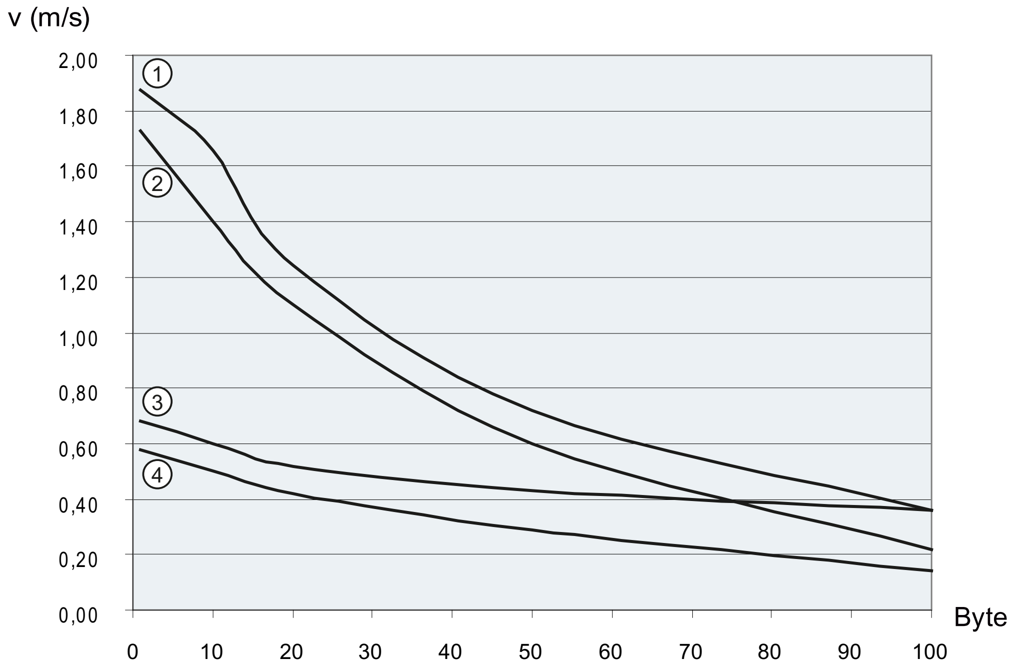
4.4.5 MDS D324 with RF310R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	20 mm		40 mm

MDS D324: Display of speed relative to data volume (read/write)



① Read RF380R
② Write RF380R
③ Read RF310R
④ Write RF310R

Figure 4-18 MDS D324 with RF310R, RF340R/RF350R and RF380R

4.4.6 MDS D424 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	20 mm		40 mm

MDS D424: Display of speed relative to data volume (read/write)

Figure 4-19 MDS D424 with RF310R, RF340R/RF350R and RF380R

4.4.7 MDS D428 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	20 mm		40 mm

MDS D428: Display of speed relative to data volume (read/write)

Figure 4-20 MDS D428 with RF310R, RF340R/RF350R and RF380R

4.4.8 MDS D460 with RF310R, RF340R/RF350R and RF380R

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF310R	RF340R/RF350R	RF380R
Operating distance (S_a)	20 mm		40 mm

MDS D460: Display of speed relative to data volume (read/write)

Figure 4-21 MDS D460 with RF310R, RF340R/RF350R and RF380R

4.5 Installation guidelines

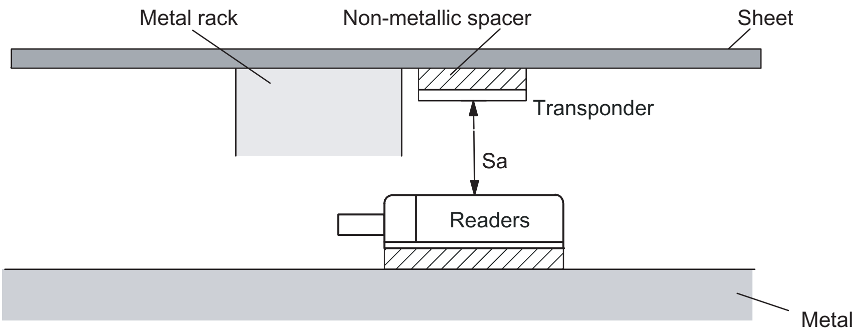
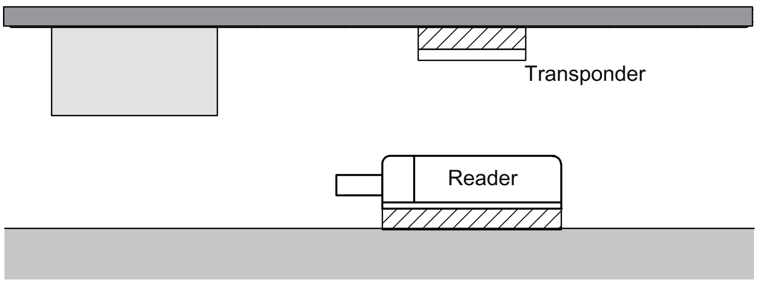
4.5.1 Overview

The transponder and reader complete with their antennas are inductive devices. Any type of metal, in particular iron and ferromagnetic materials, in the vicinity of these devices will affect their operation. Some points need to be considered during planning and installation if the values described in the "Field data" section are to retain their validity:

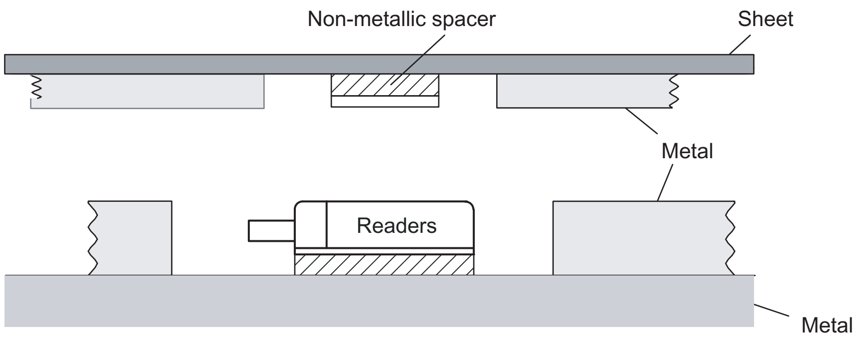
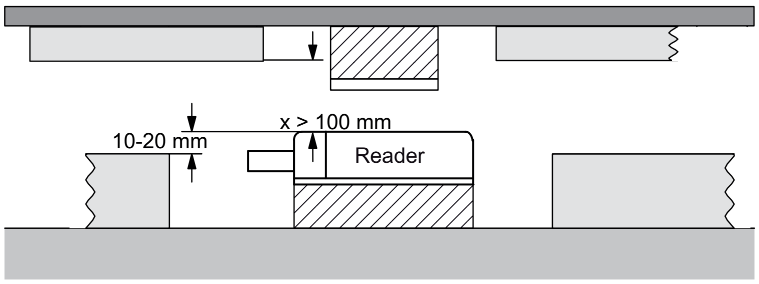
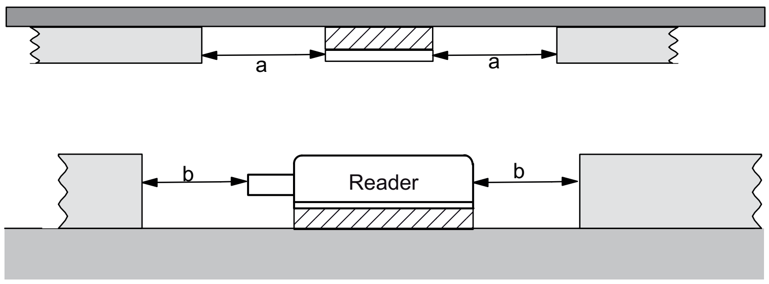
- Minimum spacing between two readers or their antennas
- Minimum distance between two adjacent data memories
- Metal-free area for flush-mounting of readers or their antennas and transponders in metal
- Mounting of multiple readers or their antennas on metal frames or racks

The following sections describe the impact on the operation of the identification system when mounted in the vicinity of metal.

4.5.2 Reduction of interference due to metal

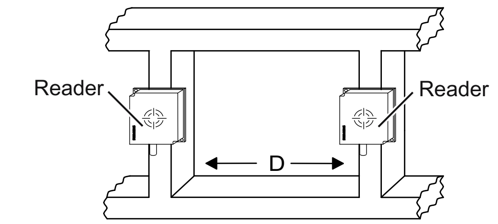
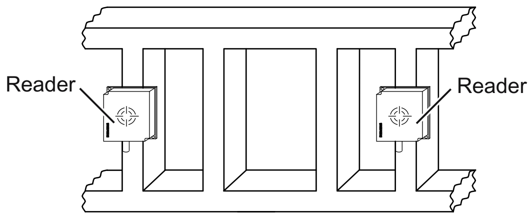
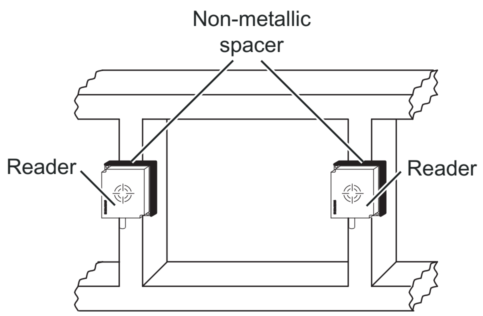
Interference due to metal rack	Problem
	A metal rack is located above the transmission window of the reader. This affects the entire field. In particular, the transmission window between reader and transponder is reduced.
	**Remedy:** The transmission window is no longer affected if the transponder is mounted differently.

Flush-mounting

Flush-mounting of transponders and readers	Problem
	Flush-mounting of transponders and readers is possible in principle. However, the size of the transmission window is significantly reduced. The following measures can be used to counteract the reduction of the window:
	**Remedy:** Enlargement of the non-metallic spacer below the transponder and/or reader. The transponder and/or reader are 10 to 20 mm higher than the metal surround. (The value x ≥ 100 mm is valid, e.g. for RF310R. It indicates that, for a distance x ≥ 100 mm, the reader can no longer be significantly affected by metal.)
	**Remedy:** Increase the non-metallic distance a, b. The following rule of thumb can be used: • Increase a, b by a factor of 2 to 3 over the values specified for metal-free areas • Increasing a, b has a greater effect for readers or transponders with a large limit distance than for readers or transponders with a small limit distance.

Mounting of several readers on metal frames or racks

Any reader mounted on metal couples part of the field to the metal frame. There is normally no interaction as long as the minimum distance D and metal-free areas a, b are maintained. However, interaction may take place if an iron frame is positioned unfavorably. Longer data transfer times or sporadic error messages at the communication module are the result.

Mounting of several readers on metal racks	Problem: Interaction between readers
	**Remedy** Increase the distance D between the two readers.
	**Remedy** Introduce one or more iron struts in order to short-circuit the stray fields.
	**Remedy** Insert a non-metallic spacer of 20 to 40 millimeter thickness between the reader and the iron frame. This will significantly reduce the induction of stray fields on the rack:

4.5.3 Effects of metal on different transponders and readers

Mounting different transponders and readers on metal or flush-mounting

Certain conditions have to be observed when mounting the transponders and readers on metal or flush-mounting. For more information, please refer to the descriptions of the individual transponders and readers in the relevant section.

4.5.4 Impact on the transmission window by metal

4.5.4.1 Impact on the transmission window by metal

In general, the following points should be considered when mounting RFID components:

- Direct mounting on metal is allowed only in the case of specially approved transponders.
- Flush-mounting of the components in metal reduces the field data; a test is recommended in critical applications.
- When working inside the transmission window, it should be ensured that no metal rail (or similar part) intersects the transmission field.
  The metal rail would affect the field data.

The impact of metal on the field data (S_g, S_a, L, B) is shown in tabular format in this section. The values in the table describe the reduction of the field data in % with reference to non-metal (100% means no impact).

4.5.4.2 RF310R

RF300 mode

Table 4- 22 Reduction of field data by metal (in %): Transponder and RF310R

Transponder		RF310R reader		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
RF320T	Without metal	100	95	80
	On metal; distance 20 mm	100	80	70
	Flush-mounted in metal; distance all-round 20 mm	80	70	60
RF340T	Without metal	100	95	80
	On metal	80	80	80
	Flush-mounted in metal; distance all-round 20 mm	70	70	70
RF350T	Without metal	100	95	85
	On metal	70	65	65
	Flush-mounted in metal; distance all-round 20 mm	60	60	60
RF360T	Without metal	100	95	85
	On metal; distance 20 mm	100	95	75
	Flush-mounted in metal; distance all-round 20 mm	60	60	60

ISO mode

Table 4- 23 Reduction of field data by metal (in %): Transponder and RF380R (ISO mode)

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D100	Without metal	100	95	80
	On metal; distance 20 mm	77	70	67
	Flush-mounted in metal; distance all-round 20 mm	58	55	52
MDS D124	Without metal	100	98	82
	On metal	93	94	87
	Flush-mounted in metal; distance all-round 20 mm	82	76	60
MDS D160	Without metal	100	92	83
	On metal; distance 20 mm	78	77	74
	Flush-mounted in metal; distance all-round 20 mm	70	63	60
MDS D324	Without metal	100	95	76
	On metal	83	81	78
	Flush-mounted in metal; distance all-round 20 mm	79	76	72
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

4.5.4.3 RF340R

RF300 mode

Table 4- 24 Reduction of field data by metal (in %): Transponder and RF340R

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
RF320T	Without metal	100	95	80
	On metal; distance 20 mm	100	90	75
	Flush-mounted in metal; distance all-round 20 mm	80	70	60
RF340T	Without metal	100	95	85
	On metal	80	80	70
	Flush-mounted in metal; distance all-round 20 mm	70	70	70
RF350T	Without metal	100	95	80
	On metal	70	65	65
	Flush-mounted in metal; distance all-round 20 mm	60	60	60
RF360T	Without metal	100	95	85
	On metal; distance 20 mm	90	90	75
	Flush-mounted in metal; distance all-round 20 mm	70	60	60
RF370T	Without metal	100	98	96
	On metal	100	97	94
	Flush-mounted in metal; distance all-round 20 mm	90	88	86
RF380T	Without metal	100	86	76 (all-round 40 mm)
	On metal	100	86	76 (all-round 40 mm)
	Flush-mounted in metal; distance all-round 40 mm	83	71	55 (all-round 40 mm)

ISO mode

Table 4- 25 Reduction of field data by metal (in %): Transponder and RF340R

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D100	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D124	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D139	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D160	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D324	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

4.5.4.4 RF350R

RF350R reader with ANT 1: RF300 mode

Table 4- 26 Reduction of field data by metal (in %): Transponder and RF350R with ANT 1

Transponder		RF350R reader		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
RF320T	Without metal	100	95	80
	On metal; distance 20 mm	100	90	75
	Flush-mounted in metal; distance all-round 20 mm	80	70	60
RF340T	Without metal	100	95	85
	On metal	80	80	70
	Flush-mounted in metal; distance all-round 20 mm	70	70	70
RF350T	Without metal	100	95	80
	On metal	70	65	65
	Flush-mounted in metal; distance all-round 20 mm	60	60	60
RF360T	Without metal	100	95	85
	On metal; distance 20 mm	90	90	75
	Flush-mounted in metal; distance all-round 20 mm	70	60	60
RF370T	Without metal	100	86	73
	On metal	100	83	69
	Flush-mounted in metal; distance all-round 20 mm	90	74	61
RF380T	Without metal	100	83	73 (all-round 40 mm)
	On metal	100	83	73 (all-round 40 mm)
	Flush-mounted in metal; distance all-round 40 mm	80	68	53 (all-round 40 mm)

RF350R reader with ANT 1: ISO mode

Table 4- 27 Reduction of field data by metal (in %): Transponder and RF350R with ANT 1

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D100	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D124	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D139	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D160	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D324	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

RF350R reader with ANT 12: ISO mode

Table 4- 28 Reduction of field data by metal (in %): Transponder and RF350R with ANT 12

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D160	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D421	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

RF350R reader with ANT 18: RF300 mode

Table 4- 29 Reduction of field data by metal (in %): Transponder and RF350R with ANT 18

Transponder		Mounting the antenna	
		Without metal	Flush-mounted In metal (10 mm all-round; 10 mm deep)
RF320T	Without metal	100	100
	On metal; distance 20 mm	100	100
	Flush-mounted in metal; distance all-round 20 mm	80	80
RF340T	Without metal	100	100
	On metal	80	80
	Flush-mounted in metal; distance all-round 20 mm	70	70

RF350R reader with ANT 18: ISO mode

Table 4- 30 Reduction of field data by metal (in %): Transponder and RF350R with ANT 18

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D124	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D160	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D324	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D421	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

RF350R reader with ANT 30: RF300 mode

Table 4- 31 Reduction of field data by metal (in %): Transponder and RF350R with ANT 30

Transponder		Mounting the antenna	
		Without metal	Flush-mounted In metal (20 mm all-round; 20 mm deep)
RF320T	Without metal	100	80
	On metal; distance 20 mm	100	80
	Flush-mounted in metal; distance all-round 20 mm	100	80
RF340T	Without metal	100	80
	On metal	80	65
	Flush-mounted in metal; distance all-round 20 mm	70	60
RF350T	Without metal	100	80
	On metal	70	60
	Flush-mounted in metal; distance all-round 20 mm	65	55

RF350R reader with ANT 30: ISO mode

Table 4- 32 Reduction of field data by metal (in %): Transponder and RF350R with ANT 30

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D124	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D160	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D324	Without metal			
	On metal; distance 20 mm			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

Transponder		RF310R reader (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

4.5.4.5 RF380R

Reader RF380R-RF300 mode

Table 4- 33 Reduction of field data by metal (in %): Transponder and RF380R (RF300 mode)

Transponder		Reader RF380R (RF300 mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
RF320T	Without metal	100	95	90
	On metal; distance 20 mm	85	75	70
	Flush-mounted in metal; distance all-round 20 mm	60	55	50
RF340T	Without metal	100	90	80
	On metal	70	65	60
	Flush-mounted in metal; distance all-round 20 mm	63	60	55
RF350T	Without metal	100	85	80
	On metal	70	65	60
	Flush-mounted in metal; distance all-round 20 mm	55	50	45
RF360T	Without metal	100	95	85
	On metal; distance 20 mm	75	70	65
	Flush-mounted in metal; distance all-round 20 mm	60	55	50
RF370T	Without metal	100	95	85
	On metal	90	85	80
	Flush-mounted in metal; distance all-round 20 mm	65	63	60

Transponder		Reader RF380R (RF300 mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
RF380T	Without metal	100	95	85
	On metal	95	90	80
	Flush-mounted in metal; distance all-round 40 mm	65	60	58

RF380R reader: ISO mode

Table 4- 34 Reduction of field data by metal (in %): Transponder and RF380R (ISO mode)

Transponder		Reader RF380R (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D100	Without metal	100	95	80
	On metal; distance 20 mm	65	62	58
	Flush-mounted in metal; distance all-round 20 mm	58	53	48
MDS D124	Without metal	100	98	92
	On metal	95	92	87
	Flush-mounted in metal; distance all-round 20 mm	70	65	50
MDS D139	Without metal	100	92	75
	On metal, distance 30 mm	93	88	72
MDS D160	Without metal	100	95	90
	On metal; distance 20 mm	87	85	80
	Flush-mounted in metal; distance all-round 20 mm	73	65	60
MDS D324	Without metal	100	95	85
	On metal	85	83	80
	Flush-mounted in metal; distance all-round 20 mm	70	65	60
MDS D424	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			
MDS D428	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

Transponder		Reader RF380R (ISO mode)		
		Without metal	On metal	Flush-mounted In metal (20 mm all around)
MDS D460	Without metal			
	On metal			
	Flush-mounted in metal; distance all-round 20 mm			

4.6 Chemical resistance of the transponders

4.6.1 Chemical resistance of the RF300 transponders

The following table provides an overview of the chemical resistance of the data memories made of glass-fiber-reinforced epoxy resin. It must be emphasized that the plastic enclosure is extremely resistant to chemicals in automobiles (e.g.: oil, grease, diesel fuel, gasoline) which are not listed separately.

Transponders RF320T, RF360T

Transponder RF 320T is resistant to the substances specified in the following table.

	Concentration	20 °C	40 °C	60 °C
Allylchloride		○○○○		
Formic acid	50 %	○○○○		
	100 %	○○		
Ammonia gas		○○○○		
Ammonia liquid, water-free		–		
Ammonium hydroxide	10 %	○○○○		
Ethyl acrylate		○○○○		
Ethyl glycol				○○○○
Gasoline, aroma-free		○○○○		
Gasoline, containing benzol		○○○○		
Benzoate (Na–, Ca.a.)			○○○○	
Benzoic acid		○○○○		
Benzole		○○○○		
Benzenesulphonic acid		○○○○		
Benzyl chloride		–		
Borax				○○○○
Boric acid		○○○○		
Bromine, liquid		–		
Bromine, gas, dry		–		

	Concentration	20 °C	40 °C	60 °C
Bromide (K–, Na.a.)				○○○○
Bromoform	100 %	○○○○		
Bromine water		–		
Butadiene (1,3–)		○○○○		
Butane gas		○○○○		
Butanol		–		
Butyric acid	100 %	○○		
Carbonate (ammonium, Na.a.)				○○○○
Chlorine, liquid		–		
Chlorine, gas, dry	100 %	–		
Chlorobenzene		○○○○		
Chloride (ammonium, Na.a.)				○○○○
Chloroform		–		
Chlorophyl		○○○○		
Chlorosulphonic acid	100 %	–		
Chlorine water (saturated solution)		○○		
Chromate (K–, Na.a.)	Up to 50 %		○○○○	
Chromic acid	Up to 30 %	–		
Chromosulphuric acid		–		
Citric acid		○○○○		
Cyanamide		○○○○		
Cyanide (K–, Na.a.)				○○○○
Dextrin, w.				○○○○
Diethyl ether		○○○○		
Diethylene glycol				○○○○
Dimethyl ether		○○○○		
Dioxane		–		
Developer			○○○○	
Acetic acid	100 %	○○		
Ethanol			○○○○	○○○○
Fixer			○○○○	
Fluoride (ammonium, K–, Na.a.)			○○○○	
Hydrofluoric acid	Up to 40 %	○○○○		
Formaldehyde	50 %	○○○○		
Formamide	100 %	○○○○		
Glucon acid		○○○○		
Glycerine				○○○○
Glycol				○○○○
Urine		○○○○		
Uric acid		○○○○		

	Concentration	20 °C	40 °C	60 °C
Hydroxide (ammonium)	10 %	○○○○		
Hydroxide (Na–, K–)	40 %	○○○○		
Hydroxide (alkaline earth metal)				○○○○
Hypochlorite (K–, Na.a.)				○○○○
Iodide (K–, Na.a.)				○○○○
Silicic acid				○○○○
Cresol	Up to 90 %	–		
Methanol	100 %		○○○○	
Methylene chloride		–		
Lactic acid	100 %	○○		
Mineral oils			○○○○	
Nitrate (ammonium, K.a.)				○○○○
Nitroglycerine		–		
Oxalic acid		○○○○		
Phenol	1 %	○○○○		
Phosphate (ammonium, Na.a.)				○○○○
Phosphoric acid	50 %			○○○○
	85 %	○○○○		
Propanol		○○○○		
Nitric acid	25 %	–		
Hydrochloric acid	10 %	–		
Brine				–
Sulphur dioxide	100 %	○○		
Carbon disulfide 100 %		–		
Sulphuric acid	40 %	–		
Sulphurous acid		○○		
Soap solution				○○○○
Sulfate (ammonium, Na.a.)				○○○○
Sulfite (ammonium, Na.a.)				–
Tar, aroma-free				○○○○
Turpentine		○○○○		
Trichloroethylene		–		
Hydrogen peroxide	30 %	○○○○		
Tartaric acid		○○○○		

Abbreviations	
○○○○	Resistant
○○○	Virtually resistant
○○	Partially resistant
○	Less resistant

Abbreviations	
–	Not resistant
w.	Aqueous solution
k. g.	Cold saturated

Transponders RF340T, RF350T, 370T

The following table gives an overview of the chemical composition of the data memories made from polyamide 12. The plastic housing has a notably high resistance to chemicals used in automobiles (e.g.: oil, grease, diesel fuel, gasoline) which are not listed separately.

	Concentration	20 °C	60 °C
Battery acid	30	○○	–
Ammonia gas		○○○○	○○○○
Ammonia, w.	conc.	○○○○	○○○○
	10	○○○○	○○○○
Benzol		○○○○	○○○
Bleach solution (12.5% effective chlorine)		○○	–
Butane, gas, liquid		○○○○	○○○○
Butyl acetate (acetic acid butyl ester)		○○○○	○○○○
n(n)		○○○○	○○○
Calcium chloride, w.		○○○○	○○○
Calcium nitrate, w.	k. g.	○○○○	○○○
Chlorine		–	–
Chrome baths, tech.		–	–
Iron salts, w.	k. g.	○○○○	○○○○
Acetic acid, w.	50	–	–
Ethyl alcohol, w., undenaturated	96	○○○○	○○○
	50	○○○○	○○○○
Formaldehyde, w.	30	○○○	–
	10	○○○○	○○○
Formalin		○○○	–
Glycerine		○○○○	○○○○
Isopropanol		○○○○	○○○
Potassium hydroxide, w.	50	○○○○	○○○○
Lysol		○○	–
Magnesium salts, w.	k. g.	○○○○	○○○○
Methyl alcohol, w.	50	○○○○	○○○○
Lactic acid, w.	50	○○	–
	10	○○○	○○
Sodium carbonate, w. (soda)	k. g.	○○○○	○○○○
Sodium chloride, w.	k. g.	○○○○	○○○○
Sodium hydroxide		○○○○	○○○○
Nickel salts, w.	k. g.	○○○○	○○○○

	Concentration	20 °C	60 °C
Nitrobenzol		○○○	○○
Phosphoric acid	10	○	V
Propane		○○○○	○○○○
Mercury		○○○○	○○○○
Nitric acid	10	○	−
Hydrochloric acid	10	○	−
Sulphur dioxide	Low	○○○○	○○○○
Sulphuric acid	25	○○	−
	10	○○○	−
Hydrogen sulphide	Low	○○○○	○○○○
Carbon tetrachloride		○○○○	○○○○
Toluene		○○○○	○○○
Detergent	High	○○○○	○○○○
Plasticizer		○○○○	○○○○

Abbreviations	
○○○○	Resistant
○○○	Virtually resistant
○○	Partially resistant
○	Less resistant
−	Not resistant
w.	Aqueous solution
k. g.	Cold saturated

Transponder RF380T

The housing of the heat-resistant data storage unit is made of polyphenylene sulfide (PPS). The chemical resistance of the data storage unit is excellent. No solvent is known that can dissolve the plastic at temperatures below 200 °C. A reduction in the mechanical properties has been observed in aqueous solutions of hydrochloric acid (HCl) and nitric acid (HNO3) at 80 °C. The excellent resistance to all fuel types including methanol is a particular characteristic. The following table provides an overview of the chemicals investigated.

Substance	Test conditions		Evaluation
	Time[days]	Temperature[°C]	
Acetone	180	55	+
n-Butanol (butyl alcohol)	180	80	+
Butanon-2 (methyl ethyl ketone)	180	60	+
n-butyl acetate	180	80	+
Brake fluid	40	80	+
Calcium chloride (saturated)	40	80	+
Diesel fuel	180	80	+

Substance	Test conditions		Evaluation
	Time[days]	Temperature[°C]	
Diethyl ether	40	23	+
Frigen 113	40	23	+
Anti-freeze	180	120	+
Kerosine	40	60	+
Methanol	180	60	+
Engine oil	40	80	+
Sodium chloride (saturated)	40	80	+
Sodium hydroxide (30%)	180	80	+
Sodium hypochlorite (5%)	30	80	/
	180	80	–
Caustic soda (30%)	40	93	+
Nitric acid (10%)	40	23	+
Hydrochloric acid (10%)	40	80	–
Sulphuric acid (10%)	40	23	+
		(10%)	40
		(30%)	40
Tested fuels:	40	80	+
(FAM-DIN 51 604-A)	180	80	/
Toluene			
1, 1, 1-trichloroethane	180	80	+
Xylene			
Zinc chloride (saturated)	180	80	/
	180	75	+
	180	80	+
	40	80	+

Assessment:	
+	Resistant, weight gain < 3 % or weight loss < 0.5 % and/or reduction in fracture resistance < 15 %
/	Partially resistant, weight gain 3 to 8 % or weight loss 0.5 to 3 % and/or reduction in fracture resistance 15 to 30 %
–	Not resistant, weight gain > 8 % or weight loss > 3 % and/or reduction in fracture resistance > 30 %

4.6.2 Chemical resistance of the ISO transponders

MDS D100, MDS D200

The housing of the MDS D100 is made of PVC.

MDS D100 is resistant to the substances specified in the following table.

Table 4- 35 Chemical resistance of MDS D100, MDS D200

Substance	Concentration
Saline solution	5 %
Sugared water	10 %
Acetic acid, aqueous solution	5 %
Sodium carbonate, aqueous solution	5 %
Ethanol, aqueous solution	60 %
Ethylene glycol	50 %
Fuel B	according to ISO 1817
Human sweat	

(Reference: ISO 10373 / ISO 7810)

MDS D139, MDS D124

The housing of the heat-resistant data storage unit MDS D139 is made of polyphenylene sulfide (PPS). The chemical resistance of the data storage unit is excellent. No solvent is known that can dissolve the plastic at temperatures below 200 °C. A reduction in the mechanical properties has been observed in aqueous solutions of hydrochloric acid (HCl) and nitric acid (HNO_3) at 80 °C.

The excellent resistance to all fuel types including methanol is a particular characteristic. The following table provides an overview of the chemicals investigated.

Table 4- 36 Chemical resistance of MDS D139, MDS D124

Substance	Test conditions		Evaluation
	Time [days]	Temperature [°C]	
Acetone	180	55	+
n-Butanol (butyl alcohol)	180	80	+
Butanon-2 (methyl ethyl ketone)	180	60	+
n-butyl acetate	180	80	+
Brake fluid	40	80	+
Calcium chloride (saturated)	40	80	+
Diesel fuel	180	80	+
Diethyl ether	40	23	+
Frigen 113	40	23	+
Anti-freeze	180	120	+
Kerosine	40	60	+
Methanol	180	60	+
Engine oil	40	80	+
Sodium chloride (saturated)	40	80	+
Sodium hydroxide (30 percent)	180	80	+
Sodium hypochlorite (5 percent)	30 180	80 80	/ -
Caustic soda (30 percent)	40	93	+

Substance	Test conditions		Evaluation
	Time [days]	Temperature [°C]	
Nitric acid (10 percent)	40	23	+
Hydrochloric acid (10 percent)	40	80	-
Sulphuric acid (10 percent) (10 percent) (30 percent)	 40 40 40	 23 80 23	 + / +
Tested fuels:	40	80	+
(FAM-DIN 51604-A) Toluol	180	80	/
1, 1, 1-trichloroethane xylene	180	80	+
Zinc chloride (saturated)	180 180 180 40	80 75 80 80	/ + + +
Assessment:			
+	Resistant, weight gain < 3 % or weight loss < 0.5 % and/or reduction in fracture resistance < 15 %		
/	Limited resistance, weight gain 3 to 8 % or weight loss 0.5 to 3 % and/or reduction in fracture resistance 15 to 30 %		
-	Not resistant, weight gain > 8 % or weight loss > 3 % and/or reduction in fracture resistance > 30 %		

MDS D324, MDS D421, MDS D424, MDS D460

The housing of the MDS D124 is made of epoxy casting resin. The following table provides an overview of the chemical resistance.

Table 4- 37 Chemical resistance of MDS D324, MDS D421, MDS D424, MDS D460

Chemical compound	Concentration	20 °C	40 °C	60 °C
Formic acid	50 %	■		
Ammonia liquid, water-free		□		
Ethanol			■	■
Gasoline, aromatic-free/containing benzol		■		
Benzol, benzoic acid		■		
Borax				■
Boric acid		■		
Bromine, liquid, bromine water		□		
Butyric acid	100 %	◪		
Carbonate (ammonium, sodium, etc.)				■
Chlorine, liquid		□		
Chlorobenzene		■		
Chloroform		□		

Chemical compound	Concentration	20 °C	40 °C	60 °C
Chlorine water (saturated solution)		◪		
Chromate (potassium, sodium, etc.)	Up to 50 %		■	
Chromic acid	Up to 30 %	□		
Citric acid		■		
Cyanide (potassium, sodium, etc.)				■
Diethylene glycol				■
Dioxane		□		
Acetic acid	100 %	◪		
Fixer			■	
Fluoride (ammonium, potassium, sodium, etc.)			■	
Hydrofluoric acid	Up to 40 %	■		
Formaldehyde	50 %	■		
Glycerine				■
Glycol				■
Urine, uric acid		■		
Hydroxide (sodium, potassium)	40 %	■		
Iodide (potassium, sodium, etc.)				■
Silicic acid				■
Methanol	100 %		■	
Lactic acid	100 %	◪		
Mineral oils			■	
Nitrate (ammonium, potassium, etc.)				■
Nitroglycerine		□		
Phosphate (ammonium, sodium, etc.)				■
Phosphoric acid	50 %			■
Propanol		■		
Hydrochloric acid, nitric acid	10 %	□		
Brine				□
Sulphur dioxide	100 %	◪		
Sulphuric acid	40 %	□		
Soap solution				■
Sulphate (ammonium, sodium, etc.)				■
Sulfide (ammonium, sodium, etc.)				□
Turpentine		■		
Trichloroethylene		□		
Hydrogen peroxide	30 %	■		
Tartaric acid		■		
Abbreviations:				
■	Resistant			
◪	Limited resistance			
□	Not resistant			

MDS D160

The housing of the MDS D160 is made of PPA (polyphthalamide). The following table provides an overview of the chemical resistance.

Table 4- 38 Chemical resistance of the MDS D160

Chemical compound	Resistance
Mineral lubricants	■
Aliphatic hydrocarbons	■
Aromatic hydrocarbons	■
Petroleum spirit	■
Weak mineral acids	■
Strong mineral acids	◪
Weak organic acids	■
Strong organic acids	□
Oxidizing acids	□
Weak alkalis	■
Strong alkalis	■
Trichlorethylene	■
Acetone	■
Alcohol	■
Abbreviations	
■	Resistant
◪	Limited resistance
□	Not resistant

MDS D428 @ fehlt noch

4.7 EMC Directives

4.7.1 Overview

These EMC Guidelines answer the following questions:

- Why are EMC guidelines necessary?
- What types of external interference have an impact on the system?
- How can interference be prevented?
- How can interference be eliminated?
- Which standards relate to EMC?
- Examples of interference-free plant design

The description is intended for "qualified personnel":

- Project engineers and planners who plan system configurations with RFID modules and have to observe the necessary guidelines.
- Fitters and service engineers who install the connecting cables in accordance with this description or who rectify defects in this area in the event of interference.

NOTICE
Failure to observe notices drawn to the reader's attention can result in dangerous conditions in the plant or the destruction of individual components or the entire plant.

4.7.2 What does EMC mean?

The increasing use of electrical and electronic devices is accompanied by:

- Higher component density
- More switched power electronics
- Increasing switching rates
- Lower power consumption of components due to steeper switching edges

The higher the degree of automation, the greater the risk of interaction between devices.

Electromagnetic compatibility (EMC) is the ability of an electrical or electronic device to operate satisfactorily in an electromagnetic environment without affecting or interfering with the environment over and above certain limits.

EMC can be broken down into three different areas:

- Intrinsic immunity to interference:
  immunity to internal electrical disturbance
- Immunity to external interference:
  immunity to external electromagnetic disturbance
- Degree of interference emission:
  emission of interference and its effect on the electrical environment

All three areas are considered when testing an electrical device.

The RFID modules are tested for conformity with the limit values required by the CE and RTTE guidelines. Since the RFID modules are merely components of an overall system, and sources of interference can arise as a result of combining different components, certain guidelines have to be followed when setting up a plant.

EMC measures usually consist of a complete package of measures, all of which need to be implemented in order to ensure that the plant is immune to interference.

Note

The plant manufacturer is responsible for the observance of the EMC guidelines; the plant operator is responsible for radio interference suppression in the overall plant.

All measures taken when setting up the plant prevent expensive retrospective modifications and interference suppression measures.

The plant operator must comply with the locally applicable laws and regulations. They are not covered in this document.

4.7.3 Basic rules

It is often sufficient to follow a few elementary rules in order to ensure electromagnetic compatiblity (EMC).

The following rules must be observed:

Shielding by enclosure

- Protect the device against external interference by installing it in a cabinet or housing. The housing or enclosure must be connected to the chassis ground.
- Use metal plates to shield against electromagnetic fields generated by inductances.
- Use metal connector housings to shield data conductors.

Wide-area ground connection

- Bond all passive metal parts to chassis ground, ensuring large-area and low-HF-impedance contact.
- Establish a large-area connection between the passive metal parts and the central grounding point.
- Don't forget to include the shielding bus in the chassis ground system. That means the actual shielding busbars must be connected to ground by large-area contact.
- Aluminium parts are not suitable for ground connections.

Plan the cable installation

- Break the cabling down into cable groups and install these separately.
- Always route power cables, signal cables and HF cables through separated ducts or in separate bundles.
- Feed the cabling into the cabinet from one side only and, if possible, on one level only.
- Route the signal cables as close as possible to chassis surfaces.
- Twist the feed and return conductors of separately installed cables.

- Routing HF cables:
  avoid parallel routing of HF cables.
- Do not route cables through the antenna field.

Shielding for the cables

- Shield the data cables and connect the shield at both ends.
- Shield the analog cables and connect the shield at one end, e.g. on the drive unit.
- Always apply large-area connections between the cable shields and the shielding bus at the cabinet inlet and make the contact with clamps.
- Feed the connected shield through to the module without interruption.
- Use braided shields, not foil shields.

Line and signal filter

- Use only line filters with metal housings
- Connect the filter housing to the cabinet chassis using a large-area low-HF-impedance connection.
- Never fix the filter housing to a painted surface.
- Fix the filter at the control cabinet inlet or in the direction of the source.

4.7.4 Propagation of electromagnetic interference

Three components have to be present for interference to occur in a system:

- Interference source
- Coupling path
- Interference sink

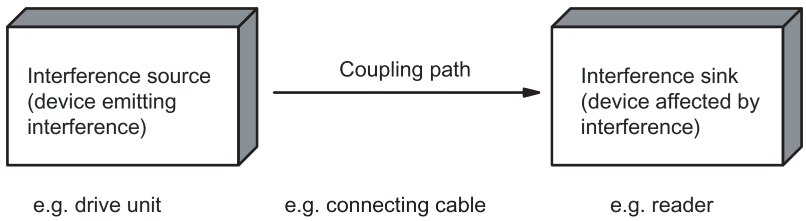


Figure 4-22 Propagation of interference

If one of the components is missing, e.g. the coupling path between the interference source and the interference sink, the interference sink is unaffected, even if the interference source is transmitting a high level of noise.

The EMC measures are applied to all three components, in order to prevent malfunctions due to interference. When setting up a plant, the manufacturer must take all possible measures in order to prevent the occurrence of interference sources:

- Only devices fulfilling limit class A of VDE 0871 may be used in a plant.
- Interference suppression measures must be introduced on all interference-emitting devices. This includes all coils and windings.
- The design of the system must be such that mutual interference between individual components is precluded or kept as small as possible.

Information and tips for plant design are given in the following sections.

Interference sources

In order to achieve a high level of electromagnetic compatibility and thus a very low level of disturbance in a plant, it is necessary to recognize the most frequent interference sources. These must then be eliminated by appropriate measures.

Table 4- 39 Interference sources: origin and effect

Interference source	Interference results from	Effect on the interference sink
Contactors, electronic valves	Contacts	System disturbances
	Coils	Magnetic field
Electrical motor	Collector	Electrical field
	Winding	Magnetic field
Electric welding device	Contacts	Electrical field
	Transformer	Magnetic field, system disturbance, transient currents
Power supply unit, switched-mode	Circuit	Electrical and magnetic field, system disturbance
High-frequency appliances	Circuit	Electromagnetic field
Transmitter (e.g. service radio)	Antenna	Electromagnetic field
Ground or reference potential difference	Voltage difference	Transient currents
Operator	Static charge	Electrical discharge currents, electrical field
Power cable	Current flow	Electrical and magnetic field, system disturbance
High-voltage cable	Voltage difference	Electrical field

What interference can affect RFID?

Interference source	Cause	Remedy
Switched-mode power supply	Interference emitted from the current infeed	Replace the power supply
Interference injected through the cables connected in series	Cable is inadequately shielded	Better cable shielding
	The reader is not connected to ground.	Ground the reader

Interference source	Cause	Remedy
HF interference over the antennas	caused by another reader	• Position the antennas further apart. • Erect suitable damping materials between the antennas. • Reduce the power of the readers. Please follow the instructions in the section *Installation guidelines/reducing the effects of metal*

Coupling paths

A coupling path has to be present before the disturbance emitted by the interference source can affect the system. There are four ways in which interference can be coupled in:

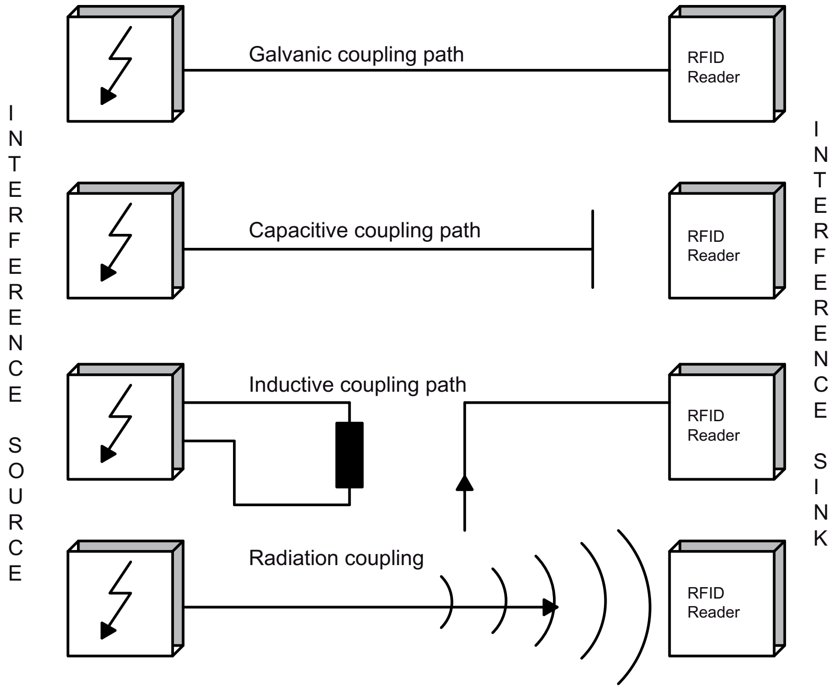


Figure 4-23 Ways in which interference can be coupled in

When RFID modules are used, different components in the overall system can act as a coupling path:

Table 4- 40 Causes of coupling paths

Coupling path	Invoked by
Conductors and cables	• Incorrect or inappropriate installation • Missing or incorrectly connected shield • Inappropriate physical arrangement of cables
Control cabinet or housing	• Missing or incorrectly wired equalizing conductor • Missing or incorrect earthing • Inappropriate physical arrangement • Components not mounted securely • Unfavorable cabinet configuration

4.7.5 Cabinet configuration

The influence of the user in the configuration of an electromagnetically compatible plant encompasses cabinet configuration, cable installation, ground connections and correct shielding of cables.

Note

For information about electromagnetically compatible cabinet configuration, please consult the installation guidelines for SIMATIC PLCs.

Shielding by enclosure

Magnetic and electrical fields and electromagnetic waves can be kept away from the interference sink by using a metal enclosure. The easier the induced interference current can flow, the greater the intrinsic weakening of the interference field. All enclosures and metal panels in the cabinet should therefore be connected in a manner allowing good conductance.

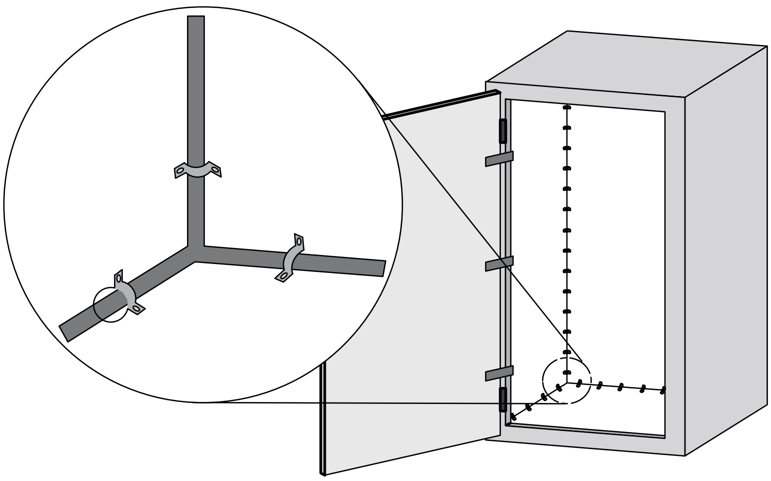


Figure 4-24 Shielding by enclosure

If the control cabinet panels are insulated from each other, a high-frequency-conducting connection can be established using ribbon cables and high-frequency terminals or HF conducting paste. The larger the area of the connection, the greater the high-frequency conductivity. This is not possible using single-wire connections.

Prevention of interference by optimum configuration

Good interference suppression can be achieved by installing SIMATIC PLCs on conducting mounting plates (unpainted). When setting up the control cabinet, interference can be prevented easily by observing certain guidelines. Power components (transformers, drive units, load power supply units) should be arranged separately from the control components (relay control unit, SIMATIC S7).

As a rule:

- The effect of the interference decreases as the distance between the interference source and interference sink increases.
- The interference can be further decreased by installing grounded shielding plates.
- The load connections and power cables should be installed separately from the signal cables with a minimum clearance of 10 cm.

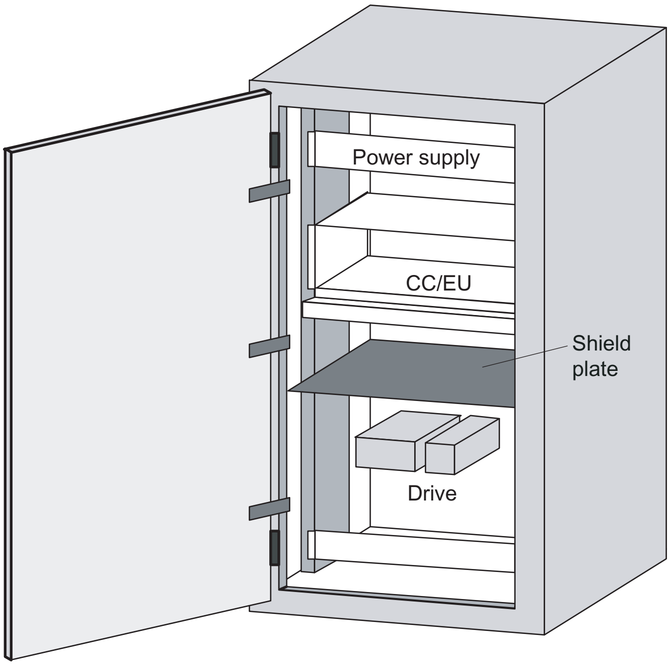


Figure 4-25 Prevention of interference by optimum configuration

Filtering of the supply voltage

External interference from the mains can be prevented by installing line filters. Correct installation is extremely important, in addition to appropriate dimensioning. It is essential that the line filter is mounted directly at the cabinet inlet. As a result, interference is filtered promptly at the inlet, and is not conducted through the cabinet.

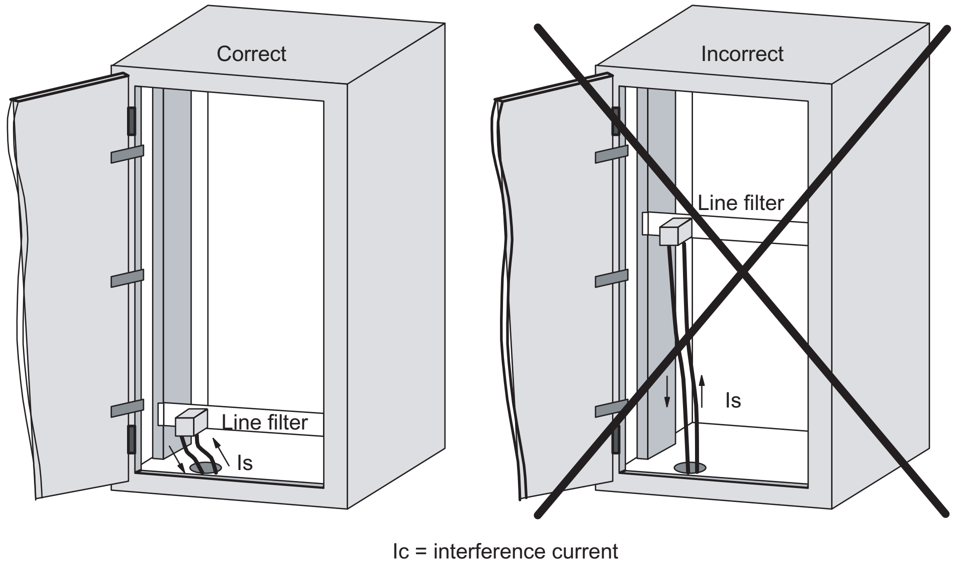


Figure 4-26 Filtering of the supply voltage

4.7.6 Prevention of interference sources

A high level of immunity to interference can be achieved by avoiding interference sources. All switched inductances are frequent sources of interference in plants.

Suppression of inductance

Relays, contactors, etc. generate interference voltages and must therefore be suppressed using one of the circuits below.

Even with small relays, interference voltages of up to 800 V occur on 24 V coils, and interference voltages of several kV occur on 230 V coils when the coil is switched. The use of freewheeling diodes or RC circuits prevents interference voltages and thus stray interference on conductors installed parallel to the coil conductor.

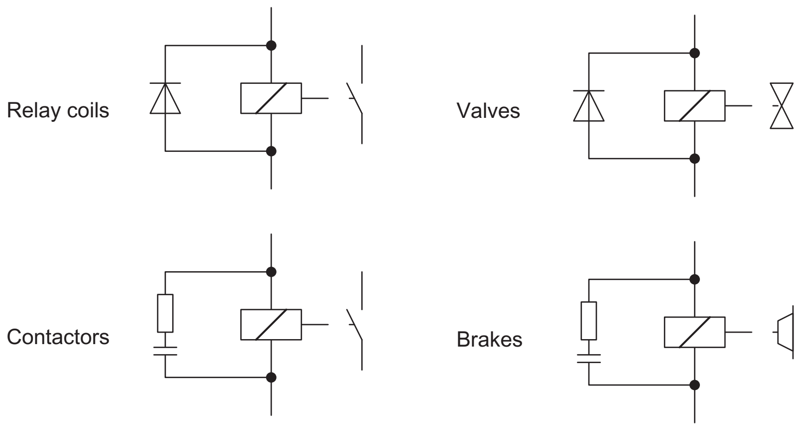


Figure 4-27 Suppression of inductance

Note

All coils in the cabinet should be suppressed. The valves and motor brakes are frequently forgotten. Fluorescent lamps in the control cabinet should be tested in particular.

4.7.7 Equipotential bonding

Potential differences between different parts of a plant can arise due to the different design of the plant components and different voltage levels. If the plant components are connected across signal cables, transient currents flow across the signal cables. These transient currents can corrupt the signals.

Proper equipotential bonding is thus essential.

- The equipotential bonding conductor must have a sufficiently large cross section (at least 10 mm^2).
- The distance between the signal cable and the associated equipotential bonding conductor must be as small as possible (antenna effect).
- A fine-strand conductor must be used (better high-frequency conductivity).
- When connecting the equipotential bonding conductors to the centralized equipotential bonding strip (EBS), the power components and non-power components must be combined.
- The equipotential bonding conductors of the separate modules must lead directly to the equipotential bonding strip.

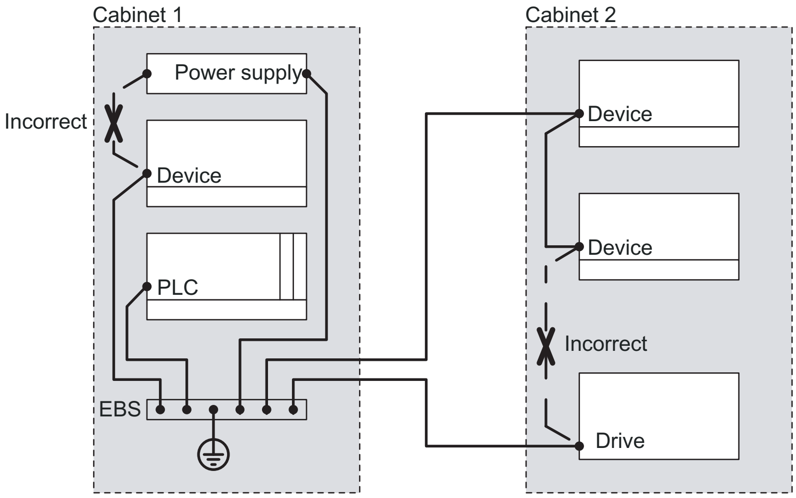


Figure 4-28 Equipotential bonding (EBS = Equipotential bonding strip)

The better the equipotential bonding in a plant, the smaller the chance of interference due to fluctuations in potential.

Equipotential bonding should not be confused with protective earthing of a plant. Protective earthing prevents the occurrence of excessive shock voltages in the event of equipment faults whereas equipotential bonding prevents the occurrence of differences in potential.

4.7.8 Cable shielding

Signal cables must be shielded in order to prevent coupling of interference.

The best shielding is achieved by installing the cables in steel tubes. However, this is only necessary if the signal cable is routed through an environment prone to particular interference. It is usually adequate to use cables with braided shields. In either case, however, correct connection is vital for effective shielding.

Note

An unconnected or incorrectly connected shield has no shielding effect.

As a rule:

- For analog signal cables, the shield should be connected at one end on the receiver side
- For digital signals, the shield should be connected to the enclosure at both ends
- Since interference signals are frequently within the HF range (> 10 kHz), a large-area HF-proof shield contact is necessary

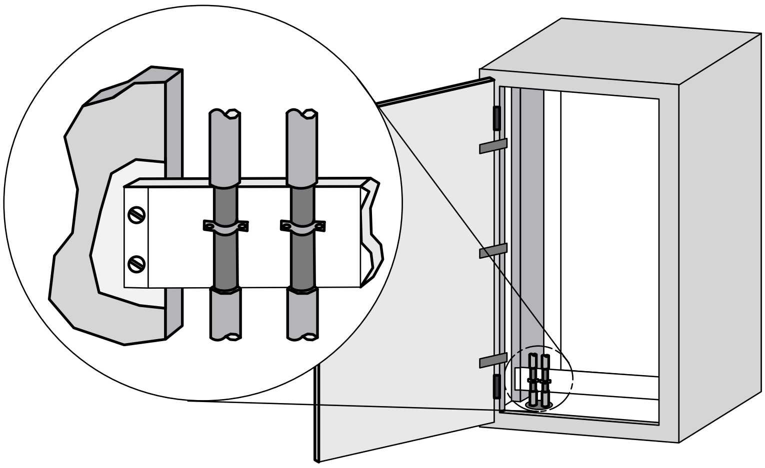


Figure 4-29 Cable shielding

The shielding bus should be connected to the control cabinet enclosure in a manner allowing good conductance (large-area contact) and must be situated as close as possible to the cable inlet. The cable insulation must be removed and the cable clamped to the shielding bus (high-frequency clamp) or secured using cable ties. Care should be taken to ensure that the connection allows good conductance.

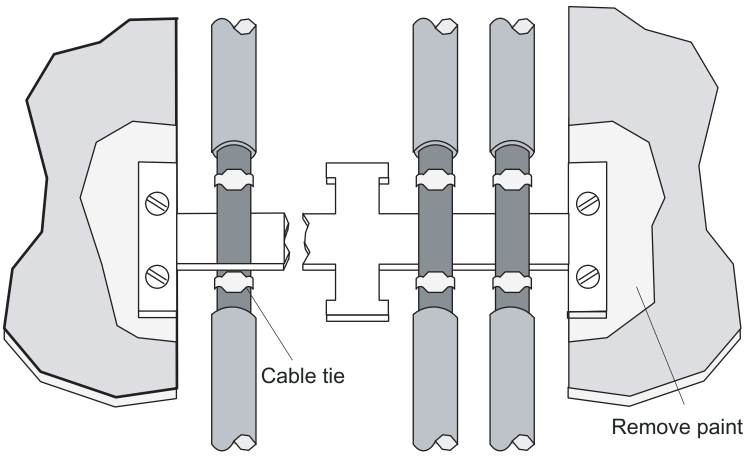


Figure 4-30 Connection of shielding bus

The shielding bus must be connected to the PE busbar.

If shielded cables have to be interrupted, the shield must be continued via the corresponding connector housing. Only suitable connectors may be used for this purpose.

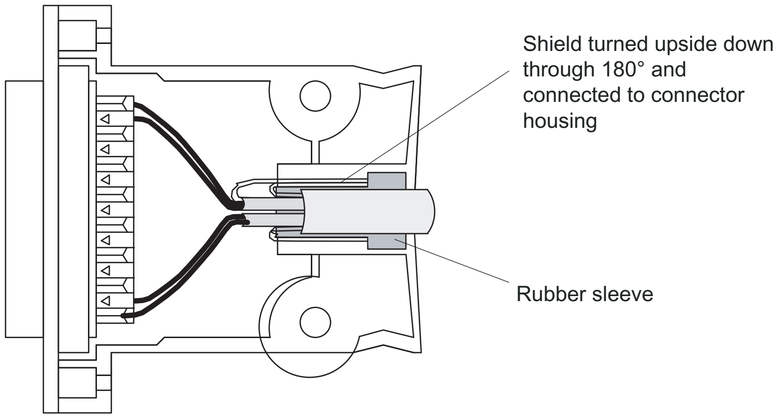


Figure 4-31 Interruption of shielded cables

If intermediate connectors, which do not have a suitable shield connection, are used, the shield must be continued by fixing cable clamps at the point of interruption. This ensures a large-area, HF-conducting contact.

Readers 5

Overview

The reader ensures inductive communication with the transponders, and handles the serial connection to the communication modules or the 8xIQ-Sense module.

Communication between the transponder and reader takes place over inductive alternating fields.

The transmittable data volume between reader and transponder depends on:

- the speed at which the transponder moves through the transmission window of the reader.
- the length of the transmission window.
- the RF300 transponder type (FRAM, EEPROM).
- the use of ISO transponders

ISO functionality

With the following readers, you can also use ISO tags:

- SIMATIC RF310R reader (with RS422 interface)
- Reader SIMATIC RF340R
- Reader SIMATIC RF350R
- SIMATIC RF380R reader

The readers must either be parameterized for the RF300 or ISO mode. The parameterization is done with the aid of the RESET message frame (INIT-Run).

You can find more detailed information on the software parameterization in Product Information "FB 45 and FC 45 input parameters for RF300 and ISO transponders" (http://support.automation.siemens.com/WW/view/en/33315697) or the Function Manual FB 45 (http://support.automation.siemens.com/WW/view/en/21738808) from edition A3 onwards.

Note

ISO functionality is only possible with certain reader MLFBs.

Only the SIMATIC RF310R and SIMATIC RF380R readers with the MLFB 6GT2801-xxBxx are suitable for operating with ISO tags.
